OIRT Journal of Information Technology

Available at: <https://journals.otuirt.com/index.php/OJIT>

SHORT COMMUNICATION

Artificial Intelligence May Help in the Containment of Cholera in Nigeria

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ABSTRACT

Artificial intelligence (AI) techniques have been widely applied to infectious disease outbreak detection and early warning, trend prediction, and public health response and assessment. Such important public health surveillance and response tasks pose unique technical challenges such as data sparsity; Traditional public health information relies heavily on epidemiological data. Recent years have seen incredible growth of AI-enabled methods, especially in developed countries, complementing statistical approaches. This chapter aims to systematically review these recent advances applying AI techniques to address the Cholera Epidemic and surveillance and response challenges.

Keywords: Artificial Intelligence, Cholera, Public Health, Nigeria

Article History

Received: January 08, 2022

Revised: February 28, 2022

Accepted: March 03, 2022

INTRODUCTION

Artificial intelligence (AI) refers to the theory and development of computer systems to perform tasks usually requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages (Buitin, 2021). Furthermore, Artificial intelligence (AI) is a wide-ranging branch of computer science concerned with building smart machines capable of performing tasks that typically require human intelligence. It endeavors to replicate or simulate human intelligence in machines (Buitin, 2021).

In the recent era, AI technology has been widely used in different fields such as social science, public health, medicine, engineering, etc. In addressing trending issues of public concern. AI has also been applied to a broad spectrum of fields. Public health surveillance is one such area that has benefited significantly from these recent AI advances (Abdullahi & Muhammad, 2021; Abdullahi et al., 2021).

Historical Background:

Cholera is a highly contagious infection. It originated in India and spread far beyond Russia and Great

Britain. Researchers at the University of California, Los Angeles, believe that the third cholera pandemic started as early as 1837 and lasted until 1863. From 1853 to 1854, the pandemic caused 23,000 deaths in Great Britain and over 10,000 deaths in London (Azizi & Azizi, 2010). As the result of the August 1854 cholera outbreak in London, John Snow identified contaminated water as the means of transmission of the disease. He mapped a cluster of cholera cases near a water pump in one neighborhood. His breakthrough led to the control of cholera epidemics in the 19th century (Azizi & Azizi, 2010). However, cholera is still prevalent in SSA areas with inadequate sanitation, poor food, and water hygiene, and remains a significant global public health problem (Weill et al., 2017).

Recently, Nigeria has faced health challenges ranging from emerging COVID-19 to re-emerging of Lassa fever, cholera, Ebola, monkeypox, and many more. These are all epidemic diseases; meanwhile, COVID19 of recent has become a global pandemic. The cholera outbreak is alarming and a concern for public health professionals in Nigeria. Recently Nigeria has been hit with an outbreak of cholera; statistics from Nigeria Centre for Disease Control and Prevention (NCDC) reveal that between 01 January and 01 August 2021, about 31,425 suspected cases of cholera, 311 confirmed cases, and 816 deaths had been reported from 22 states and FCT (NCDC, 2021). The affected states have activated an Emergency Operations Center (EOC). The EOC is co-led with the Federal Ministries of Environment and Water Resources, given the link between cholera, water, sanitation, and hygiene (NCDC, 2021).

Over the last two decades, Nigeria has faced three major cholera epidemics; furthermore, cholera is endemic to some extent in Nigeria (Acaps, 2021). Intermittent and recurrent outbreaks were common between 1995 to 2001 in Kano state. Though cholera outbreaks became less common with improved sanitation in the early 2000s, the case fatality rate has steadily increased with each additional outbreak. For example, the World Health Organization (WHO)'s 2016 Global Health Observatory reported that the case fatality rate doubled between 2015 and 2016 (Huhn, 2021)

Cholera is an acute diarrheal disease that can kill within hours if left untreated. Researchers have estimated 1.3 to 4.0 million cholera cases each year

and 21000 to 143000 deaths worldwide due to cholera (WHO, 2021).

Cholera Transmission:

Cholera is an acute diarrheal illness caused by infection of the intestine with *Vibrio cholerae* bacteria. Cholera disease is usually transmitted through the fecal-oral route of contaminated food or water caused by poor sanitation (Symington, 2011). Most cholera cases in developed countries are transmitted through contaminated food, whereas, in developing countries, it is more often through contaminated water (Mandal et al., 2011). Food transmission can occur when people harvest seafood such as oysters and shellfish in the waters infected with *V. cholerae*. People infected with cholera often have diarrhea, and hence disease transmission may occur if this diarrhea contaminates water used by other people (Miller et al., 1985). A single diarrheal incident can cause a one million increase in *V. cholerae* in the environment through waterways, groundwater, and drinking water supplies. Usually, cholera transmission is infrequent from person to person (Fung, 2014). The infection is often mild or without symptoms but can sometimes be severe and life-threatening. About 1 in 10 people with cholera will experience severe symptoms, which, in the early stages, include: profuse watery diarrhea, vomiting, thirst, leg cramps, and Restlessness or irritability (CDC, 2021).

Application of Artificial Intelligent (AI) in the Containment of Cholera:

Some countries have taken bold steps in deploying AI in the surveillance and containment of the cholera epidemic; however, four types of intelligence can contain the cholera outbreak in Nigeria.

Machine learning is an application of artificial intelligence that provides computer-based systems to automatically learn and improve from experience without being explicitly programmed (Demsar et al., 2013). Machine learning is categorized mainly into supervised and unsupervised algorithms. Supervised algorithms are used when the training data is classified and labeled, while unsupervised algorithms are used in unlabeled data (Chao, 2011; Sathya & Abraham, 2013). The basic premise of machine learning is to build models that can receive input data and use statistical analysis to predict an output while updating

outputs as new data becomes available (Olivera et al., 2017).

Over the past years, data determined the success of machine learning algorithms extensively; however, there has been a great revolution with innovative strategies such as sampling, decomposition, scaling, and aggregation (Dawson et al., 2015). A comprehensive review of some selected machine algorithms was carried out by Yahaya, Hassan, and Rabi (2020), these algorithms are used to predict cardiovascular disease, and their performances were compared. Nowadays, machine learning is used in a wide range of applications such as timely decision making, virtual personal assistance, social media services, video surveillance, identifying disease and diagnosis, drug discovery, and clinical research, since it is capable of handling data innovatively towards achieving its intended goals (Abuassba et al., 2017; Domingos, 2012).

A study set up software simulations of cholera outbreaks of varying sizes and small simulated serosurveys. This study found that testing as few as 500 people after an outbreak and applying their algorithm could generate good estimates of cholera incidence during these simulated epidemics, especially if the epidemics were relatively short, lasting weeks or months (Tectales, 2019). These advances may provide a much-needed tool for measuring and accelerating progress towards eliminating cholera as a public health threat by 2030, a recently announced objective by the WHO-backed Global Taskforce for Cholera Control. “Our approach worked quite well across a range of epidemic sizes and even with relatively small sample sizes, suggesting that models like ours—applied to data from surveys of healthy people where blood is collected—could be useful for better understanding cholera transmission in the field (Tectales, 2019). Because of this, it’s high time the Nigeria ministry of health collaborated with NCDC, WHO, CDC, and other relevant agencies to key into the transition. Furthermore, Nigeria’s health care system needs to embrace Artificial Intelligence, especially in epidemiological data collection, surveillance, and the containment of disease outbreaks in Nigeria, cholera outbreaks, and other emerging and re-emerging diseases in the country.

Cholera Scenario in Nigeria:

Nigeria faces many public health problems and challenges (Baba and Omotara, 2012; Muhammad et al., 2017). The health issues that Nigeria faces are infectious diseases, sewage disposal, health insurance, water supply, poor housing condition, solid waste disposal, disaster management & control, doctor-population ratio, population-bed ratio, population per health facility, payment system/methods, utilization of care, access to care, improper coordination of donor funds, poor sanitation and hygiene, incessant doctors strike, disease surveillance, and urbanization. The lack of Information and Communication Technological (ICT) facilities that could replace the primitive approach to the health care system in the Northern part of Nigeria also leads to inadequate health information delivery in Primary Health Care Systems (Rabi et al., 2019). Those mentioned above will give birth to a cholera outbreak in Nigeria if a concerted effort is not made to address the growing increase in infectious diseases rooted in poor water supply, sanitation, and hygiene and harnessing the potential of artificial intelligence in monitoring and tracking this epidemic. However, Nigeria’s health problem will remain unsolved (Huhn, 2021).

According to Nigeria Centre for Disease Control and Prevention, since the beginning of 2021, the reported cases of cholera among the age group 5-14 is 27.0%. Of all suspected cases, 51.0% are males, and 49.0% are females (NCDC, 2021). Previous cholera outbreaks in Nigeria have claimed hundreds of lives. However, this current outbreak could place the country in a much more serious situation without robust efforts to mitigate the risks of inadequate sanitation services and practices (Huhn, 2021).

According to zonal distribution, the northeast has the highest reported suspected case of cholera; this may be due to insurgency in the area (Boko Haram), which has a devastating effect on water supply, and sanitation hygiene in the region. However, the northwest also follows the northeast in terms of high cases of suspected cholera; meanwhile has a similar case of security challenges of banditry, which maybe affect adequate sanitation and hygiene. Lastly, northcentral has a small number of suspected cholera cases (NCDC, 2021). Furthermore, according to the UN Office for the Coordination of Humanitarian Affairs, the number of confirmed and suspected cases reported in Borno, Adamawa, and Yobe states (North-Eastern part of Nigeria), as of 30 September 2021 (3,848),

exceeds the number of cases reported for the whole year in 2020 or the entire year in 2019 (IFRC, 2021). Case management for cholera patients in affected states is said to be inadequate. Recent weeks have seen a gradual decline in cases, but additional states continue to report suspected cases (OCHA, 2021).

CONCLUSION

Statistics present in this study indicate the need for the federal ministry of health and other relevant health agencies to key into the deployment of Artificial Intelligence in addressing health care problems, especially in epidemic containment. For example, disease surveillance is seen in other developed nations such as Great Britain, the United States, France, and some African countries such as Tanzania. Furthermore, this could be achieved via collaboration with information technology sectors to reduce morbidity mortality and reduce the economic burden of disease, the health burden of disease, and the global burden of the disease.

Conflict of Interest: None

Funding/Support: None

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