

Climate and Health: Insights from Healthcare Providers on Vector-Borne Diseases

“Final Report of Summative Learning Project (SLP) presented to the BRAC James P Grant School of Public Health, BRAC University.”

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Abstract:

Objective: To assess the knowledge, attitudes, and perceptions of healthcare providers in Dhaka, Bangladesh, about climate change-induced vector-borne diseases (VBDs) and evaluate their preparedness, training gaps, challenges, and adaptation strategies.

Methodology: A qualitative study, including in-depth interviews with healthcare providers, explored their experiences and perspectives on climate change and VBDs. The study took place in urban and peri-urban health facilities, including Shaheed Suhrawardy Medical College Hospital and Keraniganj Upazila Health Center, Dhaka. The study involved Eighteen healthcare providers, comprising six doctors, ten nurses, and two ward boys actively engaged in managing and controlling VBDs.

Findings: Healthcare providers had different levels of understanding about how climate change affects health, shaped by the nature of their work. Doctors emphasized biological factors such as viral mutations, while nurses focused on environmental conditions and public awareness. Key challenges included limited training on climate-sensitive health threats, resource constraints, and gaps in systemic preparedness. Despite these limitations, healthcare providers demonstrated resilience through practical disease management strategies and personal preventive measures.

Conclusion: The study highlights the critical need for targeted training, resource allocations, and policy-driven capacity-building initiatives to address climate-sensitive health threats in public healthcare facilities. Insights from this research provide a foundation for developing climate-adaptive health systems in Bangladesh, emphasizing the importance of systemic preparedness and public health awareness in managing the impacts of climate-induced VBDs.

Keywords:

Climate Change, Vector-borne diseases (VBDs), Dengue, Healthcare Providers, Knowledge, Perceptions, Attitudes, Disease Management, Urban & Peri-Urban Health Systems.

1. Introduction:

Climate change refers to long-term alterations in temperature and weather patterns. In recent years, a clear trend of rising temperatures has emerged, signaling an ongoing warming of the global climate (Siddique et al., 2007). With ongoing climate change, rising global surface temperatures and shifting rainfall patterns alter environmental conditions, affecting mosquitos' survival and growth and potentially influencing vector-borne disease (Siddique et al., 2007). Vector-borne diseases such as dengue, malaria, zika, yellow fever, and chikungunya represent a significant public health burden globally, with incidence rates rising in tropical and urban areas. These diseases are primarily transmitted by mosquito species such as *Aedes aegypti*, *Aedes albopictus*, and *Anopheles* mosquitoes which are sensitive to changes in humidity, unpredictable rainfall patterns, and temperature (WHO, 2022; Githeko et al., 2014). Furthermore, climate change affects the life cycles and habitats of numerous organisms, influencing their ability to survive and adapt. Changes in seasons have been linked to the spread of mosquito habitats that create favorable conditions for mosquito breeding and transmission in South Asia and other regions (Morin et al., 2013; Naish et al., 2014; Mahmud, Raza, & Hossain, 2021).

Among all the known arboviruses, dengue is a viral disease transmitted by mosquitoes that has rapidly expanded across various regions and is also known to be the deadliest because of the high mortality rate around the world (Saba et al., 2021). Nearly half of the global population is at risk, as reported by the World Health Organization (WHO), of vector-borne diseases like dengue have become a significant concern due to climate change. Each year, 390 million dengue infections are recorded, with WHO noting an over eightfold increase in cases over the past two decades (WHO, 2022). Currently, 129 countries report dengue cases, and of the 3.5 billion people living in dengue-endemic regions and at risk, 10 countries in the Southeast Asia region- including Bangladesh- account for 1.3 billion people at risk (WHO, 2022). Bangladesh has faced recurring outbreaks in recent years, highlighting the urgent need to address this disease in the subtropical region. As of August 27, 2023, a total of 119,133 cases and 569 deaths have been reported across all 64 districts in the country. Dhaka, among Bangladesh's major cities, is considered the highest-risk area for dengue, according to the director general of health services.

Similarly, malaria another fatal vector-borne disease has been reported to cause more than 445,000 mortalities every year (Saba et al., 2021). Malaria transmission has expanded to peri-urban settings, partly due to climate change like increased rainfall which creates stagnant water and urban expansion that leads to optimal breeding sites for mosquitoes. Urban expansion and changes in the land in previously rural areas also increase contact between the human population and mosquito vectors (Jibon et al., 2024).

Chikungunya, which is newer to Bangladesh, has also seen outbreaks in urban areas of Dhaka and was also linked to climate patterns that encourage mosquitoes' habitat. High temperatures and substantial rainfall create favorable conditions for mosquitoes, accelerating both viral amplification and mosquito abundance (Mordecai et al., 2019).

Over the past three months, Dhaka has recorded eight new cases of Zika virus, signaling an alarming trend as per the Institute of Epidemiology, Disease Control and Research (IEDCR), confirming these developments, noting that this follows five cases reported last year (Dhaka Tribune, 2024). Zika virus, first detected in Bangladesh in 2014, poses significant public health challenges. Yellow fever has not been reported in Bangladesh.

In Dhaka, as we know, the city has densely populated areas, and urban challenges such as poor drainage systems which are favorable conditions for mosquito breeding (Faruk et al., 2021). Urban settings of healthcare facilities like Dhaka play a vital role in vector-borne prevention and control. As the studies suggest that health systems worldwide recognize the impact of climate change on infectious diseases, their preparedness for climate-sensitive health threats remains limited (WHO, 2015; Ebi & Hess, 2017). The ability to adapt strategies with limited resources and capacity constraints further challenges health facilities in line with changing climate conditions (Saha et al., 2020).

As per the studies, the link between climate and disease transmission is more proactive in modifying their approach to vector-borne prevention to highlight the healthcare providers (Githeko et al., 2012; Jeeten & Focks., 2019). Understanding the risk posed by changing climate patterns is essential to identifying and addressing the knowledge gaps among healthcare providers about how

climate impacts the transmission and management of vector-borne diseases According to Hathaway and Maibach (2018), many healthcare providers acknowledge having a lack of knowledge or limited understanding of the link between climate change and shifts of disease patterns. This gap highlights the pressing need for targeted capacity-building initiatives to equip them with the necessary skills and understanding. While the effects of climate change on infectious disease patterns are well documented, limited research on how urban and peri-urban health systems practically respond to the challenges. The impact of climate change on infectious disease patterns, very few studies focus on the practical responses of urban health systems in adapting to these changes (Matthew, Chiotha, Orbinski, & Talukder, 2021). Most studies have focused on public health awareness campaigns and vector control intervention but few studies examined the healthcare systems readiness or the knowledge, attitudes, and perception of healthcare providers regarding climate-induced health threats (Polivka, Chaudry, & Crawford, 2012 & Kircher et al., 2021).

In conclusion, there are very few studies (Vandenberg et al., 2023) to find the linkage between climate change-induced vector-borne diseases, particularly in the context of healthcare providers' knowledge, attitude, and perception. This study aimed to assess the awareness levels among healthcare providers in urban health facilities of Dhaka, focusing on their preparedness and prevention strategies for managing vector-borne diseases (Kircher et al., 2021). This study explored how well these facilities are equipped to respond to climate-induced challenges. Health facilities can significantly contribute to resilience against climate-related health impacts, particularly for vector-borne diseases like dengue, malaria, Chikungunya, etc.

Findings from this study are expected to contribute to the development of effective interventions for training and supporting healthcare providers and also insight for policymakers and healthcare leaders to enhance the health system in response to climate change. Specifically, It will investigate both structural and knowledge-based readiness of healthcare providers, their perceptions concerning climate-driven dengue transmission, and the effectiveness of current adaptation strategies within health facilities. These insights are critical for developing a resilient urban health system in Dhaka.

2. Research question:

General Question: How do healthcare providers manage climate-driven vector-borne diseases in Dhaka?

Specific objective:

1. To assess healthcare providers' knowledge, attitudes, and perceptions about the effects of climate change on vector-borne diseases.
2. To identify the barriers faced by healthcare providers in implementing preventive and treatment measures for vector-borne diseases.
3. To explore the gaps in resources, training, or information that limit healthcare providers' ability to manage climate-driven vector-borne diseases effectively.

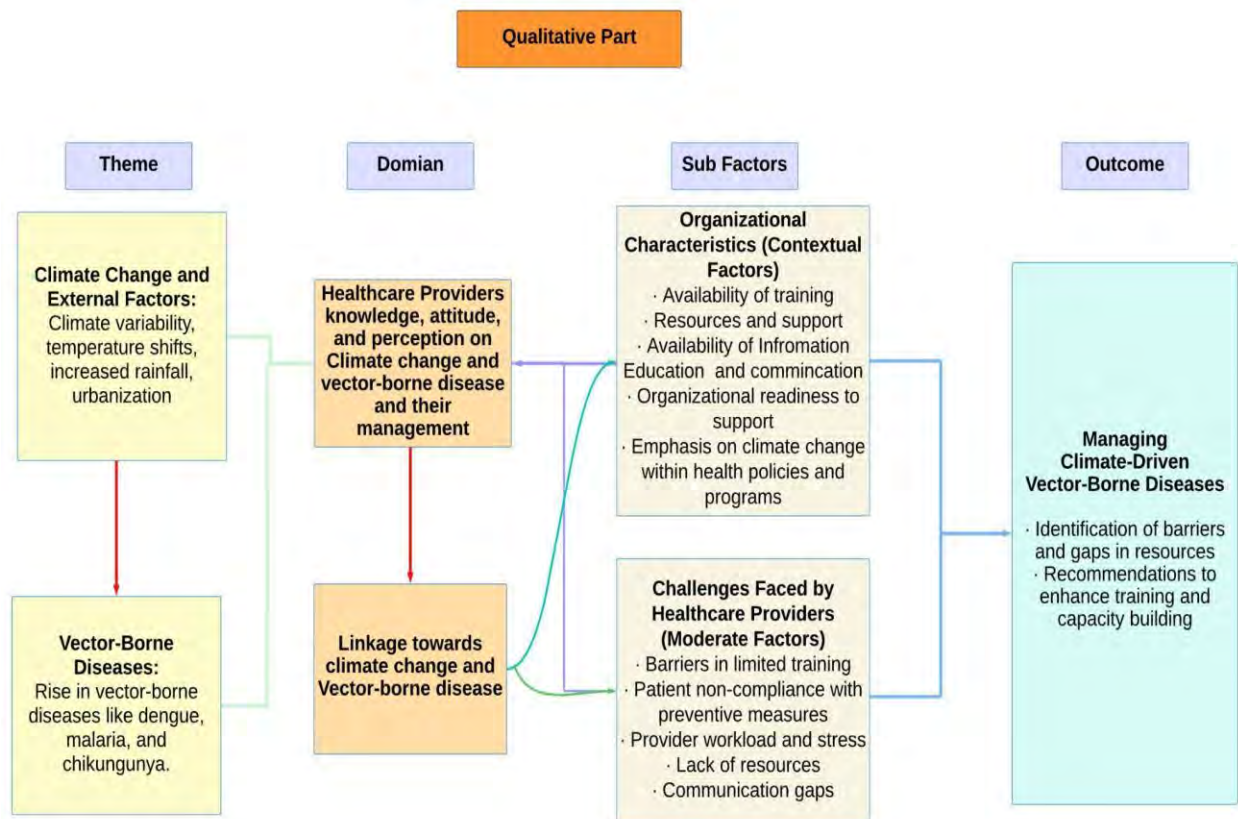
3. Conceptual Framework:

This study was guided by the Consolidated Framework for Implementation Research (CFIR), which helps to evaluate the factors influencing healthcare providers' ability to manage climate-induced vector-borne diseases. It emphasizes the role of climate change and external factors, such as temperature changes, rainfall patterns, and urbanization, which contribute to the increasing prevalence of VBDs like dengue, malaria, chikungunya, and Zika virus. The framework focuses on two main domains: healthcare providers' knowledge, attitude, and perception as well as the linkage between climate change and VBDs. The first domain highlights how healthcare workers understand and manage the relationship between climate change and the rise in VBDs. It underscores the need for healthcare systems to address the growing burden of these diseases in the face of climate change.

In terms of sub-factors, the framework identifies organizational characteristics, such as the availability of training, resources and support, information, education, and communications (IEC), organizational readiness, and the emphasis on climate change in policies. These contextual factors directly affect healthcare providers' ability to respond effectively to climate-driven health challenges. Additionally, it addresses moderate factors like barriers in training, patient non-compliance, healthcare provider workload and stress, lack of resources, and communication gaps, which hinder the management of VBDs.

The outcome of this framework is the identification of barriers and gaps that healthcare providers face when managing climate-driven VBDs. It calls for recommendations on strengthening healthcare systems, particularly through enhanced training programs, capacity building, and better resource allocations. By linking environmental factors, healthcare systems, and organizational readiness, this framework offers actionable strategies for improving the management of vector-borne diseases in the context of climate change.

Figure 1: Conceptual framework based on CFIR (Consolidated Framework Implementation Research)



4. Methodology:

Study design: This study employed a Qualitative approach data collection was conducted through face-to-face in-depth interviews between 21st Nov 2024 to 12th Dec 2024. This approach was chosen to comprehensively explore their experiences and perspectives openly.

4.1. Study Population:

The study targeted healthcare providers working in urban and peri-urban hospitals and medical colleges in Dhaka. These participants, including doctors, nurses, and ward boys were directly involved in managing and controlling vector-borne diseases.

Each participant's role was analyzed in the context of their contribution to vector-borne disease management.

- **Doctors:** Primarily responsible for diagnosing and treating patients, prescribing preventive measures, educating patients and peers about health risks, and also taking part in controlling disease outbreaks.
- **Nurses:** Focused on patient care and disease prevention, including educating patients on preventive practices such as the use of mosquito nets and maintaining clean environments. Nurses also play a vital role in early detection and reporting.
- **Ward Boys:** Responsible for maintaining hygiene in healthcare facilities, assisting in patient care, and supporting overall cleanliness to minimize mosquito breeding grounds.

4.2. Inclusion criteria:

Healthcare workers, including doctors, nurses, and ward boys, were actively involved in vector-borne disease prevention and control programs inwards.

4.3. Study site

The research was conducted in urban and peri-urban health facilities including Shaheed Suhrawardy Medical College Hospital and Keraniganj Upazila Health Center which serve targeted populations.

4.4. Study sampling and Sample size

This study followed a purposive sampling to identify healthcare professionals with relevant experience in managing vector-borne diseases. This method ensured the selection of individuals who could provide detailed and diverse perspectives on the research topic. A total of 18 participants were included, with the sample size determined by data saturation. Semi-structured interviews were conducted using a guideline to ensure comprehensive coverage of the research objectives while allowing flexibility for participants to elaborate on their responses. The participants were categorized into their professional roles in the healthcare system:

4.5. Study tool

A semi-structured guideline was developed and used to facilitate in-depth discussion with healthcare providers to explore knowledge, attitudes, and perceptions of climate-related to vector-borne risks, adaptation practices, seasonal climate change patterns, barriers, and challenges.

4.6. Data Collection Process

Interviews were conducted in the local language (Bangla) to ensure ease of communication and richness of responses. The average interview lasted approximately 20-30 minutes and was audio-recorded with prior consent. Based on semi-structured guidelines and observational checklists were also taken during the interviews to capture the environment, and cleanliness, and maintain the rules and regulations of guidelines with details relevant to the study. .

Semi-structured interview design was chosen to facilitate an in-depth exploration of a healthcare provider's perspective across six primary themes: Knowledge, attitudes, perceptions, barriers, training status, and recommendations. Each theme was further divided into subthemes, with the knowledge theme comprising five sub-themes, attitude and perceptions containing two sub-themes each, and barriers encompassing five subthemes. Additionally, training status and

recommendations were each divided into three subthemes. This comprehensive framework underscored the rationale for selecting in-depth interviews as the preferred method.

In-depth interviews were chosen as the primary data collection method due to their ability to provide rich, detailed data that captures flexibility to explore the topic, the detailed perspectives by making personal connections and experiences of healthcare workers regarding climate change-induced vector-borne diseases (Delve et al., 2024 & Brinkmann & Kvale, 2018). IDIs enable open-ended questioning, making it possible to capture important viewpoints while addressing underlying attitudes and knowledge gaps.

This design provided a snapshot of the healthcare providers' awareness and preparedness at a single point in time, making it possible to assess prevailing attitudes and identify knowledge gaps effectively. This approach not only facilitated a deeper understanding of the challenges faced by healthcare providers in urban and peri-urban health systems but also highlighted potential strategies for enhancing their capacity to address the growing threats of healthcare providers regarding climate change-induced vector-borne disease.

4.7. Data Analysis

For this research, we use the transcript to analyze using a thematic analysis approach, often performed with qualitative analysis with Dedoose software. To identify the key themes and sub-themes patterns related to healthcare providers' adaptability of dengue prevention efforts in response to climate change.

5. Ethical considerations

5.1. IRB Approval

This research protocol was submitted to the institutional review board (IRB) at BRAC James P Grant of Public Health (JPGSPH) and received approval (IRB Approval Number: MPH-2024-004). Ethical reviews were also sought from relevant institutions, such as Bangabandhu Sheikh

Mujib Medical University (BSMMU) and Dhaka University, which may also be involved in the ethical review process, which could extend the timeline for approval.

5.2. Informed Consent

All participants were fully informed about the study's purpose, procedures, potential risks, and benefits. Informed written consent was taken from all participants prior to their involvement in the study.

5.3. Data Confidentiality and Privacy

To ensure confidentiality, all collected data were anonymized. With access limited to the research team participants' data were securely stored. This collected data was used solely for the purpose of the study.

6. Findings

Climate change has emerged as a critical factor influencing the dynamics of vector-borne diseases. Healthcare providers, positioned at the forefront of disease prevention and management, hold vital insight into how climate change affects disease epidemiology. This qualitative analysis explores the awareness, perceptions, and responses of the healthcare providers (Doctors, Nurses, and Ward Boys) in Dhaka concerning climate change and its effects on the health system, focusing specifically on climate-induced vector-borne diseases. Thematic coding revealed distinct patterns across these roles, highlighting variations in knowledge, attitudes, and perceptions with the barriers, training updates, or access to update the knowledge and recommendations.

Table 1: Details of the Socio-demographic of Participants

Background Information	
Characteristics	n (%)
Sex	
Male	7 (38.9)

Female	11 (61.1)
Types of Participants	
Doctors	6 (33.3)
Nursing Supervisor	2 (11.1)
Nurses	8 (44.5)
Ward Boys	2 (11.1)
Ages of Participants	
<30	6 (33.3)
30-<40	9 (50)
40+	3 (16.7)
Name of facility	
Shaheed Suhrawardy Medical College Hospital	13 (72.2)
Keranijang Upazila Health Complex	5 (27.8)
Year of experience	
<5	5 (27.8)
5-<10	8 (44.4)
10+	5 (27.8)

The table presents a detailed breakdown of the study participants. Among the 18 participants, 7 (38.9%) were male, and 11(61.1%) were female. In terms of professional roles, 6 (33.3%) were doctors, 2 (11.1%) were nursing supervisors, 8 (44.5%) were nurses, and 2 (11.1%) were ward boys. Regarding age, 6 participants (33.3%) were under 30 years old, 9 (/50%) were 30-39 years old and 3 (16.7%) were 40 years older. The majority of the participants (13 or 72.2%) worked at Shaheed Suhrawardy Medical College Hospital, while 5 (27.8%) were based at keranijang Upazila Health Complex. Lastly, participants' years of professional experience varied from 5 (27.8%) had

less than 5 years of experience, 8 (44.4%) had between 5 and 10 years of experience, and 5 (/27.8%) had more than 10 years of experience.

6.1. Knowledge about the climate change and vector-borne diseases

From the data, it is evident that healthcare providers have a general understanding of climate change and vector-borne diseases. How they link climate change influence the vector-borne diseases in Dhaka, Bangladesh.

6.1.1. Awareness of climate change:

The participants demonstrated a foundational understanding of the relationship between climate change and VBDs. Many highlighted the observable shifts in seasonal patterns and the occurrence of extreme weather events.

This change in seasonal regularity, according to *“We can see the extremeness of changes, for example- in summer extreme temperature can be observed and because of that heat stroke is increasing but in winter there were fewer changes previously but now temperature becomes very low [P11_SSMC_DOC_A25_E3].”* This statement recognizes that changing seasonal patterns and intensifying weather extremes reflect a growing awareness of how climate change disrupts natural cycles and influences health outcomes.

Participants also emphasized the changing nature of Bangladesh’s traditional six-season cycle, observing that seasonal diversity is diminishing, with prolonged periods of heat and shorter winters. *“Bangladesh is a country of six seasons. The weather naturally changes a lot when going from one season to another. For example, now the summer's over and winter is coming. At the beginning of a season, it is hot and at the end, it is cold. In between, the weather changes [P7_KUHC_NUR_A30_E8].”*

“Climate change actually refers to the changes in our weather. For example, there are more storms during the rainy season, and cold and hot weather begins with the onset of winter. The changes in our environment that occur due to these are called climate change [P14_SSMC_NUR_A31_E6].” This reflects an awareness of how environmental change affects seasonal variability, which can influence disease patterns.

These reflections collectively underscore a deep awareness of how climate changes nowadays, with participants highlighting the lived experiences of individuals.

6.1.2. Knowledge of disease patterns:

Participants demonstrated an understanding of the relationship between environmental changes and the transmission patterns of vector-borne diseases. They linked dengue transmission directly to environmental factors, emphasizing the role of water accumulation as breeding grounds for mosquitoes.

“Due to climate change, there are extreme heatwaves and heavy rainfall in the environment. When there is excessive rainfall, water accumulates, and if it is not properly cleaned, mosquitoes breed in large numbers [P17_SSMC_DOC_A29_E5].” This ties climate change to increased vector populations, thus emphasizing its indirect role in disease transmission.

Acknowledge the challenge in identifying specific groups at risk, starting with, *“The main thing about dengue is. It is very difficult to determine which people are more vulnerable. Those who are closely associated with mosquitoes, regardless of their socio-economic status, age from children to adults, or whether they are children or elderly, are at risk. No one is safe from dengue infection if they cannot protect themselves from mosquito bites. Therefore, anyone who comes into contact with mosquitoes can be infected [P16_SSMC_DOC_A27_E8].”* This highlights the nature of the risk posed by vector-borne diseases, indicating that transmission is not confined to their Socioeconomic status.

However, the changing seasonality due to climate change was noted by participants *“Usually we receive most of the patients during September-October. But last year we received patients before that time. This year, we have received patients from September, and last year we received patients from June-July. Likewise, each year we receive patients at different times due to climate change or extreme heat, we cannot understand that (Ashole upor walai to aiguli dei, gorom beshi sheet beshi aigulo to amra beshi bujhte pari na) [P2_SSMC_NUR_A59_E34].”*

“Everyone is having dengue. Even doctors and nurses from here get dengue while treating dengue. Dengue is not leaving anyone {kaukei charche na} [P8_KUHC_WB_A57_E1].”

These reflections illustrate how participants perceive dengue as an omnipresent threat exacerbated by environmental changes, with wide-reaching implications for both the general population and healthcare providers.

6.1.3. Knowledge of transmission:

Participants demonstrated a clear understanding of the factors contributing to mosquito breeding and the transmission of vector-borne diseases like dengue. A recurring theme in their responses was the interplay between natural and human-made factors.

“The mosquito increases when it rains untimely. At that time, mosquitoes breed in stagnant water. Man-made causes are mainly responsible for climate change regarding this issue. But climate change has a huge impact on other vector-borne diseases rather than dengue [P12_SSMC_DOC_A27_E2].”

“When water accumulates in one place, it stays there for a long time until the sun dries it up. Before it dries, mosquitoes lay their eggs in the water, and they continue to breed [P5_SSMC_NUR_A43_E20].” This statement reflects that human behaviour and environmental management play a critical role in mosquito breeding and the spread of mosquito-borne diseases.

“Dhaka city has several places with lakes, and if these lakes and drains are not cleaned regularly, it can lead to problems. For example, yesterday, while passing by a hospital (I won't mention its name), I noticed a large drain in front of it. The drain was filled with dirty water, possibly from the past week or two, and I could see mosquito larvae there [P6_KUHC_NUR_A38_E12].” Participants noted the role of improper waste disposal in exacerbating mosquito proliferation.

These reflections underscore participants' good understanding of mosquito breeding and transmission dynamics, blending environmental observations with critiques of urban management and human behavior.

6.1.4. Knowledge of Symptoms:

Participants highlighted the dynamic and evolving nature of dengue symptoms, emphasizing the challenges in diagnosis due to shifting disease characteristics.

Participants explained the role of environmental changes in rainfall patterns and influencing disease patterns and symptoms were also noted. *“In the past, the rainy season lasted for about two months, and it poured continuously. During that time, water didn't accumulate in one place, which prevented mosquitoes, especially dengue mosquitoes, from breeding. But now, when water accumulates in one place, it stays there for a long time until the sun dries it up. Before it dries, mosquitoes lay their eggs in the water, and they continue to breed [P5_SSMC_NUR_A43_E20].”*

The same participant elaborates on the role of geography and infrastructure, stating: *“Those areas are usually low-lying land and overpopulated. The areas are not cleaned and water is clogged here and there. Drainage is also not cleaned which can be a reason. Upper-level land areas do not have this problem [P5_SSMC_NUR_A43_E20].”*

These reflections point to multifaceted understanding of dengue symptoms and transmission, integrating clinical observations with environmental and infrastructural factors. They highlight the need for a holistic approach to disease management that considers both evolving clinical presentations and the environmental context in which diseases thrive.

6.1.5. Link between climate change and disease incidence:

The responses from participants reveal a primary understanding of the connection between climate change and the incidence of diseases, particularly vector-borne illnesses like dengue and other health issues with changing environmental conditions.

Participants also highlight changes over time, stating, showing awareness of the link between rising temperatures and health outcomes. *“Due to climate change, it is seen that people are suffering from more cold-related diseases. For example, children are getting more pneumonia, and diarrhea is also becoming more common [P6_KUHC_NUR_A38_E12].”*

Participants also connect these climatic changes to increased dengue cases saying *“Climate change has an effect on an area not only an area on the whole earth. Bangladesh is situated in a place we call a “temperate country”. This is basically a delta. Recently we have been very worried about global warming because it definitely has an effect on Bangladesh’s climate change. Now-a-days we can observe extreme heat, it is too cold during winter and too hot during summer. This year we have a big flood incident that might happen due to the effect of climate change. So, taking all*

of them into consideration we are heading to more extreme weather. And it has an effect on health. We are getting excessive heat stroke patients. During winter due to the cold, people come with different types of cold related diseases [P1_SSMC_DOC_A34_E3].” This comment highlights that while climate change contributes to the situation, local factors like endemicity and public awareness plays significant roles.

“In summer, we see more diarrhea in children. And in winter, pneumonia is more common. Pneumonia, fever, shortness of breath, colds, allergies - children come to us with these types of illnesses more often [P9_KUHC_NUR_A29_E8].” This observation emphasizes the changing prevalence of diseases as weather patterns shift, particularly respiratory illnesses like pneumonia in colder months.

These reflections capture the primary understanding participants have of the interplay between climate change and health, emphasizing the need for adaptive health systems that can respond to these evolving challenges.

6.2: Perception to addressing climate change and vector-borne diseases:

6.2.1: Addressing climate change impacts:

Participants emphasize the growing impact of climate change on the rising burden of vector-borne diseases like dengue, especially in Bangladesh. They highlighted the importance of both individual and community-level preventive measures to combat these challenges.

“At the hospital, we have a good system in place that we provide mosquito nets to dengue-positive patients, which reduces the chances of dengue transmission. Personally, I use a mosquito net when I sleep and make sure to take care of places where water can accumulate, as this helps prevent the breeding of dengue mosquitoes [P17_SSMC_DOC_A29_E5].” Individual efforts to maintain cleanliness and adopt preventive measures were seen as crucial.

The perception of negligence and lack of awareness, particularly among younger individuals, emerged as a recurring theme. *“Our young generation is a little careless, that a mosquito bite won't hurt us. There could be some things like that. For example, the young generation thinks that*

we don't have to sleep with a mosquito net, that one or two mosquito bites won't hurt anything. Some of this negligence might be causing this [P14_SSMC_NUR_A31_E6].”

“Since I am a Hindu, I worship Thakur. You may not know that we have to perform these pujas with lamps and incense. This is our religious ritual. But the smoke of incense is also very useful for repelling mosquitoes. I put the smoke of incense under the bed or in other places where mosquitoes can be [P14_SSMC_NUR_A31_E6].” These narratives indicate a reliance on both practical and culturally influenced practices for protection.

Participants expressed a deep concern about maintaining cleanliness and controlling environment factors to prevent the breeding of mosquitoes. *“We want the environment to be clean. The brushwood should be cleaned. Mosquito repellent should be sprayed at least once in a week. Then might me Allah keep us safe {Tahole jodi Allah amader ke valo rakhe} [P8_KUHC_WB_A57_E1].”*

These findings underscore a shared among the participants that addressing vector-borne diseases in the context of climate change requires a multifaceted approach. Individual efforts, community awareness, and systemic interventions like government-led spraying programs and hospital practices were all identified as essential in mitigating the impact of climate change on public health.

6.2.2: Awareness of the prevention strategies and initiatives:

The participants' narrative analysis provided a multifaceted understanding of the challenges and strategies in addressing dengue and other vector-borne diseases. Participants expressed concern over gaps in preventive practices, such as the inadequate use of mosquito nets and repellents, compounded by ineffective implementation of environmental mosquito control programs.

“The patient came to us complaining of breathlessness. Upon initial assessment, we determined it was a case of dengue. We provided intensive care, taking opinion from all relevant specialists and considering the overall situation. The patient was treated in the ward and discharged in a healthy

condition. Additionally, I would like to inform you about a common symptom of dengue: body aches. These body aches can persist for one, two, or even three months, but they are generally not a cause for concern. If the pain is acute, it is advisable to visit a doctor [P17_SSMC_DOC_A29_E5].” This highlights a proactive stance towards improving patients’ outcomes while recognizing areas for further exploration.

“Once upon a time, food saline was made for diarrhea, and on TV, of course, they show things like sleeping with a mosquito net, or not letting water collect in the tub. If this is continuously promoted, not just promoted, but if people are counseled well, then people will try it [P7_KUHC_NUR_A30_E8].” This highlights the perception that consistent and well-structured counselling can address behavioural gaps in preventive measures.

“Usually do not spread from one person to another {dengue mosha to aivabe akjon theke ar akjone choranor kichu nai, oita to akjoner theke ar akjoner hoi na}. We are mainly focused on cleanliness. We use spray, aerosol. We always try to keep it neat and clean so that Aedes’s mosquito cannot breed. We do not allow people to bring coconut water with coconut shells. We suggest they bring that in a bottle. Any kind of garbage is restricted in the ward [P2_SSMC_NUR_A59_E34].”

Together, these insights reflect a dual focus among participants: improving individual patients’ outcomes through clinical care and addressing systemic and behavioural gaps through targeted prevention campaigns. This balance of individual and community-level strategies is vital for sustainable management of dengue and other vector-borne diseases.

6.3. Attitudes to address climate change and vector-borne diseases:

6.3.1: Climate-driven health challenges:

The Attitudes of the participants regarding climate-driven health challenges reveals diverse perceptions and responses to the increasing burden of vector-borne diseases like dengue. Through their insight, it is evident that the participants acknowledge the growing complexity of these diseases, linked to environmental and behavioural factors.

Participants linked the unusual increase in dengue cases to both viral mutation and climate change, mentioning *“We are still receiving many dengue patients, which was not the case before. This could be due to several reasons. One possibility is viral mutation, as it is a viral disease. Another reason could be climate change. There have been heavy rains at the end of the year, which is unusual for this time. So, the climate is also playing a role in this situation [P12_SSMC_DOC_A27_E2].”* This statement reflects a scientifically grounded attitude that integrates knowledge of virology with environment changes. The participants' acknowledgment of heavy, unseasonal rains points to an awareness of how climate patterns directly impact disease vectors and their proliferation.

“Nowadays, dengue test results are positive for 70 out of 100 people, while the remaining 30 people have negative results, which is a very high rate. However, if people visit a doctor at least once and get some advice, they can stay out of risk. Still, it is difficult to predict when someone's condition will worsen, but they will be under a monitoring system [P17_SSMC_DOC_A29_E5].” This statement highlights to convey concern over the high prevalence of dengue and the need for timely medical consultation with a preventive attitude, encouraging early detection and continuous monitoring to manage health risks.

6.3.2: Addressing the issue by healthcare providers:

The Attitudes of healthcare providers, including doctors, nurses, and hospital staff, towards the management of dengue and vector-borne diseases reveals a blend of preparedness, concern and strong commitment to patient care. *“Obviously arrange a separate ward for these patients because these large numbers of patients need different observations and follow up. As it occurs as an epidemic, it is necessary to open a separate ward to accommodate many patients at a time. Moreover, to provide urgent treatment for the patients it is necessary to open a separate ward, emergency support. Also, hospitals arrange all the emergency medicines. Follow up, tests are carried out and doctors come for the ward's round on a regular basis. People who come with shock, they need extra care, observation and we arrange that for them. If they need ICU support, we refer them to [P11-SSMC_DOC_A25_E3].”* This statement emphasis on immediate,

specialized care reflects a strong commitment to patients' well-being, even in the face of overwhelming demand.

“Monitoring dengue patients is very important because their condition can change rapidly. This includes changes in platelet count, the possibility of the condition worsening, the risk of shock, blood pressure can fall or the appearance of other complications. Therefore, constant monitoring is crucial in dengue. That is the difference between a dengue patient and another patient [P12_SSMC_DOC_A27_E2].” This statement reveals a focus on structured and efficient care delivery amidst the growing disease burden.

“At beginning there was no separate dengue ward in our hospital. But now we have dengue ward, male and female. We have a special mosquito net facility. Though we cannot provide it to everyone properly, we have this kind of arrangement [P13_SSMC_DOC_A31_E10].” This statement demonstrated an optimistic attitude towards noting that the hospitals had taken significant steps in preparing for dengue outbreaks.

6. 4: Barriers address by healthcare providers in managing vector-borne diseases:

This issue emphasizes the difficulty of ensuring consistent team collaboration during peak times, especially when resources are stretched thin. The shortage of manpower during critical hours, such as evenings shifts can exacerbate the challenges in managing diseases like dengue, which are heavily influenced by climate conditions. Optimizing manpower availability and shift management is crucial for improving team effectiveness in the context of climate change-induced vector-borne diseases.

“We have adequate man-power but it is not possible to always use that manpower. To manage some critical patients in some cases we had faced shortage of manpower mainly during the evening shift [P1_SSMC_DOC_A34_E3].”

“Fluid management plays a big role in dengue disease management. Earlier, we used to have problems like we didn't have enough fluids, we didn't have kits [P9_KUHC_NUR_A29_E8].” This statement highlights an evolving attitude shaped by better resources.

“Many times, the patient parties do not follow the proper directions. For example, as long as the patient has fever, the mosquito net has to be pulled up. If the patient is bitten by a mosquito and that mosquito bites another person, then the healthy person can also get sick. But when the patient's fever decreases, then this possibility is less. We tell all the patients that they have to stay inside the mosquito net for 24 hours for as long as the fever lasts. But the patients usually do not listen to these words [P14_SSMC_NUR_A31_E6]. These statements reflect the barriers in effective teamwork and collaboration, highlighting issues ranging from patient non-compliance to challenges in resource management and communication.

These statements emphasize the multifaceted challenges in dengue management, ranging from manpower shortages and resources constraints to communication and compliance barriers. Addressing these issues requires a coordinated approach that prioritizes efficient teamwork, equitable resource allocation, and robust patient education strategies to improve outcome in the context of climate change induced vector-borne diseases.

6. 5: Capacity Building: Training to address climate and VBDs

Participants highlight the critical gaps in training and knowledge as even experienced staff struggle to save patients due to a lack of awareness or updated information on managing complex cases.

“About climate change, healthcare service related, for example, we attend conferences based on flood and overall, regarding climate change we hardly receive any. Of course, it is necessary. It is needed because of well awareness and we can also better relate what we can do from our side [P12_SSMC_DOC_A27_E2].” This statement emphasized the absence of the opportunities to deepen their understanding of climate change.

We have nothing directly related to climate change. When a disease becomes an outbreak, we receive training on it, or professors arrange sessions for it. I never attend any climate change related training or session but I do not know correctly whether others have received any or not

[P16_SSMC_DOC_A27_E8].” These statements reflect the absence of opportunities to deepen their understanding of climate change’s impact on health.

Maybe there are meetings or training. But I didn’t have any. Since this is a medical college hospital, it is definitely done in different units. Without training, something cannot be done in a hurry [P15_SSMC_NUR_A43_E20].”

These selected quotes illustrate the critical gaps in both knowledge and access to training particularly regarding the management of climate change-induced vector-borne diseases. The responses emphasize a widespread need for continuous, updated, and structured training, not just in clinical management but also in the broader context of climate change’s impact on health. This lack of training and inconsistent access to resources contribute to the challenges healthcare workers face in effectively managing these diseases.

6. 6. Recommendation addressing the climate Change and vector-borne diseases:

The following quotes from the participants provides the best suggestion and recommendations are:

“Since dengue has become an epidemic in the country, it would be better if training, conferences, or seminars related to dengue management guidelines were held more frequently [P11-SSMC_DOC_A25_E3].”

“They should be aware of keeping their surroundings clean, check their refrigerator, flower pots, and other places where water is accumulating inside their home, and keep them clean. Also, if the children go outside, use anti-mosquito sprays to prevent mosquitoes from biting them [P3_SSMC_NUR_A34_E12].”

“Even we can expect more from researchers if it is possible to prepare a vaccine for dengue. If that is possible it will be a blessing for Bangladesh [P1_SSMC_DOC_A34_E3].”

“We need a lot of things in the hospital. We need more nurses, more doctors, we need more medical equipment, we need separate wards, we need more ward boys, more cleaners. We suffer for these lacking [P10_KUHC_NUR_A39_E8].”

“If increasing the number of nurses is not possible, at least hire a counselor. The counselor could handle the counseling sessions, and that would solve the problem [P5_SSMC_NUR_A43_E20].”

These quotes provide a comprehensive approach to addressing the challenge posed by climate change-induced vector-borne diseases, focusing on prevention, research, resources management and emotional support.

6.7. Observational Analysis:

During the data collection, an observational checklist was used to assess various aspects of the interview environment and the dynamics of the interview. First, since the interviews were conducted on working days, both the healthcare providers and the facility were quite busy. Most interviews took place in common areas, such as wards, doctor’s rooms, and nurse’s rooms, which were crowded, noisy, and large.

Secondly, the way the interviews went differed from across the participants. Among the six doctors, three provided a broad range of information on climate change and vector-borne diseases, while the other three appeared hesitant and were eager to finish the discussion. This difference in engagement could be attributed to factors such as workload or the interview being conducted in a public space like a ward.

Similarly, among the ten nurses, five seemed hesitant and were frequently interrupted by patients as they were being interviewed while working. In contrast, the other five nurse interviews were more engaging and informative. Participants were hesitant during the interviews because of the audio recording, and many refused to take part for reason. Recent government changes in Bangladesh also made them more cautious about being recorded.

Additionally, several other factors were observed during data collection. For example, the male dengue ward at SSMC had fewer patients than the female ward. All the beds in the female ward

were equipped with mosquito nets, but the male ward lacked them. Furthermore, there were fewer nurses than required to manage the wards, with many intern nurses taking on patient care duties. At Keraniganj UHC, there was no separate ward for dengue patients, instead, there were only 4-5 beds within the general ward designated for dengue patients.

Lastly, the interviews with ward boys were positive. However, the position of ward boys is temporary, and it was rare to find someone with more than a year of experience. Nurses at the facilities refused to recognize ward boys as healthcare providers.

7. Discussion:

The important findings from our research regarding participants' knowledge about climate change is that most of the doctors have primary knowledge about climate change and the changes occurring in the environment such as extreme heat, cold, heavy rainfall, flood etc. A quantitative study carried out in India also found similar findings among healthcare providers and their knowledge on climate change. Most of the participants were aware of climate change effects like floods, droughts, cyclones, forest fires, changing rainfall patterns, and rising sea levels. However, only about half of them recognized climate-induced migration (56.0%) and social conflicts (49.7%) as consequences (Sambath et al., 2022).

Also, the knowledge of climate change and disease patterns is common among doctors. Many of the doctors mentioned that they receive different cases at different times of the year, for example, allergies in summer, pneumonia or asthma in winter, and dengue in the rainy season. Similarly, China found that there was a high level of awareness about heat-related illnesses (92.8%) and cold-related illnesses (88.8%) (Sambath et al., 2022). One critical insight from the narratives was the acknowledgement that diseases traditionally confined to specific seasons, such as dengue, are now occurring year-round, attributed to insufficient vector control efforts. Similar observations were noted in studies conducted in other regions, highlighting the direct and indirect health impacts of climate change (Sambath et al., 2022).

Specifically, the doctors can relate the climate change and mosquito borne diseases (MBD). Bangladesh is a country of temperate region and due to humidity and temperature the mosquito

production is high in this region. Due to high mosquito production in this region the MBDs outbreak increased day by day. Study reported that, according to the World Health Organization, a significant portion of the world is affected by climate-related health issues, with Asia, particularly South and South-East Asia, experiencing the highest disease burden. In countries like Bangladesh, Pakistan, India, and Sri Lanka, dengue fever has become increasingly prevalent, largely due to the region's warm and humid climate, which is preferable to mosquito breeding. In Pakistan, for example, dengue fever has rapidly spread since 2005, with continuous outbreaks observed between 2010 and 2019 (Saba et al., 2023). Another study reveals that, mosquito species like the *Anopheles gambiae complex*, *A. funestus*, *A. darlingi*, *Culex quinquefasciatus*, and *Aedes aegypti* are key vectors for many diseases and are highly affected by temperature fluctuations both in their larval aquatic stages and as adults. As water temperature increases, the larvae mature more quickly, leading to a higher potential for producing more offspring during the transmission season (Githeko et al., 2000).

According to healthcare providers, they can identify the risk of vector borne disease especially dengue fever and vulnerable groups of people. People with low socioeconomic status and from low living conditions have higher prevalence of dengue fever. A study by Lai.Y.J. et al., 2020 showed similar results that individuals from low socio-economic status were found to have a notably higher risk of developing incident dengue hemorrhagic fever (DHF). Additionally, dengue patients residing in rural areas had a greater likelihood of experiencing DHF complications compared to those living in urban settings.

Again, different groups of healthcare providers perceive the changes in vector-borne diseases due to climate change differently. For example, doctors believe that the increase in dengue incidence is not only due to changes in weather patterns but also because of the genetic variation of the dengue virus. However, nurses think that the rising incidence of dengue is due to people's lack of awareness. While doctors claim that the recurrence of dengue is happening due to mutations in different types of the dengue virus, nurses argue that it is caused by improper cleanliness, unhygienic living conditions, inadequate mosquito control programs, and a lack of government initiatives. Additionally, the ward boys have another perception that the diseases and environment are all controlled by almighty. So, the difference in opinions among healthcare providers about the causes of increasing dengue incidence can be because of factors such as their roles and areas of

expertise. Doctors, with a focus on biological and genetic factors, emphasize the role of virus mutations and climate change. In contrast, nurses and word boys, who have more direct contact with patients and communities, are more concerned with environmental factors, sanitation, and public awareness. Doctors often rely on scientific research and data, while nurses base their views on practical experience and the immediate needs of the community. These differences reflect the varying perspectives shaped by their professional training, responsibilities, and observations. Study by Mustafa et al (2023), reported that clinicians were nearly four times more likely to have a good understanding compared to laboratory staff, nurses, or medical attendants. These results are consistent with earlier studies conducted in Ethiopia, Bhutan, Togo, the United States, Vietnam, Pakistan, and Egypt.

Attitudes of healthcare professionals regarding vector borne diseases is very positive. Both doctors and nurses are aware of how to manage vector borne disease like dengue. When they are asked about the difference between patients with other complaints and dengue, both are able to differentiate the treatment needs of dengue patients which reflects that the practice of dengue management is good in facilities. Healthcare providers mentioned the importance of fluid support, platelets count, regular vitals checkups, and emergency support (ICU) is necessary for dengue. Moreover, participants spoke about preventive measures they have adopted to protect themselves from dengue infection, for example, use of mosquito nets, removal of water accumulation, maintain cleanliness, use of mosquito repellants etc.

The findings also reveal critical gaps in training and knowledge among the healthcare providers regarding the management of climate change-induced vector-borne diseases. Despite their frontline role in combating these diseases, participants consistently reported limited access to structured training programs focused on the intersection of climate change and health. These narratives from participants reveal a predominantly reactive approach to training, where sessions are organized only during outbreaks rather than proactively equipping providers to address climate-sensitive health challenges. The recommendations from the Intergovernmental Panel on Climate Change (IPCC), which advocates for proactive capacity building initiatives to enhance resilience against climate-related health challenges (IPCC, 2014). This lack of structured, continuous, and accessible training not only undermines providers' capacity to manage these diseases effectively but also reflects broader systemic challenges within the healthcare system

(Kabir et al., 2016). Addressing these gaps is crucial, as inadequate training not only hampers effective disease management but also limits the healthcare systems ability to adapt to the evolving health impacts of climate change.

8. Conclusion:

This study highlights how healthcare providers link between climate change-induced vector-borne diseases. The findings reveal varying levels of understanding and awareness of climate change and its impacts among healthcare providers, highlighting the basis of the professional roles and experiences. Doctors possess a foundational understanding of climate change, primarily rooted in scientific evidence. They recognize the links between climate change, vector-borne diseases, and broader health outcomes, often emphasizing biological and genetic factors such as virus mutations. Nurses demonstrate a moderate understanding, derived from their practical exposure to patient care and community interactions. They emphasize environmental factors, sanitation, and public awareness as key contributors to changing patterns of diseases like dengue. Ward boys, with basic knowledge, they get some idea on observations and personal beliefs. Their views often reflect limited access to training or scientific information, with some attributing environmental changes and disease patterns to divine control.

Despite these differences, all groups share a positive attitude towards managing vector-borne diseases, particularly dengue. This study highlights the systemic gaps in healthcare training, resources which undermine the capacity to combat climate-sensitive diseases effectively. The specific training rather than continuous, climate-resilient capacity building reflects a broader issue within the healthcare system. Addressing these gaps requires strategic investment in continuous training programs, improved resources allocation and robust policy initiatives that align with global recommendations such as those from the IPCC. To build the climate-resilient healthcare system in Bangladesh will require not only enhanced training and resources management but also focus on the public awareness campaigns, and capacity building initiatives are essential to enable healthcare providers to effectively manage the health challenges posed by climate change.

9. References:

- Brinkmann, S., & Kvale, S. (2018). *Doing interviews*. SAGE Publications Ltd. <https://doi.org/10.4135/9781529716665>
- Delve, Ho, L., & Limpaecher, A. (2024, February 5). *In-depth interviews for qualitative analysis*. Retrieved from <https://delvetool.com/blog/in-depth-interviews>
- Dhaka Tribune. (2024, December 24). *Zika virus cases detected in Dhaka*. Retrieved from <https://www.dhakatribune.com/bangladesh/health/366420/zika-virus-cases-detected-in-dhaka>
- Ebi, K. L., & Hess, J. J. (2017). Health adaptation to climate change: A systematic literature assessment. *Environmental Research Letters*, 12 (12), 123006. <https://doi.org/10.1088/1748-9326/aa9676>
- Faruk, M. O., Islam, M. R., & Nasrin, N. (2021). Impact of urbanization on dengue transmission in Dhaka city. **Asian Pacific Journal of Tropical Medicine*, 14*(10), 457-463. <https://doi.org/10.1016/j.apjtm.2021.07.004>
- Githeko, A. K., Lindsay, S. W., Confalonieri, U. E., & Patz, J. A. (2012). Climate change and vector-borne diseases: A regional analysis. *Environmental Health Perspectives*, 110 (12), 1244-1249. <https://doi.org/10.1289/ehp.02110>
- Githeko, A. K., Lindsay, S. W., Confalonieri, U. E., & Patz, J. A. (2000). Climate change and vector-borne diseases: a regional analysis. *Bulletin of the world health organization*, 78(9), 1136-1147.
- Hathaway, J., & Maibach, E. W. (2018). Health implications of climate change: A review of the literature about the perception of the public and health professionals. *Current Environmental Health Reports*, 5(1), 197–204. <https://doi.org/10.1007/s40572-018-0190-3>
- Ho, T. S., Huang, M. C., Wang, S. M., Hsu, H. C., & Liu, C. C. (2013). Knowledge, attitude, and practice of dengue disease among healthcare professionals in southern Taiwan. *Journal of the Formosan Medical Association*, 112(1), 18-23.

- Jetten, T. H., & Focks, D. A. (1997). Potential changes in the distribution of dengue transmission under climate change. *Environmental Health Perspectives*, 105 (5), 1-9. <https://doi.org/10.1289/ehp.97105s11>
- Jibon, M. J. N., Ruku, S. R. P., Islam, A. R. M. T., Khan, M. N., Mallick, J., Bari, A. M., & Senapathi, V. (2024). Impact of climate change on vector-borne diseases: Exploring hotspots, recent trends and future outlooks in Bangladesh. *Acta Tropica*, 259, 107373.
- Kabir, M. I., Rahman, M. B., Smith, W., Lusha, M. A. F., & Milton, A. H. (2016). Climate change and health in Bangladesh: A baseline cross-sectional survey. *Global Health Action*, 9, 29609. <https://doi.org/10.3402/gha.v9.29609>
- Kircher, M., Doheny, B. M., Raab, K., Onello, E., Gingerich, S., & Potter, T. (2021). Understanding the knowledge, attitudes, and practices of healthcare professionals toward climate change and health in Minnesota. *Challenges*, 13(2), 57. <https://doi.org/10.3390/challe13020057>
- Lai, Y. J., Lai, H. H., Chen, Y. Y., Ko, M. C., Chen, C. C., Chuang, P. H., ... & Morisky, D. E. (2020). Low socio-economic status associated with increased risk of dengue haemorrhagic fever in Taiwanese patients with dengue fever: a population-based cohort study. *Transactions of The Royal Society of Tropical Medicine and Hygiene*, 114(2), 115-120.
- Mahmud, I., Raza, W. A., & Hossain, M. R. (2021). *Climate afflictions*. International Development in Focus. Washington, D.C.: World Bank Group. Retrieved from <http://documents.worldbank.org/curated/en/739621633671881889/Climate-Afflictions>
- Matthew, R., Chiotha, S., Orbinski, J., & Talukder, B. (2021). Research note: Climate change, peri-urban space, and emerging infectious disease. *Landscape and Urban Planning*, 213, 104298. <https://doi.org/10.1016/j.landurbplan.2021.104298>
- Mohammed Yusuf, A., & Abdurashid Ibrahim, N. (2019). Knowledge, attitude and practice towards dengue fever prevention and associated factors among public health sector health-care professionals: in Dire Dawa, eastern Ethiopia. *Risk Management and Healthcare Policy*, 91-104.

- Mordecai, E. A., Paaijmans, K. P., Tuste, D. E., & D. S. M. (2019). Global expansion and redistribution of Aedes-borne virus transmission risk with climate change. *PLOS Neglected Tropical Diseases*, 13(3), e0007213. <https://doi.org/10.1371/journal.pntd.0007213>
- Morin, C. W., Comrie, A. C., & Ernst, K. (2013). Climate and dengue transmission: Evidence and implications. *Environmental Health Perspectives*, 121(11–12), 1264–1272. <https://doi.org/10.1289/ehp.1306556>
- Mustafa, U. K., Sauli, E., Brinkel, J., & Kreppel, K. S. (2023). Health professionals’ knowledge on dengue and health facility preparedness for case detection: A cross-sectional study in Dar es Salaam, Tanzania. *PLoS Neglected Tropical Diseases*, 17(11), e0011761.
- Naish, S., Mackenzie, J. S., Faddy, H. M., & McBride, W. J. (2014). The role of climate in the transmission of dengue: A review. *Environmental Research Letters*, 9(12), 123006. <https://doi.org/10.1088/1748-9326/9/12/123006>
- Polivka, B. J., Chaudry, R. V., & Crawford, J. M. (2012). Public health nurses’ knowledge and attitudes regarding climate change. *Environmental Health Perspectives*, 120(3), 321–325. <https://doi.org/10.1289/ehp.1104025>
- Saba, S., Naeem-Ullah, U., Saeed, S., Rajwana, I. A., & Khan, A. A. (2023). Outreach vector control worker’s knowledge, attitude, and practices towards mosquito control and associated diseases. *Journal of Arthropod-Borne Diseases*, 17(2), 138–151. <https://doi.org/10.18502/jad.v17i2.13619>
- Saha, S., Rahman, M. A., & Sharker, M. A. (2020). Assessing health facility readiness for dengue prevention in Bangladesh: A qualitative study. *BMC Health Services Research*, 20 (1), 231. <https://doi.org/10.1186/s12913-020-05188-8>

- Sambath, V., Narayan, S., Kumar, P., Kumar, P., & Pradyumna, A. (2022). Knowledge, attitudes and practices related to climate change and its health aspects among the healthcare workforce in India—A cross-sectional study. *The Journal of Climate Change and Health*, 6, 100147.
- Siddique AB, Hasan M, Ahmed A, Rahman MH and Sikder MT (2024) Youth's climate consciousness: unraveling the Dengue-climate connection in Bangladesh. *Front. Public Health* 12:1346692. <https://doi.org/10.3389/fpubh.2024.1346692>
- Vandenberg, S. Y., Chircop, A., Sedgwick, M., & Scott, D. (2023). Nurses' perceptions of climate-sensitive vector-borne diseases: A scoping review. *Public Health Nursing*, 40(1), 55-65. <https://doi.org/10.1111/phn.13173>
- World Health Organization. (2015). Climate change and health: A toolkit for health professionals. Geneva: WHO. <https://www.who.int/globalchange/publications/climate-change-toolkit/en/>
- World Health Organization. (2022). *World health statistics 2022: Monitoring health for the SDGs, sustainable development goals*. <https://www.who.int/data/gho/publications/world-health-statistics>

10. Annexure:

Annexure: 1 Semi-Structured Guidelines:

Aimed at assessing healthcare providers' (doctors, nurses, and ward boys) knowledge, attitudes, and perceptions toward climate change and vector-borne diseases (VBDs).

This interview is designed to take about 20-30 minutes.

Semi- Structure Guidelines		
S. No	Subject	Primary Question
1	Introduction	Can you please introduce yourself and your role within this healthcare facility? Describe one of the typical day of work? অনুগ্রহ করে আপনি কি আপনার পরিচয় এবং এই স্বাস্থ্যসেবা প্রতিষ্ঠানে আপনার ভূমিকা সম্পর্কে কিছু বলবেন? কাজের একটি সাধারণ দিনের বর্ণনা করুন।
2	Socio-Demographic	1. Age:
		2. Gender: Male/Female/Prefer not to say
		3. Highest level of education:
		4. Years of experience:
3	Knowledge and Perceptions	1. Do you have any idea about climate change and its effects on health? জলবায়ু পরিবর্তন এবং এর স্বাস্থ্যের উপর প্রভাব সম্পর্কে আপনার ধারণা পোষণ করেন?
		2. What do you know about vector-borne diseases and their main causes? Are they prevalent? When are the more prevalent? ভেক্টর-বাহিত রোগ এবং তাদের প্রধান কারণগুলি সম্পর্কে আপনি কী

		জানেন? তারা কি প্রচলিত? এই রোগগুলি কখন বেশি দেখা যায়? For probing: How prevalent do you think in Dhaka ----- Season, time, location, density of population.
		3. What is your opinion about climate-driven health issues? জলবায়ু পরিবর্তনজনিত স্বাস্থ্য সমস্যা সম্পর্কে আপনার মতামত কি?
		4. Do you think there is a connection between climate change and vector-borne diseases? If yes, how can you connect both? If no, why do you think? আপনি কি মনে করেন জলবায়ু পরিবর্তনের সাথে ভেক্টর-বোর্ন রোগের সম্পর্ক আছে? যদি হ্যাঁ হয়, তাহলে আপনি কিভাবে এই দুই বিষয়ের সম্পর্ক আছে বলে মনে করেন?
		5. Who do you think is more vulnerable for VBDs? Why do you think so? আপনার মতে, কারা ভেক্টর-বাহিত রোগগুলোর (VBDs) জন্য বেশি ঝুঁকিপূর্ণ? কেন আপনি তা মনে করেন?
4	Attitudes	1. What are some actions when VBDs prevalence is high? When do you find the cases were high and what do you think? 2. How do you view your role in addressing climate-driven VBDs? Why or Why not? জলবায়ু পরিবর্তনজনিত ভেক্টর-বোর্ন রোগ মোকাবেলায় আপনি আপনার ভূমিকা কীভাবে দেখেন?
5	Addressing VBDs as Healthcare Providers	1. What prevention strategies do you know or use for controlling vector-borne diseases? (Patient to Patient) ভেক্টর-বোর্ন রোগ নিয়ন্ত্রণে আপনি কী ধরনের প্রতিরোধমূলক কৌশল জানেন বা ব্যবহার করেন? 2. What challenges do you face in managing VBDs at the hospital? এই রোগগুলোর প্রতিরোধ সম্পর্কে জনগণের সচেতনতা আপনি কীভাবে উপলব্ধি করেন? HR/Supply chain/ financial/ Infrastructure/ Service delivery/ Health information system/ Leadership and governance.

		3. What resource limitations do you face in managing these diseases? এই রোগগুলো মোকাবেলায় আপনি কী ধরনের সম্পদের সীমাবদ্ধতার মুখোমুখি হন?
		4. Are there challenges in mosquito control efforts? If yes, can you explain? মশা নিয়ন্ত্রণের প্রচেষ্টায় কি কোনো চ্যালেঞ্জ রয়েছে? যদি থাকে, তাহলে কি আপনি এটি ব্যাখ্যা করতে পারবেন?
6	Barriers & Challenges	1. What barriers do you face in preventing the spread of vector-borne diseases? ভেক্টর-বোর্ন রোগের বিস্তার প্রতিরোধে আপনি কী ধরনের বাধার সম্মুখীন হন? Focus on Bangladesh the move to dhaka city
		3. What difficulties do you experience in diagnosing and treating VBD cases? ভেক্টর-বোর্ন রোগ (VBD) নির্ণয় এবং চিকিৎসা করতে আপনি কী ধরনের সমস্যার সম্মুখীন হন?
7	Training and Capacity Building	1. Has the hospital given or planned for any training for healthcare providers? If Yes, then you participated in that.... Can you explain regarding the training? হাসপাতাল কি স্বাস্থ্যসেবা প্রদানকারীদের জন্য কোনো প্রশিক্ষণ দিয়েছে বা দেওয়ার পরিকল্পনা করেছে? যদি দিয়ে থাকে এবং আপনি সেই প্রশিক্ষণে অংশগ্রহণ করে থাকেন, তবে দয়া করে সেই প্রশিক্ষণ সম্পর্কে ব্যাখ্যা করুন।
		1. Have you received any training on managing diseases related to climate change? আপনি কি জলবায়ু পরিবর্তনের সাথে সম্পর্কিত রোগগুলো ব্যবস্থাপনা সম্পর্কে কোনো প্রশিক্ষণ পেয়েছেন?
		2. Are there any guidelines for managing vector-borne diseases (VBDs)? If yes, can you explain how they help? If not, what do you think could be useful? ভেক্টর-বাহিত রোগ (VBDs) ব্যবস্থাপনার জন্য কি কোনো নির্দেশিকা রয়েছে? যদি থাকে, তাহলে সেগুলো কীভাবে সাহায্য করে তা আপনি ব্যাখ্যা করতে পারবেন? যদি না থাকে, তাহলে আপনার মতে কী সাহায্যকারী হতে পারে?

8	Recommendation	1. Recommendations and share of experience প্রস্তাবনা এবং অভিজ্ঞতা ভাগাভাগি করা 2. Is there anything else you would like to share about your experience or perceptions regarding climate change and vector-borne disease to Government and Hospital administration? জলবায়ু পরিবর্তন এবং মশাবাহিত রোগ সম্পর্কিত আপনার অভিজ্ঞতা বা ধারণা সম্পর্কে সরকার এবং হাসপাতাল প্রশাসনকে বলার মতো আর কিছু কি আপনি শেয়ার করতে চান?
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Annexure: 2 Observational Checklist:

IDI report form

IDI ID Number: DHK_IDI_TEST

Interviewer Initials:

Country:

Date:

Duration of Interview:

1. Meeting place/digital platform used for the interview: detail and description, e.g., size and accessibility, connection (if virtual), and how this could have affected the discussion; any interruptions or technical issues?
2. Interview dynamics: general description – level of engagement, interest level, anxiety of the interviewee – and how this may have affected the interview. For example, did you experience any hesitation to speak freely?
3. What were the main issues or themes that struck you during this interview?
4. What new information did you gain from the interview?
5. Were there any problems with the topic guide (e.g., wording, order of topics, missing topics) you experienced?
6. Anything you would like to follow up on, request more information or clarify?

Annexure : 3 Priori Code

A Priori Codes			
S · N o	Theme	Codes	Definitions
1	Knowledge	Awareness of climate change	Changes in the environment, such as increasing temperatures, unpredictable weather, and rising sea levels
		Knowledge of symptoms	Recognize the signs and symptoms of diseases, like fever, rash, or pain, caused by vector-borne
		Knowledge of transmission	Understand how diseases like dengue or malaria spread
		Knowledge of disease patterns	Understand when, where, and how often diseases and also how patterns may change
		1. Affected Area	Those patients come from Which area
		2. Whom suffer allot	Rich or poor people or also depends upon the socio-economic status
		Link between climate change and disease incidence	Understand that changes in climate, like higher temperatures and increased rainfall, can lead to more cases of diseases
2	Perception	Addressing climate change impacts	Take action to reduce the health problems caused by climate change
		Awareness of the prevention strategies and initiatives	Know about methods and programs to stop the spread of diseases
3	Attitudes	Addressing the issue by healthcare providers	Steps they take to manage and control climate-driven diseases

		Climate-driven health challenges	Spread of diseases due to change in climate patterns
4	Barriers	Insufficient supplies	A lack of necessary resources, such as medicines, medical equipment, protective gear, or mosquito control tools
		Financial constraints	Insufficient funds or budget to support healthcare activities
		Inadequate Space	Limited beds is available for the patients
		Inadequate workforce	Overburdened staff and reduced capacity to address health challenges
		Team collaboration	Knowledge, coordinating efforts, and combining resources to improve disease prevention and treatment
		Resistance from patients	Refusal of patients to follow preventive measures or treatment recommendations
5	Training	Specific training on climate change	Focus on the effects of climate change on health
		Disease management	Process of diagnosing, treating, and controlling diseases, including climate-driven
		Access to up-to-date Knowledge	Ability to obtain the latest information, research, and guidelines about climate change
6	Recommendation	Absence of mentoring	Ability to learn effective strategies for managing disease prevention and treatment
		Climate-related health changes	The shifts in disease patterns and health outcomes caused by climate change
		Community Awareness	Awareness for the community by doing some particles to save themselves from the VBDs
		Ideas	New Ideas comes during interview want to share in my findings

Annexure: 4 Details of participants

S. No	Audi o Details	Date of Interview	Inter view Type	Hospital Name	Healthcare Providers	Gender	Age	Year s of exper ience	Time of Interv iew
1	Audi o 1	27/11/ 2024	IDI	Shaheed Suhrawaedhy MC	Doctor	Male	34	3	23:28
2	Audi o 2	27/11/ 2024	IDI	Shaheed Suhrawaedhy MC	Nursing Supervisor	Female	59	34	16:01
3	Audi o 3	27/11/ 2024	IDI	Shaheed Suhrawaedhy MC	Nursing Staffs	Male	34	12	11:08
4	Audi o 4	27/11/ 2024	IDI	Shaheed Suhrawaedhy MC	Nursing Staffs	Female	30	8	13:56
5	Audi o 5	27/11/ 2024	IDI	Shaheed Suhrawaedhy MC	Nursing Supervisor	Female	43	20	17:06
6	Audi o 6	28/11/ 2024	IDI	Keranijang UHC	Nursing Staffs	Female	38	12	12:12
7	Audi o 7	28/11/ 2024	IDI	Keranijang UHC	Nursing Staffs	Female	30	8	14:48
8	Audi o 8	28/11/ 2024	IDI	Keranijang UHC	Ward Boy/Aya	Female	57	1	23:32

9	Audio 9	28/11/2024	IDI	Keranjang UHC	Nursing Staffs	Female	29	8	16:59
10	Audio 10	28/11/2024	IDI	Keranjang UHC	Nursing Staffs	Female	39	8	13:24
11	Audio 11	1/12/2024	IDI	Shaheed Suhrawaedhy MC	Doctor	Female	25	3	16:07
12	Audio 12	1/12/2024	IDI	Shaheed Suhrawaedhy MC	Doctor	Male	27	2	24.50
13	Audio 13	1/12/2024	IDI	Shaheed Suhrawaedhy MC	Doctor	Male	31	10	15:09
14	Audio 14	1/12/2024	IDI	Shaheed Suhrawaedhy MC	Nursing Staffs	Female	31	6	18:35
15	Audio 15	1/12/2024	IDI	Shaheed Suhrawaedhy MC	Nursing Staffs	Female	27	8	24.19
16	Audio 16	1/12/2024	IDI	Shaheed Suhrawaedhy MC	Doctor	Male	32	7	24.04
17	Audio 17	1/12/2024	IDI	Shaheed Suhrawaedhy MC	Doctor	Male	29	5	39.59
18	Audio 18	1/12/2024	IDI	Shaheed Suhrawaedhy MC	Ward Boy/Aya	Male	21	0.1	10:45

