Extended Abstract

Harvesting Rainwater to improve water access for maternal health in Malawi: protocol and preliminary findings

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Background

Water plays a huge role in Malawi's economy and water-reliant sectors contribute an estimated 35% to the country's gross domestic product (GDP) but it remains scarce (World Bank, 2020). Climate change impacts such as droughts, floods, and rising sea levels create risks that will affect all human activities, including health service delivery (United Nations, 2021). It has largely affected water availability, quantity, and quality of water for basic human needs, industrial works, and other water use activities due to the increase in the growing water demand which demands energy-intensive water pumping, transportation, and treatment (UNICEF, 2021).

Hospitals in Malawi are also experiencing water challenges during health service delivery. According to WaterAid, over 24% of the country's public health facilities are running without water (WaterAid, 2022). In most health facilities, the installed water resources e.g., solar-powered systems and handpumps connected to drilled boreholes are currently not operational because of the malfunctions of the existing water sources for the health facility. Patients and their attendants are often asked to bring in buckets of water for use. The impact of the water crisis on maternal health remains a challenge in Malawian hospitals, therefore there is a need to rectify the situation.

To adapt to the changing climate and its impact on water, Health Care Facilities (HCFs) need to implement adaptive management strategies to be resilient and to protect the health of the communities they serve in an unstable and changing climate. However, this is not an easy task in resource-limited settings such as Malawi and the wider sub-Saharan Africa region, where large gaps in water supply already exist, hence the urgent need for innovative solutions.

This is a study that informs and evaluates the implementation of a water treatment solution in rural Malawi. The goal is to ensure that access to a safe water supply is maintained throughout the year and can withstand extreme weather events and mains water supply breakdowns in Thekerani and Chimvu Health Centres in Thyolo district. SURG-Water will repurpose, deploy and evaluate a new, low-cost technology to treat harvested rainwater using renewable solar UV. This is to ensure reliable access to clean water to serve the

basic needs of health facilities providing maternal and neonatal care for one the most vulnerable populations - women and newborns in remote areas.

Methods

The study will use a pre-post, mixed-methods study to evaluate the feasibility, adoption, and effectiveness of the SURG-Water technology for improving the reliability of clean water supply at district health facilities. A Participatory Research (PR) framework, will be used to gain community support and achieve longterm sustainability of the project study. PR is a research-to-action approach that emphasizes direct engagement of local priorities and perspectives, co-constructing research processes through partnerships between researchers, community members, and other insiders. The aim is to create local ownership, enabling the stakeholders to guide the research agenda. Interviews and focus group discussions will be conducted with the clinic staff members and patients to acquire knowledge of the water situation, performance, and the impact of any water crisis on the hospital to both the staff and the patients.

Our proposed solution centers on the development and demonstration of the potential of a large volume (> 150 L) transparent batch solar water disinfection (SODIS) reactor, deployed to treat harvested rainwater collected on-site in healthcare facilities in Malawi. The SODIS reactor would be used in periods of shortages, outages, or when water quality is compromised. SODIS has previously been proven effective at the household level using standard plastic bottles. In SURG-Water we will attempt a new technology using photostable and robust material, scaling up the size of the reactor and its capacity to treat water.

Preliminary design phase

Data will be collected using a structured questionnaire and question guides that will be administered to randomly sampled patients (community) and staff members. Site visits will be conducted to appreciate the facility's catchment demographics, patient flows, water sources and supply infrastructure, water quantity, quality and availability, systems operations and maintenance arrangements and gaps.

Solar and precipitation data shall be collected and analysed using Meteonorm Version 8. Meteonorm is a meteorological database that contain climatological data for solar engineering applications at every location on the globe. It is a source of information for meteorological reference for environmental research, agriculture, forestry and anyone else interested in meteorology and solar energy.

The facility records, focus group discussions with patients/guardians will supplement the sources of data and will also help understand the depth of the issues around water especially for the delivery of maternal and child health services in the selected facilities.

These results will provide the baseline data to inform designing as well as benchmarking indicators of interest for system performance and compliance monitoring at implementation.

Implementation Phase of the project

Same tools and approaches employed to collect and analyse data at baseline will be used during implementation. Water quality tests of the harvested rain water will be conducted to determine the physical, chemical and biological parameters. Analysis of the water samples for correlates to determine the presence of organic and inorganic compounds, microorganisms (bacteria, parasitic pathogens, viruses) as proxies for water quality against WHO guidelines for water quality and regulatory requirements for water by Malawi Beaureau of Standards (MBS). Periodic water quality tests would be done using portable multi-parameter handheld devices for parameters such as Ph, Total dissolved salts(TDS), Salinity, Temperature, Electrical conductivity(EC) etc. Water Samples shall be collected for microbiological tests using thermos torelant coliform count (faecal coliform counts) and analysis be done benchmarked against World Health Organization guidelines (WHO 2004). Flow rate bucket tests will be conducted using a Stop clock and bucket at all the point of accessing the water to appreciate the flow rates and water pressure using the following formula: **Flow rater(L/min) =[Bucket size(L]÷[Fill time(sec)]×60×0.8,** where 0.8 is the 20% is factored in, for eventual pressure losses within the system.

PRELIMINARY FINDINGS: A rapid situation analysis in three district hospitals and three health centres confirmed shortages of water in healthcare facilities in Malawi. In all assessed facilities water was not available uninterruptedly, and in one, water has not been available onsite at all for the last two years leading to the need for pregnant women to carry buckets with water to be used for the delivery of the babies. In the maternity wards there is no water, so expectant mothers fetch it in buckets to meet their sanitary needs. Clinicians compromise infection prevention protocols due to lack of water, leading to an increased risk of infections.

CONCLUSIONS: In Malawi, there is a currently untapped potential to harvest rainwater and treat it with UV sunlight. Low-cost solutions such as SODIS can help clinicians and patients use the solar-disinfected harvested rainwater to meet their daily water needs related to personal hygiene, infection prevention measures and provision of essential health care. The full results of the evaluation will be available end of 2024.