

## Leptospirosis outbreak in Tanzania

Masunga, Daniel Stephen; Rai, Anushree; Abbass, Mortada; Uwishema, Olivier; Wellington, Jack; Uweis, Lama; El Saleh, Rayyan; Arab, Sara; Onyeaka, Chinyere Vivian Patrick; Onyeaka, Helen

DOI:

[10.1016/j.amsu.2022.104347](https://doi.org/10.1016/j.amsu.2022.104347)

License:

Creative Commons: Attribution-NonCommercial-NoDerivs (CC BY-NC-ND)

*Document Version*

Publisher's PDF, also known as Version of record

*Citation for published version (Harvard):*

Masunga, DS, Rai, A, Abbass, M, Uwishema, O, Wellington, J, Uweis, L, El Saleh, R, Arab, S, Onyeaka, CVP & Onyeaka, H 2022, 'Leptospirosis outbreak in Tanzania: An alarming situation', *Annals of Medicine and Surgery*, vol. 80, 104347. <https://doi.org/10.1016/j.amsu.2022.104347>

[Link to publication on Research at Birmingham portal](#)

### General rights

Unless a licence is specified above, all rights (including copyright and moral rights) in this document are retained by the authors and/or the copyright holders. The express permission of the copyright holder must be obtained for any use of this material other than for purposes permitted by law.

- Users may freely distribute the URL that is used to identify this publication.
- Users may download and/or print one copy of the publication from the University of Birmingham research portal for the purpose of private study or non-commercial research.
- User may use extracts from the document in line with the concept of 'fair dealing' under the Copyright, Designs and Patents Act 1988 (?)
- Users may not further distribute the material nor use it for the purposes of commercial gain.

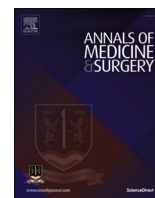
Where a licence is displayed above, please note the terms and conditions of the licence govern your use of this document.

When citing, please reference the published version.

### Take down policy

While the University of Birmingham exercises care and attention in making items available there are rare occasions when an item has been uploaded in error or has been deemed to be commercially or otherwise sensitive.

If you believe that this is the case for this document, please contact [UBIRA@lists.bham.ac.uk](mailto:UBIRA@lists.bham.ac.uk) providing details and we will remove access to the work immediately and investigate.



## Correspondence



## Leptospirosis outbreak in Tanzania: An alarming situation

## ARTICLE INFO

## Keywords

Leptospirosis  
Tanzania  
Outbreak  
Africa

## ABSTRACT

On July 5, 2022, the Tanzanian Ministry of Health (MoH) announced the re-emergence of leptospirosis after reporting 20 confirmed symptomatic cases and 3 mortalities. Leptospirosis is caused by a spirochete bacterium that lives in an animal's renal tubule and spreads to individuals through contact with contaminated animal urine. Unsupervised agricultural practices, urban development, wildlife infiltration, and a lack of sanitation have all been proposed as potential environmental causes of the present outbreak. The MoH is taking the necessary steps to halt the spread of said outbreak with assistance from the World Health Organization (WHO).

This article examines the risk factors, etiology, number of confirmed cases, and subsequent case index to analyse the epidemiology of the current leptospirosis outbreak in Tanzania's southern Linda region. In light of these findings, this research further details recent recommendations made by the WHO, Centers for Disease Control and Prevention, and MoH to mitigate such an alarming situation. These recommendations include early detection and isolation, contact tracing, and chemoprophylaxis using doxycycline. The article concludes by outlining suggestions for individuals and governments, including the launch of public awareness campaigns, immunisation, increased surveillance, rapid detection testing, and the installation of suitable purification systems, to help contain future leptospirosis outbreaks.

## 1. Introduction

Leptospirosis, a bacterial disease caused by the spirochete *Leptospira* spp., is spread by animals [1]. Due to a paucity of data, it is difficult to determine the prevalence of this condition. The bacteria are disseminated via soil and water that comes into contact with infected urine and then enter the body through skin abrasions [3,4]. Additionally, the lack of diagnostic resources makes diagnoses arduous to establish [5]. The incubation period of the bacteria varies from two days to four weeks [6]. The disease causes a plethora of nonspecific symptoms comprising fever, headache, vomiting, diarrhea, rash, jaundice, myalgia, and abdominal pain among others [4]. It may also mimic brucellosis, malaria, typhoid, and other diseases [5]. Leptospirosis may be acute, sub-acute, or chronic. It also may cause renal and hepatic dysfunction and pulmonary hemorrhagic syndrome among others [5]. According to De Laroch et al., it most commonly affects tropical areas [2].

Being a tropical country, Tanzania is considered one of many favourable areas for the growth of *Leptospira* [2]. The first incidence of leptospirosis in Tanzania was in the 1990s [5]. Recently, the Health Minister of Tanzania, Ummu Mwalimu, had twenty leptospiroses confirmed cases with three deaths [6]. The outbreak started on July 5th, 2022 with a patient presenting with an unidentified illness [3]. Three days later, a second patient presented with similar symptoms [3]. According to the president of the 20th Association of Member Episcopal Conferences in East Africa (AMECEA) Plenary Assembly organised by the Tanzania Episcopal Conference (TEC), President Hassan, reported that this outbreak may be due to environmental degradation [7].

## 2. Epidemiology and outbreak of leptospirosis in Tanzania

Concerns about an outbreak have been aroused by the Ministry of Public Health's report that leptospirosis reemerged on July 5 of 2022, killing 3 verified cases [6]. An outbreak was reported in the southern district of Lindi as the health minister confirmed 20 cases with symptoms including nasal bleeds, fever, fatigability, and headaches [6]. Leptospirosis is a recurrent neglected zoonotic disease that disseminates among the countries of subtropical regions such as Tanzania [5]. Regions with the most prevalence include South and Southeast Asia, Oceania, the Caribbean, parts of sub-Saharan Africa, and regions of Latin America [9]. It was first identified in the early 1990s and according to studies, its incidence has increased by approximately 18 per 100,000 individuals annually between the years 2012–2014 [5].

As a zoonotic disease, cattle are considered the most important reservoir for *Leptospira* bacteria, thus an essential source for human transmission. Additionally, because leptospirosis is an occupational disease that affects workers in vulnerable occupations like farms and agricultural areas, farm workers are thought to be at high risk for contracting the illness. This epidemiological finding could be translated as cases being found in Tanzanian regions with the highest concentration of farms as well as in areas with poor sanitation. This may be attributed to rodents playing a critical role in the disease's transmission to farm animals [5].

Since studies have indicated that water pollution with urine from the hosts' reservoir enhances the probability of disease transmission, sugarcane cutters and fishing communities are another high-risk community for the spread of leptospirosis [11].

The World Health Organization's (WHO) regional director for Africa claims that one of the causes of bacterial spread is primarily the rise in

<https://doi.org/10.1016/j.amsu.2022.104347>

Received 26 July 2022; Accepted 31 July 2022

Available online 6 August 2022

2049-0801/© 2022 The Authors. Published by Elsevier Ltd on behalf of IJS Publishing Group Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

### Abbreviations

AMECEA	Association of Member Episcopal Conferences in East Africa
CDC	Centre for Disease Control and Prevention
MoH	Ministry of Health
PPE	Personal Protective Equipment
RDT	Rapid Diagnostic Test
TEC	Tanzania Episcopal Conference
WHO	World Health Organization

food demand, which has led to more unchecked urbanisation, agricultural, and wildlife intrusion [10]. Additionally, a disease outbreak could be delayed and contributed to by poor sanitation and clinicians ignoring disease suspicion [10].



A map showing the country of Tanzania where cases of leptospirosis were identified in July 2022.

### 3. Etiology of leptospirosis

Three unexplained deaths in the southern part of Lindi prompted a team of health scientists to investigate the leptospirosis outbreak [5]. Leptospirosis is caused by a spirochete bacterium in the genus *Leptospira* spp. that resides in the renal tubule of animals for months or even years. Subsequent release into the urine of infected animals contaminates water or soil and then spreads to humans via percutaneous exposure (i.e., cuts or mucus membranes in the eyes, skin, or nose) [12, 13]. Consuming contaminated water is another method of disease transmission [5] (Fig. 1). This often occurs when the environment is degraded [12]. In addition, people may contract the bacteria via the inhalation of animal urine or bodily fluid droplets (excluding saliva) [13]. Only humans and animals may contract *Leptospira* spp.; human-to-human transmission has not been observed [6]. *Leptospira* spp. antibodies were positive at 38% in dogs, 5.6% in cattle, 1.8% in rodents, and 0.3% in humans. Although antibody prevalence is low in humans, the substantial risk of infection by *Leptospira* from a variety of animal species on the farm, with cattle and rodents being the most important reservoirs of *Leptospira* spp., was sufficient to raise public health concerns alongside emerging control and prevention strategies [14]. There are more than 250 pathogenic *Leptospira* serovars that may infect both humans and animals ensuing leptospirosis. Tanzania has minimal information on the variety of *Leptospira* serovars and their distribution in both humans and animals [5]. In Tanzania, there have been reports of 17 different *Leptospira* serogroups from both people and

various animal species. Icterohaemorrhagiae, Grippotyphosa, Australis, Ballum, Hebdomadis, and Sejroe were serogroups most frequently identified in humans [14].

### 4. Current efforts to mitigate leptospirosis in Tanzania

The initial complaint of the illness was made to the Mbekenyera Health Center in the Mbekenyera hamlet of the Lindi area on July 5, 2022 [3]. The hospital has already received a second occurrence within three days [3], according to Tanzania's senior medical official, Dr Aifelo Sicalwe, who had advised the populace to "remain calm" and cautioned anyone with similar symptoms to seek medical aid immediately. Sicalwe reported last week that a team of experts from the Tanzanian Ministry of Health had been sent to the Lindi region to investigate the unexplained outbreak and take precautions to halt its spread, including conducting contact tracing, identifying individuals with similar clinical manifestations, and isolating suspected infected [3]. According to Dr Fiona Braka, team lead for emergency responses at the WHO's regional office for Africa, the WHO's teams in Tanzania were also "following the situation closely" and collaborating with the Tanzanian health ministry to acquire "additional tests done to exclude out other diseases [3]. "The Centers for Disease Control and Prevention (CDC) also recommends that the dangers of exposure should be explained to travellers who may be more susceptible to infection. Said individuals should be encouraged to consider taking preventive measures such as chemoprophylaxis, protective clothing (especially footwear), and healing wounds and abrasions with occlusive dressings [4]. A few studies have suggested that doxycycline (200 mg orally, weekly), started 1–2 days before and continued during the exposure period, may be useful in preventing clinical illness in adults [4]. High-risk individuals who experience brief exposures may want to take this into account. The best method of infection prevention is to prevent exposure [4]. Travellers should avoid touching possibly affected animals or their bodily fluids, as well as potential polluted water sources and floodwaters [4].

### 5. Recommendations

Raising awareness of the causes and transmission mechanisms of leptospirosis and its epidemiology among healthcare workers and the general population is mandatory as an important strategy for the control and prevention of the disease [15,19–21]. This can be done effectively through mass education within the community by initiating public awareness campaigns, social media posters, and television and radio sessions addressing proper control and preventive measures [22,23,30]. Leptospirosis is among the under-reported causes of febrile sickness in Tanzania due to the sophisticated and expensive tools used for diagnosis. To facilitate screening, early diagnosis, and treatment of patients who present in clinical settings with febrile illness of unknown origin, it is urgently necessary to develop a rapid diagnostic test that is reliable, affordable, and simple enough to be practical in most clinical settings across the nation [5,24–26]. This will be important in the early identification of leptospirosis cases for quick intervention to prevent adverse outcomes. To assess and comprehend leptospirosis case fatality and disease burden across the nation in highly susceptible communities and healthcare facilities, strategies to enhance surveillance and monitoring systems of infectious illnesses in people and animals are also crucial [18]. Leptospirosis can be prevented by proper use of personal protective equipment, such as protective eyewear, rubber boots and gloves, for those working in farming and livestock keeping activities, which are potentially high-risk environments for leptospirosis transmission [16, 26,27]. This calls for the implementation of effective occupational health and safety regulations in potential endemic areas. The need for effective implementation of one health approach within the country through the integration of human, animal and environmental health in fighting zoonotic diseases including leptospirosis. This may be

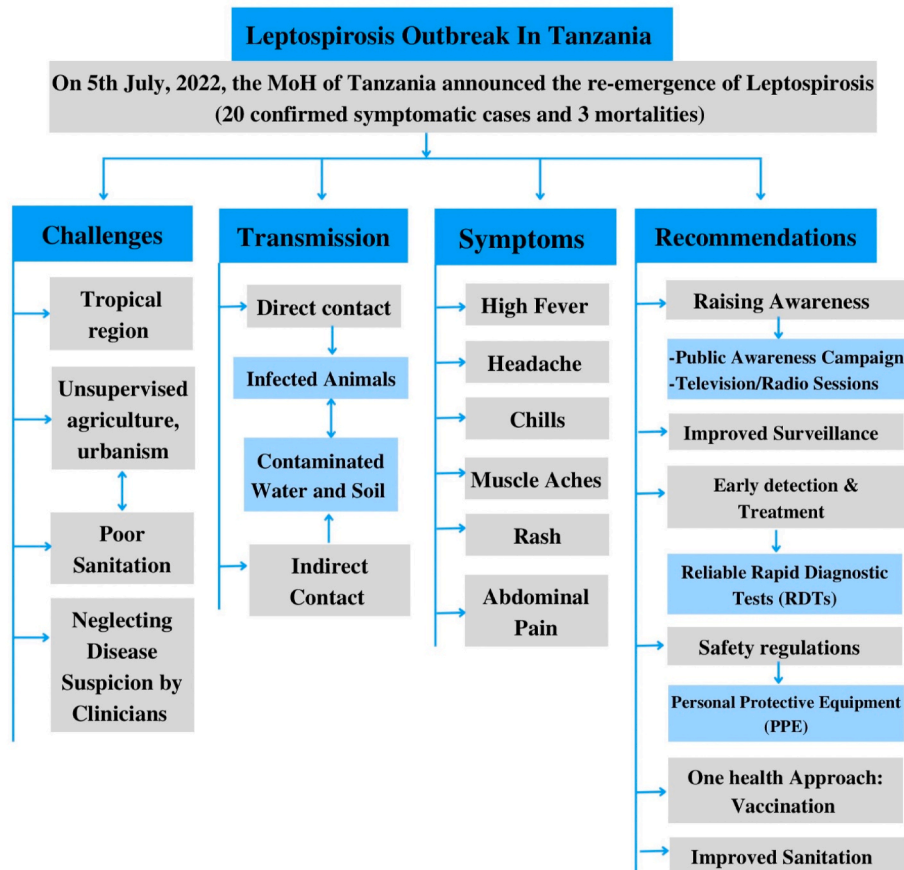


Fig. 1. Summarizing leptospirosis outbreak in Tanzania.

accomplished by implementing immunisation programmes against zoonotic illnesses, such as leptospirosis (Fig. 1), for both humans and animals [17,28,29]. Controlling the population in urban areas and the density of animals in rural regions, as well as installing proper water purification systems and maintaining hygienic conditions, including suitable housing, will aid in reducing and preventing the leptospirosis epidemic [31].

## 6. Conclusion

Since the 1990s, Tanzania has been affected by leptospirosis outbreaks because of its tropical geographical area. Due to the high risk of transmission by environmental contamination through animal urine, it has affected mostly workers in vulnerable jobs such as farms and agriculture areas. The recent outbreak of leptospirosis in the southern region of Linda with 20 confirmed cases and 3 deaths has caused an alarming situation in Tanzania. Increased food requirements, poor sanitation and thus more unsupervised implementation in agriculture, urbanism, and wildlife intrusion have been speculated to be the reasons for the outbreak.

The MoH is closely coordinating with the WHO to mitigate the outbreak by acquiring additional tests, contact tracing, and early detection and isolation of the patients. Increased awareness amongst health workers, wearing proper clothes and chemoprophylaxis by doxycycline 200 mg have also been suggested to prevent clinical illness in adults. The CDC has recommended preventative measures against the dangers of exposure to travellers. To help contain future outbreaks of leptospirosis, certain recommendations for individuals and the

government have been made in response to the current outbreak, including starting public awareness campaigns, immunising people, improving surveillance, using rapid detection tests, and installing suitable purification systems.

## Ethical approval

Not Applicable.

## Sources of funding

None.

## Author contribution

Olivier Uwishema: Conceptualization, Project administration, Writing-review and Designing.

Mortada Abbass: Collection and assembly of data.

Olivier Uwishema: Reviewed and edited the first draft, supervisor.

Jack Wellington MSc (LSHTM) FGMS: Reviewed and edited the second draft.

Helen Onyeka: Reviewed and edited the final draft, Supervisor.

Manuscript writing: All authors.

Final approval of manuscript: All authors.

Fig. 1. Summarizing Leptospirosis outbreak in Tanzania was drawn and analyzed by authors Anushree Rai [1,5] and Olivier Uwishema [1-3]\*

**Conflicts of interest**

No conflicts of interest declared.

**Registration of research studies**

1. Name of the registry: Not Applicable.
2. Unique Identifying number or registration ID: Not Applicable.
3. Hyperlink to your specific registration (must be publicly accessible and will be checked): Not Applicable.

**Guarantor**

Olivier Uwishema: Principal Investigator (PI).

**Consent**

Not Applicable.

**Provenance and peer review**

Not commissioned, externally peer reviewed.

**References**

- [1] E.M. Crecelius, M.W. Burnett, Leptospirosis, *J. Spec. Oper. Med.* 20 (4) (2020 Winter) 121–122, <https://doi.org/10.55460/8YBJ-ODLP>. PMID: 33320325.
- [2] M. De Roche, S. Jauréguiberry, Leptospirose [leptospirosis], *Rev. Prat.* 66 (8) (2016 Oct) 886–892. French. PMID: 30512544.
- [3] ABC News Network. (n.d.). ABC News. Retrieved July 23, 2022, from <https://abcnews.go.com/amp/International/tanzania-investigates-deadly-outbreak-mystery-disease/story?id=86870310>.
- [4] Centers for Disease Control and Prevention, Leptospirosis, Centers for Disease Control and Prevention, 2019, March 13. Retrieved July 23, 2022, <https://www.cdc.gov/leptospirosis/index.html>.
- [5] S.K. Motto, G.M. Shirima, B.M. de Clare Bronsvort, E.A.J. Cook, Epidemiology of leptospirosis in Tanzania: a review of the current status, serogroup diversity and reservoirs, *PLoS Neglected Trop. Dis.* 15 (11) (2021 Nov 16), e0009918, <https://doi.org/10.1371/journal.pntd.0009918>. PMID: 34784354; PMCID: PMC8631673.
- [6] B. Materu, Tanzania confirms outbreak of leptospirosis. The East African, Retrieved July 23, 2022, <https://www.theeastafrican.co.ke/tea/science-health/tanzania-confirms-outbreak-of-leptospirosis-3883916>, 2022, July 19.
- [7] B. Wambura, Nose Bleeding in Tanzania Identified as Leptospirosis, The Citizen, 2022, July 18. Retrieved July 23, 2022, <https://www.thecitizen.co.tz/tanzania/news/national/nose-bleeding-in-tanzania-identified-as-leptospirosis-3883804>.
- [8] Renee L. Galloway, Ilana J. Schafer, Robyn A. Stoddard, Leptospirosis, from, <https://wwwnc.cdc.gov/travel/yellowbook/2020/travel-related-infectious-diseases/leptospirosis>, 2019.
- [9] Makoye Kizito, After COVID-19 Tanzania grappling with another zoonotic disease. <https://www.aa.com.tr/en/africa/after-covid-19-tanzania-grappling-with-another-zoonotic-disease/2641095>, 20.7.2022.
- [10] Georgies F. Mgode, Maulid M. Japhary, Ginethon G. Mhamphi, Ireem Kiwelu, Ivan Athaide, Robert S. Machang'u, Published: <https://doi.org/10.1371/journal.pntd.0007225>, May 31, 2019.
- [11] Leptospirosis Linked to Deadly Outbreak in Lindi, Tanzania, *Outbreak News Today*, 2022. Retrieved July 23, 2022, from, July 19, <http://outbreaknewstoday.com/leptospirosis-linked-to-deadly-outbreak-in-lindi-tanzania-83033/>.
- [12] Leptospirosis: Introduction, OpenWHO, 2021, January 25. Retrieved July 23, 2022, from, <https://openwho.org/courses/leptospirosis-en>.
- [13] Tanzania identifies mystery illness as leptospirosis, 404. (n.d.). Retrieved July 23, 2022, from, <https://newsaf.cgtn.com/news/2022-07-20/Tanzania-identifies-mystery-illness-as-Leptospirosis-1bNv4tIOAw/index.html>.
- [14] H.M. Biggs, D.M. Bui, R.L. Galloway, R.A. Stoddard, S.V. Shadomy, A.B. Morrissey, J.A. Bartlett, J.J. Onyango, V.P. Maro, G.D. Kinabo, W. Saganda, J.A. Crump, Leptospirosis among hospitalized febrile patients in northern Tanzania, *Am. J. Trop. Med. Hyg.* 85 (2) (2011) 275–281, <https://doi.org/10.4269/ajtmh.2011.11-0176>.
- [15] J.V. Hookey, Leptospira and leptospirosis, *J. Biol. Educ.* 25 (3) (1991), <https://doi.org/10.1080/00219266.1991.9655201>.
- [16] M.J. Maze, S. Cash-Goldwasser, M.P. Rubach, H.M. Biggs, R.L. Galloway, K. J. Sharples, K.J. Allan, J.E.B. Halliday, S. Cleaveland, M.C. Shand, C. Muiruri, R. R. Kazwala, W. Saganda, B.F. Lwezaula, B.T. Mmbaga, V.P. Maro, J.A. Crump, Risk factors for human acute leptospirosis in northern Tanzania, *PLoS Neglected Trop. Dis.* 12 (6) (2018) 1–22, <https://doi.org/10.1371/journal.pntd.0006372>.
- [17] K.M. Thomas, T. Kibona, J.R. Claxton, W.A. de Glanville, F. Lankester, J.J. Buza, R. Carter, G.E. Chapman, J.A. Crump, M.P. Dagleish, J.E.B. Halliday, C. M. Hamilton, E.A. Innes, F. Katzer, M. Livingstone, D. Longbotton, C. Millins, B. T. Mmbaga, V. Moshia, K.J. Allan, Prospective cohort study reveals unexpected aetiologies of livestock abortion in northern Tanzania, *Sci. Rep.* (2021) 1–50, <https://doi.org/10.1038/s41598-022-15517-8>.
- [18] Olivier Uwishema, et al., The impact of COVID-19 on patients with neurological disorders and their access to healthcare in Africa: a review of the literature, *Brain Behav.* (August, 2022), <https://doi.org/10.1002/brb3.2742>.
- [19] O. Uwishema, O. Adekunbi, C.A. Peñamante, B.K. Bekele, C. Khoury, M. Mhanna, A. Nicholas, I. Adanur, B. Dost, H. Onyeaka, The burden of monkeypox virus amidst the Covid-19 pandemic in Africa: a double battle for Africa, *Ann. Med. Surg.* 2012 (2022), 104197, <https://doi.org/10.1016/j.amsu.2022.104197>. Advance online publication.
- [20] O. Uwishema, C. Berjaoui, I. Correia, H. Anis, E. Karabulut, D. Essayli, M. Mhanna, A. Oluyemisi, Current management of acute ischemic stroke in Africa: a review of the literature, *Eur. J. Neurol.* (2022), <https://doi.org/10.1111/ene.15495>. Advance online publication.
- [21] Olivier Uwishema, et al., Is Alzheimer's disease an infectious neurological disease? A review of the literature, *Brain Behav.* (Jul. 2022), <https://doi.org/10.1002/brb3.2728>.
- [22] O. Uwishema, G. Ayoub, R. Badri, H. Onyeaka, C. Berjaoui, E. Karabulut, H. Anis, C. Sammour, F. Mohammed Yagoub, E. Chalhoub, Neurological disorders in HIV: hope despite challenges, *Immun. Inflamm. Dis.* 10 (3) (2022), e591, <https://doi.org/10.1002/iid3.591>.
- [23] O. Uwishema, H. Onyeaka, R. Badri, A.N. Yücel, A.K. Korkusuz, A.O. Ajagbe, A. Abuleil, C. Chaaya, B. Alhendawi, E. Chalhoub, The understanding of Parkinson's disease through genetics and new therapies, *Brain Behav.* 12 (5) (2022), e2577, <https://doi.org/10.1002/brb3.2577>.
- [24] O. Uwishema, H. Onyeaka, B.A.A. Alshareif, M.E.A. Omer, A.L.R. Sablay, R. Tariq, et al., Current context of pneumonia amidst the COVID-19 pandemic in Africa, *J. Contemp. Stud. Epidemiol. Public Health* 2 (2) (2021), ep21007, <https://doi.org/10.30935/jconsep/11281>.
- [25] O. Uwishema, B. Alshareif, M. Yousif, M. Omer, A. Sablay, R. Tariq, A. Zahabioun, R.M. Mwazighe, H. Onyeaka, Lassa fever amidst the COVID-19 pandemic in Africa: a rising concern, efforts, challenges, and future recommendations, *J. Med. Virol.* 93 (12) (2021) 6433–6436, <https://doi.org/10.1002/jmv.27219>.
- [26] O. Uwishema, E. Chalhoub, T. Torbati, S.C. David, C. Khoury, L. Ribeiro, Y. Nasrallah, B.K. Bekele, H. Onyeaka, Rift Valley fever during the COVID-19 pandemic in Africa: a double burden for Africa's healthcare system, *Health Sci. Rep.* 5 (1) (2022), e468, <https://doi.org/10.1002/hsr2.468>.
- [27] O. Uwishema, E. Chalhoub, A. Zahabioun, S.C. David, C. Khoury, T.H. Al-Saireh, B.K. Bekele, R.M. Mwazighe, H. Onyeaka, The rising incidence of African swine fever during the COVID-19 pandemic in Africa: efforts, challenges and recommendations, *Int. J. Health Plann. Manag.* 37 (1) (2022) 561–567, <https://doi.org/10.1002/hpm.3357>.
- [28] L. Greene, O. Uwishema, A. Nicholas, A. Kapoor, C. Berjaoui, E. Adamolekun, C. Khoury, F. Mohammed, H. Onyeaka, Crimean-Congo haemorrhagic fever during the COVID-19 pandemic in Africa: efforts, recommendations and challenges at hand, *Afr. J. Emerg. Med.* 12 (2) (2022) 117–120, <https://doi.org/10.1016/j.afjem.2022.02.004>. *Revue africaine de la médecine d'urgence*.
- [29] J. Sun, O. Uwishema, H. Kassem, M. Abbass, L. Uweis, A. Rai, R. El Saleh, I. Adanur, H. Onyeaka, Ebola virus outbreak returns to the Democratic Republic of Congo: an urgent rising concern, *Ann. Med. Surg.* (2022), <https://doi.org/10.1016/j.amsu.2022.103958>.
- [30] O. Adekunbi, O. Uwishema, I. Adanur, H. Onyeaka, Prospect of acute hepatitis E virus outbreak in the context of the COVID-19 Pandemic in Africa: a contingency plan, *Ann. Med. Surg.* (2022), <https://doi.org/10.1016/j.amsu.2022.104084>.

Daniel Stephen Masunga

*Oli Health Magazine Organization, Research and Education, Kigali, Rwanda  
Kilimanjaro Christian Medical University College (KCMUCo), Kilimanjaro,  
Tanzania*

Anushree Rai

*Oli Health Magazine Organization, Research and Education, Kigali, Rwanda  
Chhattisgarh Institute of Medical Sciences, Bilaspur, Chhattisgarh, India*

Mortada Abbass

*Oli Health Magazine Organization, Research and Education, Kigali, Rwanda  
Faculty of Medicine, Beirut Arab University, Beirut, Lebanon*

Olivier Uwishema\*

*Oli Health Magazine Organization, Research and Education, Kigali, Rwanda  
Clinton Global Initiative University, New York, USA  
Faculty of Medicine, Karadeniz Technical University, Trabzon, Turkey*

Jack Wellington

*Oli Health Magazine Organization, Research and Education, Kigali, Rwanda  
Faculty of Medicine, Cardiff University School of Medicine, Cardiff  
University, Cardiff, UK*

Lama Uweis, Rayyan El Saleh, Sara Arab

*Oli Health Magazine Organization, Research and Education, Kigali, Rwanda  
Faculty of Medicine, Beirut Arab University, Beirut, Lebanon*

Chinyere Vivian Patrick Onyeaka  
*Department of Emergency Medicine, Watford General Hospital, West  
Hertfordshire Teaching Hospitals NHS Trust, Watford, United Kingdom*

Helen Onyeaka  
*School of Chemical Engineering, University of Birmingham, Edgbaston,  
Birmingham, B152TT, UK*

\* Corresponding author. Oli Health Magazine Organization, Research  
and Education, Kigali, Rwanda.  
E-mail address: [uwolivier1@ktu.edu.tr](mailto:uwolivier1@ktu.edu.tr) (O. Uwishema).