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CHOLERA OUTBREAK IN IRAQ 2022

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ABSTRACT

Background: Cholera remains a major public health challenge in many developing countries, including Iraq, where recurrent outbreaks continue to occur due to deficiencies in water, sanitation, and hygiene infrastructure. In 2022, Iraq experienced a large cholera outbreak with epidemiological characteristics different from previous outbreaks. **Objectives:** To describe the epidemiological, clinical, and laboratory characteristics of laboratory-confirmed cholera cases reported in Iraq during 2022. **Methods:** A descriptive case-series study was conducted using surveillance data of all laboratory-confirmed cholera cases reported to the Communicable Disease Control Center, Iraqi Ministry of Health, from January 1 to December 31, 2022. Data were extracted from the national cholera line-list database and included demographic characteristics, clinical presentation, laboratory findings, healthcare-seeking behavior, hospitalization, and outcomes. **Results:** A total of 2,850 laboratory-confirmed cholera cases were reported during the study period. The outbreak started in June and continued until December, representing the first documented summer cholera outbreak in Iraq. Three epidemic waves were observed. The majority of cases occurred among individuals aged 15–45 years, with no significant difference between males and females. Ogawa was the predominant serotype, while only four cases were caused by the Inaba serotype. Watery diarrhea, vomiting, and fever were reported in 42.0%, 49.1%, and 22.3% of cases, respectively. Approximately half of the patients sought healthcare within one to two days of symptom onset. The case fatality rate was 0.7%, remaining below the World Health Organization target of 1%. **Conclusions:** The 2022 cholera outbreak in Iraq showed unusual seasonal occurrence, prolonged transmission, and multiple epidemic waves. Although mortality remained low, the outbreak highlights persistent challenges related to water quality, sanitation, and environmental health infrastructure. Strengthening surveillance systems, improving access to safe water and sanitation, and enhancing public health awareness are essential to prevent future cholera outbreaks.

KEYWORDS: Cholera, outbreak, Iraq, epidemiology, Vibrio cholerae, surveillance, case fatality rate.

INTRODUCTION

Cholera is one of the oldest known infectious diseases and has historically originated from its presumed natural reservoir in the Ganges Delta near the Bay of Bengal before spreading worldwide. It remains an important public health problem, particularly in low- and middle-income countries where access to safe water and sanitation is limited. Cholera is an acute diarrheal disease caused by the ingestion of food or water contaminated with toxigenic strains of *Vibrio cholerae* serogroups O1 or O139. The disease can affect individuals of all ages and may occur as sporadic cases, epidemics, or pandemics.[1,2] The incubation period of cholera is typically short, ranging from a few hours to five days. Most infected individuals remain asymptomatic or develop only mild symptoms; however, approximately 5–10% experience severe disease characterized by profuse watery diarrhea, vomiting, muscle cramps, and rapid fluid loss leading to severe dehydration, electrolyte imbalance, hypovolemic shock, and death if prompt treatment is not provided.[3,4] Infected individuals may continue shedding the organism in their feces for up to two weeks, contributing to environmental contamination and further transmission.[2-4] Cholera is widely

recognized as one of the most significant waterborne diseases worldwide. Its transmission is strongly associated with inadequate access to clean drinking water, poor sanitation, overcrowding, and insufficient hygiene practices. Populations living in peri-urban slums, refugee camps, and areas affected by conflicts or natural disasters are particularly vulnerable.[2,5] The World Health Organization (WHO) estimates that cholera causes between 1.3 and 4.0 million cases and between 21,000 and 143,000 deaths annually worldwide.[6] Historically, six cholera pandemics occurred during the nineteenth and early twentieth centuries, causing millions of deaths globally. The ongoing seventh pandemic began in South Asia in 1961, spread to Africa in 1971, and reached the Americas in 1991. Unlike previous pandemics, the current pandemic has persisted for more than five decades and remains endemic in many countries.[1,2] Since 2021, a substantial increase in cholera outbreaks and geographical spread has been reported, particularly in the African and Eastern Mediterranean regions, with many countries experiencing higher case numbers and case-fatality rates than in previous years.[2] In Iraq, cholera remains endemic and continues to pose a significant public health challenge. Recurrent outbreaks have been linked to damaged infrastructure resulting from decades of conflict, inadequate water treatment systems, poor sanitation, electricity shortages, population displacement, and overcrowded living conditions. Major outbreaks were documented in 2007–2008, with 4,696 reported cases, and in 2015, with 2,868 cases, while 505 cases were reported during the 2017 epidemic.[7] These recurrent outbreaks highlight the need for continuous surveillance, public health preparedness, and community awareness to reduce cholera transmission and associated morbidity and mortality in Iraq.

METHOD

A descriptive case-series study was conducted to characterize laboratory-confirmed cholera cases reported in Iraq during the period from January 1 to December 31, 2022. The study utilized nationwide surveillance data collected through the Communicable Disease Control Center (CDCC) of the Iraqi Ministry of Health (MOH). Data were obtained from the Acute Enteric Diseases Section at the CDCC. All 20 health directorates in Iraq are required to immediately notify suspected and confirmed cholera cases through the national communicable disease surveillance system. Case information is reported using a standardized cholera line-list form developed according to World Health Organization (WHO) recommendations. The dataset was provided under the supervision and authorization of the Iraqi Ministry of Health following ethical approval and permission for data use. The Iraqi Ministry of Health annually distributes the National Cholera Control Plan (NCCP), which adopts the WHO case definition for cholera surveillance and outbreak investigation. A suspected cholera case was defined as any person aged two years or older presenting with acute watery diarrhea, with or without vomiting, in an area experiencing a cholera outbreak or epidemic. A confirmed cholera case was defined as a suspected case with laboratory isolation of *Vibrio cholerae* O1 or O139 from a stool specimen by culture. Detection of *V. cholerae* O1 or O139 in stool samples was considered evidence supporting the diagnosis of cholera and confirmation of outbreak activity. Variables extracted from the surveillance database included demographic characteristics (age, sex, and place of residence), health facility reporting the case, date of symptom onset, date of hospital admission, clinical manifestations, treatment received, hospitalization status, date of stool sample collection, laboratory findings, patient outcome (recovery or death), and date of outcome. Data were entered, cleaned, and analyzed using the Statistical Package for Social Sciences (SPSS), version 26. Descriptive statistics were used to summarize study variables. Categorical variables were presented as frequencies and percentages, whereas continuous variables were summarized using means, standard deviations, medians, and ranges as appropriate.

RESULTS

In year 2022, the first laboratory confirmed cases of cholera (index case) were reported from Muthana health directorate as two cases (female 65years and male 45 years) admitted at the same day on June 3rd 2022 at Al-khudur general hospital, both live in Al-khudur district and had the same source of water complaining of acute watery diarrhea, vomiting and dehydration for one day duration and confirmed in the public health laboratory in the Muthana health directorate and then confirmed in the central public health laboratory in W22. Then followed by a gradual occurrence of cases that progressed to an outbreak to register 3708 cholera cases which confirmed by Central Public Health Laboratory/Iraq (CPHL) for the first few cases at the beginning of outbreak then we depend on the results came from general hospitals and public health laboratories of health directorates that are well trained and quality controlled by the CPHL. 3 peaks were noticed during this outbreak, the 1st on W29 with 172 cass, the 2nd peak on W35(187 cases) and the 3rd peak on W42 with 182 cases. Overall the attack rate was 0.0067 and 22 deaths occur with a case fatality rate 0.77%. Out of 2850 cases. Figure 1 shows time distribution of data, the total 2850 cases registered (without Kurdistan region data because we didn't have detailed data about cases and only crude numbers were obtained from them) were distributed over three epidemiological waves, the 1st wave started on week22 and reached peak at week 29 to be ended on week 31 with total 866 cases, the 2nd wave started on week 32, reached peak on w35 to end on w39 with total 1119 cases, the 3rd and the last wave which started on w40, reached peak on w42 to be ended on w50, with total 865 cases where no cases were registered after to declare the end of outbreak.

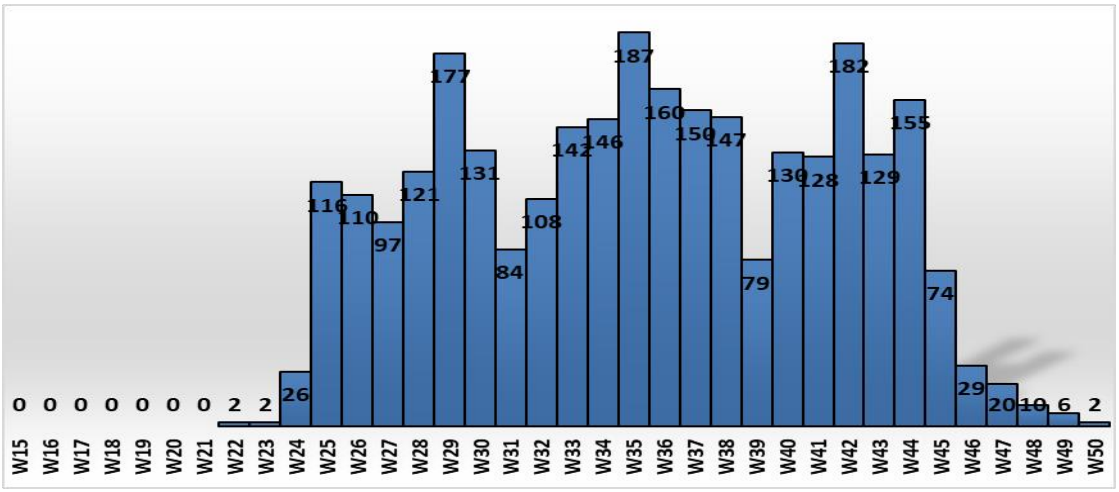

Figure 1: Epi-curve of cholera cases by international weeks. Iraq 2023.

The outbreak passes through 3 epidemiological waves, the first wave (w22-w31), the second wave (w32-w39) and the third wave (w40-w50) as shown in table 1. Male to female ratio noticed to be 1.06:0.94 in the first wave, 0.92:1.08 in the second wave and 1.02:0.98 in the third wave with no gender-based difference noticed. Age ranges from 11 days to 95 years old with mean of 35.25±19.18, the highest cholera proportion noticed among 15-45yars age group (1490, 52.28%) and the lowest proportion among <5 years' age group (185, 6.49%). The highest proportion in the first wave noticed among 15-45y age group (464) while the lowest among <5y age group (77), in the second wave the highest proportion was in 15-45y age group (586) the lowest was among <5y age group (60), the highest proportion in the third wave noticed among 15-45y age group (440) while the lowest among <5y age group (48). Regarding hospitalization 1247 cases were entered the hospital (43.75%), with the highest hospitalized portion during the 2nd wave (498 cases) and the lowest portion during the 3rd wave (337 cases). Cholera cases seeked health care mostly 1-2 days after symptoms 1299(50.3%). 951(33.3%) at the same day and 600(16.4%) after 2 days of symptoms. The largest proportion to be noticed after 1-2days in 3rd wave (58%) and the lowest after more than 2 days in the 3rd wave (13%). Cholera cases experienced many symptoms, 638(22.3%) reported fever, 1510 (52.9%) rice water diarrhea, 1402(49.1%) with vomiting and 1198(42%) with dehydration In the 1st wave 589(69%) reported rice water diarrhea, 597(69%) vomiting and 318(37%) reported dehydration and 372 (43%) fever. In the 2nd wave 597(53%) reported having rice water diarrhea, 467 (42%) vomiting and 448 (40%) dehydration. While only 117(10%) reported having fever. In the 3rd wave 432(50%) reported dehydration, 315(37%), 338(39%) reported rice water diarrhea and vomiting respectively and only 149(17%) fever. Table (1)

Table 1: distribution of cholera cases in first, second and third waves by gender, age group, hospitalization, outcome, time for health care seeking, symptoms. Iraq 2022.

Variable	First wave (w22-w31) No. (%)	Second wave (w32-w39) No. (%)	Third wave (w40-50) No. (%)	Total No. (%)
Gender				
Male	461 (53)	510 (46)	445 (51)	1416 (49.4)
Female	405 (47)	609 (54)	420 (49)	1434 (50.6)
Age group				
<5 y.	77 (9)	60 (5)	48 (6)	185 (6.49)
5-14 y.	83 (10)	84 (8)	71 (8)	238 (8.35)
15-45y.	464 (54)	586 (53)	440 (51)	1490 (52.28)
>45 y.	242 (27)	383 (34)	306 (35)	937 (32.88)
Hospitalization				
Yes	412 (48)	498 (45)	337 (39)	1247 (43.75)
No	454 (52)	621 (55)	528 (61)	1603 (56.25)
Time for health care seeking				
Same day	268 (31)	430 (38)	253 (29)	951 (33.3)
1-2 day	328 (38)	473 (42)	498 (58)	1299 (50.3)
> 2days	268 (31)	216 (20)	116 (13)	600 (16.4)
Fever				
Yes	372 (43)	117 (10)	149 (17)	638 (22.3)

No	496 (57)	1002 (90)	714 (83)	2212 (77.7)
Rice water diarrhea				
Yes	598 (69)	597 (53)	315 (37)	1510 (52.9)
No	270 (31)	522 (47)	548 (63)	1340 (47.1)
Vomiting				
Yes	597 (69)	467 (42)	338 (39)	1402 (49.1)
No	269 (31)	653 (58)	526 (61)	1448 (50.9)
Dehydration				
Yes	318 (37)	448 (40)	432 (50)	1198 (42)
No	550 (63)	671 (60)	431 (50)	1652 (58)

At the time of outbreak (w22-w50) 419695 cases of acute diarrhea, 134456 stool tested from which 2850 cases were positive for cholera with positivity of 2.1% were registered from 16 DOH out of 19 (without Kurdistan) and 572899 cases of acute diarrhea, 141811 stool tested from which 3708 cases positive for cholera and 2.6% positivity with Kurdistan. There were four DOH didn't report any positive cases for cholera despite having cases with acute diarrhea tested (ANBAR, BASRAH, MAYSAN AND DUHOK) with positivity of 0%. The highest positivity was registered from ERBIL DOH 16% with 467 positive cases for cholera out of 2815 stool sample tested from 39518 cases of acute diarrhea, and the lowest positivity was registered from NINEVEH DOH 0.3%, with only 6 positive cases out of 1781 stool sample tested from 53963 cases of acute diarrhea as shown in table 2.

Table2: distribution of acute diarrhea, stool tested, positive and positivity by DOH (w22-w50). IRAQ 2022

DOHS	Acute Diarrhea cases	Stool tested	positive	positivity
ANBAR	16387	530	0	0
BABYLON	13957	13888	369	2.65%
BAGHDAD-KARKH	15362	1942	26	1.33%
BAGHDAD-RESAFA	16800	13072	929	7.10%
BASRA	15305	8726	0	0%
DHI-QAR	26035	2026	92	4.54%
DIWANIYA	18294	4950	89	1.79%
DIYALA	20244	8661	140	1.61%
KERBALA	6253	2580	19	0.73%
KIRKUK	15414	10471	981	9.36%
MAYSAN	11709	3426	0	0%
MUTHANNA	7953	1489	23	1.54%
NAJAF	26568	10098	57	0.56%
NINEVEH	35614	1410	6	0.42%
SALAH AL-DIN	9238	157	8	5.09%
WASIT	11473	4487	111	2.47%
TOTAL WITHOUT KURDISTAN	266606	87913	2850	3.24%
DUHOK	15140	1092	0	0%
ERBIL	26827	2408	467	19.3%
SULAYMANIYA	78216	2740	391	14.2%
TOTAL WITH KURDISTAN	386789	94153	3708	3.93 %

Cholera cases were distributed over 16 DOH out of 19 DOH 3708 (with Kurdistan), giving attack rate of 0.007 without Kurdistan and 0.008 with Kurdistan. KIRKUK DOH registered the highest number of cases 981 with AR of 0.055 and NINEVAH DOH registered the lowest number of cases 6 with AR of 0.0001. 22 deaths were reported without Kurdistan from 5 DOH out of 16 and 25 deaths with Kurdistan from 6 DOH out of 19, giving a case fatality rate of approximately 0.7%. the highest number of deaths was reported from Baghdad- Resafa DOH 11 with CFR of 1.18%, and the lowest number of deaths was registered from Diwaniya and Diyala 2, 2 with CFR of 2.24% and 1.43$ respectively as shown in table 3.

Table 3: distribution of cholera cases, deaths, AR% and CFR% by DOH. Iraq 2022.

DOHS	POP22	No of Cases	AR (%)	No. Deaths	CFR (%)
ANBAR	1963346	0	0	0	0
BABYLON	2288456	369	0.016124	4	1.18
BAGHDAD-KARKH	3815810	26	0.000681	0	0
BAGHDAD-RESAFA	5190191	929	0.017899	11	1.18
BASRA	3223158	0	0	0	0
DHI-QAR	2321851	92	0.003962	0	0
DIWANIYA	1430714	89	0.006221	2	2.24
DIYALA	1814368	140	0.007716	2	1.43
KERBALA	1350577	19	0.001407	0	0
KIRKUK	1770765	981	0.0554	3	0.31
MAYSAN	1233053	0	0	0	0
MUTHANNA	902480	23	0.002549	0	0
NAJAF	1630807	57	0.003495	0	0
NINEVEH	4133536	6	0.000145	0	0
SALAH AL-DIN	1767837	8	0.000453	0	0
WASIT	1527911	111	0.007265	0	0
TOTAL WITHOUT KURDISTAN	36364860	2850	0.007837	22	0.77
DUHOK	1432369	0	0	0	0
ERBIL	2055448	467	0.022	3	0.64
SULAYMANIYA	2396206	391	0.016	0	0
TOTAL WITH KURDISTAN	42248883	3708	0.0087	25	0.67

DISCUSSION

Cholera outbreaks in Iraq have historically occurred every 3–5 years and are typically observed during the autumn season. However, the 2022 outbreak demonstrated an unusual epidemiological pattern, beginning in June and continuing through December, making it the first documented large-scale cholera outbreak in Iraq to emerge during the summer season. This shift may reflect the combined effects of environmental changes, reduced river water levels, increasing temperatures, and deterioration of water and sanitation infrastructure. Several factors likely contributed to the outbreak, including inadequate access to safe drinking water, aging water distribution networks with frequent leakages, insufficient water treatment facilities, shortages of chlorine and purification materials, untreated sewage discharge into rivers, and poor public awareness regarding preventive measures. These findings are consistent with the recognized determinants of cholera transmission in developing countries.[8] Laboratory investigation revealed that the Ogawa serotype was responsible for nearly all confirmed cases, with only four cases identified as Inaba. This finding contrasts with some previous outbreaks in Iraq in which the Inaba serotype predominated. The predominance of Ogawa suggests a shift in circulating strains and highlights the importance of continuous microbiological surveillance to monitor epidemiological trends and guide control measures.[7] Three distinct epidemic waves were observed during the 2022 outbreak, whereas previous Iraqi outbreaks in 2015 and 2017 demonstrated a single-wave pattern. Similar single-wave outbreaks have also been reported in Iraq during 2007 and in Nigeria during 2021.[7,9,10] The occurrence of multiple waves may indicate repeated environmental contamination events, prolonged transmission, or inadequate interruption of disease spread during the outbreak period. No significant difference in cholera occurrence was observed between males and females, a finding consistent with reports from the 2007 and 2017 outbreaks in Iraq.[7,9] The majority of cases occurred among individuals aged 15–45 years, similar to previous Iraqi studies. This age distribution may reflect greater occupational and social exposure to contaminated food and water sources. In contrast, a cholera outbreak in Uganda reported the highest burden among children younger than 10 years.[11] Approximately half of the patients sought healthcare one to two days after symptom onset, indicating relatively acceptable healthcare-seeking behavior. Nevertheless, earlier presentation could further reduce disease severity and transmission. Clinical manifestations differed somewhat from those reported in Uganda, where nearly all patients presented with watery diarrhea.[11] In the present study, watery diarrhea, vomiting, and fever were reported by 42%, 49.1%, and 22.3% of patients, respectively. The case fatality rate (CFR) of the outbreak was 0.7%, which was comparable to the 2017 Iraqi outbreak (0.6%) but higher than the 2015 outbreak (0.07%).[7] Despite this increase, the CFR remained below the WHO target threshold of 1%, suggesting effective case management and timely treatment. The observed CFR was considerably lower than those reported in several African outbreaks, including Kenya (1.9%) and the global average of 1.9% reported in 2021.[11-13] The attack rate observed in Iraq was substantially lower than those reported in Kenya and Uganda. Differences in population size, surveillance systems, outbreak definitions, and healthcare accessibility may partly explain these variations. Furthermore, the Iraqi surveillance system included only

laboratory-confirmed cases, which may have resulted in lower reported attack rates compared with studies that included suspected cases. Globally, cholera has resurged since 2021, with increasing numbers of outbreaks, wider geographical distribution, and higher mortality rates. Multiple concurrent outbreaks, humanitarian crises, climate change, and limitations in public health resources have challenged global response efforts.[8] These factors emphasize the need for sustained investment in water, sanitation, surveillance, and outbreak preparedness to reduce the burden of cholera in Iraq and worldwide.

CONCLUSION

The 2022 cholera outbreak in Iraq showed unusual epidemiological characteristics, beginning in summer and extending through December with three epidemic waves. Most cases occurred among individuals aged 15–45 years, and the Ogawa serotype was predominant. Despite the large number of cases, the case fatality rate remained below 1%, indicating effective case management. Persistent deficiencies in water supply, sanitation, and environmental health infrastructure likely contributed to the outbreak. Strengthening surveillance, water safety, sanitation services, and public health awareness is essential to prevent future outbreaks.

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