ARTICLE

Collective responsibility during a cholera outbreak: The case of Hammanskraal

A E Obasa,[1] PGDip, MPhil (Applied Ethics); **M Botes,**[2] BProc, LLB, LLM (Intellectual Property Law), LLD (Biotechnology Law); **A C Palk,**[3] BA (Humanities), BA Hons, MA, PhD (Philosophy)

[1] *Registrar Research Support Office, Research and Internationalisation, Development and Support Division, Faculty of Medicine and Health Sciences, Stellenbosch University, Cape Town, South Africa*

[2] *Department of Medicine, Faculty of Medicine and Health Sciences, Stellenbosch University, Cape Town, South Africa*

[3] *Unit for Bioethics, Centre for Applied Ethics, Philosophy Department, Stellenbosch University, Stellenbosch, South Africa*

Corresponding author: *A E Obasa (obasa@sun.ac.za)*

The transmission of cholera, a highly infectious disease, is closely linked to inadequate access to clean water and sanitation facilities, with resource-poor communities, including refugees, rural communities and temporary displacement camps particularly vulnerable to outbreaks. Any disruption in water and sanitation systems or a sudden surge in community size owing to displacement can spark a humanitarian and health crisis, elevating the risk of cholera transmission and possibly triggering a regional epidemic. Recently, Hammanskraal in Gauteng, South Africa, experienced such an epidemic. A multifaceted approach is essential to minimise fatalities and effectively manage healthcare services in such health emergencies. This approach includes early detection, rapid response to contain outbreaks, and the effective deployment of technical support, advocacy, resource mobilisation and partnerships at local, national, and international levels. This paper explores the responsibilities of individuals, healthcare workers, communities and governments in addressing epidemics. It also delves into the concept of collective responsibility with regard to climate change and cholera, as part of the multifaceted approach for cholera prevention and control. While economic development, equal access to safe drinking water, and adequate sanitation are necessary for cholera control, major challenges persist in achieving the fundamental right to a healthy environment in the long term. We also discuss these obstacles and conclude with practical suggestions and recommendations for future cholera prevention.

S Afr J Bioethics Law 2023;16(3):e1250. https://doi.org/10.7196/SAJBL.2023.v16i3.1250

Cholera is a rapidly developing gastrointestinal infection primarily transmitted through the ingestion of contaminated food or water containing the bacterium *Vibrio cholerae*. This bacterium is responsible for causing acute diarrhoeal symptoms in infected individuals.[1] Despite efforts to control its spread, cholera remains a significant global public health problem, often associated with social inequality and underdevelopment.[2] Cholera affects approximately 3 - 5 million individuals globally each year, resulting in approximately 100 000 fatalities.[3]

The first laboratory confirmation of cholera in South Africa (SA) dates back to 1974.[4] Cholera is not considered endemic in SA; instead, outbreaks have occurred owing to imported cases from neighbouring countries, particularly Zimbabwe and Mozambique.[3] The 2008/2009 outbreak in SA was triggered by imported cases from Zimbabwe.[5] During this period, there were over 12 000 reported cases and 65 deaths, with the majority of cases concentrated in the Mpumalanga and Limpopo provinces.[5] Since then, only a few cases (mostly imported) have been identified.[6] Five cases were reported from 2010 to 2014, and no cases were identified from 2015 to 2017.[7] Severe outbreaks in neighbouring countries, such as Mozambique and Malawi, resulted in two cases recorded in SA in February 2023.[8]

However, there has been a major outbreak in Hammanskraal, a small town in Gauteng Province,[9] with the Rooiwal plant identified as the epicentre of the crisis in the community, which has been living without safe drinking water for years.[10] At the time of writing, approximately 600 people presented with symptoms suggestive of cholera at hospitals in Gauteng and Free State. Nationally, between 1 February and 6 June 2023, there were 166 laboratory-confirmed cases of cholera and 202 suspected cases across five provinces.[11] According to reports, Hammanskraal residents have reported a higher mortality rate than any other town in the country. However, the humanitarian organisation, Gift of the Givers, suggested that there might be underreporting of cholera cases in the Free State,[12] indicating more widespread outbreaks. As of 26 June 2023, the death toll in the country has risen to 31.[13]

During an infectious disease outbreak, the importance of acknowledging collective responsibility for both the outbreak and its consequences cannot be overstated.[14] Community members, healthcare workers, and government officials all have crucial roles in mitigating the disease spread and safeguarding public health. By recognising the significance of their individual and collective roles, they pave the way for a united front capable of effectively preventing the spread of the disease and ensuring the well-being

of all. This paper examines the cholera outbreak in Hammanskraal to discuss the ethical aspects and implications of responsibility associated with responding to and mitigating such outbreaks. This includes the relationship between climate change and infectious disease outbreaks, such as cholera, proposes an ethical framework for addressing these outbreaks, and provides practical prevention and response recommendations.

Individual and government-level responsibility

In a cholera outbreak, all stakeholders must take decisive steps to minimise the transmission of the disease and deliver appropriate medical care. While community members can take steps to mitigate their risk of infection during outbreaks,[15] it is essential to address both individual-level responses and factors within the broader context that have contributed to these outbreaks in the first place.[10] This is especially pertinent because many communities in SA still lack access to safe drinking water.[16] This is noteworthy, as the right to clean water is embedded in the constitutionally protected right to an unpolluted environment that is not harmful to human health,[17] and the national government holds the responsibility to protect the quality of the country's water resources under the National Water Act.[18] While risk factors for cholera outbreaks are multifaceted, this specific outbreak is arguably associated with decades of negligence, maladministration and suboptimal maintenance of drinkable water.[10] Widespread corruption has also been identified as a contributing factor to outbreaks of this kind, as it skews the distribution of essential supplies, healthcare services and aid in favour of those with access to power or influence. This exacerbates the suffering and vulnerability of marginalised and disadvantaged communities.[19,20]

During a cholera outbreak, the National Guidelines for Cholera Control, issued by the Department of Health in 2014, specifically require that an arrangement be made to protect water sources as an important measure for reducing the risk of contamination' because treatment of the source of the outbreak 'may be the best way to prevent the spread of cholera in the community'.[21] This emphasises the critical role that government plays in controlling outbreaks by providing adequate water supply chains and sanitation infrastructures to households. Moreover, this is the constitutional and legal responsibility of the government, as mentioned earlier. However, as observed during the COVID-19 pandemic, infection prevention measures such as a nationwide lockdown in the SA context were highly ineffective owing to socio-economic inequalities, especially in communities living in overcrowded conditions or sharing ablution facilities.[22] Accordingly, South Africa should develop a risk-based strategy to manage health emergencies, such as cholera outbreaks, that is fully compatible with its socio-economic context. Unfortunately, and as demonstrated during the COVID-19 pandemic, governmental corruption further compounds the challenges in effectively managing highly infectious diseases of public health emergencies.[22]

Addressing corruption during an outbreak requires comprehensive measures, including fostering transparency, reinforcing accountability mechanisms, supporting civil society organisations, and promoting good governance practices.[23] International pressure, public awareness, and collective action can also hold corrupt government officials accountable and ensure that resources reach those in need during a public health crisis.[24] The Department of Health and various stakeholders are making efforts to contain the cholera outbreak and save lives. National, provincial, humanitarian non-government organisation (NGO), and district outbreak response teams have also been mobilised, reaching approximately 300 contacts and aiding in contact tracing and case identification.[25] Additionally, initiatives promoting health and the distribution of 3 000 hygiene packs (donated by the United Nations International Children's Emergency Fund and Doctors Without Borders) have been implemented to support affected communities.[26]

Collective responsibility: Climate change and cholera

Regarding other contributing factors to outbreaks of this nature, weather changes have a significant impact on water ecosystems by altering the habitat of pathogens, vectors and human hosts, thereby affecting the spread and geographic distribution of infectious diseases.[27] The impact of human activities on the climate also has a significant effect on the environment. Changes in temperature, precipitation and water availability create favourable conditions for cholera-causing bacteria to thrive and spread.[28,29] The increase in temperature, for instance, stimulates the growth of *Vibrio cholerae*. Simultaneously, changes in precipitation lead to contaminated water and poor sanitation, both of which increase the likelihood of cholera outbreaks.[30,31] While the relationship between climate change and infectious diseases is complex and requires further understanding,[32] it is evident that all human beings bear responsibility to some degree. Conceding our role in driving climate change, we are morally obligated to take responsibility for its consequences, including the heightened vulnerability to cholera outbreaks.[30,33]

South Africa's long-anticipated Climate Change Bill was formally introduced to parliament on 18 February 2022 by the Department of Forestry, Fisheries and the Environment for public commentary. Although the period for public commentary has closed, we are still awaiting the final draft of the bill. The bill primarily aims to ensure a comprehensive and coordinated response to climate change. It mandates every organ of state that exercises power or performs a function that may be affected by climate change to amend its policies, programmes and decisions to ensure that its actions and activities align with the objectives of this bill.[34] This emphasises the importance of following a multi-stakeholder, but holistic, approach to mitigate the effects of climate change through a coordinated and integrated government response. Critics have, however, argued that the Bill prioritises mitigation over adaptation and that it should include more robust measures to address the impacts of climate change and increase resilience in vulnerable communities, ecosystems, and infrastructure.[35] Given the recent outbreak in Hammanskraal and concerns regarding corrupt tender practices, there are uncertainties surrounding the construction of these essential infrastructures, which is one of the central tenets of the Climate Change Bill.[34]

In addition, the bill provides for 'a just transition towards a low-carbon economy and society',[33] to ensure South Africa's equitable contribution to global greenhouse gas stabilisation efforts and to ultimately 'protect and preserve the planet for the … [well-being of both] present and future generations'.[33] To give practical effect to these objectives, the bill requires the establishment of a Presidential Climate Commission which can advise the government on aspects relating to the mitigation of climate change impacts,

the government's responses to it, and monitor the government's progress towards its goal of transitioning into a low-carbon and climate-resilient economy and society. This commission, established in December 2020, released its draft, Just Transition Framework, in February 2022 for public comment.[36] Of importance for the topic under discussion is the definition of a just transition put forward in this report which states, among others, that:

> 'A just transition builds the resilience of the economy and people through affordable, decentralised, diversely owned renewable energy systems; conservation of natural resources; *equitable access of water resources*; an *environment that is not harmful to one's health* and well-being; and sustainable, equitable, inclusive land use for all, especially for the most vulnerable [our emphasis].'

This definition must be read together with the fundamental right 'to an environment that is not harmful to their health and well-being' as outlined in section 24 of the Constitution. Du Plessis'[37] opinion further expands on this concept, stating that the term 'environment' not only relates to the land, water and atmosphere of the earth but also includes socio-economic and cultural dimensions of the interrelationship between people and the natural environment, given these factors' close connection to the overall state of the environment.

At a national level, we bear a collective responsibility to adopt and commit to sustainable practices that limit our contributions to climate change, thereby reducing the drivers of climate change, which can indirectly impact the occurrence of cholera and other diseases of this nature.[38,39] This can be achieved through a transdisciplinary approach,[40] good governance,[23] reducing carbon emissions, conserving resources, and promoting environmentally friendly behaviours.[41] Mitigating and adapting to climate change also necessitates international collaborations and concerted efforts.[42] Such global cooperation includes ensuring financial and technical support for developing nations, knowledge sharing, and establishing joint action frameworks.[42] By transcending borders, we can more effectively address the root causes of climate change and mitigate its consequences, including climate change-linked disease outbreaks worldwide.[43] Embracing collective responsibility at all levels fosters a sense of shared accountability among individuals.[44] This encourages active contributions towards environmental care and maintaining good hygiene practices,[45] which, in turn, minimises the environmental impacts of outbreaks.[39,36] By recognising their role in promoting sustainable practices, individuals can work together towards common goals, creating a culture of responsibility and inspiring others to follow suit.[46]

An ethical framework for addressing cholera outbreaks responsibility

The World Health Organization (WHO) has also emphasised the influence that environmental factors play in the spread of infectious diseases, particularly those that could potentially lead to epidemics.[47] Assuming responsibility for the environment includes a strong focus on the ethical consideration of both the environment and its inhabitants, including non-human entities.[48] More specifically, it requires a shift in perspective to view nature as a community of interconnected beings deserving of respect and consideration.[49,50] In particular, an ethical and responsible attitude towards the environment includes paying deep attention to the principles and values of justice, sufficiency, sustainability and solidarity.[51]

Justice is a core ethical principle which is predicated on the equality of all persons and emphasises the fair distribution of benefits and burdens.[52] Environmental justice is a newer principle arising in response to previous injustices. In its form as a social movement, environmental justice is informed by the fact that environmental degradation tends to disproportionately affect marginalised communities, exposing them to pollution, hazardous waste, and limited access to clean resources.[53,54] The environmental justice movement is driven by the contradiction between the rhetoric of rights and the reality of unmet needs.[55] Addressing cholera outbreaks is a matter of environmental justice.[56] Achieving environmental justice entails ensuring that everyone has access to a healthy environment, clean air and water, and equitable distribution of environmental benefits and burdens.[57,58] More specifically, combating environmental injustices effectively requires that affected communities have increased political power and resources. This necessitates advocating for policies that encourage sustainable practices, reduce pollution, and allocate resources fairly.[59] The field of environmental ethics includes an emphasis on the interconnectedness of all living beings and ecosystems.[44] It also acknowledges how actions that contribute to environmental degradation, such as pollution or resource depletion, have widespread negative impacts.[60] The cholera outbreak is an example of this interconnectedness, as polluted water sources can affect entire communities and regions.[61] Therefore, addressing cholera ethically requires acknowledging that everyone has a shared responsibility[44] to protect and preserve the environment.[62] Achieving justice in this context involves taking collective action to prevent environmental damage and halt the spread of diseases such as cholera.

In addressing cholera, prioritising sufficiency and sustainability is crucial.[63] This involves using resources with consideration for both current and future generations while discouraging wastefulness and hoarding. To effectively implement sufficiency in addressing cholera outbreaks, it is crucial to recognise the limited resources available and the detrimental impact of excessive consumption on the environment.[64] Achieving a balance between sufficiency and sustainability requires exploring innovative solutions that promote responsible resource management.[63] This balance could involve improving water infrastructure, implementing efficient sanitation systems, and investing in disease prevention measures. Providing equal access to resources is crucial in preventing and managing the disease, particularly for vulnerable communities, as is addressing underlying factors and redistributing resources to prevent future outbreaks. Embracing sufficiency also entails acknowledging the finite nature of resources and striving for sustainable practices that balance human well-being with environmental preservation.[65,66]

Finally, cholera prevention, informed by an environmental ethics framework, requires solidarity. This entails collective action arising from the recognition of human interdependence and a commitment to sharing the burden of tackling environmental issues and averting outbreaks of this nature.[67] This approach prompts us to examine our relationships within different communities, including the dynamics between local and national governments and their constituents, and the ties between global and national communities. It stresses the importance of expanding our sense of community and considering the welfare of others beyond immediate boundaries. In today's global economy, where goods and services are sourced

internationally, solidarity demands that we assume responsibility for the wider international community and how our choices may have far-reaching effects that can impact ecosystems and communities worldwide.[63] Solidarity also underscores the significance of making choices that demonstrate concern for human and environmental well-being. Mindful sustainability and minimising harm to humans and the environment are critical to averting future outbreaks. When expertise is limited, solidarity necessitates advocating for worldwide collaboration and resource sharing as vital to addressing public health challenges.

Prevention of cholera: Future directions and recommendations

A comprehensive approach is essential to effectively prevent and control cholera. Key aspects include fostering collaboration between governments and NGOs to sustain progress and overcome obstacles. It is also crucial to align national efforts with global initiatives such as the WHO's Global Roadmap to eliminate cholera by 2030.[1] We conclude with some practical suggestions and recommendations.

Real-time monitoring and surveillance

Real-time monitoring and response are crucial to prevent the spread of outbreaks. This strategy necessitates a significant investment in real-time monitoring, surveillance, outbreak detection, and timely access to management and vaccines.[68] Accurate reporting of morbidity and mortality cases can significantly enhance real-time response. Developing more capacity to stay ahead of outbreaks is imperative to move from response to prevention. Simultaneously, monitoring and surveillance must adhere to ethical and legal data privacy and security requirements.

Technology transfer to fast-track vaccine development

South Africa's Biovac has signed a deal with the International Vaccine Institute to produce an oral cholera vaccine (OCV).[68] This agreement includes licensing and technology transfer and is a significant step for Biovac as it aims to establish OCV manufacturing capability. The risk of cholera outbreaks has increased in neighbouring southern African countries such as Malawi, partly owing to climate change and other regional factors. Although Malawi has received doses of OCV, limited stocks are available, and careful consideration is needed to ensure their efficient and equitable distribution.[69,70] The effectiveness of OCV campaigns in endemic regions depends on the technical proficiency and ability to produce the necessary raw materials for vaccine production. Technology transfer and sharing of knowledge necessary to develop and provide vaccines is justified by the principles of solidarity and justice, as discussed above.

Strengthening transparency and accountability

To effectively combat cholera, it is crucial to address corruption within governance systems. Corruption involving the mismanagement of funds, including practices such as 'tenderpreneurship', must be eradicated to ensure that resources are directed towards the communities affected by this disease. Achieving this will require pressure from civil society for increased transparency and implementing more robust accountability measures.

Public-private partnership

Finally, the role of national and international NGOs, such as Gift of the Givers, and organisations such as the United Nations and UNICEF in monitoring and advocating for effective cholera response is crucial. To combat governance corruption and ensure the appropriate utilisation of resources, these organisations must be empowered to actively participate in decision-making processes, collaborate with international partners, and engage in community-based initiatives.

Conclusion

In this paper, we have used the recent cholera outbreak in Hammanskraal as a focal point to emphasise the interconnected nature of our world. This further highlights the grave threat that climate change poses to the health and general well-being of all individuals. Climate change has various effects, such as altering weather patterns and disrupting the environment, which increase the likelihood of diseases such as cholera. We must acknowledge this fact by aligning national efforts with global initiatives. We can work towards eliminating cholera by 2030 by taking action to address climate change, improving healthcare systems, and implementing preventive measures to safeguard communities globally. Therefore, effectively addressing cholera requires a comprehensive and collaborative approach.

Declaration. None.
Acknowledgements. None
Author contributions. Equal contributions.
Funding. None
Conflicts of interest. None

1. World Health Organisation (WHO) Cholera Factsheet 2023; https://www.who.int/news-room/fact-sheets/detail/cholera?gclid=Cj0KCQjwnf-kBhCnARIsAFIg492_YECOtLGvTHR5bNzpunpODY5mAIC9Pb9XWCKp3YYtj332_h41-NoaAsFoEALw_wcB (accessed 29 June 2023).
2. Hamlin C. "CHOLERA FORCING" The Myth of the Good Epidemic and the Coming of Good Water. Am J Public Health 2009;99(11):1946–1954. https://doi.org/10.2105/AJPH.2009.165688
3. Enteric Diseases. The emergence of non-epidemic Vibrio cholerae O1 ST75 in South Africa. Communicable Diseases Communiqué 2021.
4. Küstner HG, Gibson IH, Carmichael TR, et al. The spread of cholera in South Africa. S Afr Med J 1981 18;60(3):87-90. PMID: 7256448.
5. Ismail H, Smith AM, Tau NP, Sooka A, Keddy KH. Cholera outbreak in South Africa, 2008–2009: Laboratory analysis of Vibrio cholerae O1 strains. J Infect Dis 2013;208(suppl_1):S39–S45. https://doi.org/10.1093/infdis/jit200
6. National Institute for Communicable Disease Bulletin. Cholera outbreak in South Africa: preliminary descriptive epidemiology on laboratory-confirmed cases, 15 November 2008 to April 2009.
7. Ismail H, Smith AM, Tau NP, Sooka A, Keddy KH. Cholera outbreak in South Africa, 2008–2009: Laboratory analysis of Vibrio cholerae O1 strains. J Infect Dis 2013;208(suppl_1):S39–S45. https://doi.org/10.1093/infdis/jit200
8. World Health Organization (WHO). cholera Mozambique 2023. https://www.who.int/emergencies/disease-outbreak-news/item/2023-DON443 (accessed 29 June 2023).
9. Chagopa AR. Hammanskraal water crisis exposes years of neglect 2023. Available from: https://mg.co.za/environment/2023-05-24-hammanskraal-water-crisis-exposes-years-of-neglect/ (accessed 29 June 2023).
10. Chagopa AR. Hammanskraal water crisis exposes years of neglect. 2023. https://mg.co.za/environment/2023-05-24-hammanskraal-water-crisis-exposes-years-of-neglect/ . (accessed 21 August 2023).
11. Cholera death toll rises to 31 in SA, 166 laboratory-confirmed cases recorded 2023. https://reliefweb.int/report/south-africa/cholera-death-toll-rises-31-sa-166-laboratory-confirmed-cases-recorded (accessed 29 June 2023).
12. Haripersad D, Gift of the Givers concerned over underreported cholera cases in Free State 2023. Available from: https://www.citizen.co.za/news/gift-of-the-givers-concerned-cholera-cases-free-state/ (accessed 29 June 2023).

13. Sobuwe Y. Cholera outbreak: Death toll rises to 31, with all but 2 fatalities in Gauteng. https://www.news24.com/news24/southafrica/news/cholera-outbreak-death-toll-rises-to-31-with-all-but-2-fatalities-in-gauteng-20230608. (accessed 29 June 2023).
14. Grigoryan YG, Krylov NN. COVID-19 and collective responsibility: a lesson from the smallpox outbreak in Moscow in 1960. J Med Ethics Hist Med 2020; 28(13):32 https://doi.org/10.18502/jmehm.v13i32.5049
15. Taylor DL, Kahawita TM, Cairncross S, Ensink JHJ. The Impact of Water, Sanitation and Hygiene Interventions to Control Cholera: A Systematic Review. PLoS One 2015;10(8):e0135676. https://doi.org/10.1371/journal.pone.0135676
16. Meissner R, du Plessis A. South Africa's increasing water stress requires urgent informed actions. https://theconversation.com/south-africas-increasing-water-stress-requires-urgent-informed-actions-189659 (accessed June 30, 2023).
17. South African Government https://www.gov.za/coronavirus/faq/vaccine/evds. (accessed 30 June 2023).
18. Government South Africa. National Water Act 36 of 1998. https://www.gov.za/documents/national-water-act#:~:text=The%20National%20Water%20Act%2036,provide%20for%20matters%20connected%20therewith. (accessed 30 June 2023).
19. Njilo N. Tshwane mayor points finger at 'network of corruption' as cholera death toll rises to 17. Daily. Maverick 2023. https://www.dailymaverick.co.za/article/2023-05-25-tshwane-mayor-points-finger-at-network-of-corruption-as-cholera-death-toll-rises-to-17/. (accessed 21 August 2023).
20. Plessis A du. Cholera in South Africa: a symptom of two decades of continued sewage pollution and neglect. Conversation 2023. https://theconversation.com/cholera-in-south-africa-a-symptom-of-two-decades-of-continued-sewage-pollution-and-neglect-206141 (accessed 21 August 2023).
21. Department of health Republic of South Africa. National Guidelines for Containment : National Guidelines for Cholera Control 2014;1(May):1–32. https://www.nicd.ac.za/assets/files/2014%20SA%20Cholera%20Guidelines.pdf (accessed June 30, 2023).
22. South African Government. South Africa Covid-19 Country Report First Edition June 2021. Available from: https://www.gov.za/documents/south-africa-covid-19-country-report-first-edition-june-2021-30-jun-2022-0000 (accessed June 30, 2023).
23. United Nations Human Rights Good Governance Practices for the Protection of Human Rights. https://www.ohchr.org/en/publications/special-issue-publications/good-governance-practices-protection-human-rights (accessed 30 June 2023).
24. Vian T. Anti-corruption, transparency and accountability in health: concepts, frameworks, and approaches. Glob Health Action 2020;13(sup1):1694744. https://doi.org/10.1080/16549716.2019.1694744
25. Government SA. Health update on response to Cholera outbreak in South Africa https://www.gov.za/speeches/health-update-response-cholera-outbreak-south-africa-8-jun-2023-0000 (accessed 30 June 2023).
26. Government South Africa. Health update on response to Cholera outbreak in South Africa. https://www.gov.za/speeches/health-update-response-cholera-outbreak-south-africa-8-jun-2023-0000 (accessed 30 June 2023).
27. Caminade C, McIntyre KM, Jones AE. Impact of recent and future climate change on vector-borne diseases. Ann N Y Acad Sci 2019 Jan;1436(1):157–173. https://doi.org/10.1111/nyas.13950
28. Lipp EK, Huq A, Colwell RR. Effects of Global Climate on Infectious Disease: the Cholera Model. Clin Microbiol Rev 2002;15(4):757–770. https://doi.org/10.1128/CMR.15.4.757-770.2002
29. Asadgol Z, Mohammadi H, Kermani M, Badirzadeh A, Gholami M. The effect of climate change on cholera disease: The road ahead using artificial neural network. PLoS One 2019;14(11):e0224813. https://doi.org/10.1371/journal.pone.0224813
30. Lipp EK, Huq A, Colwell RR. Effects of Global Climate on Infectious Disease: the Cholera Model. Clin Microbiol Rev 2002;15(4):757–770. https://doi.org/10.1128/CMR.15.4.757-770.2002
31. Asadgol Z, Mohammadi H, Kermani M, Badirzadeh A, Gholami M. The effect of climate change on cholera disease: The road ahead using artificial neural network. PLoS One 2019;14(11):e0224813. https://doi.org/10.1371/journal.pone.0224813
32. Nel J. Climate change and impact on infectious diseases. Wits J Clin Med 2022;4(3):129. https://doi.org/10.18772/26180197.2022.v4n3a1
33. Christaki E, Dimitriou P, Pantavou K, Nikolopoulos GK. The Impact of Climate Change on Cholera: A Review on the Global Status and Future Challenges. Atmosphere (Basel) 2020;11(5):449. https://doi.org/10.3390/atmos11050449
34. Department of Fisheries F and the E. CLIMATE CHANGE BILL (As introduced in the National Assembly (proposed section 76); explanatory summary of Bill and prior notice of its introduction published in Government Gazette No. 45299 of 11 October 2021) (The English text is the official text of the. 2022;(45299):1–28 (accessed June 28, 2023).
35. van Diemen, E. Is SA's Climate Change Bill good enough? It depends on who you ask. Available from: https://www.dailymaverick.co.za/article/2022-09-12-good-but-not-good-enough-the-flaws-in-south-africas-climate-change-bill/ (accessed June 28, 2023).
36. A Presidential Climate Commission Report-A Framework for a Just Transition in South Africa. 2022. : https://pccommissionflow.imgix.net/uploads/images/A-Just-Transition-Framework-for-South-Africa-2022.pdf (accessed 21 August 2023).
37. Plessis A Du. Fulfilment of South Africa's Constitutional Environmental Right in the Local Government Sphere. Wolf Legal Publishers, 2009
38. United Nations. Support Sustainable Development and Climate Action. https://www.un.org/en/our-work/support-sustainable-development-and-climate-action (accessed 30 June 2023).
39. United Nations Goal 13: Take urgent action to combat climate change and its impacts. Available from: https://www.globalgoals.org/goals/13-climate-action/?gclid=Cj0KCQjwnf-kBhCnARIsAFIg493_Y1dNmkEnrHi5sDmCaZpIBKeIyIzFituIsGcXbyClpIFmkOtBINgaAp4lEALw_wcB (accessed June 30, 2023).
40. Wright CY, Moore CE, Chersich M, et al. A Transdisciplinary Approach to Address Climate Change Adaptation for Human Health and Well-Being in Africa. Int J Environ Res Public Health 2021;18(8):4258. https://doi.org/10.3390/ijerph18084258
41. United Nations. Department of Economic and Social Affairs Sustainable, Development Reducing Carbon Emission Through Environmental Conservation and Awareness. Available from: https://sdgs.un.org/partnerships/reducing-carbon-emission-through-environmental-conservation-and-awareness (accessed June 30, 2023).
42. United Nations Climate Change. The Paris Agreement. Available from: https://unfccc.int/process-and-meetings/the-paris-agreement (accessed June 30, 2023).
43. World Health Organization (WHO). Southern African countries call for urgent action against cholera, climate-related health emergencies. https://www.afro.who.int/news/southern-african-countries-call-urgent-action-against-cholera-climate-related-health (accessed 21 June 2023).
44. Kezar A, Holcombe E, Vigil D. Shared Responsibility Means Shared Accountability: Rethinking Accountability Within Shared Equity Leadership. https://www.acenet.edu/Documents/Shared-Equity-Leadership-Accountability.pdf (accessed 25 June 2023).
45. Taylor DL, Kahawita TM, Cairncross S, Ensink JHJ. The Impact of Water, Sanitation and Hygiene Interventions to Control Cholera: A Systematic Review. PLoS One 2015;10(8):e0135676. https://doi.org/10.1371/journal.pone.0135676
46. United Nations. Support Sustainable Development and Climate Action. Available from: https://www.un.org/en/climatechange/climate-adaptation?gclid=Cj0KCQjwnf-kBhCnARIsAFIg4907PC7ZSotMZ3fGCZ8xE1b3Hc2Ugxu0-ZqeWywz9cp6U6sUtuNvNQsaArKVEALw_wcB (accessed June 25, 2023).
47. World Health Organisation (WHO). Environment, Climate Change and Health. https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health (accessed25 June 2023).
48. Das Gupta A. Environmental Ethics. In: Encyclopedia of Corporate Social Responsibility. Berlin, Heidelberg: Springer Berlin Heidelberg; 2013. page 979–982.
49. Primack RB, Cafaro PJ. Environmental Ethics. In: Encyclopedia of Biodiversity. Elsevier; 2007. page 1–11.
50. Carroll L. Pollution and Environmental Ethics. In: Environmental Pollution and Control. Elsevier; 1998. page 1–14.
51. Warner KD, DeCosse D. Using ethical principles in moral reasoning about the environment. 2009.
52. Beauchamp TL, Childress JF. The capacity for autonomous choice. 1994.
53. Primack RB, Cafaro PJ. Environmental Ethics. In: Encyclopedia of Biodiversity. Elsevier; 2007: 1–11.
54. Carroll L. Pollution and Environmental Ethics. In: Environmental Pollution and Control. Elsevier; 1998: 1–14.
55. Cock J. Connecting the Red, Brown and Green: The Environmental Justice Movement in South Africa. Voices Protest Soc Movements Post-Apartheid South Africa 2006:179–201. https://ccs.ukzn.ac.za/files/Cock%20Connecting%20the%20red,%20brown%20and%20green%20The%20environmental%20justice%20movement%20in%20South%20Africa.pdf (accessed 25 June 2023).
56. Kekana HN, Ruhiiga TM, Ndou NN, Palamuleni LG. Environmental justice in South Africa: the dilemma of informal settlement residents. GeoJournal 2023; https://doi.org/10.1007/s10708-022-10808-z
57. Social and environmental justice. https://www.forestresearch.gov.uk/tools-and-resources/fthr/urban-regeneration-and-greenspace-partnership/greenspace-in-practice/practical-considerations-and-challenges-to-greenspace/social-and-environmental-justice/
58. Kekana HN, Ruhiiga TM, Ndou NN, Palamuleni LG. Environmental justice in South Africa: the dilemma of informal settlement residents. GeoJournal 2023; https://doi.org/10.1007/s10708-022-10808-z
59. Mokaba PR. White Paper on Environmental Management Policy Department of Environment Affairs and Tourism July 1997:1–68. https://www.dffe.gov.za/sites/default/files/legislations/environemtal_management_0.pdf (accessed 29 June 2023)
60. Nel J. Climate change and impact on infectious diseases. Wits J Clin Med 2022;4(3):129. https://doi.org/10.18772/26180197.2022.v4n3a1
61. Jensen PKM, Grant SL, Perner ML, et al. Historical and contemporary views on cholera transmission: are we repeating past discussions? Can lessons learned from cholera be applied to COVID-19? APMIS 2021;129(7):421–430. https://doi.org/10.1111/apm.13102
62. Huq A, Hasan N, Akanda A, et al. Environmental Factors Influencing Epidemic Cholera. Am J Trop Med Hyg 2013;89(3):597–607. https://doi.org/10.4269/ajtmh.12-0721

63. Warner KD, DeCosse D. Using ethical principles in moral reasoning about the environment. 2009. https://www.scu.edu/environmental-ethics/short-course-in-environmental-ethics/lesson-three/
64. Huq A, Hasan N, Akanda A, et al. Environmental Factors Influencing Epidemic Cholera. Am J Trop Med Hyg 2013;89(3):597–607. https://doi.org/10.4269/ajtmh.12-0721
65. Kuhlman T, Farrington J. What is Sustainability? Sustainability 2010;2(11):3436–3448. https://doi.org/10.3390/su2113436
66. United Nations. Achieving Sustainable Development and Promoting Development Cooperation, 2008. https://www.un.org/en/ecosoc/docs/pdfs/fina_08-45773.pdf (accessed 29 June 2023)
67. Moyano-Fernández C. Building Ecological Solidarity: Rewilding Practices as an Example. Philosophies 2022;7(4):77. https://doi.org/10.3390/philosophies7040077
68. Biovac and IVI enter deal to develop oral cholera vaccine, 2022. https://www.pharmaceutical-technology.com/news/biovac-oral-cholera-vaccine/ (accessed 29 June 2023)
69. Sauvageot D, Saussier C, Gobeze A, et al. Oral cholera vaccine coverage in hard-to-reach fishermen communities after two mass Campaigns, Malawi, 2016. Vaccine 2017;35(38):5194–5200. https://doi.org/10.1016/j.vaccine.2017.07.104
70. Heyerdahl LW, Ngwira B, Demolis R, et al. Innovative vaccine delivery strategies in response to a cholera outbreak in the challenging context of Lake Chilwa. A rapid qualitative assessment. Vaccine 2018;36(44):6491–6496. https://doi.org/10.1016/j.vaccine.2017.10.108

Accepted 1 October 2023.