

Lassa Virus Vaccines: A Critical Tool for Saving Lives, Strengthening Economies, and Enhancing Global Pandemic Preparedness

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Abstract

The infectious hemorrhagic disease known as Lassa fever, which is native to West Africa, continues to pose a serious risk to public health and has far-reaching societal and economic consequences. There is no human-use vaccination for this virus, even though it keeps popping up. The creation of vaccinations against the Lassa virus is discussed in this article as a crucial measure to reduce casualties, lessen financial losses, and strengthen international readiness for a pandemic. This study highlights the need to invest globally in Lassa virus vaccine research and distribution by looking at vaccine candidates being developed, their possible economic advantages, and their role in improving healthcare systems. Looking forward to future global health policies, the research emphasises the significance of vaccinations within the framework of pandemic preparation, learning from the experiences of COVID-19.

Keywords

Lassa virus, Lassa fever, Vaccine development, Non-invasive diagnosis, Public health, Economic stability, Pandemic preparedness, Viral hemorrhagic fever, Ensemble classifier, Emerging infectious diseases, Global health security

1. Introduction

1.1 Background

Infected Mastomys rats are the most common vector for transmitting the Lassa virus, which causes an acute viral hemorrhagic disease known as Lassa fever. Because of its recurrent outbreaks, the illness continues to be a serious concern in many West African nations, such as Guinea, Sierra Leone, Liberia, and Nigeria. There is a mortality incidence of up to 20% among hospitalised patients due to severe instances, which may cause multi-organ failure and death. Many cases are moderate or asymptomatic, but a small percentage are severe. Further, long-term health problems, such as hearing loss, are common among survivors.

Millions of people are at risk since there is no approved vaccination for Lassa fever, even though it is pretty standard. Repeated outbreaks of the Lassa virus have jeopardised lives and wreaked havoc on the economies of the areas hit. We must take proactive steps to prepare for future pandemics, as shown by the rise of global pandemics like COVID-19. Improving public health resilience and economic stability via

developing a safe and effective Lassa virus vaccine might be a game-changer regarding disease management and pandemic preparation.

1.2 Problem Statement

Lassa fever continues to claim lives and disrupt economies in endemic regions, yet efforts toward vaccine development remain underfunded and under-prioritised. This paper explores the significance of Lassa virus vaccines in saving lives, minimising economic losses, and improving global pandemic preparedness.

1.3 Contributions

This paper contributes to the understanding of:

- The current state of Lassa virus vaccine research and development.
- The potential impact of a Lassa vaccine on public health and regional economies.
- The role of Lassa vaccines in enhancing global pandemic preparedness.

2. Lassa Fever: Public Health and Economic Impact

2.1 Health Impact

Nearly 5,000 people die each year from Lassa fever, which infects 100,000 to 300,000 people in West Africa. Because people in endemic regions are always at risk of infection, the absence of an approved vaccine adds to the high disease burden. Many patients come late, which increases the risk of morbidity and death, even though antiviral medications, such as ribavirin, are effective when given early. Additionally, healthcare institutions are already under a lot of pressure because up to one-third of survivors have long-term consequences, including hearing.

2.2 Economic Burden

Beyond the health impact, Lassa fever has significant economic consequences. Outbreaks cause disruptions to trade, agriculture, and local businesses, especially in rural areas where the disease is most prevalent. The costs of diagnosis, treatment, and long-term care for survivors with disabilities compound the financial burden on healthcare systems. Moreover, recurring outbreaks reduce workforce productivity and deter international investments in the affected regions. The World Health Organization (WHO) estimates that Lassa fever could cause up to \$150 million in economic losses annually in West Africa, underscoring the need for preventive measures such as vaccination.

3. Lassa Virus Vaccine Development

3.1 Vaccine Candidates in Development

Efforts to develop a Lassa virus vaccine have gained momentum in recent years, thanks to molecular biology, virology, and immunology advancements. Multiple vaccine platforms are currently under investigation, including:

- **Live-Attenuated Vaccines:** Vaccines against Lassa fever employ an attenuated strain of the virus to elicit a protective immune response. Results from preclinical studies are encouraging; for example, in animal models, live-attenuated vaccines elicit robust immune responses and provide long-term protection.
- **Viral Vector-Based Vaccines:** Viral vectors, such as adenoviruses, are being used to deliver Lassa virus antigens to the host's immune system. This approach has successfully treated other diseases, such as Ebola, and could provide a fast-track solution for Lassa fever vaccine development.
- **DNA and mRNA Vaccines:** DNA and mRNA vaccines encode Lassa virus antigens, prompting the body to produce viral proteins that elicit an immune response. These vaccine platforms have gained global attention following their success in COVID-19 vaccines, and they offer the advantage of rapid production and scalability.

3.2 Challenges in Vaccine Development

Despite the progress, several challenges remain in Lassa virus vaccine development. These include:

- **Limited funding:** Lassa fever is endemic in low-income regions, resulting in limited financial incentives for vaccine developers.
- **Viral diversity:** Several strains of the Lassa virus exist, making it challenging to develop a vaccine that offers broad protection.
- **Infrastructure for clinical trials:** Endemic regions often lack the necessary infrastructure for large-scale vaccine trials, complicating the assessment of vaccine efficacy.

3.3 Future Prospects

Recent advances in vaccine technology, combined with increased global attention to emerging infectious diseases, offer hope for developing a Lassa virus vaccine. Organisations such as the Coalition for Epidemic Preparedness Innovations (CEPI) have prioritised Lassa fever in their funding agenda, which could accelerate the vaccine development process.

4. Economic Benefits of Lassa Vaccination

4.1 Reducing Healthcare Costs

A Lassa virus vaccine could significantly reduce the healthcare costs associated with treating the disease. With fewer cases requiring hospitalisation and long-term care, healthcare systems in endemic regions

would experience less strain. Vaccination would also alleviate the need for expensive treatments such as ribavirin, which must be administered early to be effective.

4.2 Boosting Economic Productivity

A vaccine would reduce the loss of workforce productivity caused by illness and death by preventing Lassa fever infections. In agricultural areas, where Lassa fever often hits hardest, vaccination could help ensure a stable labour force, essential for food security and economic growth. Reducing disease outbreaks could also improve investor confidence, leading to more significant financial opportunities in the region.

4.3 Pandemic Preparedness and Economic Stability

Lassa fever vaccines would not only protect against this specific disease but could also contribute to broader pandemic preparedness. The infrastructure developed for Lassa vaccine distribution—such as cold chains, healthcare worker training, and public health education—could be leveraged in future pandemic responses. Furthermore, investing in Lassa vaccines would signal a commitment to addressing neglected diseases and enhancing global health security.

5. Lassa Vaccines and Pandemic Preparedness

5.1 Lessons from COVID-19

The COVID-19 pandemic highlighted the importance of vaccines in controlling outbreaks and mitigating economic damage. Swift vaccine development and distribution played a pivotal role in reducing the spread of the virus and saving lives. The experience with COVID-19 also underscored the value of investing in vaccine platforms that can be rapidly adapted to new threats.

5.2 Strengthening Global Health Systems

A successful Lassa vaccine program could serve as a model for improving global health systems, particularly in low-resource settings. Countries could strengthen their overall pandemic preparedness by building vaccine infrastructure and fostering public trust in vaccination. This, in turn, would reduce the likelihood of future epidemics spiralling into global pandemics, as happened with COVID-19.

5.3 Global Collaboration for Lassa Vaccines

Developing and distributing Lassa vaccines will require global collaboration between governments, non-governmental organisations, pharmaceutical companies, and international health bodies. Ensuring equitable access to vaccines in low-income regions must be a priority, as was demonstrated during the COVID-19 pandemic. Public-private partnerships and international funding mechanisms, such as Gavi and the Vaccine Alliance, could ensure that Lassa vaccines reach those most in need.

6. Conclusion

Lassa virus vaccines represent a vital opportunity to save lives, protect economies, and strengthen global health systems in preparation for future pandemics. The development of a safe and effective Lassa vaccine would reduce the disease's health and economic burdens in endemic regions while offering valuable lessons for pandemic preparedness. By investing in vaccine research, production, and distribution, the global community can ensure a more resilient future in the face of emerging infectious diseases.

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