

## Letter to Editor

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## Using X Social Networks and web news mining to predict Marburg virus disease outbreaks

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Marburg virus disease (MVD) is a highly fatal illness, with a case fatality rate of up to 88%, though this rate can be significantly reduced with prompt and effective patient care. The disease was first identified in 1967 during concurrent outbreaks in Marburg and Frankfurt, Germany, and in Belgrade, Serbia, linked to laboratory use of African green monkeys imported from Uganda. Subsequent outbreaks and isolated cases have been reported in various African countries, including Angola, the Democratic Republic of the Congo, Equatorial Guinea, Ghana, Guinea, Kenya, Rwanda, South Africa (in an individual with recent travel to Zimbabwe), Tanzania, and Uganda. Initial human MVD infections typically occur due to prolonged exposure to mines or caves inhabited by *Rousettus aegyptiacus* fruit bats, the natural hosts of the virus. After introduction to human populations, MVD spreads through direct contact with blood, secretions, organs, or other bodily fluids of infected individuals, or contact with contaminated surfaces and materials such as bedding and clothing[1,2].

In recent years, significant outbreaks have underscored the need for rapid response and containment measures. For instance, in February 2023, Equatorial Guinea declared an outbreak following reports of deaths suspected to be due to viral hemorrhagic fever. The World Health Organization and other global health organizations provided support, deploying clinical experts and establishing a treatment center equipped with specialized bio-secure units. Similarly, in 2024, Rwanda reported its first-ever MVD outbreak with confirmed cases, emphasizing the virus's potential for regional spread. Effective containment of MVD requires coordinated international support, comprehensive contact tracing, safe burial practices, and the provision of medical supplies and resources[2]. Despite the severity of the disease, no specific antiviral treatments or vaccines have been approved, though experimental options are in development[3].

With the rise of digital platforms, real-time data from sources like X Social Networks (formerly Twitter) and web news outlets can now be leveraged for public health surveillance and outbreak prediction. The application of web news mining to detect disease trends has already been explored in the context of various infectious diseases, such as COVID-19, measles, and monkeypox[4–6]. In the case of MVD, timely and accurate information regarding disease spread is crucial for effective response. In this letter, we explore how infodemiology—the study of online health data—can be applied to predict and monitor MVD outbreaks.

Our study utilized a hybrid deep learning model combining RoBERTa with a Bidirectional Gated Recurrent Unit (BiGRU) to analyze X Social Networks data concerning MVD. Tweets were collected through the platform's API, using hashtags such as #Marburg, #MarburgVirus, #NewMarburg, and #MarburgEpidemic, with preprocessing steps including text normalization, removal of stop words, and lemmatization. We then applied Concept-LDA to extract relevant discussion topics, which were processed by RoBERTa for conversion into numerical representations[7]. These representations were fed into a BiGRU network to capture temporal trends, with an attention layer identifying the most significant tweet content for analysis.

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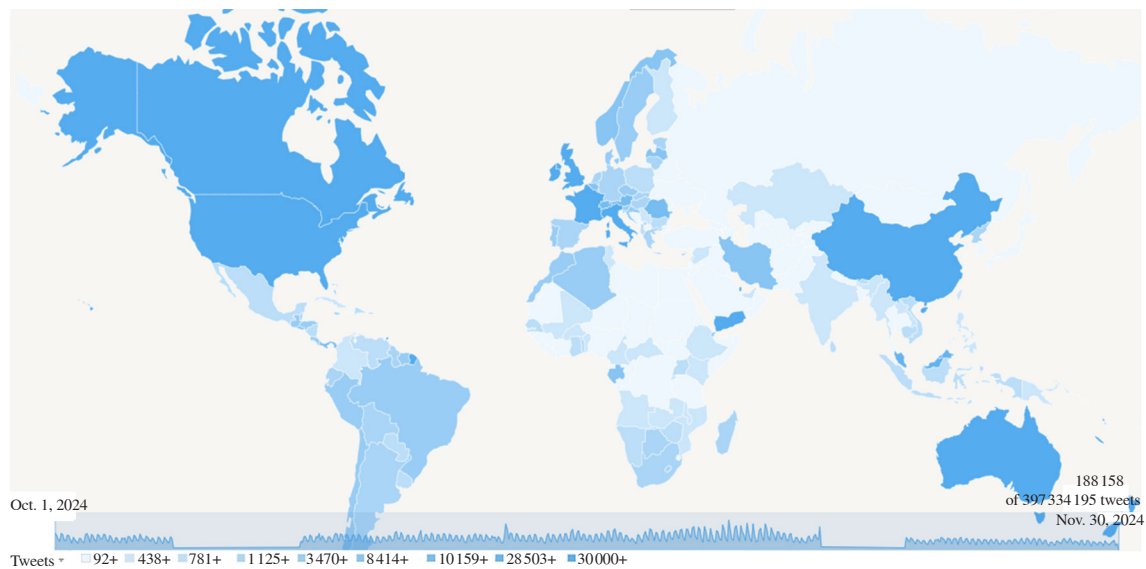
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**Figure 1.** Geographic spread of tweets related to Marburg virus disease from October 1, 2024, to November 30, 2024.

From October 1 to November 30, 2024, we analyzed over 188 155 tweets from 397 334 195 collected using keywords like Marburg, Marburg virus, new Marburg, and Marburg epidemic. The highest number of tweets related to this disease in Africa came from Algeria, Gabon, Morocco, Uganda, Yeman, and South Africa. In the Americas, the United States, Canada, Brazil, and Ecuador were prominent contributors, while Oceania's Australia also had significant tweet activity. In Europe, the United Kingdom, Italy, Romania, Spain, Ireland and Norway were key sources of MVD-related discussions. Interestingly, only a few tweets were recorded from Asia, except for China. This distribution is consistent with the recent MVD outbreaks in Equatorial Guinea and Rwanda. By mapping tweet locations, we identified potential hotspots for further public health investigation and intervention (Figure 1).

Infodemiology has become an essential tool in tracking infectious diseases and shaping public health interventions. The rapid dissemination of health-related information *via* X Social Networks allows for real-time monitoring of disease-related discussions. Previous studies have successfully utilized this methodology for the prediction of diseases and other outbreaks within public health surveillance systems, transitioning from monitoring and prediction to public response[4–6,8–10]. By applying this approach to MVD, public health agencies can forecast outbreak patterns and mobilize resources more efficiently. Additionally, integrating web news mining enhances surveillance by providing insights into the broader media coverage surrounding MVD outbreaks, helping to validate trends seen on social media.

In conclusion, our findings emphasize the need to complement traditional health data systems—based on routine reporting and

monitoring—with insights drawn from social media platforms, which have large user bases. By incorporating data from social media, such as tweets, posts, likes, and news coverage, into public health surveillance, we can better track disease outbreaks and epidemics in real time. Infodemiology, a growing branch of epidemiology, deserves increased attention from public health policymakers. As digital platforms continue to play a crucial role in information dissemination, health authorities should integrate social media data into health planning to enhance the efficiency and accuracy of epidemic forecasting and response, ultimately reducing the burden of diseases like Marburg virus disease.

### Conflict of interest statement

The authors declare no competing interests.

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### Authors' contributions

KJ and VR were responsible for the conceptualization and planning of the study. MJ took on the role of searching and screening the relevant literature. Data collection was managed by KJ, while VR contributed to data analysis. Both VR and MJ assisted with the

interpretation of the data. The manuscript was written by MJ, KJ, and VR, who also contributed to the revision process. All authors reviewed and approved the final manuscript.

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