Introduction of a novel chlorine generator in Ghana, Uganda, and Ethiopia public health systems

A learning series on the Aqua Research STREAM™ Disinfectant Generator
About the STREAM Learning Brief Series

Poor water, sanitation, and hygiene practices contribute to the spread of infections and negative health outcomes in communities and health care settings. Globally, roughly 3.85 billion people use health facilities that lack basic hand hygiene services, while 1.7 billion people access health facilities that lack basic water services. Achieving the United Nations Sustainable Development Goal 6 (SDG 6)—ensuring access to water and sanitation for all—demands innovative and strategic solutions. One such solution is the Aqua Research STREAM™ Disinfectant Generator (STREAM). The STREAM is an onsite chlorine generator that uses common salt and water to generate liquid chlorine that meets global standards for intermediate-level disinfection of surfaces in healthcare settings and can be used for treating drinking water.

With funding from the Conrad N. Hilton Foundation and in collaboration with ministries of health, this learning brief series provides real-world examples and lessons learned from implementing the STREAM in three countries: Ghana, Uganda, and Ethiopia.

It describes how PATH in collaboration with ministries of health is using the SDG 6 Global Accelerator Framework to introduce and scale up the STREAM on a national level. Each issue focuses on one of the five SDG 6 accelerators:

![Diagram of the five SDG 6 accelerators: Governance and policy, Financing, Data and information, Capacity development, Innovation.]


Cover photos: PATH/Thomas Mugumya, PATH/Patrick McKern, PATH/Adam Drolet
INTRODUCTION OF A NOVEL CHLORINE GENERATOR IN GHANA, UGANDA, AND ETHIOPIA HEALTH SYSTEMS

Learning brief: The role of government champions in national adoption of the Aqua Research STREAM™ Disinfectant Generator

February 2024

A health center in North Mecha, Ethiopia using a STREAM device.

Investing in relationships: Government champions are critical for driving national policy and regulatory approvals and health system adoption

Starting in 2018, PATH has cultivated strong relationships with government actors responsible for water, sanitation, and hygiene (WASH) services in health facilities across various levels of the health system (national, regional, district or woreda). In these settings, we take a collaborative approach to project design and implementation with government leaders, jointly implementing activities such as assessing evidence gaps and conducting evaluations, codeveloping policy roadmaps and introduction strategies, and piloting activities that integrate WASH innovations into routine health service delivery.

Our collaborative approach has enabled us to achieve key milestones on the introduction of a novel chlorine generator—the Aqua Research STREAM™ Chlorine Generator (STREAM)—in Ghana, Uganda, and Ethiopia. Illustrative successes include: national MOH approval for the STREAM introduction in the Uganda health system; certification of STREAM chlorine by national drug and pharmaceutical regulatory bodies in Uganda, Ethiopia, and Ghana (pending final result); expansion of STREAM evidence base through four codesigned studies between PATH and national/regional/district health service leaders; and integration of the STREAM into routine infection prevention and control (IPC) training and supervisory activities in Ghana and Uganda. Below we describe specific examples of how work by PATH and key government champions led to the various successes.

This document is part of the Stream learning brief series and focuses on how strong government partnerships can drive successful introduction of the Aqua Research STREAM™ Disinfectant Generator (STREAM) across national health care systems. It explores the critical role of government champions in navigating approvals, fostering key partnerships, and ultimately delivering safe and effective water, sanitation, and hygiene services in health facilities.
Governance: WASH service delivery in health facilities

In all three project countries—Ethiopia, Ghana and Uganda—WASH services in health facilities are governed by the respective MOHs. Typically, this includes responsibilities such as developing national guidelines and policies for the delivery of WASH services, supporting capacity development for health staff and implementation of WASH activities in health facilities, and establishing national budgets and standardized monitoring systems. Within MOHs, oversight of WASH services is often nested within clinical care departments. For example, in Uganda, the Clinical Services Department (CSD) within the MOH is responsible for policies, standard operating procedures, and guidelines on clinical care; information, education, and communication materials; and trainings—whereas the Environmental Health Department is focused on infrastructure, water availability, and water quality. WASH services are considered a core element of clinical care.

In Ghana, the Ghana Health Service’s Institutional Care Division is responsible for leading, supporting, and providing oversight to client-centered, high-quality clinical services, which includes WASH services, across all service delivery levels in the Ghana health system. In Ethiopia, the Hygiene and Environmental Health Directorate of the Federal Ministry of Health is responsible for overseeing policy, strategy, and interventions of environmental determinants on health, including WASH services, within the health system. This directorate published the WASH in HCF guidelines (2021) for the country. In each country, PATH has established strong relationships with directors from each of these departments, which has helped inform and drive project objectives, generate ownership and buy-in for the project, and further integrate the device into national health systems.

Uganda

PATH’s collaboration with the Ministry of Health’s (MOH) Clinical Services Department (CSD) Acting Commissioner, Dr. Rony Bahatungire, has been instrumental for securing policy and regulatory approvals for the STREAM’s introduction into the public health system. Starting in 2019, PATH and Dr. Bahatungire co-outlined a roadmap for navigating policy approval processes; designed STREAM evaluations to generate evidence on the performance, acceptability, and cost impact of the STREAM in health facilities; and jointly prepared and presented results to several governmental policy approval bodies (see Figure 1).

As a final step for national approval, PATH and Dr. Bahatungire jointly presented STREAM results to the MOH’s Top Management Committee (TMC) on the STREAM evaluation in June 2023. PATH and Dr. Bahatungire presented the performance, cost, and acceptability results from ten STREAM devices installed across ten Central and Western Region health facilities to Uganda’s Minister of Health, Dr. Jane Ruth Aceng Ocero, and the TMC. Following their review, the TMC approved the use of the STREAM in Uganda’s health care system, officially enabling government-led introduction into the public health system, as well as providing a strong vote of confidence for uptake and use in private—not-for-profit and private-for-profit health facilities.

“As the Ministry of Health, we are in full support of this technology. I call upon the leadership of the private health facilities and private—not-for-profit health facilities to embrace this new technology to solve the challenges of stockouts and the effects of corrosion of medical equipment and damage to linen and gowns.”

— Dr. Henry G. Mwebesa, Director General of Health Services, Uganda MOH

**FIGURE 1. STREAM policy and regulatory approvals, Uganda.**

<table>
<thead>
<tr>
<th>STREAM units installed (Dec 2020)</th>
<th>Senior Management Committee approval (Jun 2021)</th>
<th>National Drug Authority Certificate of Analysis (Jul 2022)</th>
<th>Top Management Committee approval (Jun 2023)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOH Letter of Support (Sep 2020)</td>
<td>WASH/IPC/Hospital &amp; Health Infrastructure TWG approval (Mar 2021)</td>
<td>Health Policy and Advisory Committee approval (Apr 2022)</td>
<td>National Committee on Medical Equipment approval (Oct 2022)</td>
</tr>
<tr>
<td>2020</td>
<td>2021</td>
<td>2022</td>
<td>2023</td>
</tr>
</tbody>
</table>

Abbreviations: IPC, infection prevention and control; MOH, ministry of health; TWG, technical working group; WASH, water, sanitation, and hygiene.
The June 2023 TMC approval, which officially enables government institutions to purchase STREAM devices and provides a strong vote of confidence for uptake and use in private-not-for-profit and private-sector health facilities, was the result of roughly three years of advocacy, evidence generation, and a close working partnership between the MOH/CSD and PATH.

### Ghana

Starting in 2018, PATH began working closely with the Ghana Health Service's Institutional Care Division (GHS/ICD) and its Director, Dr. Samuel Kaba, to strengthen the delivery of WASH and IPC services in health facilities through the evaluation and introduction of on-site chlorine generators. In September 2019, the GHS/ICD and PATH teams collaborated to design and launch an observational study design involving eight STREAM units in the Eastern Region. Following delays due to the SARS-CoV-2 pandemic, in December 2020, PATH and the ICD team co-led installations and training sessions with STREAM users across eight health facilities (see Figure 2). Over the next 18 months, Eastern Region biomedical engineers regularly accompanied PATH on monitoring trips to build familiarity and hands-on experience troubleshooting and repairing STREAM devices. The GHS/ICD staff frequently joined PATH on monitoring visits to these facilities, eventually leveraging these monitoring trips (starting in December 2021) to conduct in-service IPC refresher training for health staff. In June 2022, PATH officially turned over the operation of STREAM units in the Eastern Region (Jun 2023).

### FIGURE 2. STREAM policy and regulatory approval, Ghana.

<table>
<thead>
<tr>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
</tr>
</thead>
<tbody>
<tr>
<td>GHS Letter of Support (Sep 2020)</td>
<td>STREAM observational study launched in Eastern Region (Dec 2020)</td>
<td>PATH/GHS observational monitoring and IPC training (2021–2022)</td>
<td>STREAM units installed in Central, Volta, Ahafo Regions (Jun 2023)</td>
</tr>
<tr>
<td>STREAM dissemination meeting (Nov 2021)</td>
<td></td>
<td>Ghana Standards Authority/Bureau Veritas Certificate of Conformity (Jan 2022)</td>
<td>National STREAM dissemination meeting (Sep 2023)</td>
</tr>
</tbody>
</table>

Abbreviations: GHS, Ghana Health Service; IPC, infection prevention and control.
and maintenance/repair of the STREAM in the Eastern Region to the regional health management team, health facilities, and Eastern Region biomedical staff.

Results from this study led the Eastern Region health directorate to commit to providing ongoing funding for STREAM chlorine production supplies (salt, vinegar). In August 2022, four additional STREAM units were installed in two district hospitals and two health centers by the Eastern Region health management team. All STREAM maintenance and repair services have been transferred to PATH–trained Eastern Region biomedical staff, who continue to provide technical assistance to STREAM users. The success and sustained adoption of the STREAM devices in the Eastern Region led Dr. Kaba to publicly voice his support and confidence in the STREAM and call for national scale–up of the device, starting with an expansion in the Volta, Ahafo, and Central Regions.

In parallel with the observational study and with the intent of moving toward STREAM product registration in Ghana, Aqua Research contracted Bureau Veritas to assess the STREAM’s compliance with the Ghana Standards Authority’s safety measures (IEC 61010-1:2010) for electrical equipment. In January 2022, Bureau Veritas issued a certificate of conformity for and on behalf of the Ghana Standards Authority for the STREAM device. The following month (February 2022), PATH held a series of meetings with the GHS/ICD, the Ghana Standards Authority, and the Ghana Food and Drug Authority (FDA) to review and agree upon the classification of the STREAM. Ultimately in January 2023, the Ghana FDA issued a final determination stating the STREAM “does not fall within the definition and classification rules per the Authority’s Guidelines for the Registration of Medical Devices.” This determination is a significant milestone for the project as it simplifies the registration, import, and market adoption of the STREAM in Ghana.

In June 2023, PATH and the GHS/ICD jointly installed 18 STREAM devices in 12 Central, Volta, and Ahafo Region HCFs. Similar to the observational monitoring in 2020–2022, the GHS and PATH coupled the introduction and use of STREAM devices with IPC assessments and supportive supervision visits, reaching more than 200 health care professionals from June to November 2023. Additionally, PATH and the GHS ensured regional biomedical engineers from the Volta, Central, and Ahafo Regions were trained on technical maintenance and repair procedures and facilitated connection with biomedical engineers from the Eastern Region.

Finally, PATH and the GHS/ICD have submitted a request for laboratory analysis and certification by the Ghana FDA on the chlorine concentration of the STREAM. PATH and the GHS/ICD Director expect the regulatory and combined evaluation results (expected March 2024) will provide a strong case for the policy adoption of the STREAM as a tool for enhancing IPC in HCFs by GHS/MOH leadership in 2024.

### Policy and regulatory approvals for STREAM introduction in Ghana

<table>
<thead>
<tr>
<th>Month</th>
<th>Authority</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 2022</td>
<td>Ghana Standards Authority</td>
<td>Certificate of conformity issued by Bureau Veritas certifying the STREAM’s compliance (GHS 2021 357364 / 0001).</td>
</tr>
<tr>
<td>January 2023</td>
<td>Ghana Food and Drug Authority</td>
<td>The letter confirms that the device does not fall within the definition and classification rules per the Authority’s Guidelines for the Registration of Medical Devices. In short, we do not need to register the STREAM with the Ghana FDA based on their current regulations.</td>
</tr>
<tr>
<td>April 2023</td>
<td>Ghana Health Service collaborates and supports regional expansion</td>
<td>GHS approves installation and evaluation of 18 STREAM devices in Ahafo, Volta, and Central Regions (GHS/ICD/L2023).</td>
</tr>
<tr>
<td>February 2024</td>
<td>Ghana Food and Drug Authority</td>
<td>Certificate of analysis certifying the STREAM chlorine complies with Ghana Standard 186 on available chlorine content.</td>
</tr>
</tbody>
</table>

*Abbreviations: FDA, Food and Drug Authority; GHS, Ghana Health Service; ICD, Institutional Care Division.*

### Ethiopia

The STREAM project’s experience in Ethiopia highlights the importance of generating national, regional, and woreda–level ownership at the project outset and the need for flexibility. PATH’s steady progress toward securing launching an evaluation of 10 STREAM devices in 10 Amhara region health facilities was put on hold due to the armed conflict that erupted in the Amhara region in May 2023. The ongoing conflict in Ethiopia’s Amhara region, which has resulted in the seizure of major towns by insurgents and ongoing rural unrest, has required the project to rethink and be flexible as to where the project is implemented. Prior to the start of the conflict, PATH was able to secure approvals from the Amhara regional health bureau in May 2023 for the overall project and proposed evaluation. PATH staff met with woreda leaders and health facility administrators from the proposed health facilities to confirm their participation in the study and share information on the STREAM and study objectives.
A study protocol was prepared and approved by a Scientific Merit Committee within PATH, however final IRB approvals remain outstanding, due to the uncertainty of study locations and the fact that the Amhara public health institute who reviews and approves ethics submissions for the region is not accepting or reviewing ethics submissions at this time.

### Policy and regulatory approvals for STREAM introduction in Ethiopia

<table>
<thead>
<tr>
<th>Date</th>
<th>Organization</th>
<th>Approval Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>April 2022</td>
<td>Ethiopia Conformity Assessment Enterprise</td>
<td>Laboratory test report confirming the STREAM chlorine adhered to chlorine testing standards (ES 887:2002) with a result of 0.42% mg/L.</td>
</tr>
<tr>
<td>March 2023</td>
<td>Amhara Regional Health Bureau</td>
<td>STREAM project approved by the Amhara regional health bureau, which enabled PATH to prepare and submit a STREAM protocol and study documentation to ethics review committees.</td>
</tr>
<tr>
<td>November 2023</td>
<td>Ethiopia Ministry of Finance</td>
<td>Tax exemption granted for 20 STREAM devices for Ethiopia</td>
</tr>
</tbody>
</table>

### Next steps

The three country examples described above illustrate how developing strong working relationships with key government leaders is critical for advancing health programs and innovations. Collaboration with health system champions led to policy approvals and regulatory certifications that are expanding the reach of the STREAM across public health systems in Ghana, Uganda, and Ethiopia. In parallel, Aqua Research continues to expand its market reach and presence, building on the experience and lessons learned in this project. Finally, PATH will continue to support government leaders, private-sector partners, and other WASH and health stakeholders through technical product and market expertise to expand the adoption of the STREAM worldwide.

### For more information

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This project directly contributes to the Sustainable Development Goals 3 and 6, as well as global WASH in health care facility targets.

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