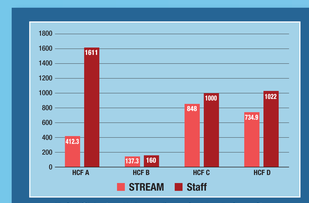
Remote Data Capture and Visualization Frameworks to Support Chlorine Generator Use throughout National Healthcare Systems

Envicom is collaborating with Aqua Research, Catholic Relief Services (CRS), and PATH to develop and pilot an **IoT** solution that can automatically collect and transmit frequent technical performance data from an onsite chlorine generator – Aqua Research's **STREAM** Disinfectant Generator – to cloud-based, end user-centric dashboards. This pilot project is taking place in Ghana in support of the Ghana Health Service.

The Need for Automated, Objective Date

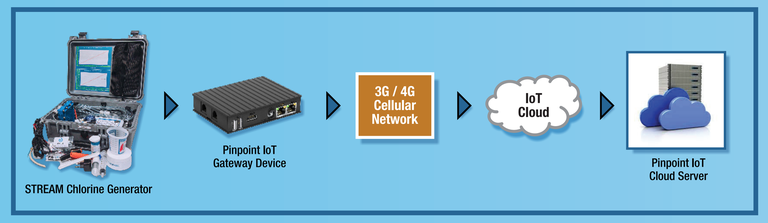


Total Chlorine Volume Reported by Automation Versus User (PATH Project)

Many reasons contribute to a low level of confidence in user-reported data. Either it is not reported, not accurately reported, or it is over-reported. The challenges related to these behaviors have many negative implications. Where stock data is not registered, how can informed decisions be made regarding supplies and associated costs? When there are multiple users with heavy workloads and various levels of training, how can the accuracy of user-reported data be assured? Over-estimating by users who want to look productive or want reward / recognition –as well as those who simply do not measure and over-report – can be as problematic as not reporting at all.

Data acquired from the **STREAM** chlorine generator is intended to provide insights to national and district health leaders regarding HCF-based hygiene services, as well as by **STREAM** maintenance service providers to sustain operation. Given the importance of this data among project stakeholders, we sought to automate collection using Internet of Things **(IoT)** technology. Ten **IoT** gateway units were deployed to Ghana in December 2021, with each being assigned to a single Aqua Research **STREAM** Disinfectant generator. Five of these **STREAM / IoT** Gateway Systems are being overseen by **PATH**, and five by **CRS**, and are geographically well distributed across Ghana. All of the components required for installation of the units onsite arrived in Ghana on March 31, 2022.

IoT System for Data Communication with STREAM



IoT What Is It?

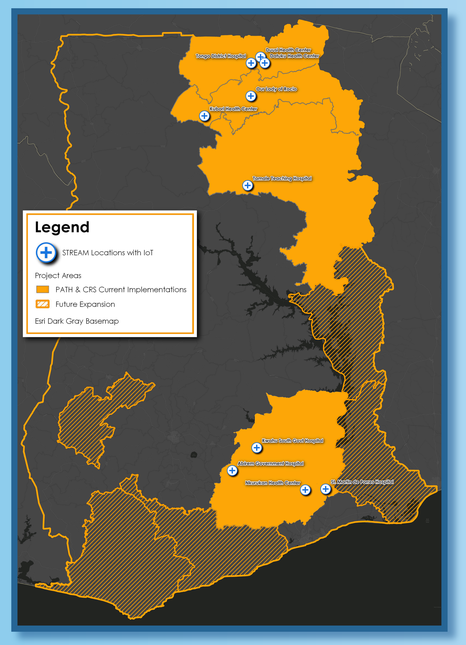
The term **IoT**, or Internet of Things, refers to the collective network of connected devices and the technology that facilitates communication between devices and the cloud, as well as between the devices themselves (AWS 2022).* **Envicom** developed an **IoT** device known as a Gateway, that would communicate with the **STREAM** unit via Bluetooth every 5 minutes. The Gateway device then uses available 3G/4G cellular network to transmit data packages to the **IoT** Cloud where it is then sent to our **IoT** Server. At that point, the data is ingested into preconfigured visualizations which update in near real-time.

* Amazon Web Services. 2022. What is the Internet of Things (IoT)? https://aws.amazon.com/what-is/iot/ (accessed October 11, 2022)

Good data architecture is an imperative component of strengthening healthcare systems and evidence-based decision making. While data in the WASH in HCF sector has become increasingly available, the environmental hygiene service area remains a clear gap.

Remote Data Capture Locations from STREAM Units in Ghana

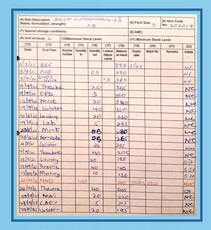
This map shows the distribution of **STREAM / IoT** implementations across Ghana, with **CRS** managing the systems in northeastern Ghana and **PATH** managing those in the southeast of the country.

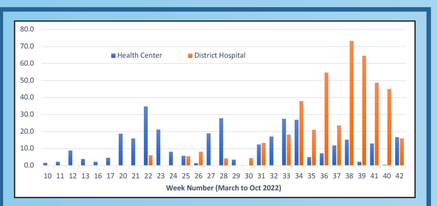


Data Visualizations: Improvements over Prior Insights

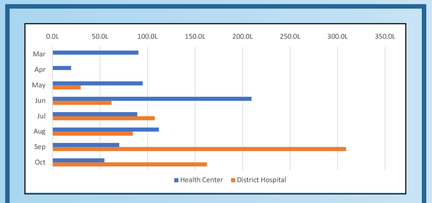
When compared with the paper stock cards, the improvements in information available to all project stakeholders are substantial:

- Hour-by-hour information on production and supply
- Granularity of the data allows for clear view of activity over time
- Provides a common operating picture for all stakeholders
- Addresses a gap in our understanding of the supply chain
- Provides insights to maintenance staff that improve useability of the **STREAM**
- Helps our understanding of use challenges by staff (e.g., common errors)
- Provides visual guidance on the maintenance needs of the asset
- Downloadable reports are available with pre-aggregated data (efficiencies)

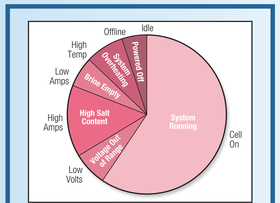

Chlorine Stock Card



Hourly Usage per Week by Facility Type



Monthly Production Volumes by Facility Type



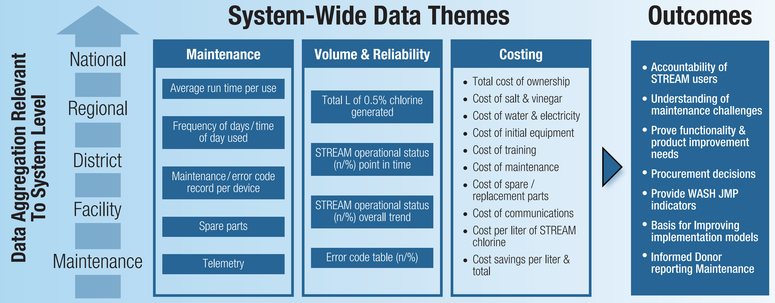
STREAM State Summary

What Makes this Solution Novel?

Our work strengthens IPC activities within healthcare systems by providing automated data capture from **STREAM** chlorine generators. It **does not require any behavior change from overworked healthcare workers with regard to consistent or accurate data collection.** Further, the data architecture we configure behind the visualization platform allows it to be 'served' to different end users throughout the healthcare system to **directly support their role (e.g., National Government Administrator vs. Regional Biomedical Engineers)** while at the same time validating the ongoing efficacy of the **STREAM** as a systemic solution.

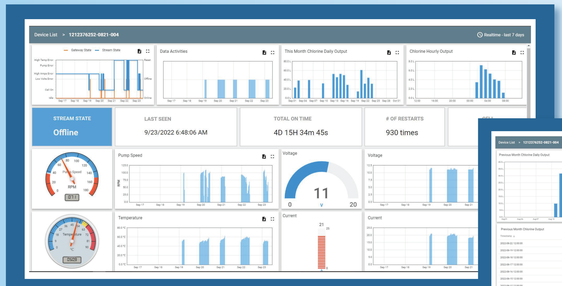
End User Data Needs

In order to measure the effectiveness of the **STREAM** Chlorine Generator for their work, different end users need to see different information, based entirely on their job responsibilities and the level of government at which they work. Generally, these data themes are all relevant to all users, however, more granular or more aggregated presentations of the data are needed depending on the user role within the healthcare system. Some examples of data themes and outcomes are indicated here:



Future Opportunities

During the next phase of the project, we plan to scale this concept throughout the whole health system, with targeted data visualizations for different users at the national, regional, district, and facility levels, as well as maintenance personnel. The results of this exercise can be used to demonstrate the power of trustworthy data for systems strengthening, in addition to enabling decision-making. We will also perform research and development to implement a novel technology that will reduce the cost of **IoT** communications substantially. Our goal is to make this remote data capture capability more accessible to many more users in LMICs.



Telemetry


Monthly Production Volumes