

Finding of the desk research on “Developing and piloting a new tool for measuring waterborne diseases in Mekong, Ayeyarwady, and other rivers to identify hot spots for disease outbreaks, which results in policy recommendations on improved water management”

Abstract

A tool for measuring waterborne diseases in Mekong, Ayeyarwady, and other rivers to identify hot spots for disease outbreaks as an early warning system. A successful Early Warning System-EWS saves lives and jobs, land and infrastructures and supports long-term sustainability. Early warning systems will assist public officials and administrators in their planning, saving money in the long run and protecting economies. Stakeholder participation is required to prevent waterborne disease outbreaks. Proposed tool for measuring waterborne diseases need to be adapt and adopt.

1. Introduction

Forest Resource Environment Development and Conservation Association (FREDA) is implementing the project on “Advancing Cooperation Between Lower Mekong Countries to support governance, transparency and local voices, concerning with water and Water Related Ecosystem” from 5th October, 2022 to 15 August 2023, with the financial assistant of Pact, Inc. under “Mekong Connections: Governance, Transparency, and Local Voices” funded by the US Department of State East Asia and Pacific Bureau.

Finding of the desk research on “Developing and piloting a new tool for measuring waterborne diseases in Mekong, Ayeyarwady, and other rivers to identify hot spots for disease outbreaks, which may result in policy recommendations on improved water management” are reported.

World Health Organization (WHO) estimated that unsafe drinking water, sanitation and lack of hygiene caused 870, 000 associated deaths globally in 2016. [1]

Worldwide, diarrhea is the fifth leading cause of death in children younger than 5 years old. The leading risk factors for diarrhea among these children are childhood wasting (low weight for height score), unsafe water, and unsafe sanitation. The germs that cause diarrhea are commonly spread by food or water that has been contaminated with human or animal poop. This contamination can occur in the environment because of inadequate sanitation and inadequate protection of drinking water sources and food products. Contamination can also happen in the home through unsafe water storage and poor hygiene. Unsafe water is water that contains germs, parasites, or toxic chemicals. Harmful germs, parasites, and chemicals can

get in water from many sources, including human or animal feces (poop), pesticides, and other chemicals. Contaminated water and poor sanitation are linked to the transmission of diseases such as [cholera](#), [typhoid](#), and [polio](#). [2]

The World Health Organization says that every year more than 3.4 million people die as a result of water related diseases, making it the leading cause of disease and death around the world. Most of the victims are young children, the vast majority of whom die of illnesses caused by organisms that thrive in water sources contaminated by raw sewage. A report published in the medical journal concluded that poor water sanitation and a lack of safe drinking water take a greater human toll than war, terrorism and weapons of mass destruction combined. According to an assessment commissioned by the United Nations, 4,000 children die each day as a result of diseases caused by ingestion of filthy water. The report says four out of every 10 people in the world, particularly those in Africa and Asia, do not have clean water to drink. Resources analyst Erik Peterson, of the Center for Strategic and International Studies in Washington, describes the water crisis this way: "At any given time, close to half the population of the developing world is suffering from waterborne diseases associated with inadequate provision of water and sanitation services," Mr. Peterson explained. "There are about four billion cases of diarrhea disease per year, resulting in about one or two million deaths, some ninety percent of which, tragically, are in children under the age of five." Cholera, typhoid fever and hepatitis A are caused by bacteria, and are among the most common diarrheal diseases. Other illnesses, such as dysentery, are caused by parasites that live in water contaminated by the feces of sick individuals. Lakes and streams which people use for drinking water, bathing and defecating are sources of disease, as water is polluted by natural disasters. Last year's tsunami left victims in ankle-deep water, amid destroyed sewage pipes. People can also contract a diarrheal disease by eating food that's prepared by sick individuals who have not washed their hands, or touching something handled by an infected person and then putting their own hands into their mouths. The spread of waterborne illnesses can be prevented in short term and long term measures. In the short term, people should wash their hands as much as possible. People should use a latrine, and avoid choosing fields, bushes, forests, gully, stream, ditches, streets, canals, or other open spaces for defecation. For the long term, communities must have sources of clean drinking water. The United Nations has set a goal of cutting in half by the year 2015 the number of people without access to safe drinking water and basic sanitation. [3]

Forest Resource Environment Development and Conservation Association (FREDA) Myanmar try to develop and propose to introduce a tool for measuring

waterborne diseases to identify hot spots for disease outbreaks, which will result in policy recommendations on improved water management.

2. Literature review

2.1 One of the best management practice to control waterborne disease is “New York City’s Waterborne Disease Risk Assessment Program” which was established to obtain data on the rates of *giardiasis* and *cryptosporidiosis*, along with demographic and risk factor information on case patients, to provide a system to track diarrheal illness to assure rapid detection of any outbreaks, and to determine the contribution (if any) of tap water consumption to gastrointestinal disease. This program began in 1993 and is jointly administered by the New York City Department of Health and Mental Hygiene and the New York City Department of Environmental Protection. New York City Department of Environmental Protection conduct [Drinking Water Monitoring](#), and they publish a Waterborne Disease Risk Assessment Program Annual Report as a deliverable under the [Filtration Avoidance Determination](#). The report provides an annual overview of program achievements as well as data results from the Active Disease Surveillance Program. In addition, the report summarizes trends observed in each of the program’s distinct and complementary gastrointestinal (GI) outbreak detection systems: gastrointestinal disease observed in sentinel nursing homes, number of stool specimens submitted to clinical laboratories for microbiological testing, hospital emergency department visit reports, and volume-of-sales of non-prescription anti-diarrheal medication. Each of these systems adds to the comprehensiveness of the program, ranking it among the best public health surveillance systems for water quality in the nation. Although these syndromic surveillance systems do not identify specific routes of exposure, nor explicitly *giardiasis* or *cryptosporidiosis*, they do serve as important and sensitive tools to help detect GI outbreaks. While some localized GI outbreaks in NYC have been detected through these monitoring systems, none of these outbreaks have been found to be attributed to waterborne agents. [4]

1. Monitoring of hospital Emergency Department-ED visits, Epidemiological Unit of Health Department, with waterborne disease such as Gastroenteritis (Traveler’s Disease), Hepatitis A, *Cryptosporidiosis*, *Giardiasis*, *Campylobacteriosis*, *Legionnaires' Disease*, *Shigellosis* (*Dysentery*), diarrhea, dysentery, viral hepatitis, typhoid, paratyphoid, cholera

2. Transmit electronic files hourly containing chief complaint and demographic information for patient visits.
3. Classify the Patients into disease severity, categories, and
4. Conduct daily analyses to detect any unusual patterns or signals.
5. Citywide analyses and assess whether the frequency of ED visits for the disease has increased in the last seven days compared to the previous 28 days.
6. Examine clustering by both hospital location and residential zip code.
7. Apply probability estimates such as Monte Carlo probability estimates for Statistical significance to adjust for the multiple comparisons inherent in examining many candidate clusters each day.
8. The threshold of significance for citywide and spatial signals is set at a recurrence interval of 365 days, indicating a false signal rate of once every 365 days.
9. Tracking anti waterborne disease, anti-diarrheal drug sales as an indicator.
10. Modifications and enhancements to city anti-diarrheal medication surveillance program.
11. Tracking of sales of over-the-counter, non-bismuth- containing anti-diarrheal medications and of bismuth subsalicylate medications, searching for citywide as well as local signals. Sales of anti-diarrheal, for example;
 - a. Oral rehydration salts
 - b. Zinc syrup and tablets
 - c. Probiotics and prebiotics
 - d. Antibiotics, Metronidazole, Norfloxacin, Sceptin
 - e. Antispasmodic agents, hyoscyamine, dicyclomine
12. Apply the clinical laboratory monitoring system, the number of stool specimens submitted to clinical laboratories for bacterial and parasitic testing also can be a source of information on waterborne disease trends in the population.
13. Review the Clinical Laboratory Monitoring results upon their receipt.
14. Apply a model to establish statistical cut-offs for significant increases in clinical laboratory submissions.

15. Apply the cumulative sums (CUSUM) method to a two-week baseline to identify statistically significant aberrations (or signals) in submissions for ova and parasites and for bacterial culture and sensitivity. CUSUM is a quality control method that has been adapted for aberration detection in public health surveillance.
16. Adopt the nursing home surveillance system for waterborne disease,
17. Provided with stool collection kits in advance. When such an outbreak is noted, specimens are to be collected for testing for bacterial culture and sensitivity, ova and parasites, *Cryptosporidium spp.*, viruses, and *Clostridium difficile* toxin.
18. Control waterborne disease by adopting one health approach (a collaborative, multi sectoral, and transdisciplinary approach.)

2.2 Great innovation and momentum around the movement from paper-based record keeping and transmittal systems to electronic systems was seen by the Routine Health Information Network - RHINO community over the past decade. Electronic Health Management Information Systems (eHMIS) is a facility based data aggregation system that is used for public health-related decision making. Its main users are public policy makers, health officers, researchers, planning departments of health offices, HMIS focal persons, data entry clerks and many others ranging from health facility to federal management levels. Moreover, eHMIS is best referred as a system that is designed to fulfill the need of automated national health information management system. It helps to accurately and timely collect, aggregate, store, analyze and evaluate health related data from health facility to federal level. The system also has decision support tools mainly used by decision makers at the federal, regional, zonal and world levels. eHMIS, therefore, is composed of a set of interrelated components and procedures organized with the objective of generating health information and intelligence to monitor the health status and health services of the nation to improve public health care leadership and management decisions at all levels ([MEASURE Evaluation](#)). Benefits of electronic systems include the rapid speed of aggregation and transmittal, improved data quality by limiting the opportunities for human error in the data flow process, and the availability of dashboards and related visualization tools that bring routine health statistics to life and promote data use. Implementation of these electronic systems is not without challenges though, particularly connectivity, availability of technology at lower levels of the system, and needs for customization and training to promote local use

of the tools available in the system. In many countries, electronic systems are used from the district level up to the national level, while facilities continue to capture patient records in paper registers. Despite these challenges though, electronic systems are being adapted and implemented in countries around the world. There are even [limited examples](#) of community-based implementation and use of electronic systems with great success.

2.3 The most widely used open source eHMIS system is DHIS2. As of 2015, the product is being used at national scale in 30 countries and by various organizations across four continents; DHIS2 is being used at various levels of the health system in 47 countries. The platform is designed to help governments in developing countries and health organizations to manage their operations more effectively, monitor processes and improve communication. The DHIS2 suite of tools provides flexibility, specifically customization of data elements, data entry forms, validation rules, indicators and reports in order to create a fully-fledged system for data management. The platform can be used on PCs as well as tablets and smartphones, in an effort to make data readily available across devices. DHIS 2 provides a wide range of solutions based on HTML5, SMS and Java.[5]

2.4 In accordance with the National Health Plan (2017-2022), Ministry of Health and Sports, Myanmar, is in the process of developing a comprehensive Health Information Strategy. The Ministry has decided that there will be one common national platform for health information in Myanmar, namely DHIS2. The choice of DHIS2 fulfils an aim of the MY-NORTH-project. The [DHIS2](#) is an open source software platform for reporting, analysis and dissemination of data for births, deaths, diseases and various health programs, initiated by Professor Jørn Braa and his group at the Department of Informatics at the University of Oslo. The MY-NORTH-project has paved the way, enabling DHIS2 to become the common health information platform for Myanmar, and Senior Engineer Knut Staring, member of the MY-NORTH steering group, has played a key role in this work since 2014. Their ambition is that the MY-NORTH partner university, University of Public Health, Yangon, will become the training hub for health information systems in Myanmar. The establishment of DHIS2 as the national platform for health information systems is a great achievement for Myanmar, and represents a success for Department of Informatics at the University of Oslo and for the MY-NORTH project.

2.5 Oral Rehydration Therapy- ORT Utilization Rate in under five Diarrhoea (Myanmar) show that 98.3% in (2014), 98.5% in (2015), 98.9% in (2016). [6] Diarrhea is a leading killer of children, accounting for approximately 9 per cent of all deaths among children under age 5 worldwide in 2019. This translates to over

1,300 young children dying each day, or about 484,000 children a year, despite the availability of a simple treatment solution. [7]

2.6 The 2014 Myanmar population and housing census showed that 25.7 percent of households have using traditional pit latrines, bucket surface latrines or no latrines at all. Open defecation or poor quality toilets that ruin their health and pollute their environment. Inadequate sanitation systems spread human waste into rivers, lakes and soil, contaminating the water resources, and as a consequences waterborne diseases. Low level sanitation or open defecation can be major contributors to the disease spreading (WHO, 2000). Water can get contaminated with human or animal feces from community sewage, septic tanks or latrines. Diarrhea can be contracted by personal contact as a result of poor personal hygiene or indirectly spread from the water and contaminated food (WHO, 2000). Floods are also major concern because they can spread the animal or human feces into the drinking water sources (Ahern et al., 2005; Schwartz et al., 2006). According to a Myanmar Red Cross report summarized by Eleven Myanmar (2017), 77% of the diseases in Myanmar are waterborne. The water-associated diseases registered on the territory of Myanmar are: malaria, dengue, cholera, acute diarrhea, schistosomiasis, plague, leptospirosis, Japanese encephalitis, Chikungunya, hepatitis A and typhoid fever (CDC, 2016; CIA, 2018). Rakhine State is the region of Myanmar with the highest risk for waterborne diseases (Motlagh, 2014; Pink, 2016; Mahmood et al., 2017; Ahmed et al., 2018). Constant unrests (Albert, 2017), the impending humanitarian catastrophe (Motlagh, 2014; Ahmed et al., 2018) and the high vulnerability to cyclones and floods (Ahmed et al., 2018), puts this region on the highest priority map for the international UN and other humanitarian organizations (UNHCR, 2018). According to the UNHCR (2018), the lack of transport, health and education infrastructure and the continuous disinterest from the Myanmar government makes the situation even more difficult. Numerous townships are isolated and difficult to be reached from the relief teams. Even if international relief teams succeed in reaching there, they still do not have enough data and precise maps to prioritize the highest priority settlements (UNHCR, 2018). There are many internally displaced persons and Rakhine refugees in Bangladesh (Parnini et al., 2013). Amongst them, there are many children which are the first victims of the waterborne diseases (Motlagh, 2014). [8]

2.7 A data culture will be promoted for evidence-based decision making. This comprises the demand for quality and timely data, its collection, analysis and use. A functional HMIS unit that is situated at the Minister's office, MoHS, and with the mandate to establish a more integrated and expanded Health Management Information System - HMIS is urgently needed. This unit should build on the ongoing exercise to assess all existing information systems and develop a

comprehensive HIS strategy, which should include feasible mechanisms for systematic data collection starting at the community level and which should cover e-health. Important will be to integrate the many parallel systems that are currently supported and promoted by vertical programs, and to move to the already agreed-upon common platform (the DHIS-II). This will substantially reduce the burden on health workers throughout the health system. Also important will be to ensure interoperability with information systems related to other functions of the health system— such as HRIS and LMIS – vital statistics (e.g. birth and death registries) and other information such as the NCD database and the Master Patient Index (MPI). As the MPI is being further developed and rolled-out, alternative ways for personal identification of service users will be explored, including the use of biometrics. Household surveys and facility surveys will also be part of the HIS architecture. They should be repeated at regular intervals; indicators across the different surveys and survey types should be harmonized. The HMIS will be gradually expanded to also include information from providers outside MoHS. Purchase of services from private and EHO providers will be conditional on submitting a required set of data. Introduction of DHIS-II will be accompanied by adequate capacity building and resources. Roll-out should follow the same sequence as the operationalization of the NHP.[9]

2.8 According to the “Hospital Statistics Report” published by Ministry of Health and Sports The Republic of the Union of Myanmar, Health Information Division, Department of Public Health In collaboration with Department of Medical Services, it was learnt that single leading causes of morbidity for Union (2014-2018) with Diarrhea and gastroenteritis of presumed infectious origin (Code number A09)[10]

| Sr | Year | Number | % |
|----|------|--------|-----|
| 1 | 2014 | 117656 | 5.6 |
| 2 | 2015 | 152528 | 6.0 |
| 3 | 2016 | 144052 | 5.2 |
| 4 | 2017 | 142060 | 4.9 |
| 5 | 2018 | 127493 | 4.3 |

2.9 In December 2016 the United Nations General Assembly unanimously adopted the resolution “International Decade for Action – Water for Sustainable Development” (2018–2028) in support of the achievement of SDG 6 and other water-related targets, and on 21 December 2020, the resolution on the “United Nations Conference on the Midterm Comprehensive Review of the Implementation of the Objectives of the International Decade for Action, “Water for Sustainable Development”, 2018–2028”, the first UN Conference on water since 1977. Water is

also at the heart of milestone agreements such as the Sendai Framework for Disaster Risk Reduction and the 2015 Paris Agreement. [11]

Water Borne diseases come in the form of viruses, bacteria, or protozoa, all of which are invisible to the naked eye. Pathogen, Common waterborne diseases, their symptoms and water purification method for each pathogen are summarized in the following table.[12]

| Sr | Pathogen | Disease | Symptom | Water Purification Methods for each pathogen |
|----|--------------------------------|---|---|---|
| 1 | Norovirus | Gastroenteritis (inflammation of the lining membrane of the stomach and the intestines characterized especially by nausea, vomiting, diarrhea, and cramps) | dehydration in older adults, younger children, or those with other illnesses due to excessive vomiting and diarrhea | <ol style="list-style-type: none"> 1. Iodine Treatment 2. Solar Purification 3. Boiling 4. Distillation 5. Chlorination 6. Reverse Osmosis 7. Ultra-Violet Light |
| 2 | HAV (Hepatitis A Virus) | Hepatitis A Hepatitis means inflammation of the liver. When the liver is inflamed or damaged, its function can be affected. Heavy alcohol use, toxins, some | tiredness, muscle soreness, loss of appetite, fever, stomach ache, light-colored stool, dark yellow urine, and yellowish skin | <ol style="list-style-type: none"> 1. Iodine Treatment 2. Solar Purification 3. Boiling 4. Distillation 5. Chlorination 6. Reverse Osmosis 7. Ultra-Violet Light |

| Sr | Pathogen | Disease | Symptom | Water Purification Methods for each pathogen |
|----|---|--|--|--|
| | | <p>medications, and certain medical conditions can cause hepatitis, but it is often caused by a virus.</p> | | |
| 3 | <p>Cryptosporidium (Protozoa) very tolerant to chlorine disinfection.</p> | <i>Cryptosporidiosis</i> | stomach cramps, watery diarrhea, vomiting, fever, and weight loss. | <ol style="list-style-type: none"> 1. Specified Filters 2. Boiling 3. Distillation 4. Reverse Osmosis 5. Ultra-Violet Light |
| 4 | <p>Giardia (Protozoa)</p> | <i>Giardiasis</i> | fatigue, vomiting, nausea, loss of appetite, greasy stools, diarrhea, bloating, excessive gas, abdominal pain, and headaches | <ol style="list-style-type: none"> 1. Specified Filters 2. Chlorination (45 min.) 3. Iodine Treatment (50 min.) 4. Boiling 5. Distillation 6. Reverse Osmosis 7. Ultra-Violet Light |

| Sr | Pathogen | Disease | Symptom | Water Purification Methods for each pathogen |
|----|--|--|--|---|
| 5 | Campylobacter Jejuni (Bacteria) | <i>Campylobacteriosis</i> | diarrhea, fever, stomach cramps, and vomiting | <ol style="list-style-type: none"> 1. Specified Filters 2. Iodine Treatment 3. Solar Purification 4. Boiling 5. Distillation 6. Chlorination 7. Reverse Osmosis |
| 6 | Legionella (Bacteria) | <i>Legionnaires' Disease</i> | becomes infected when the water droplets are breathed in and enter the lungs. cough, fever, muscle pains, shortness of breath, vomiting, and occasionally, diarrhea. | <ol style="list-style-type: none"> 1. Specified Filters 2. Iodine Treatment 3. Solar Purification 4. Boiling 5. Distillation 6. Chlorination 7. Reverse Osmosis 8. Ultra-Violet Light |
| 7 | Shigella (Bacteria) | <i>Shigellosis</i> <i>(Dysentery)</i> | fever, stomach pains, and | <ol style="list-style-type: none"> 1. Specified Filters |

| Sr . | Pathogen | Disease | Symptom | Water Purification Methods for each pathogen |
|---------|-------------------|-------------------|--|---|
| | | | diarrhea, dehydration, rectal bleeding, and seizures in small children. | 2. Iodine Treatment 3. Solar Purification 4. Boiling 5. Distillation 6. Chlorination 7. Reverse Osmosis 8. Ultra-Violet Light |
| 8 | Rota virus | Rotavirus disease | Rotavirus commonly causes severe, watery diarrhea and vomiting in infants and young children. Children may become dehydrated and need to be hospitalized and can even die. he most common symptoms of rotavirus are severe watery diarrhea, vomiting, fever, | |

| Sr | Pathogen | Disease | Symptom | Water Purification Methods for each pathogen |
|----|--------------------------|---------|---|---|
| | | | and/or abdominal pain. | |
| 9 | Hepatitis E virus | | Like hepatitis A, hepatitis E usually follows an acute and <u>self-limiting course of illness</u> (the condition is temporary and the individual recovers) with low death rates in resource-rich areas; however, it can be more severe in pregnant women and people with a <u>weakened immune system</u> , with substantially higher death rates. In <u>pregnant women</u> , especially in the third trimester, the disease is more often severe and is associated with a | Prevention Sanitation <u>Sanitation</u> is the most important measure in prevention of hepatitis E; this consists of proper treatment and disposal of human waste, higher standards for public water supplies, improved personal hygiene procedures, and sanitary food preparation. |

| Sr | Pathogen | Disease | Symptom | Water Purification Methods for each pathogen |
|----|--------------------|--|--|--|
| | | | clinical syndrome called fulminant liver failure , with death rates around 20%. ¹ | |
| 10 | E.coli | Escherichia coli (E. coli) bacteria | <ul style="list-style-type: none"> • Diarrhea, which may range from mild and watery to severe and bloody • Stomach cramping, pain or tenderness • Nausea and vomiting, in some people | E. coli can cause an infection even if you ingest only small amounts. Because of this, you can be sickened by E. coli from eating a slightly undercooked hamburger or from swallowing a mouthful of contaminated pool water. |
| 11 | Salmonellas | Salmonella infection (salmonellosis) is a common bacterial disease | Salmonella infection is usually caused by eating raw or undercooked | the bacteria also spread through contaminated water, the |

| Sr | Pathogen | Disease | Symptom | Water Purification Methods for each pathogen |
|----|----------|--|--|--|
| | | <p>that affects the intestinal tract. Salmonella bacteria typically live in animal and human intestines and are shed through stool (feces). Humans become infected most frequently through contaminated water or food.</p> | <p>meat, poultry, and eggs or egg products or by drinking unpasteurized milk. The incubation period — the time between exposure and illness — can be 6 hours to 6 days. Often, people who have salmonella infection think they have the stomach flu.</p> <p>Possible signs and symptoms of salmonella infection include:</p> <ul style="list-style-type: none"> • Diarrhea • Stomach (abdominal) cramps • Fever • Nausea • Vomiting • Chills | <p>environment, other people, and animals. Cooking, Pasteurization</p> |

| Sr • | Pathogen | Disease | Symptom | Water Purification Methods for each pathogen |
|---------|----------|---------|--|--|
| | | | <ul style="list-style-type: none"> • Headache • Blood in the stool | |

2.10 The Government of the Republic of the Union of Myanmar, Ministry of Planning and Finance, developed Myanmar Sustainable Development Plan (2018 – 2030) The following Action Plans have been identified to achieve this strategy.

Pillar 3 People & Planet

Goal 5 Natural Resources & the Environment for Posterity of the Nation

Strategy 5.3 Enable safe and equitable access to water and sanitation in ways that ensure environmental sustainability Access to adequate water, sanitation and hygiene are essential to ensuring the health of individuals and communities, combatting the spread of disease and keeping our young people in school. Much of Myanmar receives abundant rainfall; however, water shortages can still be found throughout the Dry Zone area. Geographical disparities between urban and rural areas also exist. The result of geographic variation, degradation of important ecosystems and underinvestment in water-related infrastructure (for household, private sector and agricultural usage) has meant that too many of our people remain without access to improved sanitation facilities. Recognizing the important role that ecosystems play in providing clean water during the dry season and that degradation of these ecosystems ultimately affects water quality and quantity, Myanmar will enhance investments in conservation and in water-related infrastructure. The GoM will also promote township-level water use planning and encourage healthy water use practices, in order to ensure that the water supply, sanitation and hygiene needs of our schools, health facilities, urban, private sector, and rural communities are met.

5.3.1 Introduce catchment-based integrated water resources planning and management to ensure that water resources are used equitably and sustainably and are responsive to gender-specific needs. Water resources are managed to

support access to effective, efficient and affordable services for improved water supply

5.3.2 Develop national and sub-national inventories of existing water supply services, repair and/or upgrade existing water supply services, and prepare plans for the development of new water supply services. Water resources are managed to support access to effective, efficient and affordable services for improved water supply.

5.3.3 Develop township and village water safety plans, including ensuring the provision of clean and safe water to all people

Water resources are managed to support access to effective, efficient and affordable services for improved water supply.

5.3.4 Facilitate greater cross-border, regional and international collaboration on water related matters in partnership with sub- national governments.

Water resources are managed to support access to effective, efficient and affordable services for improved water supply.

5.3.5 Increase people's use of safe practices for the handling and use of water for domestic and drinking purposes.

Water quality standards are ensured for access to effective, efficient and affordable services for improved water supply.

5.3.6 Practice effective and environmentally safe waste management and disposal in industrial, commercial, household, and public-sector use contexts. Domestic solid waste safely and effectively disposed to promote healthy communities

5.3.7 Enable greater knowledge, attitude and practice of safe hygiene at household and community levels. Hygiene behavior change to promote healthy communities.[13]

3. Objective

The objectives of the desk research on “Developing and piloting a new tool for measuring waterborne diseases” are;

- 1) to provide a system to track waterborne disease
- 2) to apply electronic Health Management Information System - eHMIS
- 3) to assure rapid detection of any outbreaks, and

- 4) to identify hot spots for disease outbreaks, which results in policy recommendations on improved water management

4. Materials and Method

4.1 Research Method

Desk research or Secondary research or “[documentary research](#)” was used in this study. *Desk research* is a type of research that is based on the material published in reports and similar documents that are available in public libraries, websites, data obtained from surveys already carried out, etc. Some organizations also store data that can be used for research purposes. It is a research method that involves the use of existing data. These are collected and summarized to increase the overall effectiveness of the investigation. Secondary research is much more cost-effective than [primary research](#), as it uses existing data, unlike primary research, in which data is collected first-hand by organizations, companies, or may employ a third party to obtain the data in your name. It’s also called “[documentary research](#)“. One of the most popular ways to collect data for desk research is through the Internet. [14]

4.2 Research Orientation

4.2.1 Consultation with the people who had ever been to villages was done and asked the experience of waterborne disease at the villages. Program manager had ever infested with Hepatitis A Virus in 2002, a daughter of program manager passed away with Dysentery at ten months old in 1991, and a brother of program manager passed away at age 22 with Typhoid Fever in 1978. When program manager visited to the villages at the watershed area of Meikthila lake, most of the villages does not have decent toilet, and they practice open defecation in the gully near the village. The water from the gully flows into streams and enter into Meikthila lake carrying feces in the gully. Project manager of ACTMANG mangrove restoration project, who live in delta area of Ayeyarwaddy river, said that most of the villages along the river disposes feces into the river directly from their toilet, many people got waterborne disease in rainy season. Moreover, U Sann Lwin, consultant for environmental conservation explained that most of the villages he had ever visited in Myanmar use open defecation practice in his presentation on 28th December, 2022 at online meeting, organized by “Advancing Cooperation Between Lower Mekong Countries to support governance, transparency and local voices, concerning with water and Water Related Ecosystem” program of Pact Thailand. So, program manager tried to understand the meaning of waterborne

disease, pathogen, symptom, water purification methods to develop and pilot a new tool for measuring waterborne diseases in rivers to identify hot spots for disease outbreaks, which may result in policy recommendations on improved water management.

4.2.2 On 28th December, 2022, Daw Theaint Theaint Aung, consultant for water pollution gave a presentation with the use of the slide of Dr. Khaing Khaing Soe.

4.2.3 Program manager tried to understand the literature of Routine Health Information Network (RHINO) Electronic Health Management Information Systems (eHMIS) <https://www.rhinonet.org/rhis-data-sources/ehmis/>, and University of Oslo Mar 6, 2017 “FROM PAPER BASED- TO ELECTRONIC Health Information (DHIS2) IN MYANMAR”, <https://www.mohs.gov.mm/Main/content/page/electronic-health-management-information-system>

4.2.4 Program manager study the law enforcement, rule of law to control waterborne disease in Myanmar. It stated that the citizen has to legally report to the nearest health department or hospital to identify hot spots for disease outbreaks, which results in policy recommendations on improved water management. According to the “prevention and control of communicable disease law, 1995” and Amendment of Prevention and Control of Communicable Diseases Law (2011) it need to inform promptly to the nearest health department or hospital if the following are occurred;(section 9)

(a) mass death of birds or chicken

(b) mass death of mouse

(c) suspense of occurring of communicable disease or occurring of communicable disease

(d) occurring of communicable disease which must be informed,

4.2.5 Program manager also study the strategy to address water borne disease with the use of One health approach for stakeholder identification and stakeholder engagement in Myanmar. One Health is a collaborative, multi sectoral, and transdisciplinary approach — working at the local, regional, national, and global levels — with the goal of achieving optimal health outcomes recognizing the interconnection between people, animals, plants, and their shared environment. One Health is an approach that recognizes that the health of people is closely connected to the health of animals and our shared

environment. One Health is not new, but it has become more important in recent years. This is because many factors have changed interactions between people, animals, plants, and our environment.

4.2.6 And then, Program manager collected information on the “Waterborne Disease Risk Assessment Program” conducted By New York City Department Of Health & Mental Hygiene, Bureau Of Communicable Disease & New York City Department Of Environmental Protection, Bureau Of Water Supply. Best management practice of the Bureau Of Communicable Disease are;

1. Monitoring of hospital Emergency Department-ED visits, Epidemiological Unit of Health Department, with waterborne disease such as Gastroenteritis (Traveler’s Disease), Hepatitis A, *Cryptosporidiosis*, *Giardiasis*, *Campylobacteriosis*, *Legionnaires’ Disease*, *Shigellosis (Dysentery)*, diarrhea, dysentery, viral hepatitis, typhoid, paratyphoid, cholera
2. Transmit electronic files hourly containing chief complaint and demographic information for patient visits.
3. Classify the Patients into disease severity, categories, and
4. Conduct daily analyses to detect any unusual patterns or signals.
5. Citywide analyses and assess whether the frequency of ED visits for the disease has increased in the last seven days compared to the previous 28 days.
6. Examine clustering by both hospital location and residential zip code.
7. Apply probability estimates such as Monte Carlo probability estimates for Statistical significance to adjust for the multiple comparisons inherent in examining many candidate clusters each day.
8. The threshold of significance for citywide and spatial signals is set at a recurrence interval of 365 days, indicating a false signal rate of once every 365 days.
9. Tracking anti waterborne disease, anti-diarrheal drug sales as an indicator.
10. Modifications and enhancements to city anti-diarrheal medication surveillance program.
11. Tracking of sales of over-the-counter, non-bismuth- containing anti-diarrheal medications and of bismuth subsalicylate medications, searching for citywide as well as local signals. Sales of anti-diarrheal, for example;
 - f. Oral rehydration salts

- g. Zinc syrup and tablets
 - h. Probiotics and prebiotics
 - i. Antibiotics, Metronidazole, Norfloxacin, Sceptin
 - j. Antispasmodic agents, hyoscyamine, dicyclomine
12. Apply the clinical laboratory monitoring system, the number of stool specimens submitted to clinical laboratories for bacterial and parasitic testing also can be a source of information on waterborne disease trends in the population.
 13. Review the Clinical Laboratory Monitoring results upon their receipt.
 14. Apply a model to establish statistical cut-offs for significant increases in clinical laboratory submissions.
 15. Apply the cumulative sums (CUSUM) method to a two-week baseline to identify statistically significant aberrations (or signals) in submissions for ova and parasites and for bacterial culture and sensitivity. CUSUM is a quality control method that has been adapted for aberration detection in public health surveillance.
 16. Adopt the nursing home surveillance system for waterborne disease,
 17. Provided with stool collection kits in advance. When such an outbreak is noted, specimens are to be collected for testing for bacterial culture and sensitivity, ova and parasites, *Cryptosporidium spp.*, viruses, and *Clostridium difficile* toxin.
 18. Control waterborne disease by adopting one health approach (a collaborative, multi sectoral, and transdisciplinary approach.)

5 Findings

- 5.1 It need to get permission and approval from government organization for pilot application of “a tool for measuring waterborne diseases in Mekong, Ayeyarwady, and other rivers to identify hot spots for disease outbreaks, which results in policy recommendations on improved water management”
- 5.2 It need to identify stakeholders who should participate in one health approach and application of Electronic Health Management

Information Systems (eHMIS), and promotion of “From Paper Based-To Electronic Health Information (DHIS2) in Myanmar”

- 5.3 It need to promote stakeholder engagement for the application and regular data entry in the tool for measuring waterborne diseases in Mekong, Ayeyarwady, and other rivers to identify hot spots for disease outbreaks.
- 5.4 It need to disclose the news for early warning on occurring of communicable disease which must be informed.
- 5.5 It need to add the waterborne disease in the list of communicable disease which must be informed.
- 5.6 It need to promote the environmental ethic to prevent from the outbreak of communicable disease.
- 5.7 Ministry of Health, Department of Public Health, Health Information Division published the “Public Health Statistics, 2017-2019”, and it is known that environmental sanitation is one of basic requirements for the uplift of human well-being and quality living conditions. The information on sanitary latrine coverage by households was assessed and reported annually by Basic Health Services Professional- BHSP. At national level, 68.3 percent of households had sanitary latrine in 2016 and the coverage increased to 72.9 percent in 2019

Sanitary Latrine Coverage, Myanmar, 2016-2019

| No | Year | % of household |
|----|------|----------------|
| 1 | 2016 | 68.3 |
| 2 | 2017 | 70.0 |
| 3 | 2018 | 71.1 |
| 4 | 2019 | 72.9 |

Over the four-year period of 2016 to 2019, a steady increase of latrine coverage was seen in most states and regions except Chin State for which the coverage decreased in the year 2019. Rakhine State had the lowest coverage with a minimal increase throughout the four years period. The level of coverage was fluctuated during these four years in Shan(East), Shan(South) and Kachin States, and Tanintharyi Region. In 2019, Yangon Region had the highest level of sanitary latrine

coverage at 85.9 percent whereas Rakhine State had the lowest coverage at 39.1 percent. Although Shan(North) State, Bago Region, Chin State, Shan(South) State, and Ayeyawady Region had over 60 percent coverage, it was lower than the national average (Figure 78). Acknowledging the access to safe water at health facilities is crucial for proper sanitary procedures, the information on safe water coverage at primary health facilities was collected annually since 2019. On average around 8 out of 10 primary health care facilities have access to improved water source in 2019. Primary health facilities in Chin and Rakhine States had the lowest level of access with only six out of ten health care facilities received safe water. [15]

- 5.8 Dr. Khaing Khaing Soe, Deputy Director of Occupational and Environmental Health Division, gave a presentation at World Water Day on 22nd, February 2018, organized by National Water Resource Committee at Nay Pyi Taw, Myanmar. Dr. Khaing Khaing Soe, gave a presentation on “Water and Health in Myanmar. In her presentation, it includes Water-borne Diseases in Myanmar, 2017, She collected the data from eHMIS, DHIS2 as follow.

| No | Name of Diseases | Cases | Deaths |
|----|------------------|---------|--------|
| 1 | Diarrhea(mild) | 472,275 | 58 |
| 2 | Diarrhea(severe) | 9,576 | 1,173 |
| 3 | Dysentery | 123,741 | 35 |
| 4 | Typhoid | 3,955 | 7 |
| 5 | Hepatitis | 6,434 | 45 |

Source: E-HMIS, DHIS2

- 5.9 It need to end open defecation and promote access safe water at health facilities in Myanmar, according to the above finding in Sanitary Latrine Coverage, Myanmar, 2016-2019 and Water-borne Diseases in Myanmar, 2017.
- 5.10 In Myanmar, 27% of household does not have decent toilet. They use open defecation. The villages in Inlay lake are floating community. The village along river dispose fecal directly into river. To address this issue it need to introduce handy pod. The Handy Pod is a water treatment system designed to filter wastewater in floating communities using

natural vegetation. The Handy Pod is inserted under a floating house's toilet, capturing the raw sewage into an expandable bag, called a digester. The Pod uses microbes and fungi to break down the organic sludge into gases such as carbon dioxide, ammonia, and hydrogen. While some microbes in the waste survive the first step of filtration, they are then washed into a pod filled with water hyacinth. The hyacinth roots collect bacteria, leaving the water surrounding it safe enough to play and swim in, but not drink. Further testing is being conducted in order to fully treat the wastewater. The Handy Pod was tested in a floating village in Cambodia for over three years with support from Conservation International and the Bill and Melinda Gates Foundation's Grand Exploration Challenges Program for Water and Sanitation. During the pilot project, Handy Pods were given to 35 houses in a village on Tonle Sap Lake, and the pods reduced E. coli in the ambient water by 50 percent.[16]

- 5.11 It need to attain the Sustainable Development Goals in Myanmar, as it works collaboratively with all sectors to develop a Myanmar Action Plan for the International Decade for Action, Water for Sustainable Development (2018-2028).
- 5.12 It need to implement the strategy 5.3, and associated management activities of Myanmar Sustainable Development Plan (2018 – 2030), developed by Republic of the Union of Myanmar, Ministry of Planning and Finance.
- 5.13 It need to conduct stakeholder identification and promotion of stakeholder engagement to implement the following management activities prescribed in Myanmar Sustainable Development Plan;
 1. Introduce catchment-based integrated water resources planning and management
 2. Ensure that water resources are used equitably and sustainably and are responsive to gender-specific needs.
 3. Manage water resources to support access to effective, efficient and affordable services for improved water supply.
 4. Develop national and sub-national inventories of existing water supply services,
 5. Repair and/or upgrade existing water supply services.
 6. Prepare plans for the development of new water supply services.

7. Develop township and village water safety plans,
8. Ensure the provision of clean and safe water to all people
9. Facilitate greater cross-border, regional and international collaboration on water related matters in partnership with sub-national governments.
10. Increase people's use of safe practices for the handling and use of water for domestic and drinking purposes.
11. Ensure water quality standards for access to effective, efficient and affordable services for improved water supply.
12. Practice effective and environmentally safe waste management
13. Conduct Health Impact Assessment, Environmental Impact Assessment and develop Environmental Management Plan for the disposal in industrial, commercial, household, and public-sector use contexts.
14. Dispose domestic solid waste, Municipal Solid Waste, Hazardous Waste safely and effectively to promote healthy communities.
15. Enable greater knowledge, attitude and practice of safe hygiene at household and community levels.
16. Hygiene behavior change to promote healthy communities.

6. Recommendations

6.1 Early warning is essential to prevent the outbreak of waterborne disease. It is recommended the following stakeholders should participate in one health approach and application of Electronic Health Management Information Systems (eHMIS), and promotion of “From Paper Based- To Electronic Health Information (DHIS2) in Myanmar”

- 1) Ministry of Health and Sports, The Republic of the Union of Myanmar, <https://mohs.gov.mm/>
- 2) Department of Public Health
- 3) Department of Medical Services
- 4) University of Public Health, Department of Epidemiology,
- 5) Health Information Division, Department of Public Health
- 6) Epidemiological Unit of Health Department
- 7) Occupational and Environmental Health Division,
- 8) Public Hospitals,

- 9) Private Hospitals, Clinic,
- 10) National Health Laboratory, public and private health laboratory technicians to apply the clinical laboratory monitoring system
- 11) The Disease Control Division
- 12) non-governmental organizations such as the Myanmar Maternal and Child Welfare Association and the Myanmar Red Cross Society
- 13) Pharmacists
- 14)

6.2 Policy implementation

1. Implement the National Health Policy (1993)[17]
2. Implement the Myanmar Sustainable Development Plan (2018 – 2030), developed by Ministry of Planning and Finance.
3. Develop a comprehensive Health Information Strategy.
4. Adopt one common national platform for health information in Myanmar, namely DHIS2.
5. Apply one health approach
6. Implement Myanmar National Health Plan
7. Develop township and village water safety plans
8. Conduct [Drinking Water Monitoring](#) regularly and apply suitable water purification method
9. Promote township-level water use planning and encourage healthy water use practices,
10. Conduct Waterborne Disease Risk Assessment Program
11. Monitoring of hospital Emergency Department-ED visits,
12. Promote rule of law such as “Prevention and control of communicable Disease Law, 1995” and Amendment of Prevention and Control of Communicable Diseases Law (2011)
13. Promote environmental justice, environmental ethic
14. Adapt and adopt the following proposed tool for Measuring Waterborne Diseases to identify hot spots for disease outbreaks, which results in policy recommendations on improved water management

**Proposed tool for Measuring Waterborne Diseases to identify hot spots for
disease outbreaks In The World**

- 1. Name**
- 2. Sex (Male, Female)**
- 3. Phone number**
- 4. Email address**
- 5. Job (Doctor, Nurse, Health Laboratory Technician, Pharmacist, other)**
- 6. Country**

Please select the country you live in;

1. Afghanistan
2. Albania
3. Algeria
4. Andorra
5. Angola
6. Antigua and Barbuda
7. Argentina
8. Armenia
9. Australia
10. Austria
11. Azerbaijan
12. Bahamas
13. Bahrain
14. Bangladesh
15. Barbados
16. Belarus
17. Belgium
18. Belize
19. Benin
20. Bhutan
21. Bolivia
22. Bosnia and Herzegovina
23. Botswana

24. Brazil
25. Brunei
26. Bulgaria
27. Burkina Faso
28. Burundi
29. Côte d'Ivoire
30. Cabo Verde
31. Cambodia
32. Cameroon
33. Canada
34. Central African Republic
35. Chad
36. Chile
37. China
38. Colombia
39. Comoros
40. Congo (Congo-Brazzaville)
41. Costa Rica
42. Croatia
43. Cuba
44. Cyprus
45. Czechia (Czech Republic)
46. Democratic Republic of the Congo
47. Denmark
48. Djibouti
49. Dominica
50. Dominican Republic
51. Ecuador
52. Egypt
53. El Salvador
54. Equatorial Guinea
55. Eritrea
56. Estonia
57. Eswatini (fmr. "Swaziland")

58. Ethiopia
59. Fiji
60. Finland
61. France
62. Gabon
63. Gambia
64. Georgia
65. Germany
66. Ghana
67. Greece
68. Grenada
69. Guatemala
70. Guinea
71. Guinea-Bissau
72. Guyana
73. Haiti
74. Holy See
75. Honduras
76. Hungary
77. Iceland
78. India
79. Indonesia
80. Iran
81. Iraq
82. Ireland
83. Israel
84. Italy
85. Jamaica
86. Japan
87. Jordan
88. Kazakhstan
89. Kenya
90. Kiribati
91. Kuwait

92. Kyrgyzstan
93. Laos
94. Latvia
95. Lebanon
96. Lesotho
97. Liberia
98. Libya
99. Liechtenstein
100. Lithuania
101. Luxembourg
102. Madagascar
103. Malawi
104. Malaysia
105. Maldives
106. Mali
107. Malta
108. Marshall Islands
109. Mauritania
110. Mauritius
111. Mexico
112. Micronesia
113. Moldova
114. Monaco
115. Mongolia
116. Montenegro
117. Morocco
118. Mozambique
119. Myanmar (formerly Burma)
120. Namibia
121. Nauru
122. Nepal
123. Netherlands
124. New Zealand
125. Nicaragua

126. Niger
127. Nigeria
128. North Korea
129. North Macedonia
130. Norway
131. Oman
132. Pakistan
133. Palau
134. Palestine State
135. Panama
136. Papua New Guinea
137. Paraguay
138. Peru
139. Philippines
140. Poland
141. Portugal
142. Qatar
143. Romania
144. Russia
145. Rwanda
146. Saint Kitts and Nevis
147. Saint Lucia
148. Saint Vincent and the Grenadines
149. Samoa
150. San Marino
151. Sao Tome and Principe
152. Saudi Arabia
153. Senegal
154. Serbia
155. Seychelles
156. Sierra Leone
157. Singapore
158. Slovakia
159. Slovenia

160. Solomon Islands
161. Somalia
162. South Africa
163. South Korea
164. South Sudan
165. Spain
166. Sri Lanka
167. Sudan
168. Suriname
169. Sweden
170. Switzerland
171. Syria
172. Tajikistan
173. Tanzania
174. Thailand
175. Timor-Leste
176. Togo
177. Tonga
178. Trinidad and Tobago
179. Tunisia
180. Turkey
181. Turkmenistan
182. Tuvalu
183. Uganda
184. Ukraine
185. United Arab Emirates
186. United Kingdom
187. United States of America
188. Uruguay
189. Uzbekistan
190. Vanuatu
191. Venezuela
192. Vietnam
193. Yemen

194. Zambia
195. Zimbabwe

6. Please select the state or region, and township of Myanmar where you live in

1. [Ayeyarwady Region](#)
2. [Bago Region](#)
3. [Chin State](#)
4. [Kachin State](#)
5. [Kayah State](#)
6. [Kayin State](#)
7. [Magway Region](#)
8. [Mandalay Region](#)
9. [Mon State](#)
10. [Naypyidaw Union Territory](#)
11. [Rakhine State](#)
12. [Sagaing Region](#)
13. [Shan State](#)
14. [Tanintharyi Region](#)
15. [Yangon Region](#)

7. **Township**

Please select the township in [Ayeyarwaddy Region](#) where you live

1. [Bogale Township](#)
2. [Danubyu Township](#)
3. [Dedaye Township](#)
4. [Einme Township](#)
5. [Hinthada Township](#)
6. [Ingapu Township](#)
7. [Kangyidaunt Township](#)

8. [Kyaiklat Township](#)
9. [Kyangin Township](#)
10. [Kyaunggon Township](#)
11. [Kyonpyaw Township](#)
12. [Labutta Township](#)
13. [Lemyethna Township](#)
14. [Ma-ubin Township](#)
15. [Mawlamyinegyun Township](#)
16. [Myanaung Township](#)
17. [Myaungmya Township](#)
18. [Ngapudaw Township](#)
19. [Nyaungdon Township](#)
20. [Pantanaw Township](#)
21. [Pathein Township](#)
22. [Pyapon Township](#)
23. [Thabaung Township](#)
24. [Wakema Township](#)
25. [Yegyi Township](#)
26. [Zalun Township](#)

Please select the township in [Bago](#) Region where you live

1. Bago Township
2. [Daik-U Township](#)
3. [Kawa Township](#)
4. [Nyaunglebin Township](#)
5. [Shwegyin Township](#)
6. [Thanatpin Township](#)
7. [Waw Township](#)
8. [Kyauktaga Township](#)
9. [Kyaukkyi Township](#)
10. [Oktwin Township](#)
11. [Pyu Township](#)
12. [Tantabin Township](#)
13. [Taungoo Township](#)
14. [Yedashe Township](#)
15. [Pandaung Township](#)
16. [Paukkaung Township](#)

17. [Paungde Township](#)
18. [Pyay Township](#)
19. [Shwedaung Township](#)
20. [Thegon Township](#)
21. [Gyobingauk Township](#)
22. [Letpadan Township](#)
23. [Minhla Township](#)
24. [Monyo Township](#)
25. [Okpho Township](#)
26. [Tharrawaddy Township](#)
27. [Nattalin Township](#)
28. [Zigon Township](#)

Please select the township in Chin State where you live

1. [Falam Township](#)
2. [Hakha Township](#)
3. [Kanpetlet Township](#)
4. [Matupi Township](#)
5. [Mindat Township](#)
6. [Paletwa Township](#)
7. [Tedim Township](#)
8. [Thantlang Township](#)
9. [Tonzang Township](#)

Please select the township in Kachin State where you live

1. [Bhamo Township](#)
2. [Chipwi Township](#)
3. [Hpakant Township](#)
4. [Hsawlaw Township](#)
5. [Injyangyang Township](#)
6. [Kawnglanghpu Township](#)
7. [Machanbaw Township](#)
8. [Mansi Township](#)
9. [Mogaung Township](#)
10. [Mohnyin Township](#)

11. [Momauk Township](#)
12. [Myitkyina Township](#)
13. [Nogmung Township](#)
14. [Putao Township](#)
15. [Sadon](#)
16. [Shwegu Township](#)
17. [Sumprabum Township](#)
18. [Tanai Township](#)
19. [Waingmaw Township](#)

Please select the township in Kayah State where you live

1. [Bawlakhe Township](#)
2. [Demoso Township](#)
3. [Hpasawng Township](#)
4. [Hpruso Township](#)
5. [Loikaw Township](#)
6. [Mese Township](#)
7. [Shadaw Township](#)

Please select the township in Kayin State where you live

1. [Hlaingbwe Township](#)
2. [Hpa-an Township](#)
3. [Hpapun Township](#)
4. [Kawkareik Township](#)
5. [Kyain Seikgyi Township](#)
6. [Myawaddy Township](#)
7. [Thandaunggyi Township](#)

Please select the township in [Magwe](#) Region where you live

1. [Aunglan Township](#)
2. [Chauk Township](#)
3. [Gangaw Township](#)
4. [Htilin Township](#)
5. [Kamma Township](#)
6. [Magway Township](#)
7. [Minbu Township](#)

8. [Mindon Township](#)
9. [Minhla Township, Magway](#)
10. [Myaing Township](#)
11. [Myothit Township](#)
12. [Natmauk Township](#)
13. [Ngape Township](#)
14. [Pakokku Township](#)
15. [Pauk Township](#)
16. [Pwintbyu Township](#)
17. [Salin Township](#)
18. [Saw Township](#)
19. [Seikphyu Township](#)
20. [Sidoktaya Township](#)
21. [Sinbaungwe Township](#)
22. [Taungdwingyi Township](#)
23. [Thayet Township](#)
24. [Yenangyaung Township](#)
25. [Yesagyo Township](#)

Please select the township in [Mandalay](#) Region where you live

1. [Amarapura](#)
2. [Aungmyethazan Township](#)
3. [Chanayethazan Township](#)
4. [Chanmyathazi Township](#)
5. [Kyaukpadaung Township](#)
6. [Kyaukse Township](#)
7. [Maha Aungmye Township](#)
8. [Mahlaing Township](#)
9. [Meiktila Township](#)
10. [Mogok Township](#)
11. [Myingyan Township](#)
12. [Myittha Township](#)
13. [Natogyi Township](#)
14. [Ngazun Township](#)

15. [Nyaung-U Township](#)
16. [Patheingyi Township](#)
17. [Pyawbwe Township](#)
18. [Pyigyidagun Township](#)
19. [Pyinoolwin Township](#)
20. [Singu Township](#)
21. [Sintgaing Township](#)
22. [Tada-U Township](#)
23. [Taungtha Township](#)
24. [Thabeikkyin Township](#)
25. [Thazi Township](#)
26. [Wundwin Township](#)
27. [Yamethin Township](#)

Please select the township in [Mon](#) state where you live

1. [Bilin Township](#)
2. [Chaungzon Township](#)
3. [Kyaikmaraw Township](#)
4. [Kyaikto Township](#)
5. [Mawlamyine Township](#)
6. [Mudon Township](#)
7. [Paung Township](#)
8. [Thanbyuzayat Township](#)
9. [Thaton Township](#)
10. [Ye Township](#)

Please select the township in [Naypyidaw Union Territory](#) where you live

1. [Ottarathiri Township](#)
2. [Pobbathiri Township](#)
3. [Tatkone Township](#)
4. [Zeyathiri Township](#)
5. [Dekkhinathiri Township](#)
6. [Lewe Township](#)
7. [Pyinmana Township](#)

8. [Zabuthiri Township](#)

Please select the township in [Rakhine state](#) where you live

1. [Ann Township](#)
2. [Buthidaung Township](#)
3. [Gwa Township](#)
4. [Kyaukpyu Township](#)
5. [Kyauktaw Township](#)
6. [Manaung Township](#)
7. [Maungdaw Township](#)
8. [Minbya Township](#)
9. [Mrauk-U Township](#)
10. [Myebon Township](#)
11. [Pauktaw Township](#)
12. [Ponnagyun Township](#)
13. [Ramree Township](#)
14. [Rathedaung Township](#)
15. [Sittwe Township](#)
16. [Taungup Township](#)
17. [Thandwe Township](#)

Please select the township in [Sagaing Region](#) where you live

1. [Banmauk Township](#)
2. [Hkamti Township](#)
3. [Homalin Township](#)
4. [Htigyaing Township](#)
5. [Indaw Township](#)
6. [Kale Township](#)
7. [Kalewa Township](#)
8. [Kanbalu Township](#)
9. [Kani Township](#)
10. [Katha Township](#)
11. [Kawlin Township](#)

12. [Khin-U Township](#)
13. [Kyunhla Township](#)
14. [Lahe Township](#)
15. [Leshi Township](#)
16. [Mawlaik Township](#)
17. [Mingin Township](#)
18. [Myaung Township](#)
19. [Myinmu Township](#)
20. [Nanyun Township](#)
21. [Pale Township](#)
22. [Paungbyin Township](#)
23. [Pinlebu Township](#)
24. [Sagaing Township](#)
25. [Salingyi Township](#)
26. [Shwebo Township](#)
27. [Tabayin Township](#)
28. [Tamu Township](#)
29. [Taze Township](#)
30. [Wetlet Township](#)
31. [Wuntho Township](#)
32. [Ye-U Township](#)
33. [Yinmabin Township](#)

Please select the township in [Shan state](#) where you live

1. [Hsi Hseng Township](#)
2. [Kalaw Township](#)
3. [Langhko Township](#)
4. [Mawkmai Township](#)
5. [Mong Ton Township](#)
6. [Nansang Township](#)
7. [Nyaungshwe Township](#)
8. [Taunggyi Township](#)
9. [Hopang Township](#)
10. [Hopong Township](#)
11. [Hsenwi Township](#)

- 12.[Hsi Hseng Township](#)
- 13.[Hsipaw Township](#)
- 14.[Kalaw Township](#)
- 15.[Kengtung Township](#)
- 16.[Konkyan Township](#)
- 17.[Kunhing Township](#)
- 18.[Kunlong Township](#)
- 19.[Kutkai Township](#)
- 20.[Kyaukme Township](#)
- 21.[Kyethi](#)
- 22.[Kyethi Township](#)
- 23.[Lai-Hka Township](#)
- 24.[Langhko Township](#)
- 25.[Lashio Township](#)
- 26.[Laukkaing Township](#)
- 27.[Lawksawk Township](#)
- 28.[Loilem Township](#)
- 29.[Mabein Township](#)
- 30.[Mantong Township](#)
- 31.[Mawkmai Township](#)
- 32.[Mong Hpayak Township](#)
- 33.[Mong Hsat Township](#)
- 34.[Mong Hsu Township](#)
- 35.[Mong Khet Township](#)
- 36.[Mong Kung Township](#)
- 37.[Mong Nai Township](#)
- 38.[Mong Pan Township](#)
- 39.[Mong Ping Township](#)
- 40.[Mong Yang Township](#)
- 41.[Mong Yawng Township](#)
- 42.[Mongmao Township](#)
- 43.[Mongmit Township](#)
- 44.[Mongyai Township](#)
- 45.[Mu Se Township](#)
- 46.[Namhkam Township](#)
- 47.[Namhsan Township](#)
- 48.[Namtu Township](#)
- 49.[Nansang Township](#)
- 50.[Nawngkhio Township](#)
- 51.[Nyaungshwe Township](#)

52. [Panglong, Southern Shan State](#)
53. [Pekon Township](#)
54. [Pindaya Township](#)
55. [Pinlaung Township](#)
56. [Tachileik Township](#)
57. [Tangyan Township](#)
58. [Taunggyi Township](#)
59. [Ywangan Township](#)

Please select the township in [Thaninthayi](#) Region where you live

1. [Bokepyin Township](#)
2. [Dawei Township](#)
3. [Kaleinaung Subtownship](#)
4. [Kawthaung Township](#)
5. [Kyunsu Township](#)
6. [Launglon Township](#)
7. [Myeik Township](#)
8. [Myitta Subtownship](#)
9. [Palaw Township](#)
10. [Tanintharyi Township](#)
11. [Thayetchaung Township](#)
12. [Yebyu Township](#)

Please select the township in [Yangon](#) Region where you live

1. [Ahlon Township](#)
2. [Bahan Township](#)
3. [Botataung Township](#)
4. [Dagon Seikkan Township](#)
5. [Dagon Township](#)
6. [Dala Township](#)
7. [Dawbon Township](#)
8. [East Dagon Township](#)
9. [Hlaing Township](#)
10. [Hlaingthaya Township](#)
11. [Insein Township](#)
12. [Kamayut Township](#)

13. [Kyauktada Township](#)
14. [Kyimyindaing Township](#)
15. [Lanmadaw Township](#)
16. [Latha Township](#)
17. [Mayangon Township](#)
18. [Mingala Taungnyunt Township](#)
19. [Mingaladon Township](#)
20. [North Dagon Township](#)
21. [North Okkalapa Township](#)
22. [Pabedan Township](#)
23. [Pazundaung Township](#)
24. [Sanchaung Township](#)
25. [Seikkan Township](#)
26. [Seikkyi Kanaungto Township](#)
27. [Shwepyitha Township](#)
28. [South Dagon Township](#)
29. [South Okkalapa Township](#)
30. [Tamwe Township](#)
31. [Thaketa Township](#)
32. [Thingangyun Township](#)
33. [Yankin Township](#)

8. Please select the nearest river with your home

1. [Ataran River](#)
2. [A-thút](#)
3. [Bago River](#) (Pegu River)
4. [Bilin River](#)
5. [Chaungmagyi River](#)
6. [Chindwin River](#)
7. [Dagā River](#)
8. [Dapein River](#)
9. [Dawei River](#) (Tavoy River)
10. [Great Tenasserim River](#) (Tanintharyi River)
11. [Gyaing River](#)
12. [Haungtharaw River](#)
13. [Heinze River](#)
14. [Hsim River](#)
15. [Irrawaddy River](#) (Ayeyarwady River)
16. [Kaladan River](#)

17. [Kaleindaung River](#)
18. [Kha Paung Creek](#)
19. [Kraburi River](#) (Pakchan River)
20. [Kyaw River](#)
21. Lai Za Stream
22. [Lemro River](#)
23. [Lenya River](#)
24. [Mali River](#)
25. [Manipur River](#)
26. [Mayu River](#)
27. [Moei River](#) (Thaungyin River)
28. [Mon River](#)
29. [Mu River](#)
30. Mung Lai Stream
31. [Myitmaka River](#)
32. [Myitnge River](#)
33. [Myittha River](#)
34. [Nāf River](#)
35. [Nam Pang River](#)
36. [Nanding River](#)
37. [N'Mai River](#)
38. [Pai River](#)
39. [Pathein River](#) (Bassein River)
40. [Paung Laung River](#)
41. [Paunglaung River](#)
42. [Pawn River](#)
43. [Phyu Creek](#)
44. [Pilu River](#)
45. [Pyanmalot River](#) (Pyamalaw River)
46. [Salween River](#) (Thanlwin River)
47. [Shweli River](#)
48. [Sinthay River](#)
49. [Sittaung River](#)
50. [Taping River](#)
51. [Tarpein River](#)
52. [Teng River](#)
53. [Thandi River](#)
54. [Tizu River](#)
55. [Uyu River](#)
56. [Winyaw River](#)

57. [Yangon River](#) (Rangoon River) (Hlaing River)
58. [Yaw River](#)
59. [Ye River](#)
60. [Yin River](#)
61. [Yunzalin River](#)
62. [Zami River](#)
63. [Zawgyi River](#)

9, Please select the nearest lake with your home

1. [Indawgyi Lake](#)
2. [Inle Lake](#)
3. [Inya Lake](#)
4. [Kan Thar Yar Lake](#)
5. [Kandawgalay](#)
6. [Kandawgyi Lake](#)
7. [Meiktila Lake](#)
8. [Moe Yin Gyi Reservoir](#)
9. [Lake of No Return](#)
10. [Rih Dil](#)
11. [Sunye Lake](#)

10. Is there natural disaster such as flood, earthquake or tsunami which can destroy sewage pipe and contaminate with pathogen to drinking water pipe, lakes, well and streams which people use for drinking water?
11. Is there the habit of bathing and defecating or disposal of feces in water body or practice of open defecation which can cause the outbreak of waterborne disease in your township?
12. If you are health workers from hospital,
 1. Could you please give early warning by Monitoring of hospital Emergency Department-ED visits, with waterborne disease?
 2. Could you please transmit electronic files hourly containing chief complaint and demographic information for patient visits, with waterborne disease
 3. Could you please classify the Patients into disease severity and categories?

4. Could you please conduct daily analyses to detect any unusual patterns or signals?
 5. Could you please conduct citywide analyses and assess whether the frequency of ED visits for the disease has increased in the last seven days compared to the previous 28 days?
 6. Could you please examine clustering by both hospital location and residential zip code?
 7. Could you please apply probability estimates such as Monte Carlo probability estimates for Statistical significance to adjust for the multiple comparisons inherent in examining many candidate clusters each day?
 8. Could you please estimate the threshold of significance for citywide and spatial signals at a recurrence interval of 365 days, indicating a false signal rate of once every 365 days?
13. If you are Pharmacists
19. Could you please take part in sharing information to prevent outbreaks, and tracking anti waterborne disease, anti-diarrheal drug sales as an indicator.?
 20. Could you please take part in Modifications and enhancements to city anti-diarrheal medication surveillance program?
 21. Could you please share the information on the sales of anti-diarrheal? for example;
 - k. Oral rehydration salts
 - l. Zinc syrup and tablets
 - m. Probiotics and prebiotics
 - n. Antibiotics, Metromidazole, Norfloxacin, Septrim
 - o. Antispasmodic agents, hyoscyamine, dicyclomine
14. If you are public and private health laboratory technicians, do you usually apply the clinical laboratory monitoring system, and the number of stool specimens submitted to clinical laboratories for bacterial and parasitic testing? It also can be a source of information on waterborne disease trends in the population.

15. If you are public and private health laboratory technicians, what are the findings of the review on the Clinical Laboratory Monitoring results upon their receipt.
16. If you are public and private health laboratory technicians, do you apply a model to establish statistical cut-offs for significant increases in clinical laboratory submissions, and could you please share the data?
17. If you are public and private health laboratory technicians, do you apply the cumulative sums (CUSUM) method to a two-week baseline to identify statistically significant aberrations (or signals) in submissions for ova and parasites and for bacterial culture and sensitivity?. CUSUM is a quality control method that has been adapted for aberration detection in public health surveillance.
18. Is there adoption of the nursing home surveillance system for waterborne disease?
19. If the nursing home surveillance system is adopted, how many patients are being surveyed?
20. Are the stool collection kits provided in advance?
21. If the stool collection kits are provided, how many specimens are collected for testing for bacterial culture and sensitivity, ova and parasites, *Cryptosporidium spp.*, viruses, and *Clostridium difficile* toxin etc?
22. Thank you for your kind participation in controlling waterborne disease by adopting one health approach.

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