

A commentary

OPEN ACCESS

Sudan's neglected tropical zoonotic diseases: A One-Health approach in the face of the current armed conflict

Abdullah Mohammed^{1*}, Musa Ahmed², Nasir Adam Ibrahim³

¹ Department of Biomedical Sciences, Faculty of Veterinary Sciences, University of Gadarif, Gadarif, Sudan

² Department of Veterinary Surgery, Faculty of Veterinary Medicine, AL-Salam University, West Kordofan, Sudan

³ Department of Biology, Faculty of Science, Imam Mohammed Ibn Saud Islamic University, Riyadh, Saudi Arabia

* Email: Bahlol32029@gmail.com

ABSTRACT

This commentary explores the detrimental impact of the recent armed conflict in Sudan on neglected tropical zoonotic diseases (NTZDs). Sudan is already grappling with a substantial NTZD burden due to historical conflicts and natural disasters. However, the current conflict has exacerbated the situation by hindering healthcare access, displacing populations, and worsening socio-economic conditions. These factors create a breeding ground for a surge in NTZD outbreaks, particularly during the months of the rainy season (June–September). The commentary emphasizes the urgent need for a One-Health approach to combat this impending public health crisis. This approach requires a multifaceted strategy encompassing integrated surveillance, enhanced diagnostic capabilities, robust emergency preparedness, and investment in workforce training. Community engagement and vector control measures are also crucial for mitigating the spread of these zoonotic diseases.

Keywords: armed conflict, neglected tropical diseases, zoonotic diseases, Sudan, One-Health approach

Cite this article as: Mohammed A, Ahmed M, Ibrahim NA. Sudan's neglected tropical zoonotic diseases: A One-Health approach in the face of the current armed conflict. Qatar Journal of Public Health. 2024(1):7 <https://doi.org/10.5339/qjph.2024.7>

Submitted: 14 May 2024; Accepted: 23 June 2024; Published: 12 August 2024

<https://doi.org/10.5339/qjph.2024.7>

© 2024 The Author(s), licensee HBKU Press. This is an Open Access article distributed under the terms of the Creative Commons Attribution License CC BY 4.0, which permits unrestricted use, distribution and reproduction in any medium, provided the original work is properly cited.

Page 1 of 4

DEAR EDITOR,

Sudan, burdened by a protracted history of armed conflicts and natural disasters, faces a significant challenge in addressing neglected tropical zoonotic diseases (NTZDs), a diverse group of diseases transmissible between animals and humans. Despite their detrimental impact on public and animal health, tackling these diseases remains under-resourced and under-addressed in endemic regions like Sudan [1-7]. This commentary delves into the factors contributing to this neglect and proposes a One-Health approach—a collaborative, cross-sectoral strategy encompassing human, animal, and environmental health sectors [8]—to mitigate the impending surge in NTZD outbreaks exacerbated by the recent conflict.

1. THE BURDEN OF NTZDS AND UNDERLYING CHALLENGES

A confluence of factors contributes to the under-addressed nature of NTZDs in Sudan. Insufficient data on disease prevalence, coupled with inadequate public awareness, presents a significant obstacle [9]. This is further compounded by a lack of readily available diagnostic tools and treatment resources. Importantly, the weakness of the veterinary public health infrastructure—the critical first line of defense against zoonotic diseases—creates a gap in disease control efforts [9]. Furthermore, the absence of robust intersectoral collaboration between the animal and human health sectors hinders a comprehensive approach, as evidenced by a Ugandan case study [10].

2. EXACERBATION BY RECENT CONFLICT

The outbreak of armed conflict between the Sudanese Armed Forces and Rapid Support Forces in April 2023 has significantly worsened the existing NTZD situation. This 8-month-long conflict has collided with pre-existing challenges like seasonal floods, droughts, and a deteriorating healthcare system [11,12]. The conflict has had several detrimental consequences:

Impaired healthcare system: Reduced accessibility to medical facilities, essential medications, and preventative interventions has hampered disease surveillance, diagnosis, and treatment efforts [13-15].

Internally displaced populations: Over 8.4 million people are internally displaced due to the conflict, residing in overcrowded and unsanitary conditions. This increases exposure to disease vectors and animal reservoirs, creating a perfect storm for outbreaks [16].

Worsened socio-economic situation: The conflict has exacerbated poverty and food insecurity, leading to malnutrition, co-infections, and compromised immune systems, further increasing vulnerability to NTZDs [16].

3. PREDICTED SURGE AND THE ONE-HEALTH APPROACH

The aforementioned factors suggest a probable surge in NTZD outbreaks, particularly during the upcoming rainy season, within communities affected by the recent escalation of the armed conflict and displacement. To mitigate this impending crisis, a robust One-Health approach—a collaborative, cross-

sectoral strategy encompassing both human and animal health—is crucial [17].

One-Health measure for mitigating NTZD outbreaks: The One-Health approach necessitates a multi-pronged strategy, with key components outlined below:

- I. **Integrated surveillance and monitoring:** Implementing comprehensive systems to track disease trends in both human and animal populations is essential for early detection and outbreak prevention.
- II. **Enhanced laboratory and diagnostic capacity:** Strengthening diagnostic infrastructure and capabilities for rapid and accurate identification of NTZDs is crucial for timely intervention.
- III. **Emergency preparedness and response:** Developing robust plans with swift outbreak detection, containment, and treatment measures is vital for minimizing the impact of outbreaks.
- IV. **Workforce development and training:** Equipping healthcare professionals with the necessary skills and knowledge to manage NTZDs effectively is critical for a competent response.
- V. **Empowering local communities through enhanced knowledge and behavior change strategies:** Effective control of NTZDs in conflict zones necessitates multifaceted interventions that prioritize community engagement and education. This involves fostering elevated public health literacy regarding NTZDs, their transmission dynamics, and available preventative measures. Additionally, it requires the development and implementation of culturally sensitive behavior change communication strategies that promote preventative behaviors, such as improved sanitation practices and responsible animal husbandry. Ultimately, establishing robust partnerships with local communities is crucial for collaborative surveillance, ensuring timely outbreak detection and response, and facilitating the co-creation of sustainable solutions tailored to the specific socio-ecological context.
- VI. **Mass drug administration and vector control interventions:** Implementing targeted interventions to control disease transmission and break the zoonotic cycle is fundamental for long-term disease control [17].

4. MITIGATING NTZDS IN CONFLICT: LESSONS FROM THE ONE-HEALTH APPROACH BEYOND SUDAN

The detrimental impact of conflict on public health, particularly NTZDs, extends beyond Sudan. Countries like Syria [18] and Yemen [19] have documented surges in NTZDs due to conflict-induced disruptions to healthcare systems, population displacement, and environmental degradation. These experiences offer valuable insights for mitigating the impending NTZD crisis in Sudan.

One key takeaway from these experiences is the demonstrably effective role of the One-Health approach in conflict settings. This collaborative strategy emphasizes cross-sectoral collaboration between the human, animal, and environmental health sectors.

Several inspiring examples from Africa and the Arab world illustrate the One-Health approach's effectiveness in mitigating NTZDs during the conflict. In Yemen, during the civil war, a collaborative effort involving the human and

animal health sectors, along with community engagement, successfully controlled a dengue fever outbreak [20]. This case highlights the crucial role of both cross-sectoral collaboration and community involvement in addressing NTZDs in conflict zones.

The ongoing conflict in Syria has exacerbated existing Leishmaniasis cases, a vector-borne NTZD. However, promising efforts offer valuable lessons. The Food and Agriculture Organization and the Mentor Initiative, an international not-for-profit organization, have implemented programs aimed at controlling sandfly populations, the primary vector of Leishmaniasis [21]. This demonstrates the additional value of environmental interventions within the One-Health framework.

South Sudan, with its long history of conflict, grapples with NTZDs like human African trypanosomiasis. However, reports suggest successful control programs implemented through a One-Health approach provide hope. These programs combine veterinary public health initiatives with human treatment efforts, demonstrating the effectiveness of integrated disease management. While the long-term success of these programs is still being evaluated, the initial positive outcomes highlight the value of the One-Health approach [22].

By incorporating these lessons learned from other conflict-affected countries, Sudan can strengthen its response to the impending NTZD surge. The One-Health approach, with its emphasis on collaboration, preparedness, and community engagement, offers a comprehensive framework for achieving this critical goal [23].

5. CONCLUSION

The ongoing armed conflict in Sudan has exacerbated the pre-existing burden of NTZDs, posing a significant threat to public health. A multi-faceted approach, centered on the rigorously implemented One-Health approach, is imperative

REFERENCES

1. Brosché J, Elfversson E. Communal conflict, civil war, and the state: complexities, connections, and the case of Sudan. *Afr J Confl Resolut.* 2012;12(1):9-32.
2. Ghomian Z, Yousefian S. Natural disasters in the Middle-East and North Africa with a focus on Iran: 1900 to 2015. *Health Emerg Disasters Quart.* 2017;2(2):53-62.
3. Ahmed M, Abdulslam Abdullah A, Bello I, Hamad S, Bashir A. Prevalence of human leishmaniasis in Sudan: a systematic review and meta-analysis. *World J Methodol.* 2022;12(4):305-18. <https://doi.org/10.5662/wjm.v12.i4.305>
4. Abdullah AA, Ahmed M, Bello II, Tawor A, Ahmed AO, Khider M, et al. Prevalence of toxoplasma gondii in domestic animals in Sudan: a systematic review and meta-analysis. *Acta Vet Eur.* 2022;48(3):216-26.
5. Hajissa K, Marzan M, Idriss MI, Islam MA. Prevalence of drug-resistant tuberculosis in Sudan: a systematic review and meta-analysis. *Antibiotics (Basel).* 2021;10(8):932. <https://doi.org/10.3390/antibiotics10080932>
6. Mohammed A, Ahmed M, Osman Ahmed A, Yousof S, Hamad S, Shuaib Y, et al. Seroprevalence and risk factors of brucellosis in dromedary camels (*Camelus dromedarius*) in Sudan from 1980 to 2020: a systematic review and meta-analysis. *Vet Quart.* 2023;43(1):1-15.
7. Abdullah AA, Ahmed M, Gadeed A, Eltayeb A, Ahmed S, Hamad S, et al. Five-year retrospective hospital-based study on epidemiological data regarding human leishmaniasis in West Kordofan state, Sudan. *World J Clin Infect Dis.* 2022;12(2):61-8.
8. Waltner-Toews D. Zoonoses, one health and complexity: wicked problems and constructive conflict. *Philos Trans R Soc Lond B Biol Sci.* 2017;372(1725):20160171. <https://doi.org/10.1098/rstb.2016.0171>
9. Peterson JK, Bakuza J, Standley CJ. One health and neglected tropical diseases—Multisectoral solutions to endemic challenges. *Trop Med Infect Dis.* 2020;6(1):4. <https://doi.org/10.3390/tropicalmed6010004>
10. Buregyeya E, Atusingwize E, Nsamba P, Musoke D, Naigaga I, Kabasa JD, et al. Operationalizing the one health approach in Uganda: challenges and opportunities. *J Epidemiol Glob Health.* 2020;10(4):250-7. <https://doi.org/10.2991/jegh.k.200825.001>
11. Bellizzi S, Lane C, Elhakim M, Nabeth P. Health consequences of drought in the WHO Eastern Mediterranean Region: hotspot areas and needed actions. *Environ Health.* 2020;19(1):114. <https://doi.org/10.1186/s12940-020-00665-z>
12. Charani E, Cunningham AJ, Yousif AHA, Seed Ahmed M, Ahmed AEM, Babiker S, et al. In transition: current health challenges and priorities in Sudan. *BMJ Glob Health.* 2019;4(4):e001723. <https://doi.org/10.1136/bmjgh-2019-001723>

to address this escalating public health crisis and ensure the synergistic safeguarding of both human and animal health in Sudan.

By prioritizing intersectoral collaboration, fostering elevated public health literacy, and implementing culturally sensitive behavior change communication strategies, Sudan can effectively mitigate the impending surge in NTZD outbreaks. Furthermore, establishing robust partnerships with local communities to facilitate collaborative surveillance and the co-creation of sustainable solutions is crucial for long-term success.

In light of this critical juncture, we urge policymakers and stakeholders to prioritize comprehensive NTZD control strategies within the framework of the One-Health approach. This proactive approach holds the potential to safeguard public health, minimize economic disruptions, and pave the way for a more resilient and disease-free future for Sudan.

ETHICS APPROVAL

This study does not involve any novel or original data collection or analysis that would necessitate such approval; therefore, no further ethical clearance is required.

AUTHORS' CONTRIBUTIONS

Concept—AM, MA, and NI; Design—AM and MA; Supervision—AM and MA; Resources—AM and MA; Materials—AM and MA; Data collection and processing—AM, MA, and NI; Analysis and interpretation—AM and MA; Literature search—AM and MA; Writing manuscript—AM and MA; Critical review—AM and MA; Other—AM, MA, and NI.

CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

13. Saied ARA. Sudan's health-care system is in danger of collapse. *Lancet*. 2023;401(10388):1565. [https://doi.org/10.1016/S0140-6736\(23\)00858-9](https://doi.org/10.1016/S0140-6736(23)00858-9)
14. Aderinto N, Olatunji D. The consequences of Sudan's armed conflict on public health: a closer look at the devastating impact. *IJS Glob Health*. 2023;6(4):e0179.
15. Mohammed A, Ahmed M. Veterinary services under siege: how the armed conflict in Sudan threatens animal and human health and how to respond. *Infect Ecol Epidemiol*. 2023;13(1):2281054. <https://doi.org/10.1080/20008686.2023.2281054>
16. Khalid Abdelaziz NE, Tetrault-Farber G. Sudan 'spiralling out of control' as 1 million flee country, UN warns. London: Reuters; 2023.
17. World Health Organization. The control of neglected zoonotic diseases: from advocacy to action: report of the fourth international meeting held at WHO Headquarters, Geneva, Switzerland; 2015 19–20 November 2014. Geneva: World Health Organization; 2015.
18. Al-Salem WS, Pigott DM, Subramaniam K, Haines LR, Kelly-Hope L, Molyneux DH, et al. Cutaneous Leishmaniasis and conflict in Syria. *Emerg Infect Dis*. 2016;22(5):931-3. <https://doi.org/10.3201/eid2205.160042>
19. Al-Kamel MA. Impact of leishmaniasis in women: a practical review with an update on my ISD-supported initiative to combat leishmaniasis in Yemen (ELYP). *Int J Womens Dermatol*. 2016;2(3):93-101. <https://doi.org/10.1016/j.ijwd.2016.04.003>
20. Alghazali KA, Teoh B-T, Sam S-S, Abd-Jamil J, Johari J, Atroosh WM, et al. Dengue fever among febrile patients in Taiz City, Yemen during the 2016 war: clinical manifestations, risk factors, and patients knowledge, attitudes, and practices toward the disease. *One Health*. 2020;9:100119. <https://doi.org/10.1016/j.onehlt.2019.100119>
21. Rehman K, Walochnik J, Mischlinger J, Alassil B, Allan R, Ramharter M. Leishmaniasis in Northern Syria during civil war. *Emerg Infect Dis*. 2018;24(11):1973-81. <https://doi.org/10.3201/eid2411.172146>
22. Ruiz-Postigo JA, Franco JR, Lado M, Simarro PP. Human African trypanosomiasis in South Sudan: how can we prevent a new epidemic? *PLoS Neglect Trop Dis*. 2012;6(5):e1541. <https://doi.org/10.1371/journal.pntd.0001541>
23. Berrang-Ford L, Lundine J, Breau S. Conflict and human African trypanosomiasis. *Soc Sci Med*. 2011;72(3):398-407. <https://doi.org/10.1016/j.socscimed.2010.06.006>