Cholera outbreak – an overview of management and prevention

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Abstract

Cholera is a water-borne disease, caused by the bacteria *Vibrio cholerae*, and it is spread by contaminated food and water. Transmission happens through the oral-faecal route, by ingestion of contaminated food or water and poor sanitation. The risk factors include limited access to safe water and sanitation facilities. The symptoms include severe watery diarrhoea and dehydration. Management is based on proper and timely rehydration as well as preventative measures to stop the transmission of the bacteria. Antibiotics such as doxycycline or ciprofloxacin are effective treatment options. Hand hygiene and proper sanitation are of the utmost importance to reduce the spread of the disease. This review will focus on assessing the aetiology, pathophysiology, modes of transmission, treatment, and prevention methods available for cholera, with an aim to raise public awareness on the cholera outbreak currently affecting the country.

The review conducted searches on Pub-Med and Google Scholar databases to find literature covering different aspects of cholera, such as its causes, pathophysiology, transmission, treatment, and prevention. Articles on cholera in the current year of 2023 up to a limit of 2012 and written in English language were used in this review. In addition, this review made use of the standard treatment guideline for cholera treatment options provided by the South African National Department of Health.

Keywords: cholera, prevention measures, treatment options

Background

Cholera is a water-borne disease, caused by the bacteria *Vibrio cholerae*, and it is spread by contaminated food and water. The bacteria is transmitted through the oral-faecal route, by the ingestion of contaminated water, uncooked or contaminated raw food and poor sanitation.¹

A recent outbreak of cholera has been reported in the north of Gauteng Province, with the first patient identified in February, and the first death reported in March. Several patients have since died.¹

The World Health Organization (WHO) estimates 1.3 to 4.0 million incidents of cholera each year with 21 000 to 143 000 deaths worldwide.² The disease dates back to the 5th century on the Indian subcontinent, where it originated and later spread followed by a prevalence of six global cholera pandemics between 1817 and 1923. The seventh ongoing cholera pandemic identified in 1961 in Indonesia continues to spread through Asia, Africa, Europe, and Latin America.³

The risk factors for cholera outbreaks include limited access to safe water and sanitation facilities, extreme climate change such as rainy seasons that cause damage to water infrastructure, travelling to cholera endemic regions, and poverty leading to poor access to sanitation, thus increasing susceptibility to becoming infected.⁴ Presently, water, sanitation, and hygiene, also known as the WASH measures, together with the new generation oral cholera vaccines are considered interventions and beneficial preventative tools in cholera-endemic countries and in areas prone to risk for outbreaks.⁵

Despite improved knowledge of how cholera spreads and preventive measures and measures to control outbreaks, the disease remains a major health problem in many African, Asian, and South American countries.⁶ There have been continuous and recurrent episodes of cholera outbreaks in Africa, which have led to a rise in morbidity and mortality in several countries.⁶ Based on the global patterns of trends in cholera mortality between 1990 and 2019, there has been an increase in the number of cholera-related deaths worldwide, which doubled in 2010 as a result of a vast increase in cholera epidemics in many countries including Haiti, Nigeria, Cameroon, Chad, and the Democratic Republic of Congo. This is due to poverty in these countries, which limits access to basic services such as clean running water.⁶ Nigeria recorded the highest mortality rates at 4.5% over the period from 1990 to 2019.⁶

In 1974, South Africa recorded its first case of cholera, however, most outbreaks that followed were a result of importation from the neighbouring countries, Zimbabwe and Mozambique.⁷ This includes the 12 706 cases reported during the 2008 outbreak from November 2008 to April 2009, five cases from 2010–2014, and 102 *V. cholerae* isolates identified from February 2018 to January 2020.⁷ The National Institute for Communicable Diseases (NICD) in South Africa, is notified of all suspected cholera cases, they receive all human and environmental isolates, then make a definitive diagnosis if *V. cholerae* O1 or O139 is isolated.⁷

Different studies have been done covering aspects such as the aetiology, pathophysiology and transmission of cholera, as well as previous reports across many countries. It is important to assess
the current information on cholera and to better understand the disease so that appropriate preventative measures can be implemented to avoid future outbreaks. This review aims to provide information to the public about cholera and to aid healthcare workers, including pharmacists, to be aware of symptoms like diarrhoea, especially during an epidemic and the relevant treatment options available to them.

**Methods**

**Search strategy**

The review conducted searches on Pub-Med and Google Scholar databases to find literature covering different aspects of cholera, such as its causes, pathophysiology, transmission, treatment, and prevention. Literature searches were done using the following keywords in different combinations on the online search; cholera, prevention measures and treatment options.

**Article selection**

All the selected articles were independently reviewed by the five authors for eligibility to be used in this review. All the disagreements were resolved by consensus. Articles on cholera in the current year of 2023 up to a limit of 2012 and written in English language were used in this review. In addition, this review made use of the standard treatment guideline for cholera treatment options provided by the South African National Department of Health.

**Aetiology**

Cholera infection is caused by toxins produced by the comma-shaped, Gram-negative bacteria *V. cholera*, namely O1 and O139 serogroups of the bacterium that take residence in the small intestine. The onset of symptoms of cholera can occur within 12 hours and up to five days after ingesting the bacterium. Symptoms are often mild, and some infected people can be asymptomatic. Even if people are asymptomatic, they can still spread the infection through their faeces for up to 10 days. The key symptoms of cholera are diarrhoea and dehydration due to the rapid loss of fluids and electrolytes. Some people may experience vomiting, shock, seizures, leg cramps, abdominal pain, and kidney failure. In addition to diarrhoea and dehydration, drowsiness, fever, and convulsions are some of the symptoms noted in children with cholera.

**Pathophysiology**

Entering the human body, *V. cholera* avoids the low pH environment of the stomach where the acidity will destroy the bacteria, which reduces the infectious dose significantly. The cells, which withstand the acidic environment of the stomach, eventually reside in the intestinal tract. Their residence is aided by the toxin co-regulated pilus, which can eradicate other bacteria.

Cholera toxin (CT) is a toxin released by *V. cholera*, which elicits its effect intracellularly once the toxin enzyme has activated the adenylate cyclase regulatory proteins. The CT and other proteins block the normal ion transport through the gut epithelium by increasing the efflux of chloride from the plasma to the lumen and decreasing the absorption of sodium from the lumen into the plasma. Additionally, CT also causes an increase in adenyl cyclase activity, which causes cyclic adenosine monophosphate (cAMP) to rise, ultimately reducing the intestinal villus cell’s ability to actively absorb sodium, potassium, and bicarbonate. This increase in electrolytes in the gut results in massive water loss that presents as severe diarrhoea and vomiting. The diarrhoea is severe, and if not treated timeously, it can be fatal.

**Transmission**

The main routes of transmission for cholera include the oral-faecal route, human-to-human transmission, and the consumption of contaminated food or water. Table I depicts the different routes of transmission for the bacteria.

**Prevention**

Authorities in charge of public health face several demands on their limited resources during a cholera outbreak. Thousands of lives can be saved by ensuring that the front-line healthcare workers have the tools and training necessary to address the acute dehydration and other symptoms caused by cholera. The burden of cholera can be reduced by advising households to treat diarrhoea with oral rehydration solution, disinfect drinking water with an effective disinfectant, such as chlorine, which can be found at non-governmental organisations (NGOs), and washing their hands with soap under running water.

The Centers for Disease Control and Prevention (CDC) recommend five basic steps to prevent the disease. These steps are depicted in Figure 1.

Firstly, people can ensure that they use uncontaminated water by using bottled water with unbroken seals. Alternatively, methods such as boiling water before use, using bleach, filters or treating water with chloride products can be used to ensure that water is not contaminated. The method of boiling water is a reliable method of sanitising water when access to chlorine products is not available. Households that cannot boil water can use household bleach (two drops for every one litre of water) as an alternative to sanitise water, but this method requires waiting 30 minutes before using the water. One can also use filters of 0.3 microns or less to filter water together with the use of chemicals.
like chlorine, chlorine dioxide, or iodine to disinfect the water before use. Additionally, the purified water should be stored in clean and covered containers.23

Regular washing of hands with soap and clean water should be done before, during and following food preparation as well as when feeding children or yourself. Hands should be washed after every visit to the bathroom and immediately after wiping the bottoms of babies. Caregivers should wash their hands after caring for a person suffering from diarrhoea. In situations where there is no access to soap and water, alcohol-based hand sanitisers that contain at least 60% alcohol can be used.23

Good toilet hygiene such as getting rid of waste in toilets and not in open spaces and using properly maintained sanitary facilities to dispose of child waste, must be practised minimising the spread of cholera. Additionally, proper hand washing with clean water and soap should be practised, following a visit to the bathroom.23

Good food preparation is important to ensure that fruits and vegetables are cleaned and peeled correctly. All surfaces and items, which will be used to prepare food, should be adequately cleaned with soap and water. When cooking, ensure that meals are cooked thoroughly, and store leftover food in sealed or covered containers. All food should be consumed while warm. Lastly, bathing and washing of dirty clothes or diapers should be performed at least 30 meters away from sources of drinking water. Toilets and other faeces-contaminated surfaces should first be washed down with soapy water and then disinfected with a solution of 1:9 parts household bleach and water. Once cleaning is done, the water and dirty rags should be disposed of properly, and hands should be washed with soap and clean water.23

**Management**

In an endemic or epidemic condition, anyone over two years of age with clinical presentation of acute watery diarrhoea (three or more watery stools in the last 24 hours) of short duration (24–48 hours), with or without vomiting, accompanied with dehydration, should be treated as cholera.24

Early rehydration is the cornerstone of care (regardless of the causative organism), and time should not be wasted thinking about investigations or the best antibiotic to utilise.24

Cholera is easily curable. Most patients can be successfully treated with timely oral rehydration solution (ORS) delivery. One litre (L) of clean water is used to dissolve the WHO/United Nations International Children's Emergency Fund (UNICEF), ORS standard sachet. For the first day’s treatment of moderate dehydration in adult patients, up to 6L of ORS can be administered. Patients with severe dehydration need to receive intravenous fluids quickly, because they run the danger of developing shock.2 Additionally, the appropriate antibiotic therapy such as ciprofloxacin or doxycycline, are administered to these patients to minimise the duration of diarrhoea, to lessen the amount of rehydration fluids they require, and to reduce the amount and duration of *V. cholerae* excretion in their stool.2
The WHO further states that for children under the age of five, zinc can be crucial supplementary therapy that also shortens the duration of diarrhea, and it may help avoid recurrences of other types of acute watery diarrhea. Breastfeeding in babies should be encouraged. Treatment options for cholera according to the South African Treatment Guidelines and the CDC are depicted in Table II.

Erythromycin is an excellent alternative treatment for cholera that is safe for use in both children and adults, including those who are pregnant. While doxycycline has benefits relating to simplicity of administration and equivalent or greater effectiveness, norfloxacin, trimethoprim-sulfamethoxazole (TMP-SMX), and ciprofloxacin are also effective antibiotics. Recently, it was discovered that azithromycin was more effective than erythromycin and ciprofloxacin.

The volume of fluid required to rehydrate patients depends on the severity of dehydration. IV Sodium chloride 0.9% or homemade sugar and salt solution (½ level medicine measure of table salt plus 8 level medicine measures of sugar dissolved in 1 litre of boiled (if possible) then cooled water). Rehydration together with ciprofloxacin antibiotic treatment is recommended in both children and adults. The management of cholera relies heavily on replacing fluids and electrolytes as soon as possible, in combination with antibiotics.

**Conclusion**

The findings indicate that cholera remains a major health concern in many regions, particularly in African, Asian, and South American countries, despite significant efforts to control its spread. The cholera incidence in Hammanskraal, Gauteng, South Africa, serves as a poignant example of the consequences that can arise when prevention and management strategies are not adequately implemented. The outbreak may have led to avoidable deaths and illnesses, putting a strain on the local healthcare system, and causing social and economic disruptions in the affected area. Although cholera poses a significant health problem, it can be effectively managed with appropriate oral rehydration fluids and antibiotic medications like ciprofloxacin and doxycycline.

Healthcare workers should be aware of current outbreaks and treat all watery diarrhea as cholera. Healthcare workers, including pharmacists, play a role in educating the population on proper hygiene, effective handwashing and food preparation.

**References**


