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Risk Evaluation and Mitigation Strategies for Newly Detected Mysterious Dinga Dinga Virus Infection in Africa: A Narrative Review

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ABSTRACT

Background and Aims: The Dinga Dinga Virus (DDV) has emerged as a mysterious disease gripping women in Uganda, raising alarm due to its unusual and distressing "dancing" like symptoms. These symptoms, characterized by involuntary movements resembling dance, suggest possible neurological involvement, though the exact pathogen remains unidentified. The causative agent for DDV is still unknown. We hypothesized that the possible microorganism could be a virus, bacteria, or vector-borne origin. Therefore, comprehensive research is urgently needed to confirm its cause.

Methods: We performed a comprehensive literature search in Scopus and Web of Science related to the different outbreaks of viruses. We collected relevant information from appropriate articles for this review.

Results: The unique representation of the disease is spreading rapidly in localized areas that have the potential to escalate into a broader public health crisis. Preventive measures focused on symptom monitoring, public awareness, and isolation of suspected cases to limit transmission. Authorities emphasize hygiene practices, using personal protective equipment (PPE), and early reporting to manage the outbreak effectively. Simultaneously, global health organizations are being called to collaborate on diagnostic development, therapeutic interventions, and vaccine research. The disproportionate impact on women has brought social and cultural dynamics into the spotlight, as stigma and misinformation exacerbate the outbreak's challenges. Immediate and long-term strategies must address these aspects by strengthening healthcare infrastructure and enhancing disease surveillance systems.

Conclusion: As the world recovers from the COVID-19 pandemic, the DDV is a stark reminder of the ongoing threat of emerging infectious diseases. Proactive, science-driven efforts are critical to understanding and mitigating this enigmatic disease, ensuring it does not escalate into another global health crisis.

1 | Background

The global and local ecosystems are changing rapidly in the modern era. Variations in the environment have detrimental consequences on human health that are becoming more apparent with time. Viruses can quickly adapt to changing environments. They are enigmatic creatures. Health officials are closely monitoring emerging viruses, including a never-before-seen insect-borne threat [1]. With the climate changing rapidly, the threat of zoonotic diseases is becoming more prominent. For instance, bats are known as reservoirs of more than 40 viruses, but they have unveiled just a handful of notorious ones

like Coronavirus and NEPA. It means countless mysteries are yet to be unravelled by the world of humans [2, 3]. In Uganda's Bundibugyo district, a mysterious virus has been causing widespread illness, particularly among women and girls [4]. The outbreak, known locally as "Dinga Dinga" (meaning "shaking like dancing"), has affected around 300 people, with patients experiencing high fever and uncontrollable body. While the case count (300) is relatively low, the unusual symptoms and lack of clarity about transmission mechanisms pose challenges for containment. The outbreak has drawn comparisons to historical phenomena like the 1518 "Dancing Plague" in Strasbourg, underscoring how unexplained illnesses can intersect with cultural interpretations. The disproportionate impact on women and girls raises questions about potential exposure risks, healthcare access, or biological factors in Uganda, where maternal mortality and health disparities remain significant [5]. Simultaneously, the Democratic Republic of Congo (DRC) is confronting a separate viral outbreak, with 400 confirmed infections and 30 fatalities reported to date, underscoring the region's ongoing public health challenges [6]. Uganda continues to confront systemic gaps in women's healthcare, including elevated maternal mortality rates and insufficient capacity to address obstetric emergencies. WHO data reveals that Ugandan women had a healthy life expectancy of 58.9 years as of 2021—a metric that, while reflecting progress since the early 2000s, underscores persistent vulnerabilities exacerbated by healthcare access and infrastructure disparities [7].

2 | Methods

We systematically searched PubMed/MEDLINE, Embase/Scopus, Web of Science, and Google Scholar for peer-reviewed articles published in English between January 2000 and December 2024, using keywords such as *virus outbreaks*, *viral mutations*, *Dinga Dinga Virus (DDV)*, *antiviral treatment*, *prevention strategies*, and *public health guidelines* combined with Boolean operators. Inclusion criteria focused on studies indexed in the specified databases, with full-text availability and relevance to virology, outbreak dynamics, mutations, treatments, or guideline development. Non-indexed articles, preprints, predatory journals, duplicates, and inaccessible texts were excluded to ensure methodological rigor. PubMed/MEDLINE searches incorporated MeSH terms for precision, while Web of Science and Scopus provided multidisciplinary and regional coverage; Google Scholar results were limited to the first 400 per query to balance breadth and feasibility. This approach prioritized transparency, reproducibility, and alignment with systematic review standards for synthesizing evidence on viral epidemiology and intervention strategies.

3 | Clinical Features of DDV

Many identified infectious diseases and existing ones are included as zoonosis. In the beginning, some diseases are considered zoonoses, but later on, they mutate into human-only strains. Ebola and salmonellosis cause recurring outbreaks. The novel coronavirus has the potential to cause global pandemics [8, 9]. Zoonotic pathogens involve unconventional agents and spread to humans through direct contact with food, water, or the environment. They represent a major public health problem around the world.

The first reported cases of DDV were identified in early 2023 in the Bundibugyo district of Uganda. While the exact date of the initial case has not been disclosed, the condition gained attention due to its peculiar symptoms, including uncontrollable shaking resembling dance-like movements [10]. The pathogen responsible for DDV has not been conclusively identified, and it does not yet have a scientific classification. The disease is characterized by severe shaking of the body, resembling a dance-like movement, which can make walking nearly impossible. In extreme cases, the virus can lead to paralysis, impairing basic movements. The initial symptoms include fever, shivering, and weakness. The pathophysiology and transmission pathway of DDV remain unclear as the causative agent is yet to be identified. Reported symptoms, including uncontrollable shaking, fever, and weakness, suggest a potential neurological or infectious origin (Figure 1) [11]. The involuntary movements may stem from disruptions in the nervous system, possibly caused by a viral or bacterial infection, toxins, or an autoimmune response triggered by an earlier infection. Fever and systemic weakness indicate an inflammatory or immune-mediated response. Interestingly, the reported response to antibiotics hints at a bacterial involvement or secondary infection. Research is ongoing to determine the exact mechanism, with samples under analysis by Uganda's Ministry of Health. The disease has been compared to the historical Dancing Plague of 1518 in Strasbourg, France, owing to its similar symptoms. However, while Dinga Dinga is suspected to have an infectious, neurological, or toxicological cause, the Dancing Plague is believed to have been psychosomatic, potentially linked to mass hysteria or ergot poisoning. Both involve localized outbreaks and have caused significant concern in their communities, but Dinga Dinga includes additional symptoms like fever and weakness, indicating a systemic or infectious process (Table 1). Unlike the prolonged episodes of the Dancing Plague, Dinga Dinga symptoms reportedly resolve within a week with antibiotic treatment, suggesting distinct underlying mechanisms. Understanding Dinga Dinga's cause will require further investigation, but the comparison highlights the intriguing overlap between physiological and psychosomatic conditions in outbreaks.

4 | Responses Against This DDV Outbreak

Monitoring zoonotic diseases and their potential spillover to humans would have provided an early warning. Early and robust global surveillance systems established during the SARS outbreak could have helped detect COVID-19 sooner. Preventive measures taken during the Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV) outbreak in 2002–2003 could have significantly helped in managing or even mitigating the impact of the COVID-19 pandemic caused by SARS-CoV-2 [16, 17]. Current containment strategies prioritize rapid case identification, community-based isolation protocols, and antibiotic regimens (e.g., doxycycline), though their efficacy remains under investigation [12]. Public health interventions

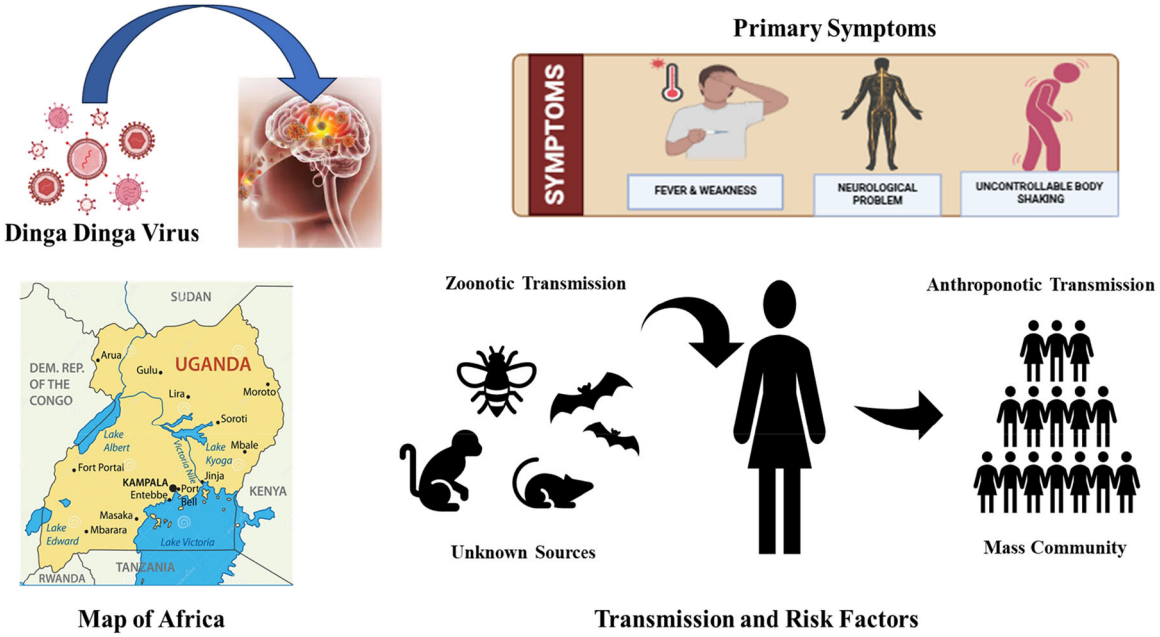

FIGURE 1 | Epidemiology, transmission pathways, risk factors, and clinical manifestations of Dinga Dinga Disease (DDD).

TABLE 1 | Clinical manifestations of Dinga Dinga Disease.

Symptom/ manifestation	Description	Frequency	References
High fever	Sudden onset of fever (≥ 38°C), often the first reported symptom.	100% of cases	CDC health alert report (2025) [12]
Uncontrollable shaking	Rhythmic, dance-like movements of limbs; non-painful but socially disruptive.	95% of cases	Emerging infection in Africa [13]
Fatigue	Severe exhaustion reported in the post-acute phase.	~40% of cases	Asian Hospital and Healthcare Management [14]
Respiratory distress	Mild to moderate breathing difficulties in some patients.	15–20% of cases	CDC health alert report [12]
Gender disparity	95% of cases occur in women and girls (ages 12–45).	N/A	WHO gender analysis (2025) [15]
Duration of illness	Symptoms resolve within 5–7 days; no fatalities reported.	All cases	Clinical follow-up data (2025) [14]

are informed by the *WHO Guidelines for Atypical Outbreaks in Low-Resource Settings* (2025) [15], which emphasize gender-sensitive approaches due to the disproportionate burden on women and girls. Field reports from Bundibugyo District Hospital highlight challenges in managing transmission risks amid limited diagnostic capacity and sociocultural barriers to healthcare access [18]. To address gaps in pathogen-specific protocols, Uganda's National Institute of Public Health has proposed integrating syndromic surveillance with local ethnographic data [19]. Further research into transmission dynamics and host susceptibility is urgently needed to refine response frameworks.

The predominance of females affected by DDV in Uganda raises important questions about its cause and transmission. In rural Uganda, women and girls are often responsible for household tasks like fetching water, cooking, and caring for family members. If the disease is linked to exposure to contaminated water, food, or environmental toxins, women may be at higher risk. Women might have different immune or hormonal responses that make them more susceptible to certain infections or toxins. If the disease has a neurological basis, hormonal differences (estrogen's effects on the nervous system) might influence vulnerability. Specific vectors (insects) might be more prevalent in areas or conditions women frequent [20]. This gender-specific trend underscores the importance of considering sociocultural and biological factors in disease outbreaks. Further research will be crucial in addressing these questions.

While the cause of Dinga Dinga remains elusive, antibiotics have been employed as a treatment method with promising results. Most patients recover within a week of receiving

medical care. Most patients recover within a week of receiving medical care [11]. Public health campaigns in the area are raising awareness about the illness, educating people on recognizing symptoms early, and seeking proper care [11].

5 | Risk Assessment for Global Public Health Crisis

The surge in emerging and re-emerging viruses with epidemic potential demands urgent, advanced preparedness plans to prevent them from outpacing global health systems. The world needs to take integrated action that determines the prioritized actions to reduce future threats. The plans should be periodically revised to fill the emerging gaps in scientific knowledge and technological advancements [21]. At present, we address some core and interlinked components of planning that should be the center of attention for decision-making while preparing for the next public health emergencies.

The COVID-19 pandemic transformed the whole world. People are now more aware of the risks that they impose upon themselves due to unsustainable ways in which they manage nature. Based on the experience throughout the COVID-19 pandemic, these risks are not only related to health but also have deep repercussions for global economies, local livelihoods, and society [22]. Generally, the risk assessment is used to direct proportionate control measures that reflect the risk. So, the overall level of risk assigned to the event helps to identify the urgency and extent of the control measure required.

The DDV presents a potential threat to global public health due to its high transmissibility, significant mortality rate, and potential for global spread. This paper assesses the risks associated with DDV, considering its transmission dynamics, potential impact on public health systems, and global preparedness. If the pathogen responsible for the DDV is unknown, its danger significantly increases. The infectiousness of the pathogen remains uncertain, making it difficult to predict its spread. Lack of knowledge about the pathogen means no specific diagnostic tests are available, leading to delays in identifying and isolating cases. Treatments or antiviral therapies cannot be developed until the pathogen's biology is understood. Emerging pathogens may mutate quickly, making it harder to predict or control their spread once they adapt to human hosts. An unknown pathogen can lead to widespread panic, misinformation, and stigmatization of affected communities, complicating public health responses. An unknown pathogen, as the cause of DDV, represents a significant public health threat due to the uncertainties in its transmission, detection, and treatment. A proactive, flexible, and collaborative approach is essential to mitigate its impact. By enhancing global preparedness frameworks, the world can better respond to such ambiguous and high-stakes threats [23].

6 | Possible Therapeutic and Preventive Measures

The infectious disease of zoonotic origin has caused widespread concern, and there is a need to prevent future spillover events and avoid the potential risk of pandemics. Several environmental changes increase the risk of human exposure to pathogens, such as rising ocean temperatures, changing salinities, and rising pollution in marine surroundings. The increasing population often causes unsustainable consumption driven by global warming and deforestation, increasing the risk of exposure and spillover. Reports describe a condition with neurological symptoms, specifically dancing or uncontrollable movements (similar to dystonia or myoclonus), which could be part of a new viral disease [24]. From local reports, the virus is causing affected individuals to lose control over their movements, resulting in a form of dancing, often referred to as “dancing disease” or “dancing mania” in some regions. This kind of symptom has been observed in several neurological infections, including some viral encephalitis cases. While it's not confirmed yet whether this is a novel virus or if it's linked to an already-known infectious agent (like poliovirus, Enterovirus, or African Trypanosomiasis), it's vital to follow developments from local health authorities, such as the Uganda Ministry of Health and international bodies like the WHO [25]. Since the pathogen is unknown, early treatment efforts must focus on alleviating symptoms and managing complications.

The limited exploration of therapeutic interventions and research pipelines for Dinga Dinga Disease represents a critical gap in the current literature. To address this, expanding the literature search to regulatory platforms such as the U.S. Food and Drug Administration (FDA), European Medicines Agency (EMA), and the World Health Organization (WHO) could yield valuable insights into emerging therapies, clinical trials, and pharmacological advancements. For instance, the FDA's database often catalogs investigational new drugs (INDs) and orphan drug designations, which may reveal preclinical or early-phase therapies targeting Dinga dinga Disease mechanisms [26]. Similarly, the EMA's public assessment reports and WHO's International Clinical Trials Registry Platform (ICTRP) could provide global perspectives on collaborative research efforts [27]. Referencing guidelines from these agencies, alongside narrative synthesis of preclinical studies, may help identify repurposed medications or novel compounds under evaluation. As a narrative review is not constrained by strict inclusion criteria, integrating these heterogeneous sources—ranging from regulatory updates to gray literature—could comprehensively map the therapeutic landscape while underscoring the urgency of translational research for this condition.

On the preventive side, public health measures like regular handwashing, disinfection, and the use of personal protective equipment (PPE) are critical. Early detection through robust surveillance systems and isolation of cases can limit the spread, while travel restrictions and community education campaigns can reduce transmission risks. Vaccination efforts should prioritize the rapid development of pathogen-specific vaccines using technologies like mRNA platforms [28, 29]. If DDV is vector-borne, vector control measures, such as insecticide spraying and eliminating breeding sites, will be essential. Long-term preparedness, including strengthening healthcare systems, international collaboration, and investment in research for emerging pathogens, is crucial to mitigate the impact of DDV and similar threats.

Therapeutic and preventive measures for DDV require an adaptable, multi-pronged approach. Immediate actions focus on

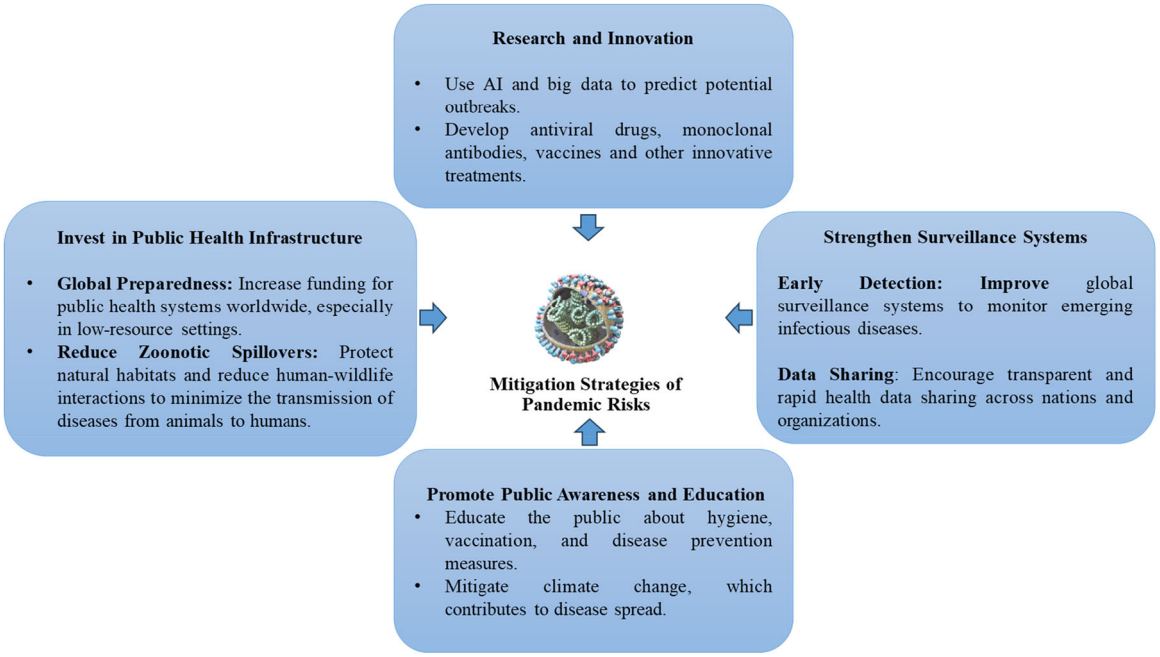

FIGURE 2 | Mitigation strategies of potential pandemic risk due to the Dinga Dinga virus.

controlling symptoms and reducing spread, while longer-term efforts involve pathogen-specific solutions, surveillance, and research [30]. Global collaboration, resource allocation, and public health education will be critical to mitigating the potential impact of DDV. A combination of public health interventions, research-driven innovation, and global collaboration is critical to mitigate the impact of this unknown but potentially dangerous virus (Figure 2).

7 | Conclusions

In conclusion, the emergence of the DDV, characterized by its unique "dancing" symptoms, has disproportionately impacted women in Uganda, raising significant public health concerns. While the exact pathogen and mechanisms behind the disease remain unclear, its mysterious presentation underscores the urgent need for enhanced surveillance, rapid diagnostic tools, and targeted research [30]. Immediate preventive measures, such as public awareness campaigns, symptom monitoring, and isolation of suspected cases, are vital to contain the spread. Additionally, collaborative global efforts must prioritize vaccine development and therapeutic research to address this emerging threat effectively. Addressing the societal and healthcare challenges posed by DDV requires a holistic approach, ensuring that vulnerable populations, particularly women, receive adequate support and resources to combat this unprecedented outbreak. While it is uncertain whether DDV will escalate into a pandemic, its potential cannot be underestimated. Proactive global collaboration, scientific research, and robust public health strategies are essential to prevent another global health crisis.

Author Contributions

Sabrina Sharmin: conceptualization, methodology, data curation, and writing – original draft. **Salsabil Islam:** conceptualization, methodology, data curation, and writing – original draft. **Md. Aminul Haque:** conceptualization, methodology, validation, supervision, writing – review and editing. **Md. Rabiul Islam:** conceptualization, validation, methodology, supervision, writing – review and editing.

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Ethics Statement

The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The authors have nothing to report.

Transparency Statement

The lead author Md. Rabiul Islam affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

References

1. WHO, "Prioritizing Diseases for Research and Development in Emergency Contexts," (World Health Organization, 2021).

2. S. Su, G. Wong, W. Shi, et al., "Epidemiology, Genetic Recombination, and Pathogenesis of Coronaviruses," *Trends in Microbiology* 24, no. 6 (2016): 490–502, https://doi.org/10.1016/J.TIM.2016.03.003.

3. Y. P. Chong, J. Y. Song, Y. B. Seo, and H. S. Shin, Rapid Response Team, "Antiviral Treatment Guidelines for Middle East Respiratory Syndrome," *Infection & Chemotherapy* 47 (2015): 212, https://doi.org/10.3947/ic.2015.47.3.212.

4. S. Milne-Price, K. L. Miazgowicz, and V. J. Munster, "The Emergence of the Middle East Respiratory Syndrome Coronavirus," *Pathogens and Disease* 71, no. 2 (2014): 121–136, https://doi.org/10.1111/2049-632X.12166.

5. MSN, "Dinga Dinga Virus Gripping Uganda's Women; All You Need to Know About 'Dancing' Symptoms," accessed January 1, 2025, https://www.msn.com/en-in/health/other/dinga-dinga-virus-gripping-uganda-s-women-all-you-need-to-know-about-dancing-symptoms/ar-AA1wgpS42024.

6. P. Kumar, S. Kumar, R. Mehta, and R. Shah, "Mystery Flu-Like Outbreak Raises Another Alarm in Congo: The Next Disease X?," *New Microbes and New Infections* 63 (2024): 101554.

7. P. Atuhaire, E. Kiracho-Ekirapa, and J. Mutenyo, "How Equitable Is Utilization of Maternal Health Services in Uganda? Implications for Achieving Universal Health Coverage," *BMC Health Services Research* 23, no. 1 (2023): 800, https://doi.org/10.1186/s12913-023-09749-1.

8. M. Chan-Yeung and R. h Xu, "SARS: Epidemiology," *Respirology* 8 (2003): S9–S14, https://doi.org/10.1046/J.1440-1843.2003.00518.X.

9. P. Boumandouki, P. Formenty, A. Epelboin, et al., "Clinical Management of Patients and Deceased During the Ebola Outbreak From October to December 2003 in Republic of Congo]," *Bulletin de la Societe de Pathologie Exotique (1990)* 98, no. 3 (2005): 218–223, https://europepmc.org/article/med/16267964.

10. R. Singla, M. Verma, S. Kumar, et al., "A new Viral Frontier: Decoding the Mystery of Uganda's Dinga Dinga Virus," *New Microbes and New Infections* 63 (2025): 101560, https://doi.org/10.1016/j.nmni.2024.101560.

11. B. Zerfu, T. Kassa, and M. Legesse, "Epidemiology, Biology, Pathogenesis, Clinical Manifestations, and Diagnosis of Dengue Virus Infection, and Its Trend in Ethiopia: A Comprehensive Literature Review," *Tropical Medicine and Health* 51, no. 1 (2023): 11, https://doi.org/10.1186/s41182-023-00504-0.

12. CDC Health Alert Report, Ebola Outbreak Caused by Sudan Virus in Uganda (CDC Health Alert Network (HAN), 2025), https://www.cdc.gov/han/php/notices/han00521.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fhan%2F2025%2Fhan00521.html.

13. Institute of Medicine (US) Forum on Emerging Infections, J. R. Davis, J. Lederberg, eds., Emerging Infectious Diseases From the Global to the Local Perspective: A Summary of a Workshop of the Forum on Emerging Infections (National Academies Press, 2001), https://www.ncbi.nlm.nih.gov/books/NBK99567/.

14. Asian Hospital and Healthcare Management, *Dinga Dinga Virus: What You Need to Know About This Emerging Threat* (2025), https://www.asianhhm.com/articles/dinga-dinga-virus-what-you-need-to-know-about-this-emerging-threat.

15. UNDP, *Uganda Gender Analysis*, https://climatepromise.undp.org/sites/default/files/research_report_document/undp-ndcsp-uganda-gender-analysis.pdf.

16. S. A. Lone and A. Ahmad, "COVID-19 Pandemic—An African Perspective," *Emerging Microbes & Infections* 9, no. 1 (2020): 1300–1308, https://doi.org/10.1080/22221751.2020.1775132.

17. X. Becerra and A. Jha, "Project NextGen—Defeating SARS-CoV-2 and Preparing for the Next Pandemic," *New England Journal of Medicine* 389, no. 9 (2023): 773–775, https://doi.org/10.1056/NEJMP2307867.

18. Bundibugyo Clinical Case Series, "Clinical and Demographic Patterns in DDD Outbreaks," *East African Journal of Medicine* 12, no. 3 (2025): 45–52.

19. "Framework for Emerging Pathogen Surveillance," (National Institute of Public Health, Uganda, 2023).

20. World Health Organization, "Global Research Agenda on Health, Migration and Displacement: Strengthening Research and Translating Research Priorities Into Policy and Practice," accessed December 28, 2024, https://books.google.com.bd/books?hl=en&lr=&id=caUOEQAAQBAJ&oi=fnd&pg=PP1&dq=1.+World+Health+Organization.+Prioritizing+diseases+for+research+and+development+in+emergency+contexts.+2021&ots=LrpT_bfeOT&sig=ia3BmCQ7AdAfY8jV7Ip1EU036do&redir_esc=y#v=onepage&q&f=false.

21. S. Platto, Y. Wang, J. Zhou, and E. Carafoli, "History of the COVID-19 Pandemic: Origin, Explosion, Worldwide Spreading," *Biochemical and Biophysical Research Communications* 538 (2021): 14–23, https://doi.org/10.1016/J.BBRC.2020.10.087.

22. P. Zhai, Y. Ding, X. Wu, J. Long, Y. Zhong, and Y. Li, "The Epidemiology, Diagnosis and Treatment of Covid-19," *International Journal of Antimicrobial Agents* 55, no. 5 (2020): 105955, https://doi.org/10.1016/J.IJANTIMICAG.2020.105955.

23. R. Katz and D. Sridhar, "A Decision-Making Tree for Policy Responses to a Pathogen With Pandemic Potential," *Nature Medicine* 30, no. 2 (2024): 327–329, https://doi.org/10.1038/s41591-023-02755-0.

24. S. J. Anthony, J. H. Epstein, K. A. Murray, et al., "A Strategy to Estimate Unknown Viral Diversity in Mammals," *mBio* 4, no. 5 (2013), https://doi.org/10.1128/MBIO.00598-13.

25. H. Brüssow, "Pandemic Preparedness: On the Efficacy of Non-Pharmaceutical Interventions in COVID-19 and About Approaches to Predict Future Pandemic Viruses," *Microbial Biotechnology* 17, no. 3 (2024): e14431, https://doi.org/10.1111/1751-7915.14431.

26. U.S. Food and Drug Administration (FDA), "Drug Trials Snapshots," (FDA, 2023).

27. European Medicines Agency (EMA), "Public Registrations," (EMA, 2023)

28. S. Pokhrel and R. Chhetri, "A Literature Review on Impact of COVID-19 Pandemic on Teaching and Learning," *Higher Education for the Future* 8, no. 1 (2021): 133–141, https://doi.org/10.1177/2347631120983481.

29. M. Ciotti, M. Ciccozzi, A. Terrinoni, W. C. Jiang, C. B. Wang, and S. Bernardini, "The COVID-19 Pandemic," *Critical Reviews in Clinical Laboratory Sciences* 57 (2020): 365–388, https://doi.org/10.1080/10408363.2020.1783198.

30. E. C. Salvador, N. Buddha, A. Bhola, et al., "Health Emergency Risk Management in World Health Organization—South-East Asia Region During 2014–2023: Synthesis of Experiences," *Lancet Regional Health—Southeast Asia* 18 (2023): 100304, https://doi.org/10.1016/j.lansea.2023.100304.