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ORIGINAL ARTICLE

Threatening reoccurring infection of Cholera in Kerbala Province

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ABSTRACT

Objective: Regular Cholera outbreaks continue to happen across the globe affecting both developed and under developed nations. 6 pandemics hit the continents and the seventh yet to finish. *Vibrio cholerae* is the causative bacterium. Iraq is one of the countries affected by cholera which claimed lives and impose a considerable strain on public health resources.

Methods: 67 stool samples were collected across Kerbala province with cholera like symptoms for the period from 1st of November 2017 till 30th of December 2017, male and female from age groups of >1 year, 1-4 years, 5-14 years, 15-45 and <45 years of age.

Results: The study revealed that the number of cholera cases has progressed to be significant over the past year with female predominance of 63%. The highest incidence of disease was in the age group 15-45 and mainly among girls and young women which reflect features of susceptibility that could relate to their gender roles and health condition. The tendency of infection is much greater in highly populated residential areas of the province at central Kerbala as represents more than half of the total cases then decreased considerably to just 9 cases at Al- Jazeera sub-district which located at the outer skirt of the City Centre. The study unveiled that 67% of the patients were using R.O. water supplied by local portable distributors for drinking.

Conclusion: Prevalence of cholera remains high. Therefore, maintainable enhancements in water and sanitation are still required as long-term solution especially as Kerbala City is densely populated areas with limited resources. The urgent need for continued monitoring and surveillance of water supplies is vital to tackle a disease that continually causing humanitarian crisis.

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INTRODUCTION

Cholera has remained a universal challenge to many regions across the continents ¹. For many years the pandemics have been regular worldwide; however, recently it is more prevalent in underdeveloped countries, mainly in the tropical and sub-tropical regions ². It's an acute diarrhoeal infection of small intestine caused by ingestion of contaminated food or

water with the bacterium *Vibrio cholerae*. *V. cholerae* is a Gram-negative curved rod motile bacterium that part of the family Vibrionaceae ³. The vibrios are found in marine and surface water ⁴. Although, there are 200 recognised O serogroups, serogroup O1 and O139 have been mainly associated with the disease severe epidemic, endemic and pandemics cholera ³. The

primary symptoms of cholera are profuse diarrhoea and vomiting after an incubation period of about 2 hours to 5 days⁴. Cholera infects individuals from all age groups ranging from infants to elderly¹. Symptoms can vary from mild to life-threatening ones especially if left without treatment. Asymptomatic infected individuals can even have the microorganisms in their faeces for 1-10 days resulting in infecting others¹. Recently a new variety has evolved, El Tor variant which was reported initially from Bangladesh⁵. After cholera was contained in the Ganges delta in India, it spread globally during the 19th century and costed lives of millions and followed by six subsequent pandemics. The seventh ones started in Asia in 1961 entering Africa in 1971 then Americas in 1991 and yet to finish⁶. In 2015, the number of infected people with cholera reached 172,454 in 42 countries and 1304 deaths were recorded, making the overall case fatality ratio (CFR) of 0.8%⁷.

Iraq is at risk of epidemics from surrounding states. In 1820, a cholera wave hit Basra initially resulting in many fatalities and many others uninhabited⁸. Identical effects the disease had when extended to Baghdad. Afterwards in 1871, 1889, 1894, 1899 and 1917 cholera occurred in epidemic forms⁹. This followed by a period of absolute absence of the disease until hit the country again in August 1966 through the 7th pandemic wave^{10,11}. Then several outbreaks had been reported. In August and October 2008 a sum of 644 infected person with cholera had been verified in Iraq with laboratory test confirmation, including eight deaths¹². While in 2015, an outbreak of 4965 cases recorded in Iraq, involving 2 deaths, spread to the whole country except Anbar district. Central and southern districts, including Babylon, Baghdad, Kerbala, Diwaniya, and Muthanna were the main affected areas⁷. Despite the measures that had been taken by the ministry of health to stop cholera there were reported cases in 2017. Cholera has shown an association with local environmental conditions; And considerably varies at a local population status^{13,14,15}.

The objective of this study is to examine the scale of Cholera infection occurrence in Kerbala province determine its genuine threat to both individuals and communities general health. By comparing the respective infection in 2017 to the previous year episode in 2015, the study attempts to establish what other measures need to be taken to eradicate this infection completely. It also explores the regional environmental initiators of cholera while instantaneously consider the local level variation of socio-economic status. The latter has variables associated with cholera aetiology such as accessibility to clean water, sanitation, level of education and occupation.

MATERIALS AND METHODS

Subjects of the study

All Kerbala resident patients who presented to AlHussieny Medical Teaching Hospital, Paediatrics Hospital, Gyne and Obstetric Hospital and all primary Health centres across Kerbala province with cholera like

symptoms for the period from 1st of November 2017 till 30th of December 2017, male and female from age groups of >1 year, 1-4 years, 5-14 years, 15-45 and <45 years of age.

Data collections

Data were collected from patients by filling specific designed questionnaire to include name, age, sex, marital status, occupation, date started their symptoms and notification, date of diagnosis, place of residence(district), source of water supply. Also following those patients up after their management to record their recovery status.

Laboratory investigation

Stool specimens were collected in sterile containers from enrolled subjects to determine eligibility as cases. Specimens were transported in Cary-Blair media to the Central Health Laboratory in Saif Saad, Kerbala for culture confirmation. Samples treated with Alkaline Peptone Water pH 8.6 and incubated for 4-6 hours at 35°C. Then plated on selective blood b- haemolysis agar, thiosulfate-citrate-bile salts-sucrose agar and MacConkey agar for the isolation of *V. cholera*. The purification after oxidase positive from blood or MacConkey Not from TCBS and tested biochemically by EPI 20 E. Finally serological confirmation was then performed using a standard slide agglutination procedure with polyvalent antisera to *V. cholerae* O1, followed by monovalent antisera to differentiate between Ogawa and Inaba serotypes¹⁶. Positive culture tested for susceptibility on Mullar Hinton Media or Nutrient agar. All the positive culture sample will be tested again in Ministry of Health central laboratory in Baghdad for confirmation.

RESULTS

Comparison of Occurrence of Cholera infection in 2017 and 2015

The total number of cases in Kerbala province was 67 cases in 2017. 42 cases were diagnosed in female and 25 in male patients. Unlike 2015, Infection in male was much higher than in female with 42 to 36 Cholera case respectively (Figure 1).

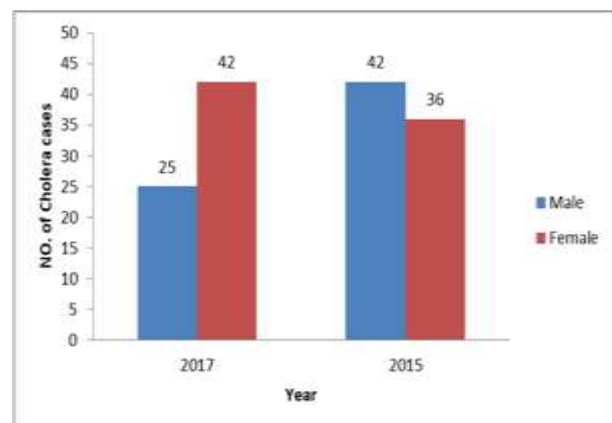


Figure 1: Occurrence of cholera cases in 2017 to 2015 in both genders in Kerbala province.

Association of Cholera with the age group

Figure 2 indicates that age group of 15-45 years of age was the worst affected as represents 60% of the total number of cases. Older children between the age of 5-14 was second with 20% while younger children group of under 5 represents 9% . The group of elderly patients of over 45 years of age was third with 11%.

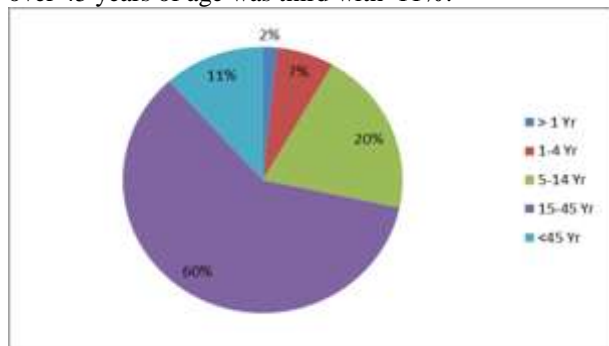


Figure 2: Distrubtion of Cholera cases among different age groups.

Demographic distribution of Cholera infection in province of Kerbala

Table 1 lists the number of cholera cases per each district in Kerbala province. Kerbala Central comprises The Old City, Al-Haydaria and Al-Jazeera sub-districts had reported the highest number of infection accumulatively of 34 cases. Al-Hur district had a significant 21 cases while Al-Hindia district possessed the least number of just 12 cases. Ayan-tamer which considered being the largest district in the province had no reported cases of Cholera.

Table 1: Number of cholera cases in various area of Kerbala province

District	Sub-district	Number of cases	Total
Central	Old City	3	34
	Al-Haydaria	22	
	Al-Jazeera	9	
Al-Hur		21	21
Al-Hindia		12	12
Ayn Al-tamr		0	0
Total		67	67

Figure 3 illustrates the percentage of the infection across the province. 51% of the cases were reported in Kerbala central district while all other suburbs districts were accumulatively reported 49%. Those are Al-Hur, Al-Hindia and Ayan Al-tamer which was Cholera free.

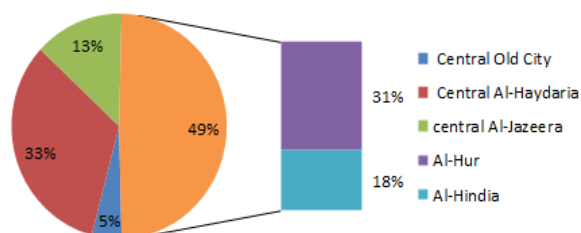


Figure 3: Cholera infection percentage distributed over the different district of Kerbala.

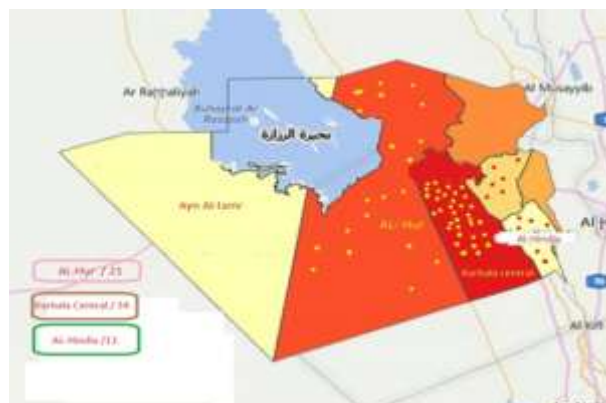


Figure 4: Administrational map of Kerbala showing identified cases of Cholera a cross the province.

Correlation of Cholera infection to water source

Table 2 presents the outcomes of the patient's 'Yes' and 'No' answers to the water supply questionnaire that was given to them as a part of this study. 45 out of 46 of the patients confirmed using R.O. water from local portable distributors for drinking and mainly tap water for cooking and cleaning. The rest have used water from Home fitted filter system.

Table 2: Source of water supply used by cholera patients

Water Source	Yes	Percentage %	No	Percentage %	Total
Tap water	46	68.7	31	46.3	67
Home-filtered water	21	31.3	56	83.6	67
R.O. water	45	67.2	22	32.8	67

Discussion

In 2015, Iraq reported an outbreak of 4965 cases, involving 2 deaths. ¹In City of Kerbala only, there were 78 cases in the period of September and October. After a cholera-free period at the end of 2015 till late 2017, other cases started showing up on November and finish up to the mid of December 2017.

Figure 1 points out that the number of cholera cases has progressed to be significant over the duration of 2017 with 67 cases. Interestingly infection in female was considerable greater with 63% to 37% in male. In Iraq where the females are in charge of the domestic tasks, looking after children, the sick ones of the family members and the elderly if present. In addition, females are working in different settings to raise the family financial level and they have a crucial role in the social networking. All this make the females more prone and vulnerable to contract cholera infection ¹⁷.

In contrast to year 2015, Cholera affected more male individuals than female. This may be attributed to the nature of the male work, their absence from home for many reasons like studying, searching for work, pursuing their career and socializing. Therefore, they generally eat and drink from places with low sanitary level which make them more expose to cholera and this may explain the greater number of the infected males in the city especially in those aged 25 or over.

By examining how cholera infection associates with different age groups. **Figure 2** demonstrates unsurprisingly that Infants younger than one year of age were least affected as they form just 2% from the total number of identified cases. This is due to the fact that infants are mainly rely on their mother's milk as a source of food and drink which make their exposure to contaminates is minimal. Consistently, the rate of infection has risen in toddlers in age 1-4 years and once additional food types are introduced and children obtain their drink independently.

The uneven number of male cases in the age group of 5-14 years is also witnessed. The socialization of boys into a masculine identity can be blamed for lower standard of care from mothers to their sons, in comparison to their daughters.

By looking at **Figure 1** and **2** collectively, we notice the highest incidence of disease was in the age group 15-45 and mainly among girls and young women which reflect their size relatively within the whole population, but may also reflect aspects of vulnerability that connected to gender roles and health status", such as looking after small children and reduction to their immunity during pregnancy. Girls in Iraq generally are often tutored from a young age to take up their maternity role at very young age^{18,19} young girls who clean and feed the child are likely to contract the disease if the infant is infected with cholera. Checking marital status of affected women, some were single mothers who often experience inadequate support of social services and so that struggle to meet their needs and encounter challenges in earning while looking after infants and babies. Male cases were represented in over 25 years of age, slightly and consistently more prevalent. This can be explained by their exposure to the disease whilst convening and eating in crowded places that often short of basic sanitation as a result of their typical gender roles¹⁸. In the urban setting, men around this age are less likely to spend time in the household, their lifestyle typically to leave in the morning to go to, or look for work. In big cities, such as Kerbala, working age people tend to eat more food prepared by local vendors than in rural areas, for convenience and affordability for lower-income groups. Eating street food seems to be more prevalent amongst men, particularly those who are unmarried, from lower-income households and have no one to cook for them at home.

Kerbala is an average size densely populated city, river-sided at Al-Hysannia. Al-Razazah Lake located at west border of the province often called buhayrat Al-Razazah which considered to be the second largest lake in Iraq and listed as a wetland of international importance²⁰.

Table1, Figure 3 and **4** consolidate that tendency of infection is much greater in highly populated residential areas of the province at central Kerbala as represents more than half of the total cases. Increase in population density can pressurize sanitation systems in place, as a result putting people at risk of contracting cholera^{21,22}.

Cholera incidence at the central part of the province appears very high in comparison to low rates at the

peripheries. Such high urbanization rate strain existing resources leading to a lower the standards of hygiene for drinking water. Unsatisfactory sanitation systems combined with an irregular supply of pipe-borne water puts the society at risk of cholera. Surface water pollution is more likely when rivers pass through urban and overcrowded cities. The commonest contamination is from human excrete and sewage²³.

21 cases were reported at suburbs district of Al-Hur, 3 kilometers away from Kerbala's centre. This remarkably represents 31% from the total number of cases which considered being significantly high comparing to the overall community population of approximately 7500²⁴. The district services are basic and over burdened, and informal housing on agricultural lands is having a negative ecological impact on the area causing health deterioration to the community. The number of confirmed Cholera decreased considerably to just 9 cases at Al- Jazeerha sub-district which located at the outer skirt of the City Centre.

Due to the cosmopolitan nature of Kerbala as well as the vast number of tourists coming to the city every year make the city at increased risk for cholera. The existing laws which were used to protect water bodies from waste and faecal pollution is no longer adhering. Therefore, defecating and dumping of waste in and at the banks rivers and streams have become a common practice in most inner-city communities. However, during periods of water shortage residents resort to such polluted water for various household activities like cooking and washing.

Kerbala current water and sewage infrastructure is hugely damaged including treatment plants and pipe networks. There are several factors causing operating budgets to be exacerbated. Those are including but not limited to unreliable electricity, poorly trained personnel, and a tendency to look for quick fixes rather than long-term solutions to problems²⁵.

The transmission of cholera is closely linked to insufficient access to clean water and sanitation facilities. In order to determine if water supplies are correlate in any way to the number of infections occurred in 2017. A survey questionnaires' was completed by each patient stating the source of water supply they have used prior to their infection. More the 67% of the patients were using R.O. water for drinking. Reverse Osmosis, commonly referred to as RO, is a process where water is demineralize or deionize. This happen by pushing the water under pressure through a semi-permeable Reverse Osmosis Membrane²⁶.

Although main stations producing R.O. water undergo periodic examination and constant monitoring by Kerbala Health Directorate, however portable distributors who delivers R.O. water to people's homes are not inspected by Health authorities and for some of them allowed to use their primitive equipment in doing so. Kerbala districts are typically at-risk as they include peri-urban slums, and shelter houses for internally displaced refugees. Unfortunately minimum requirements of clean water and sanitation are not been

met for those refugee camps¹. Despite of tap water samples that were taking from all over water stations in Kerbala were tested negatively for *V. Cholerae*, almost 69% of the patients had used it for cooking and cleaning. Access to sewage and water networks is borderline in urban areas and extraordinarily poor in many rural areas¹⁹.

CONCLUSIONS

Cholera remains a universal threat to public health and an indicator of inequity and lack of social development. In spite of the progress in socio-economics that Iraq witnessed in the past few years, high cholera prevalence remains. Kerbala city is expanding rapidly so that sustainable enhancements in water and sanitation infrastructures are still the only ultimate solution. The unstable and unpredictable political climate hinders implementation of plans that address socio-economic and environmental risk factors²⁷. In the short run supplementary avenues such as clinical management via vaccination needs to be explored to. Furthermore, in order to fully understand the changing in clinico-pathologic facets of cholera and the appearance of hybrid and drug resistance strains, there is a need for monitoring and surveillance²⁸.

Our study revealed that testing for cholera as part of the routine microbial check on tap water is essential to detect contaminated water by sewage that might have eased the transmission of the disease, causing a prolonged community-wide cholera outbreak. Large number of visitors from abroad could have introduced cholera into the community. Subsequently making the containment of the disease more challenging.

Recommendations

- Control the transmission of cholera and other waterborne diseases via a critical provision to safe water and sanitation.
- Patient's faeces should be disinfect and properly dispose by public health authorities which should also fix the leaking pipeline, chlorinate the piped water system, and conduct health education on boiling and chlorinating drinking water.
- Regular Health and Safety inspections to local portable distributors of R.O. water and their equipment should be introduced and maintained efficiently.
- Safe oral cholera vaccines should be used in combination with improvements in water and sanitation in areas known to be high risk for cholera.
- Update the existing strategy on cholera control to target reduction in cholera infection and prevent progression to various and serious complication.
- Raise public awareness about the disease and mode of infection and prevention.

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