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Recent Trends of *Vibrio cholerae:* Global and Regional Incidences

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Introduction

Cholera is still with us! The foodborne/waterborne disease caused by the bacterium *Vibrio cholerae* continues to pose a significant threat to the safety of public health globally (Mohammed et al., 2024). Despite various medical interventions such as the use of oral cholera vaccines (OCVs) (Zeitoun et al., 2024), hundreds of thousands of lives are lost annually worldwide to this virulent disease. Cholera mostly affects vulnerable populations in regions with inadequate access to clean water and sanitation (Bose et al., 2024). Recent outbreaks in parts of Asia (Nasr et al., 2024), Africa (Taty et al., 2024), and the Caribbean underscore the ongoing risk and the urgent need for comprehensive strategies to control its spread (Siamalube and Ehinmitan, 2024). This commentary aims to unravel the challenges caused by *V. cholerae* by exploring the global cholera incidences and the multifaceted approaches required to combat this persistent pathogen.

Recent Global and Regional Trends of Cholera

Recent data indicate fluctuations in cholera incidences worldwide (World Health Organization International, 2024), with some regions experiencing significant outbreaks (Miggo et al., 2023; Abou Fayad et al., 2024; Arnaout et al., 2024) while others have seen declines (D'Mello-Guyett et al., 2022). Notably, foodborne cholera incidences have emerged as a critical concern in several areas, highlighting the role of contaminated food in the transmission of *V. cholerae* (Tavelli et al., 2022). Sub-Saharan Africa (SSA) continues to experience high and frequent episodes (Beenzu et al., 2024), particularly in conflict-affected areas that are hard to reach as well as resource-limited zones (Charnley et al., 2022). In like manner, South Asia faces persistent cholera outbreaks, especially during the monsoon seasons (Subedi et al., 2025). And the Caribbean has recently recorded upticks in cholera cases (Wheeler et al., 2024), often linked to natural disasters disrupting the already weak water and sanitation infrastructure (Kim et al., 2024).

Nonetheless, some countries have reported substantial reductions in cholera incidences, which we shall refer to as "success stories." For instance, Bangladesh in South-Central Asia has comprehensively implemented water, sanitation, and hygiene (WASH) programs alongside the effective use of OCVs, coupled with robust health care infrastructure (George et al., 2022). Replicating these integrated drivers can help other regions too. In SSA, Zambia has adopted government-led initiatives and strengthened international partnerships to ameliorate health care access (Siamalube and Emmanuel, 2024). Thus, leveraging strong political will, conducting mass vaccination campaigns (Hamorsky et al., 2013), and soliciting regional and global collaboration can be key strides toward controlling and eventually eradicating cholera as a public health threat in the world (Siamalube et al., 2024).

Oral Cholera Vaccines

OCVs are whole-cell killed vaccines, traditionally administered via the oral route in a double-dose regimen. The World Health Organization (WHO) has prequalified three OCVs (Terrinoni et al., 2023), namely, Euvichol, Shanchol, and Dukoral. Each of these commercially available OCVs has distinct features (Briskin et al., 2024). Euvichol, for example, is designed for mass vaccination campaigns as it does not require reconstitution. It proved efficient during a 2-year cross-sectional descriptive study in Zambia (Mukonka et al., 2023) as well as during a case-control study in Haiti (Matias et al., 2024). On the contrary, Shanchol is suitable for both endemic and epidemic settings (Ng′ ombe et al., 2022) because it has a longer shelf life and is less temperature sensitive (Ilboudo et al., 2021). While Dukoral requires reconstitution with a buffer solution; hence, it is more expensive and is often used in nonendemic areas or by travelers (Dash et al., 2024).

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Deployment Barriers—Vaccine Hesitancy

Although efforts have been made to reduce the cost of OCVs, they still present financial constraints, predominantly in low-income countries (Ilboudo et al., 2021). The cost per dose, storage, transportation, and administration add up, limiting widespread deployment. In addition, vaccine hesitancy (Alidu, 2021) is an aspect to be considered prior to the distribution of OCVs (Sallam et al., 2024). Because in some communities there is limited understanding of cholera and the benefits of immunization. This can result in low uptake and acceptance of vaccines (Muluneh et al., 2023). Furthermore, historical mistrust of health interventions, fueled by past experiences or misinformation, contributes to hesitancy (Galgali, Helm, and Arndt, 2023). Thus, addressing these concerns requires targeted community involvement and awareness. Similarly, cultural and religious beliefs can also impact vaccine acceptance (Romate et al., 2022). Therefore, tailored communication strategies are essential to overcome these barriers.

Recent Discoveries—Plant-Based Edible Vaccines

Edible vaccines derived from plants or plant products have a great potential to offer a promising alternative for conventional immunization (Siamalube et al., 2024). Especially in cholera hotspots, due to limited access to standard WASH services (Tsekleves et al., 2022). With previous research and ongoing studies, these green factory vaccines (Xu, 2023) could become a viable tool for the WHO's efforts to combat foodborne diseases, such as cholera, complementing existing strategies and contributing to broader global health goals (Manchal et al., 2024). Continued investment in research, public education, and infrastructure development will be critical to realizing the potential of the innovative approach.

Recent and Ongoing Preclinical/Clinical Trials

Research in Japan has shown promising results, with rice genetically modified to produce cholera toxin B subunit (CTB) antigens (Yuki et al., 2021). The study depicted effectiveness in animal models, and a follow-up clinical trial was conducted in volunteer human beings to confirm long-term efficacy and safety (Yuki et al., 2022). Likewise, a tomato-based vaccine study to test immune response from genetically engineered tomatoes expressing CTB was carried out at the Zunyi Medical University in China. Preclinical trials demonstrated immune response in laboratory animal models (Guan et al., 2021). Similarly, in Mexico, scientists assessed the stability and effectiveness of edible vaccines produced from corn smut. The vaccine indicated thermostability and induced toxin-neutralizing IgA responses in mice. (Monreal-Escalante et al., 2016) Furthermore, ongoing research shows potential in transgenic potatoes expressing CTB in Kenya; preliminary results indicate a good safety profile. Awaiting preclinical trials to ascertain efficacy (Trujillo and Angulo, 2025).

Suggested Strategies to Reduce Cholera Incidences

Some solutions to practically address cholera outbreaks in high-risk zones would be the incorporation of public health measures that can be applied to reduce disease incidences (Walton et al., 2023). For example, developing flood-resistant water supply systems and sanitation facilities (Marcus, 2022) to ensure safe drinking water would reduce reliance on contaminated water sources and prevent sewage overflow into drinking water (Lebu et al., 2024). Also, enhanced drainage channels to manage floodwater and implement stormwater management solutions like permeable pavements and rain gardens may prevent water stagnation and contamination, in turn, reducing breeding grounds for cholera-causing bacteria—*V. cholerae* (Martinelli Filho et al., 2020).

In addition, establishing operational health care services during extreme weather, such as rapid response schemes (George et al., 2022) and disease surveillance, would allow timely treatment of cholera cases, alongside facilitating early detection and containment of outbreaks (Al Khatib et al., 2024). Besides, creating green spaces in urban design and zoning to absorb excess rainwater would prevent informal settlements in flood-prone areas, reducing exposure (Eneh et al., 2024). Consequently, improving water absorption capacity and minimizing the risk of *V. cholerae* contamination.

Authors' Contribution

B.S.: Writing—original draft, formal analysis, conceptualization. E.E.: Data curation, software. S.R.: Resources, supervision. M.N.: Investigation, supervision. J.O.: Project administration, supervision. All authors reviewed the work and validated it.

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