An Exploration of Waterborne Disease and Their Post Impact

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Abstract: The quality of water we drink has a significant impact on our health. Water is necessary for survival at the most basic level, hence having access to some sort of water is a necessity for all people. The amount and quality of the water provided are essential factors in determining how healthy people and whole communities are, but water has a far larger impact on health and well-being. The most important thing to do is make sure that everyone has access to a better water supply. Low coverage, poor continuity, inadequate quantity, poor quality, and excessive cost in relation to capacity and desire to pay may all limit access to services. All these concerns must be addressed in order to enhance public health when it comes to drinking water. While water quality issues are essential, they are not the only ones that have an influence on people's health. Nevertheless, water quality has a significant impact on public health, with microbiological quality playing a particularly important preventive role. Infectious water-related illnesses are more prone to spread if there is poor microbiological quality. This might trigger major epidemics. When it comes to chemical water quality, time is less of an issue since the consequences on health are more long-term and chronic. Where severe pollution has occurred, or where particular chemicals, such as fluoride or nitrate, are present in high concentrations from natural or manmade sources, acute impacts may be seen.

Keywords- Water Quality, Waterborne Disease, Infectious Disease, contaminated water.

I. INTRODUCTION

Waterborne pathogenic microorganisms and associated illnesses were ultimately under control in most nations only in the early 19th century with the introduction of water filtration, wastewater disposal, chlorine treatment of drinking water, and pasteurisation of milk and food. Illnesses transmitted by water should not be considered an end in and of themselves, but rather as a means by which other diseases might spread. Despite the fact that we believe that a considerable number of these gastrointestinal disorders are waterborne, we lack the information necessary to determine their total burden of disease (Figure 1). This integrative strategy should reduce the overall incidence of gastroenterological disorders as well as waterborne sickness. Reduced transmission between people and reduced danger of food contamination from contaminated water or diseased persons via drinking water have also contributed to this improvement (Figure 2).

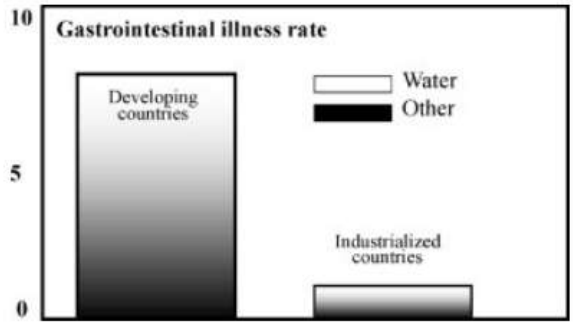

Fig. 1: The rate of gastrointestinal illnesses in developing countries is much less than in developing countries, but we still know very little about the proportion that can be assigned to water compared to other routes of transmission.

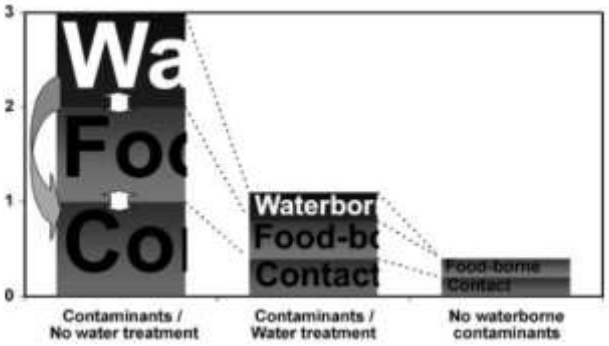

Fig. 2: Interrelations between waterborne disease and other routes of infection: reducing the role of water as a vehicle of transmission will significantly reduce the level of infectious disease in the community.

To what extent do we know about the health impacts of drinking water today, as we enter the third millennium? It's well documented that untreated or inadequately treated drinking water causes hundreds of outbreaks of bacteria, viruses, and parasitic microorganisms in nations across the globe. These studies show that water availability and quality have a direct impact on life expectancy and child mortality, since nations with limited access to safe drinking water have the greatest morbidity rates among children under the age of five.

1.1 Infectious Disease

Drought-induced increases in infectious illness are possible. When rainfall drops, bacteria, protozoa, and ruses

may contaminate both groundwater and surface water. Drought-related infectious diseases may put those who rely on private wells for their drinking water at greater risk. Those with underlying chronic diseases are also at greater risk. When there is a perceived or actual dearth of water available, diseases such as acute respiratory and gastrointestinal ailments are more likely to transmit from one person to the next. When water is scarce, infectious illness risks rise if cleanliness standards are not met.

During a drought, germs such as Coli and Salmonella are more likely to contaminate food and spread sickness. Water constraints may force farmers to irrigate their crops with recycled water and prepare the food they raise. This makes food a vehicle for disease spread. By using contaminated or polluted water in agricultural production, the danger of a wide range of infectious illnesses (such as those caused by toxin-producing E. coli and Salmonella) increases, which may have serious consequences for individuals who are already vulnerable. Dry and compacted soil that commonly comes along with drought may create surface runoff, which in turn can cause contamination of crops when rain cannot penetrate.

Drought-induced pollution of surface waterways and other forms of water that are utilised for recreational reasons provides another infectious disease danger. People are more inclined to engage in water-related activities when temperatures are higher and rainfall is lower. A person's risk of contracting infections that flourish in warm, shallow waters during drought increases when they are exposed to polluted recreational water.

Water, which is both life-giving and life-taking, may be both. Unhygienic and poor water quality are to blame for around 3.1 percent of global mortality. Approximately 80% of all infections are water-borne, according to the WHO. One-third of India's 600 districts have groundwater that is classified unsafe for drinking due to high levels of fluoride, iron, salt, and arsenic. This is a major concern. Fluorosis is a debilitating illness that affects 65 million people worldwide and is caused by exposure to excessive fluoride, which is widespread in Rajasthan, a northern Indian state.

A frightening 70% of India's water supply has been deemed severely contaminated, according to a World Resources Institute report from Washington, DC. Also, according to the United Nations, India's water quality was listed as the 120th poorest out of 122 countries for the quality of drinking water accessible to humans.

1.2 Waterborne diseases

When water is contaminated by industrial waste, human waste, animal waste, rubbish, untreated sewage, chemical effluents, and other pollutants, poor water quality is unavoidable. Waterborne illnesses and infections such as amoebiasis, giardiasis, and toxoplasmosis may be spread by drinking or cooking with filthy water. E.coli bacteria, which may be spread from person to person through street food sellers or food that has been touched by someone who has been infected with E.coli bacteria, can be found in contaminated water. (Food poisoning is a possibility as a result of this). As a consequence, deadly illnesses such as cholera and typhoid fever spread over the area. Diarrhoea, dysentery, polio, and meningitis are all examples of illnesses spread by water. Skin and infectious eye diseases like Trachoma may be spread by the use of dirty washing water. Trachoma may cause vision loss or even blindness in certain people. Rural residents are more susceptible to waterborne ailments, yet dirty or contaminated water may harm anybody. Anyone, anywhere may become sick from a waterborne sickness. Infants, young children, the elderly, and those with diabetes, heart disease, renal illness, and other chronic conditions are at greater risk.

Precautions to prevent waterborne disease:

- Clean the water by checking for sand and silt in the surface. Remove any apparent dirt from the water by filtering it.
- Only drink water that has been filtered using water purifiers or is available as portable water.
- Filters, RO units, and other water purification systems should be serviced and maintained on a regular basis.
- Make certain that the water you're storing is sanitised.
- When showering, use an antibacterial substance, such as Dettol.
- When you get home, use the restroom, prepare food, and consume anything, wash your hands with soap before and after each of these events.
- Teach youngsters the importance of good hand hygiene. When they go home from playing games, kids should make it a practise to wash their hands.
- Make certain that the food is fully cleaned and prepared.
- While feasible, eat off disposable glasses and plates when dining on street food or other takeout.
- Stay away from food that has been exposed to the elements for an extended period, such as stale cooked food or unrefrigerated food.
- Get immunised against illnesses that may be prevented, such as Typhoid, Hepatitis A, and Polio.

II. LITERATURE REVIEW

Ajmal et al. (2021), Azamgarh city in India has been identified as having a high risk of waterborne disease outbreaks due to the use of fuzzy analytic hierarchy process (FAHP) and geospatial analysis. Synergistically, it uses two phases of analysis: five socio-economic elements, one drinking water criterion (WQI), and two environmental criterion support the second stage of analysis utilising FAHP in the first stage. A weighted overlay analysis of the vulnerability map was also used. Water quality index, irregular water supply, and poor sanitation have weights of 0.247, 0.204, and 0.194, respectively, according to the research of triangular fuzzy numbers and extent analysis. These characteristics help prevent the spread of waterborne illnesses in the city. According to the findings, around 1.99% of the city's land area is classified as being very vulnerable, while 16.48% is classified as high, 37.11% is

classified as medium, 37.30% is classified as low, and 7.12 percent is classified as being extremely low. Similarly, it has been shown that the majority of the area classified as high-vulnerability zones is located in the city's crowded core. According to ground data on waterborne illness occurrence, high incidence was in line with the most susceptible zones for waterborne diseases. Validation of the findings. This validates the present methodology for identifying areas at risk from waterborne illnesses. The results of the study also imply that the research strategy and application procedure used in this study may be used in future research to identify disease-vulnerable zones.

Manetu & Karanja (2021), Waterborne infections continue to be a serious public health and environmental hazard across the world, with outbreaks occurring often in African nations. In less developed nations, illness caused by waterborne infections is a leading cause of morbidity and death in children under the age of five. A literature analysis of historical and current research on waterborne illnesses, risk factors, and intervention strategies was the goal of this study. As piped water becomes more scarce, people living in rural areas are forced to rely on surface water that is often polluted with faeces. Unhealthy hygiene practises have also been linked to the spread of waterborne infections, such as cholera. Deteriorating sanitary conditions, such as those caused by insufficient sanitation facilities, contribute to the rapid spread of waterborne diseases. There have been several studies that point to better drinking water, sanitation, and hygiene practises in developing nations as crucial interventions in the fight against water-borne illnesses.

Rachma et al. (2021), Direct contact with polluted recreational water may transmit pathogenic pollutants and hazardous substances that cause Recreational Water Illnesses (RWIs). The American Centers for Disease Control and Prevention (CDC) tracked 1,700 instances of recreational water illness (RWI) from 2011 to 2012. (CDC). The goal of this research is to examine the water quality in public baths and the resulting health issues, using the most recent developments in previously published studies as a foundation. This research was a review of the literature based on a systematic search, selection, synthesis, and analysis of relevant scientific publications and papers already published. After that, they were thoroughly reviewed and summarised based on the findings. There were a total of 11 pieces of content (articles with appropriate topics published after 2010, original, systematic, and those located in Asia and Europe). A new research has shown that the quality of water used in public baths is a crucial indication of health concerns. Various ailments were induced by it, including digestive and respiratory problems, as well as skin, eye, and ear irritations. Water quality was shown to be critical to a number of health issues raised by patrons of public baths. Using systematic literature review and meta-analysis methodologies, future study should give more solid scientific evidence based on the high correlation between factors.

Ahmed et al. (2020), In especially for those living in impoverished nations, climate variability has a significant influence on human health across the world. Sea level rise and changes in rainfall patterns are causing more damage to surface and groundwater resources as well as water-borne diseases. These impacts are only going to become worse as the climate changes. There are new water-borne illnesses emerging that affect the lives of the poor, such as dengue fever or chikungunya. Providing clean water and health care is thus critical in developing nations as a way to counteract the spread of diseases like those mentioned above. Water quality assessments and health care facilities are provided by government, university, and private water bodies, but current tactics for water treatment and management, as well as governance, must be improved. On the basis of a comprehensive analysis, new approaches to combating water-borne and water-related illnesses in developing countries, with a special emphasis on Pakistan, are explored. There is a lot of value in this research for policymakers and scholars working on climate change, water quality and risk assessment in poor nations.

El Baz & Kahime (2019), A changing climate will have an impact on water's biological, physical, and chemical components in numerous ways, increasing the risk of waterborne infections as a consequence of higher heat waves and flooding/drought frequencies and intensities. Climate change is expected to increase the frequency of severe precipitation and temperature events, making it critical to understand the impact weather plays in waterborne illness. This chapter shows that precipitation and temperature may have an impact on water quality, which in turn can have an impact on human health. An interesting association between precipitation and waterborne diseases such as diarrhoea, gastroenteritis, and cryptosporidiosis is also discussed in this chapter. Cholera is also an example of one of these diseases.

Sharma & Kumari (2019), The impact of pollution on the spread of waterborne infections is examined using a non-linear mathematical model. It's done by figuring out the fundamental reproduction number (also known as threshold amount). Disease-free equilibrium and endemic equilibrium are found to exist in the model. When the fundamental reproduction number is less than or equal to one, the disease-free equilibrium is globally asymptotically stable.. Disease continues if the fundamental reproduction number is greater than one; at this point, the endemic equilibrium point is asymptotically stable worldwide. Through the use of a compound matrix, it is possible to derive global stability requirements for the endemic equilibrium. When looking at how pollution affects the spread of waterborne infections, our model's dynamical analysis sheds light on this. This shows that environmental pollution increases the magnitude of epidemics by increasing the diseased population and stress-related

characteristics. Despite the seriousness of the problem, little little has been done. They are certain that our research will fill up this knowledge gap and assist policymakers in their efforts to control waterborne infections that are often lethal in their victims' bodies.

Abuzerr et al. (2019), Most developing nations may learn a lot from Gaza's water quality and waterborne illness outbreaks. There has been a substantial decline in the quality and quantity of Gaza's only water supply, groundwater, during the last few of decades. There are several contributing causes to Gaza's poor water quality, including the proliferation of cesspools, excessive pesticide and fertiliser usage, and inappropriate wastewater treatment and disposal. All of these have contributed to the continuous degradation of Gaza's water supply. For the Gaza Strip water industry, there is little question that the Israeli-Palestinian war has been disastrous. Gaza's water supply systems must implement the WHO's water safety plan from catchment to tap in order to ensure sustainability and quality of water resources and avoid outbreaks of waterborne illnesses. This plan must be implemented immediately. The purpose of this research is to shed light on the overall picture of the water crisis in the Gaza Strip in recent years, as well as to identify the origins, types, levels and health hazards associated with water pollution caused by microorganisms. Political tensions in the Gaza Strip's water sector were also examined. In addition, suggestions were developed to help and guide future researchers, stakeholders, and policymakers in order to prevent further worsening of water pollution and to safeguard public health.

Levy et al. (2018), As a result of worldwide progress made in reducing infectious illness rates in recent decades, climate change poses a hazard. Review of research on climate change's possible influence on waterborne infections arranged around a framework of issues that may be answered based on existing evidence is summarised in this review document.

Yarima & Yarima (2018), The illness burden caused by waterborne diseases is enormous on a worldwide scale. A bacterial organism found in the population of the Islamic University of Uganda (IUIU) has spread waterborne sickness. To find out how often aquatic bacterial infections are in IUIU, researchers looked at data from 2011 to 2014 to gauge the microbiological quality of the water on campus. Review of IUIU Health Centre archival data revealed a high frequency of disorders caused by aquatic germs. Total coliform and feacal coliform indicators were found in 48 of the water samples collected and analysed. Typhoid was found to be the most common waterborne bacterial illness on campus, according to the findings. The water sample's TC and FC mean levels were likewise higher above the WHO's recommended limits. Water samples collected from various water sources had substantially varying TC and FC counts, with p=0.018 for Total Coliform and p=0.010 for Feacal Coliform. According to the results of this investigation, water from IUIU is safe to drink, while water kept for a long time by the student was not.

Hurst (2018), This chapter explains how water treatment prevents the spread of infectious illness across a community. It opens with statistics showing how the introduction of filtration equipment in early twentieth-century American communities led to a decrease in typhoid risk. Salmonella enterica serovar Typhi, the bacterium that causes typhoid, is one of several infectious disorders linked to contaminated water. It's possible that these infections get into people via contaminated water, and then become spread across the community through secondary channels. For the first time, a compartment disease transmission model has been developed to show how treatment technologies may be used to minimise the spread of infectious diseases that can be acquired from drinking water and then spread across the population. An further risk calculation approach is described, which shows how pathogenic bacterial, protozoal, and viral counts in drinking water may properly quantify the chance of community gastrointestinal sickness in human communities.

III. Waterborne Outbreaks

Many gastrointestinal pathogens have been linked to waterborne outbreaks. Others have just recently come to light as possible carriers of illnesses that are spread by contact with water. There are many factors that might raise the danger of waterborne infectious illnesses, including population growth, ageing water treatment facilities, and the presence of more immunocompromised people. As we'll see in a moment, illness endemicity has been linked to drinking water intake, and this helps keep germs alive in the communities where they've been found. However, it should not lead to a decline in therapy effectiveness because of the challenge of balancing microbiological and malignant health concerns. If you don't have access to proper water treatment, your chance of contracting a waterborne infectious illness is much higher.

This book as well as numerous contemporary works on clinical and environmental microbiology provide descriptions of the bacteria that are suspected. There is a lot of data accessible on waterborne infections because of the long-term work of Gunther Craun and other researchers, and the United States has compiled the majority of that data during the last few decades. Lack of resources to detect water-related occurrences and the absence of centralised data collecting official entities are two reasons why data collection is typically subpar in other nations. Waterborne epidemic detection and investigation techniques have been published, but they are seldom applied because of a lack of resources and finances, even in developed nations. It will take a tremendous amount of work to raise awareness about the role water plays in the

spread of illness. Improving water quality is a crucial step in bettering the quality of life and health for everyone in society, from the average consumer to elected officials.

3.1 Preventing Waterborne Illnesses

We need a comprehensive strategy that incorporates policymakers, industrial partners, building managers, public health, and other stakeholders in order to control these pathogens and help avoid future waterborne infections.

- Water system infrastructure upkeep and modernization
- To help state, municipal, and territorial health authorities, more funding for waterborne illness public health efforts will be provided.
    - o Disease surveillance, investigation, notification, and prevention
    - o Recognizing and addressing new problems and risks.
- Incorporation of illness attribution by water type into existing estimates of burden
- Promoting adherence to current policies/regulations and best practises by major building owners/managers (e.g., . healthcare institutions, hotels, recreational water amenities) (for example, the Model Aquatic Health Code [MAHC] and water management programs)
- • Support for public health partner activities to design preventative campaigns and distribute prevention messaging; • Continued research on waterborne illness and development of best practises for waterborne disease prevention
- • Public awareness campaigns on waterborne disease prevention

Safe water supplies and systems are critical to the well-being of our country. Prevention of waterborne illness will depend on sustaining the public health advances gained over the previous century while developing solutions, such as these suggestions, to safeguard people from existing and future dangers.

3.2 Other aspects of microbiological quality

Although the faecal-oral route is the most important means of transmitting water-borne illness over the world, it is not the only one. The following are some important microbiological aspects:

3.3 Opportunistic and other water-associated pathogens

Human health is seldom endangered by opportunistic infections, which are common in the environment and pose little threat to humans. People with compromised local or systemic immune defences are more susceptible. Elderly and young individuals; people who have had major burns; people who are having immunosuppressive treatment; and people who have disorders linked to immunodeficiency are all examples of folks who fall into this category (such as AIDS). Examples of opportunistic pathogens include the bacteria Pseudomonas aeruginosa as well as certain Flavobacterium and Acinetobacter species, as well as Klebsiella and other'slow growing' mycobacteria. It's possible that inhaling water contaminated with infectious organisms can get you sick. Like Legionnaire's disease and Naeglaria fowleri (a parasite that causes malaria) (an occasional cause of primary amoebic meningoencephalitis).

3.4 Cyanobacterial Toxins

Toxins such as hepatotoxins, neurotoxins, and lipopolysaccharides may be produced by certain cyanobacteria (also known as 'blue-green algae'). A few epidemiological studies have been conducted, but the full scope of the issue is still unknown. Blooms of cyanobacteria in drinking water reservoirs pose a health danger, hence impounded surface waters utilised for drinking water supply should be safeguarded against nutrient pollution.

3.5 Nuisance organisms

There are some organisms that aren't harmful to the public health because they cause turbidity, have a bad taste or smell, or are visible to drinkers. The fact that they're there suggests that the water treatment and delivery systems aren't properly maintained. Actinomyces and Cyanobacteria produce tastes and odours, and animals such as the crustacean Gammarus pulex, Nais worms, and chironomid larvae feed on microbial films in water mains.

3.6 Chemical contamination and health

Unless a particular pollution event has occurred, the health impacts of chemical contamination of drinking water are more chronic than acute, and are thus typically seen as less important than microbiological contamination. Nitrate, arsenic, mercury, and fluoride are just a few of the toxic chemicals that may harm your health. Furthermore, a rising number of synthetic organic chemicals are released into the environment, the effects of which on human health are unknown, but many seem to be carcinogenic. The four compounds listed above are discussed in further depth below, however it should be emphasised that exposure to high amounts of any chemical known to have negative effects on human health may result in long-term difficulties. Land-use regulation, the designation of protection zones, and the implementation of proper wastewater treatment are generally recommended for water sources utilised for drinking water supply to prevent chemical contamination.

3.7 Nitrate

Methemoglobinemia, or the "blue-baby" condition, has been related to high levels of nitrate in drinking water. Normal haemoglobin is oxidised to methaemoglobin when

exposed to nitrate, and methaemoglobin cannot carry oxygen to tissues. Sometimes, this causes cyanosis (a severe blue discoloration) and even death.

IV. Conclusion and future work

Human health is strongly influenced by water quality. Put another way, a certain quantity of water must be consumed every day in order to live, therefore having access to water is essential. Whereas about water, the consequences for health and well-being are far broader. Issues like as availability, quality, and quantity play crucial roles in determining individual health and the health of whole communities. The first and most crucial goal is to provide a better water supply for the whole population. However, inadequate quantity, poor quality, and an extravagant price compared to one's capacity and desire to pay may all make it difficult for people to obtain services due to the lack of coverage and consistency. Consequently, addressing all these issues in the context of drinking water is critical for promoting public health. While water quality is an important aspect, it is not the only one that has an impact on people's health. the microbiology of water may make or break public health, whereas water quality has a direct influence on how well people are able to stay healthy. Poor microbiological quality might lead to infectious water-related illness outbreaks, which could cause severe epidemics. Since the effects on health are often chronic and long-term in character, chemical water quality is often regarded less essential.

References

1. Ajmal, U., Jamal, S., Ahmad, W. S., Ali, M. A., & Ali, M. B. (2021). Waterborne diseases vulnerability analysis using fuzzy analytic hierarchy process: a case study of Azamgarh city, India. *Modeling Earth Systems and Environment*, 1-27.
2. Manetu, W. M., & Karanja, A. M. (2021). Waterborne Disease Risk Factors and Intervention Practices: A Review. *Open Access Library Journal*, *8*(5), 1-11.
3. Rachma, U. S., Adriyani, R., Husnina, Z., & Farumi, S. S. (2021). Literature Review: Water Quality of Public Bathing, Potential Health Problems and Water Borne Diseases on Visitors. *JURNAL KESEHATAN LINGKUNGAN*, *13*(2), 102-112.
4. Ahmed, T., Zounemat-Kermani, M., & Scholz, M. (2020). Climate change, water quality and water-related challenges: a review with focus on Pakistan. *International Journal of Environmental Research and Public Health*, *17*(22), 8518.
5. El Baz, S., & Kahime, K. (2019). Waterborne diseases arising from climate change: An overview on the possible link. *Handbook of research on global environmental changes and human health*, 408-431.
6. Sharma, S., & Kumari, N. (2019). Dynamics of a waterborne pathogen model under the influence of environmental pollution. *Applied Mathematics and Computation*, *346*, 219-243.
7. Abuzerr, S., Nasseri, S., Yunesian, M., Yassin, S., Hadi, M., Mahvi, A. H., ... & Darwish, M. (2019). Microbiological quality of drinking water and prevalence of waterborne diseases in the Gaza strip, Palestine: a narrative review. *Journal of Geoscience and Environment Protection*, *7*(04), 122.
8. Levy, K., Smith, S. M., & Carlton, E. J. (2018). Climate change impacts on waterborne diseases: moving toward designing interventions. *Current environmental health reports*, *5*(2), 272-282.
9. Yarima, S. A., & Yarima, U. A. (2018). The Occurrence of Waterborne Bacterial Disease and Water Quality in Higher Institution of Learning.
10. Hurst, C. J. (2018). Understanding and estimating the risk of waterborne infectious disease associated with drinking water. In *The connections between ecology and infectious disease* (pp. 59-114). Springer, Cham.