

Cholera Prevention and Treatment Policy Analysis in India

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Abstract. In India, cholera has been a problem for a long time, yet it is still widespread. Cholera can cause severe diarrhea and dehydration, with a high mortality rate in untreated patients. Despite the efforts of the government of India, the cholera pandemic in India has not yet been eradicated. Consequently, it is essential to analyze the reasons. This presentation will also present a possible reaction mechanism from the standpoint of public policy. Even though cholera is a preventable and curable illness, it is seen as a severe public health issue in a developing and densely populated nation such as India. Cholera is transmitted primarily through contaminated water, and migration, restricted access to clean drinking water, poor sanitation, a climate conducive to virus transmission, overcrowding, religious beliefs, open defecation, and ignorance of disease transmission are the primary causes of its rapid spread in India. Awareness of cholera control, the development of public restrooms, and the availability of vaccines are therefore crucial.

Keywords: India, Cholera, Prevention, Outbreaks, Vaccination.

1. Introduction

Until today, 1.3 to 4 million people worldwide become newly infected with cholera each year, among whom 21,000 to 143,000 lost their lives. Based on the etiology of this disease elaborated above, lowering the prevalence and fatality require us to well address the issues that raise the risk of cholera infection. The Ganges Delta of India was the origin where the first cholera pandemic broke out in 1817. Despite the efforts that the Indian government has made, the epidemic of cholera there remains largely unsolved. This is primarily due to the lack of access to clean water and sanitary facilities. Hence, a reduction in diarrheal morbidity and mortality would be expectedly to be achieved by improving the overall status of public sanitation and nutrition, which eventually accelerates socio-economic development. This essay will analyze the main causes of the cholera epidemic in India and then provide feasible coping strategies from the standpoint of public policy.

The first cholera pandemic originated in the Ganges Delta in 1817, when tainted rice caused an epidemic in Jessore, India. By moving along European-established trade routes, the epidemic swiftly spread over the majority of India, Myanmar, and Sri Lanka [1]. Between 2011 and 2020, 565 outbreaks were documented, resulting in 45,759 illnesses and 263 fatalities. Throughout the year, there were outbreaks, although they peaked during the monsoon season. The peak of cholera epidemics in Tamil Nadu often comes between December and January. 72% percent of outbreak-related cases were reported in five Indian states [2].

2. Overview of cholera

2.1. Definition

Cholera is a highly contagious disease transmitted through the fecal-oral route. It has long been a serious threat to public health in India and yet remains prevailing up until today. Cholera is an infectious disease of *Vibrio cholera* (a kind of pathogenic bacteria) and is clinically characterized by acute watery diarrhea that is extremely severe and incurs a high fatality in the patients. After consuming the food or water contaminated by *Vibrio cholera*, people typically begin to show symptoms between less than 12 hours to 5 days, and those receiving no proper treatment may even die within hours due to the lethal dehydration caused by diarrhea. This disease is most prevalent in the summer when the bacteria grow faster due to a higher temperature, and has proven infectious to

the whole population regardless of race, age and sex. Notably, there are cholera patients who are asymptomatic, and yet the bacteria still propagate inside their digestive tracts and get released along with the feces between one to ten days after infection. The released bacteria can again contaminate the water source, subsequently exacerbating the spread of cholera.

2.2. Mechanism and symptom

Cholera, a category A infectious disease, is a violent intestinal infection caused by *Vibrio cholera* that is typically fatal if not appropriately treated. *Vibrio cholera* is highly acid-sensitive. Unkilled *Vibrio* penetrates the small intestine when stomach acid is low or the number of invasive bacteria is high, multiplies fast in the alkaline intestinal fluid, and attaches to the surface of the intestinal mucosa. The higher the adhesion capability, the higher the pathogenicity. In the process of reproduction, *Vibrio cholera* can create enterotoxin, which is the primary cause of severe diarrhea. The cholera enterotoxin binds to the receptors in the epithelial cells of the small intestine. Then it will make adenylate cyclase activated in the epithelial cells, which catalyzes the conversion of adenosine triphosphate into cAMP, resulting in a sharp increase in the content of cAMP in the intestinal mucosa, inhibiting the reabsorption of sodium by the intestinal mucosa cells and actively secreting chloride and water, leading to the hyper-secretory function of the intestinal mucosa cells and the appearance of the disease.

The severity of the clinical symptoms varies, but the principal pathophysiological alteration of the disease is a significant loss of water and electrolytes owing to excessive vomiting and diarrhea. In extreme cases, the daily stool excretion might approach 18,000 ml, causing severe clinical dehydration, hypovolemic shock, hypokalemia, metabolic acidosis, and acute renal failure. The disease's pathological alterations are insignificant; mainly dehydration, dry skin, and cyanosis are seen. The subcutaneous tissues and muscles are exceedingly dry, the visceral plasma membrane is dark red and lackluster, and the corpse stiffens rapidly after death; the intestinal cavity is filled with a liquid resembling "rice slop" and occasionally blood-like substances. The gallbladder was full of thick bile. The majority of the heart, liver, spleen and other organs were shrunk, the glomerulus and interstitial capillaries were dilated, and the renal tubules were hazy, bloated, deteriorated, and necrotic [3].

2.3. Clinical Treatment

Rapid replacement of fluids and electrolytes, prompt correction of acidosis accompanied by antimicrobial therapy, and symptomatic treatment are the guiding principles of treatment. The general symptoms are distinguished by category. In a intestinal infectious disease, significant patients should pay special attention to warmth, oxygen administration, good care for serious disease, enhance symptomatic therapy, and prevent co-infection. Intravenous administration of medication Rehydration is the primary treatment for cholera; an infusion containing 5g of sodium chloride, 4g of sodium bicarbonate, and 1g of potassium chloride per 1,000ml can be employed. Oral rehydration treatment is straightforward, inexpensive, secure, and effective. Oral rehydration solution can be used to treat the entire course of vomiting in patients of moderate type and average size. In severe cases, in newborns and the elderly, intravenous rehydration should be administered initially, followed by oral rehydration if the condition improves or vomiting ceases. Appropriate antibacterial medication therapy can lower the total quantity of feces, the total amount of rehydration, and the duration of defecation. First-choice antibacterial medications are tetracycline, followed by doxycycline, chloramphenicol, sulfamates, and furans. *Vibrio cholera* resistance to tetracycline has risen in recent years, although doxycycline is still effective against tetracycline-resistant strains. The key to the prevention and treatment of problems is the prompt replacement of isotonic saline, the prompt correction of acidosis and the proper replacement of potassium salts, and the prevention of cardiopulmonary insufficiency. Patients with severe conditions should be given calories and adrenocorticosteroids [3].

3. Risk factors for outbreaks

3.1. Water contamination

The natural habitats of *Vibrio cholera* include rivers and lakes. These bacteria may be transmitted to human bodies by the media of water or aquatic products (e.g., fish, shrimp). As mentioned before, *Vibrio cholera* may survive for many days in untreated feces, and the feces of cholera patients further pollute water sources near human habitats, leading to an exponential growth of cases. *Vibrio cholera* originates from the Ganges River in India. The first outbreak is closely related to Indian people's long-term habit that they drink untreated Ganges water directly while discarding wastes and corpses into the river. India has 1.15 billion people, of which roughly two-thirds inhabit rural areas where just 28% of households have access to clean water and 26% to decent sanitation. Vectors of transmission included leaking water pipes, inadequate sanitation or hygiene, including open defecation, waterborne with inadequate sanitation/hygiene, foodborne/household transmission, and social gatherings [2]. Thus, it is hardly surprising that cholera remains a critical public health issue in this nation. Since the year 2000, both the frequency of the cholera outbreaks and the fatality it causes have climbed steadily. A cumulative number of 838,315 cases was reported by the World Health Organization (WHO) between 2004 and 2008, much greater than that of 676,651 recorded between 2000 and 2004, which is equivalent to a drastic 24% increase. Still, it is believed that the annual cases should be between 3 and 5 million, with the deaths equal to 100,000 to 130,000.

3.2. Religion

The Ganges rises at the southern foot of the Himalayas, runs across the middle plains, and empties into the Bay of Bengal with a large valley, gentle flow, and many tributaries. Hindus have been revering it as a sacred river since ancient times, so a significant number of people can be attracted to the lower Ganges during their festivals. Each year, more than 12 million people visit Uttar Pradesh's 400 festival locations. Particularly, between March and April, when the weather is conducive to cholera outbreaks, 116 festivals in the eastern area often gather over 287,000 pilgrims annually. Due to the property of pilgrimage, the assembly of such a huge number of people from all over the world in a short time and a limited space rapidly causes the deterioration of the environment. The improvised camps are unplanned and nearly devoid of drainage systems, resulting in stagnant water and human feces everywhere. The collection and use of unsanitary water also exacerbate the contamination of water sources. The aforementioned factors collectively contribute to the transmission of pathogens, which consequently evokes the epidemic. Of note, religion has played a key adverse role in spreading cholera. Pilgrimage activities and religious festivals are crucial ways for the followers to show their faith and purify their spirit, where bathing in the Ganges River is their only option for physical and spiritual purification. Therefore, the practice of entering the Ganga to cleanse the body or drinking its water for the purpose of cleansing the soul exacerbated the contamination and spread of cholera. Accordingly, many patients also rush to the Ganges before they die or have their bodies burned there by their family members. Pilgrims are encouraged to directly drink Ganges' water as a part of the pilgrimage site, which allows the rapid and continuous spread of water-borne *Vibrio cholera*. Moreover, the pilgrims' act of taking this water to their friends and family members facilitates the distribution of this contaminant. This also happens during the group activities such as communicating religious ideas, sharing meals, drinking river water, and bathing together. Additionally, certain practices in Hindu culture potentially aggravate cholera transmission. For instance, most Hindus eat without cutlery (e.g., knives, forks, or spoons); instead, they use their right hand to roll vegetables inside a pancake or to mix rice and vegetables with the hand. As well, long traveling to the sacred locations along the Ganges River during pilgrimage can substantially impair the immune defense of pilgrims. Although human beings are innately susceptible to cholera, the impoverished often have a much greater possibility of infection.

3.3. Climate

As a classical bacterial disease, cholera in India shows epidemiological characteristics that are intimately associated with the region-specific native ecology and ecosystem. India's territory is geographically featured by its northern areas adjacent to the Himalayas and the rest encircled by the Indian Ocean. Its river systems are abundantly located in the western, northern, and central areas, with the Ganges River basin that forms the Ganges Delta being the largest. The climate of the delta is humid and tropical; the annual precipitation ranges from 1,250 to 1,500 mm. India's topography is fairly distinctive, making its climate a tropical monsoon one (i.e., the year-round high temperature and the evident wet and dry seasons). Due to the monsoon climate and topography, the spatiotemporal distribution of precipitation is very irregular. The majority of the precipitation falls between June and September, causing local flooding during the wet season, whereas water shortage can be severe in the rest months. Regarding regional distribution, the Ganges Delta always has the greatest amount of precipitation. From June through September, the Ganges Delta experiences heavy rainfalls that frequently results in flood. Since cholera has a natural epidemiological origin and the water is its primary medium of transmission, the quality and ecology of natural water sources exert a key effect on the survival, spreading area, and transmission rate of *Vibrio cholera*. The primary sources of drinking water in India include pools and wells, which are filled with rainfalls that seep into the earth. Provided the water in these places is contaminated by algae, the resulting increase in alkalinity will produce a better environment for the growth of *Vibrio cholera*, thereby stimulating cholera infection [2].

3.4. Health Awareness

As mentioned before, the rapid transmission of cholera is frequently related to the widespread contamination of untreated human excrement. The UNICEF found that 50% of people's waste worldwide has not been properly disposed of through sewage facilities. Likewise, about half of Indian citizens defecate in the open space. In 2014, WHO/UNICEF estimated that 60% of the global people are engaged in open defecation. The lack of knowledge on cholera and the shortage of preventive strategies remain to be the leading cause. The great majority of rural Indians defecate in the open, which contaminates water supplies and exacerbates the situation. Heavy rains also aggravate this issue, as they raise the water level and accordingly allow sewage and stagnant water to leak from broken pipes [4]. In the regions with endemic diseases, poor people have a higher risk of infection, which in turn incurs severe poverty. Such a vicious circle would eventually endanger the public and interrupt the socioeconomic advancement of the country. Therefore, how to make healthcare available to all ranks of people despite their social and financial statuses, gender, and living environment is a prerequisite for well dealing with cholera prevalence in India. This is of particular importance as approximately more than 39 million individuals fall into poverty annually as a consequence of paying for healthcare costs.

4. Preventive measures

In order to reduce the damage brought about by this disease, several effective interventions have been recommended and clinically used. For example, oral rehydration salts (ORS) can be used to correct mild dehydration, while intravenous transfusion to compensate for diarrhea-induced losses of water and electrolytes must be applied to patients with severe dehydration. Besides, antibiotics may be used as an adjunct to kill the pathogen if necessary. Further, cutting off the fecal-oral route can be a relatively easier and simpler way to prevent cholera infection, which includes the maintenance of good personal hygiene, frequent hand-washing, consumption of clean water, and fully-cooked hot meals.

Previous research looking at epidemics in India has suggested similarly crucial steps that may be taken to avert outbreaks in the future. Previous research looking at epidemics in India has suggested similarly crucial steps that may be taken to avert outbreaks in the future. For example, the use of

proper sanitation, good personal hygiene, safe food handling, etc. can be effective preventive measures that cost little but work well.

Vaccines against killed cholera were created and used in India around the turn of the twentieth century but were abandoned because of their high cost and questionable effectiveness [5]. The oral vaccine Dukoral was WHO-approved in 1991, but its use as a travel vaccination has been mostly restricted to the industrialized world due to its expensive cost [5, 6]. The International Vaccine Institute (IVI), based in South Korea, updated this vaccine to satisfy international requirements and produce a new, low-cost OCV that could be readily administered and widely distributed [7]. In addition to the commercial manufacture of the first OCV in India, all clinical trials necessary to show the vaccine's safety, tolerability, and efficacy were undertaken in the highly endemic populations of Kolkata, India. The cumulative protective effectiveness of the vaccination after five years of follow-up was 65% [8]. Reanalysis of the data revealed a higher degree of protection gained in the vicinity of areas with high vaccination coverage, highlighting the potential use of ring vaccination for cholera control [9]. A Geographic Information System (GIS)-based research revealed the indirect or "herd" protection of the vaccination among non-vaccinated recipients, showing greater public health effects than efficacy [10]. This is the first trial to demonstrate its good effectiveness of it and to build the evidence that led to its licensing.

Build toilets and prohibit open defecation. Hygiene education for the new generation and allocating resources for cholera surveillance and awareness: In order to avoid and be ready for diseases like cholera, proper resource allocation for prompt identification through monitoring and widespread public health awareness are both important [11]. Swachh Bharat Abhiyan was noticed by the government, the objectives of which include improving awareness of the public regarding the drawbacks of open field defecation and promoting latrine use in the villages. By now, 86,700,446 toilets were built, and 504,316 villages forbade open field defecation. It has positive future prospects to help to decline the use of open field defecation, and occurrences of cholera in poverty areas [12]. Isolation and treatment of patients primarily with the purpose of avoiding infection transmission, as well as management of contacts of cases to do the same.

The infrastructure, such as distribution, logistics of the vaccine, and other factors, presents challenges to the systematic introduction of the oral cholera vaccine (OCV). The policy result of the implementation of OCV in India would also depend on sustained political commitment and cooperation from media professionals.

5. Conclusions

Having gained an understanding of the pathophysiology and reasons for cholera's spread, the Indian government should also enhance its policies for the prevention of epidemics. It is essential to recognize that India still faces substantial health and safety issues that contribute to the spread of infectious illnesses like cholera. Increase health and hygiene promotion, construct more public toilets, and urge homes to construct toilets. Increase the availability of oral vaccinations and offer access to clean water that has been appropriately treated in the majority of communities. In the near future, cholera will be drastically decreased in India if these steps are taken.

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