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Distribution of Vibrio Cholera in Urban Areas of Iraq

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ABSTRACT

Objective: *This study aims to examine the distribution, epidemiological characteristics, and public health response to Vibrio cholerae outbreaks in urban areas of Iraq.* ***Method:*** *The research employed a literature-based analysis supported by epidemiological surveillance data, case reports, and antibiotic resistance profiles, focusing on outbreaks from 2003 to 2022.* ***Results:*** *Findings reveal recurring cholera outbreaks with seasonal peaks during summer months, primarily affecting regions such as Baghdad and Sulaymaniyah. Demographic analysis indicates a higher prevalence among individuals aged 15–44, with variability in gender distribution across regions. The bacteria showed sensitivity to Ciprofloxacin and Tetracycline, while oral cholera vaccination (OCV) campaigns demonstrated high effectiveness in refugee and internally displaced populations.* ***Novelty:*** *This study offers a localized, data-driven understanding of cholera's urban distribution in Iraq, highlighting the integration of demographic trends, antibiotic resistance, and the role of vaccination campaigns – an approach that remains underrepresented in existing regional literature. These insights are essential for developing more targeted and effective public health strategies.*

INTRODUCTION

The number and percentage of people living in urban regions has increased globally, meaning that urbanization has accelerated. Between 1990 and 2015, the percentage of people living in urban areas jumped from 43% to 54% [1]. According to many projections, by 2050, this expansion would account for 68% of the world's population [1,2].

With rising living standards, cholera has been almost eradicated in affluent nations for many decades, but it remains an important cause of disease and mortality in many underdeveloped nations [3]. Based to the 1969 International Health Regulations (IHR), it was one of the three diseases that required WHO notice. Even after the IHR was revised in 2005, it is still regarded as an emergency and has to be reported [4].

Since the first cholera epidemic in 1966, when the case fatality rate was 8.8%, cholera has been regarded as an endemic illness in many parts of Iraq. There was a significant outbreak in 1998, with at least 2560 cases recorded [5]. In addition to limited sanitary facilities, particularly in areas that have been lost or just reclaimed due to conflicts and infrastructure devastation, there is a lack of consistent and equal access to a clean supply of water [6] maintained cholera prevalent in Iraq, with outbreaks recorded in 2007–2008, 2012, and 2015 [7].

The most frequent source of cholera infections is drinking water containing V. cholerae, either naturally occurring or introduced via an infected person's feces. Other

typical carriers include fruit, leftover cooked grains that haven't been thoroughly reheated, and infected seafood and shellfish. There is very little evidence of transmission from person to person, including among medical personnel during outbreaks. Aquatic environments are ideal for Vibrio cholerae growth, especially in surface water. Humans and pathogenic strains are mostly connected through water, especially in locations with limited financial resources and adequate water purification systems [8].

If treatment is delayed, the enterotoxin produced by Vibrio cholerae, which causes profuse, painless, watery diarrhea, can swiftly cause severe dehydration and death. Additionally, the majority of patient's vomit [9]. Seventy-five percent of cases in endemic regions are asymptomatic, twenty percent are mild to moderate, and two to five percent are severe types, including cholera gravis [10].

The public health agency learns about the epidemic through the epidemiological monitoring system and those who are either directly or indirectly impacted by it. The primary goal of the epidemiological surveillance system is to gather, examine, and assess health-related data in order to plan and assess public health initiatives. Planning any type of action becomes hard because the information collected from the public is equally as inaccurate as the data collected by the monitoring system [11].

In this article, we discussed:

1. Define Vibrio cholera, Environmental reservoirs, Controlling cholera
2. Epidemiology of Cholera Disease
3. Distribution of Cholera in urban areas of Iraq

RESEARCH METHOD

This study employed a descriptive-analytical approach to examine the distribution and epidemiology of cholera, particularly *Vibrio cholerae*, in urban areas of Iraq. Data were gathered from a combination of official health surveillance reports, academic journals, and case studies conducted between 2003 and 2022. The analysis focused on identifying environmental reservoirs, demographic patterns, seasonal influences, and the antibiotic resistance profiles of cholera cases in Iraq. Cholera incidence data from regions such as Baghdad, Babylon, Wassit, and Sulaymaniyah were critically reviewed to assess temporal trends and geographic clustering. The research also evaluated the effectiveness of public health interventions, including oral cholera vaccination (OCV) campaigns, hygiene practices, and water sanitation efforts, by referencing international guidelines and reports from organizations like WHO, UNICEF, and MSF. Through synthesis of both quantitative case statistics and qualitative epidemiological assessments, the study aimed to provide an integrative understanding of cholera dynamics and inform future prevention and control strategies in Iraqi urban settings.

RESULTS AND DISCUSSION

Vibrio cholera

Vibrio cholerae is a curved, rod-shaped, motile, Gram-negative bacteria that thrives in aquatic conditions and causes cholera, an acute, watery diarrheal illness. Cholera can cause severe dehydration and even death if treatment is delayed. Depending on the severity, treatment include giving intravenous fluids, saline oral rehydration treatments, or antibiotics [12, 13]. Via the fecal-oral pathway or indirectly through tainted food and water, *V. cholerae* can spread from person to person [13]. In many parts of Africa and Asia, cholera is endemic, and outbreaks might happen occasionally or seasonally (14 –15), mostly in nations with unsanitary conditions, such as unsanitary food handling, open defecation, and restricted access to clean drinking water [16].

Based on the structure of the O-antigen of lipopolysaccharide (LPS), Vibrio cholerae is classified into over 200 serogroups (Figure 1). Because they can generate cholera toxin (CTX), a subset of strains from serogroups O1 and O139 are capable of causing cholera and outbreaks. Although they do not cause cholera, serogroups that are not O1 and O139—collectively known as non-O1/non-O139—usually do not have the CTX and cause minor outbreaks of gastroenteritis, occasional cases of bacteremia, and wound infections. (17 - 19). Over 85% of non-O1 serogroups, including O139, have a capsule, which is essential for virulence in extraintestinal infections, in contrast to O1. (20).

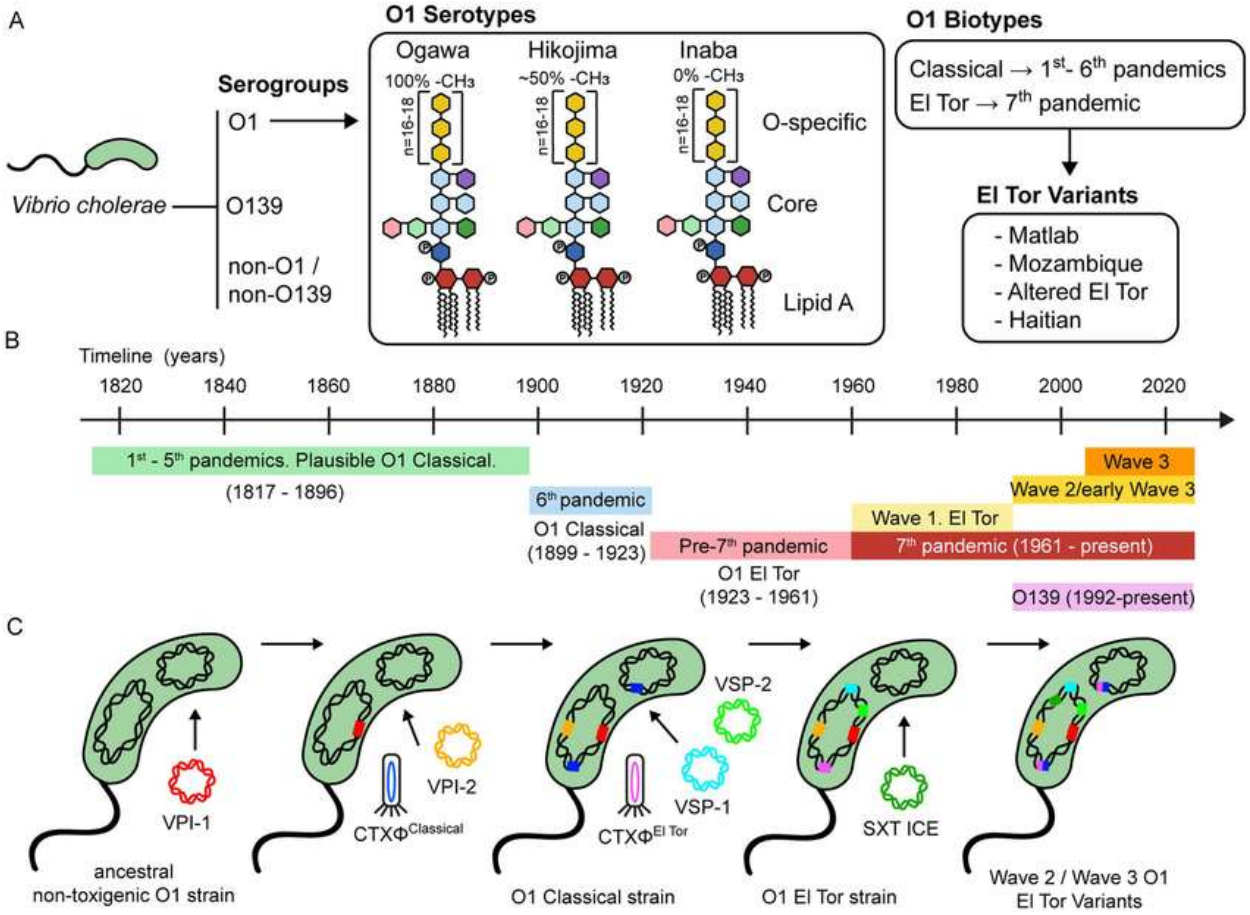

Figure 1. V. cholerae classification and evolution. (A) Serogroups of V. cholerae are distinguished by the makeup of the LPS O antigen.

Ogawa, Hikojima, and Inaba are the three serotypes into which strains of the O1 serogroup are further subdivided. The approximate amount of methylation of the terminal perosamine is displayed schematically in the LPS of these three serotypes. Based on genetic and behavioral indicators, serogroup O1 is also divided into the Classical and El Tor biotypes. Hybrid or variant strains of V. cholerae have emerged as a result of an increasing number of reports over the past 20 years on strains that have genetic traits with both the Classical and El Tor biotypes. These strains have greatly increased the global burden of cholera and have been connected to several outbreaks throughout the world. (B) A chronology of cholera pandemics throughout history. (C) A schematic illustration of the evolutionary mechanism by which serogroup O1 developed pathogenicity. The acquisition of mobile genetic elements, such as bacteriophages, genomic islands, integrative and conjugative elements, and others, is the primary driver of this process.

Controlling cholera

Rapid early response and careful attention to detail, including infection control procedures, are necessary to manage cholera cases successfully. These don't have to be very costly, either. MSF, ICDDR, and B are among the organizations with well established, protocolized processes that may be applied efficiently and at scale in locations with limited resources. There is a wealth of information available on managing cholera from WHO, UNICEF, and other organizations. taking use of internet training tools. Citations [21–25].

Epidemiology of Cholera Disease

Cholera Burden and Regional Dispersion According to data from the last 10 years, cholera has become more common and a serious public health issue in endemic nations with little resources [26]. The global geographical expansion of cholera from 2016 to 2019 is depicted in Figure 1 [27–29]. Cholera used to be endemic across the Asian subcontinent, which encompasses Bangladesh, Vietnam, Thailand, Pakistan, Nepal, Indonesia, India, and Iraq. However, it is currently endemic in a number of locations in Latin America, the Caribbean, and Africa, including South Africa, Mozambique, Zambia, Sierra Leone, Nigeria, Angola, the Democratic Republic of the Congo (DRC), Yemen, Zimbabwe, the United Republic of Tanzania, and Guinea [27-29]. Due to insufficient or nonexistent monitoring mechanisms, many countries do not keep track of cholera cases or fatalities [30].

Some countries are cautious when announcing cholera outbreaks to prevent social turmoil and financial losses due to a decline in exports and tourism. However, early reporting of cholera outbreaks has resulted in shorter epidemic durations [31]. 52 developing nations have reported an increase in cholera infections since 2006 [32]. Contributors to Hazards Cholera risk factors include contaminated drinking water, unhygienic living circumstances, and consuming food from the street is associated with poverty. There is a decreased risk before, after, and after defecation when hands are cleaned with soap [33]. Female gender, blood type O, retinol insufficiency, and

hypochlorhydria—a condition when a person uses antacids, proton pump inhibitors, or histamine receptor blockers—are biological characteristics that have been identified as cholera risk factors [34 –39]. Moreover, two significant factors that contribute to severe disease are Helicobacter pylori infection and gastrectomy [40]. Malnutrition increases susceptibility, especially in young children [40]. In endemic nations, children under five have the highest prevalence of cholera due to lower levels of acquired immunity than adults [41]. First-degree family members—parents, kids, and siblings—are more likely to contract cholera than second-degree relatives—grandchildren, grandparents, uncles, and aunts—who reside in the same home, according to a household contact study of cholera patients in Bangladesh [42]. Cholera outbreaks in Haiti and Africa are relatively new, despite the fact that the illness has long been common in many regions of Asia. In many parts of Africa, particularly the Central African Rift Valley, cholera is now thought to be endemic [43]. The World Health Organization's standards, which demand that cases be verified by culture for three of the preceding five years, are met by this. In Haiti, where outbreaks had not happened for over a century, cholera was considered widespread until making a resurgence in 2010 [43].

Cholera Distribution in Urban Iraq

High Incidence Areas: Cholera outbreaks in Iraq have been recurrent, with notable peaks in 2003, 2007, 2012, and 2015, reflecting a trend of increasing frequency and burden on the health system [44, 45]. In 2017, Baghdad-Alrisafa recorded the highest number of cholera cases, followed by Babylon and Wassit, indicating a concentration of infections in these urban areas [46]. In 2022, a significant outbreak was reported in Baghdad, with the highest cases occurring in the summer months [47]. Sulaymaniyah also experienced a notable outbreak in 2022, with a peak in June [48].

Demographic Patterns: Cholera infections are more prevalent among individuals over 15 years of age, with a slight predominance in females in some areas [44]. However, in Baghdad during 2022, males had a higher infection rate [45]. In Sulaymaniyah, the majority of cases were among people aged 20-44, with no significant gender difference [49].

Seasonal and Environmental Factors:

Cholera outbreaks in Iraq are often linked to the hot months, with peaks in summer due to increased transmission via contaminated water sources [49]. Poor sanitation and inadequate water infrastructure exacerbate the spread of the disease [47].

Management and Prevention:

The cholera bacteria in Baghdad showed sensitivity to Ciprofloxacin and Tetracycline but resistance to other antibiotics, highlighting the need for careful antibiotic management [49].

1. **Vaccination Campaigns**: Oral cholera vaccine (OCV) campaigns have been implemented, achieving high coverage rates, particularly in refugee and internally displaced persons camps [49]. These campaigns are part of broader efforts to manage outbreaks in high-risk populations.

2. **Public Health Strategies**: Rapid intervention, infection control, and public awareness campaigns are essential components of cholera management. Organizations like WHO and UNICEF emphasize early detection and treatment to mitigate outbreaks [44].

CONCLUSION

Fundamental Finding : This study underscores that cholera remains a persistent and recurrent public health threat in urban areas of Iraq, primarily driven by inadequate water infrastructure, poor sanitation, and demographic vulnerabilities. **Implication :** These findings highlight the urgent need for integrated public health strategies that encompass not only medical treatment and vaccination but also sustainable improvements in urban infrastructure and hygiene education. **Limitation :** The study is limited by its reliance on secondary data sources and the absence of primary field data, which may restrict the depth of analysis on causal relationships and real-time outbreak dynamics. **Future Research :** Further investigations are recommended to explore the effectiveness of intervention programs through longitudinal field studies and to assess the impact of climate change and internal displacement on the spread of *Vibrio cholerae* in Iraq's urban contexts.

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