

# Sustainability and Impact of Hospital Water Treatment Systems in Honduras



Katharine Robb<sup>1</sup> and Katherine Roguski<sup>1</sup>, Alexandra Huttinger<sup>1</sup>, Moitreyee Sinha<sup>2</sup>, Krista Bauer<sup>2</sup>, Christine Moe<sup>1</sup>

<sup>1</sup>Center for Global Safe Water at Emory University, <sup>2</sup>The General Electric Foundation

## BACKGROUND

• 86% of Latin America has access to improved water sources. In urban areas, the majority of these sources are piped distribution networks.



Hospital staff preparing chlorine solution next to GE ultrafiltration system, La Esperanza

- However, water in piped networks may not be treated and quality can be rapidly degraded by pipe breakages and pressure drops.
- Water treatment at the point-of-use (POU) can assure water quality.
- In recent years, NGOs have donated water treatment devices to institutions (such as hospitals and schools); however, evaluation of the sustainability and impact of these systems in low-income settings is lacking.

### Objectives

- 1) Evaluate **water quality** in 4 hospitals in Honduras where ultrafiltration (UF) water treatment systems have been implemented by GE Foundation. Installation years range from 2007 to 2011.
- 2) Evaluate the **environment and knowledge, attitudes and practices (KAP)** that enable or limit the sustainable operation and use of the water treatment systems in these 4 hospitals.
- 3) Compare KAP and water quality to two matched control hospitals without UF systems.

## METHODS



6 district-level government hospitals participated:  
• 4 hospitals with UF systems (blue)  
• 2 without UF systems (red)



Roguski conducting an interview with a hospital staff member, Olanchito

**Facility inspections and interviews (n=150)** were conducted with staff and patients regarding safe water knowledge, attitudes and practices.

**Water samples (n=200)** were collected and analyzed for *E. coli*, total coliforms, chlorine residual and turbidity.

A **metric** was developed to evaluate environments that enable or limit the sustainability of water systems using four domains of sustainability. Each domain is associated with four subdomains (below).

<b>On-Site Capacity</b> <ul style="list-style-type: none"> <li>• Organization and Communication</li> <li>• Training and Capacity Strengthening</li> <li>• Routine Maintenance</li> <li>• Repairs</li> </ul>	<b>Technical Feasibility</b> <ul style="list-style-type: none"> <li>• Water Sources and Availability</li> <li>• Local Availability of Supplies and Equipment</li> <li>• Current Infrastructure</li> <li>• Water Quality Testing</li> </ul>
<b>Accountability</b> <ul style="list-style-type: none"> <li>• Monitoring Performance</li> <li>• Oversight by Another Entity</li> <li>• Sources of Funding</li> <li>• Finances</li> </ul>	<b>Institutional Engagement and Support</b> <ul style="list-style-type: none"> <li>• Demand</li> <li>• Satisfaction and Valuation</li> <li>• Engagement of Hospital Staff</li> <li>• Educational Messaging</li> </ul>

Subdomains were divided into broad questions.

Interview questions and observations were grouped under broad questions and scored from 0-4 (4 being the most sustainable).

## RESULTS

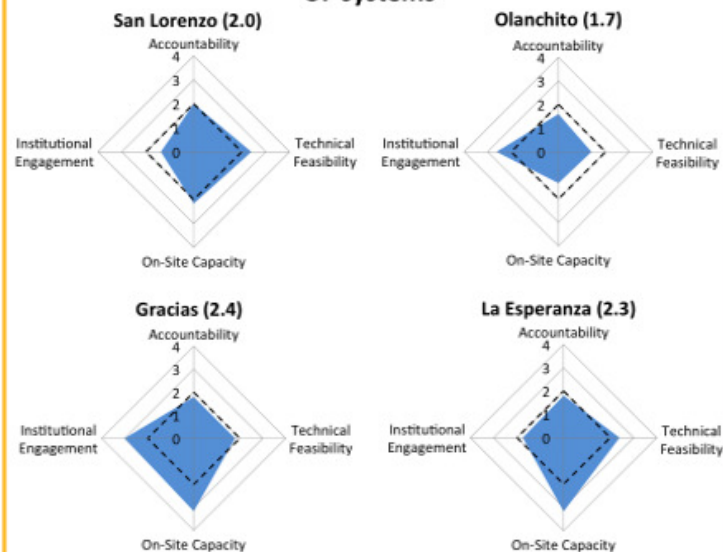
### Water Quality, Infrastructure, and Usage and Sustainability Scores: Comparing hospitals with and without UF systems

Hospital Location	Water Treatment	% of samples that meet microbial standards*	% of samples that meet chlorine residual standards*	% of functional taps	% of patients and staff who drink tap water	Sustainability Score
La Esperanza	UF and chlorination	88%	31%	83%	32%	2.3
Gracias	UF and chlorination	80%	43%	79%	11%	2.4
San Lorenzo	POU UF at 4 taps with centralized chlorination	90%	65%	100%	4.9%	2.0
Olanchito	UF and chlorine	17%	17%	100%	19%	1.7
La Paz	Chlorination 1x per week	0%	0%	82%	13%	NA
Danli	Chlorination 1x per week	47%	60%	86%	13%	NA
Comparing proportions in hospitals with and without UF systems ( $\chi^2$ test) <sup>†</sup>		$p$ -value<0.0001	$p$ -value=0.11	$p$ -value=0.35	$p$ -value=0.60	NA

\* WHO drinking water quality standards for *E. coli* (<1 CFU/100ml sample) and CDC Safe Water System drinking water quality standards for chlorine residual (0.2-2.0 ppm)

<sup>†</sup> Reported  $p$ -values test the null hypothesis that there is no difference in the stated percentage between hospitals with and without UF systems using  $\chi^2$  (Fisher exact) tests.

### Sustainability domain score diagrams for four hospitals with UF systems



Sustainability domain scores were obtained by averaging the broad question scores within each domain.

## RESULTS, CONT.

### Interview Results

- Staff in hospitals that have UF systems were **more likely to believe that hospital tap water was safe to drink** in comparison to staff in hospitals that do not have UF systems (24% and 0% respectively,  $p$ -value = 0.02).
- **62% ( $\pm 20\%$ ) of staff working in hospitals with UF systems are aware that the water in their hospital is treated.**



Hospital maintenance man demonstrating his trust in the hospital water quality, Olanchito

### Sustainability Metric

- Sustainability domain score diagrams show differing strengths and challenges related to the sustainability of the water system within each hospital.
- A score of 2.0 was defined as the cut-off for sustainability. Below this point, there is not evidence of an enabling environment for sustainability within a particular domain. The hospital with the poorest water quality (Olanchito) also had sustainability score below 2.0.

## CONCLUSIONS

- Hospitals with UF systems donated by GE Foundation have significantly cleaner water than control hospitals without UF systems.
- Based on the metric, the hospitals with UF systems are near the cutoff for sustainability (score of  $\geq 2$ ) and are vulnerable to becoming unable to sustain safe water provision.



Robb leading discussion of water quality results with hospital staff, Gracias

- There was no difference in infrastructure upkeep or staff and patient drinking water habits between hospitals with and without UF systems.
- The hospitals with UF systems, and efforts to support these hospitals, should focus on targeting specific domains to improve the sustainability and impact of safe water provision.
- Institutional engagement could be increased by developing staff awareness about safe water provision at the hospital. Future donations should be coupled with staff education.
- Best practices from each hospital (evidenced by high domain score) can be adapted to increase the impact and sustainability of water treatment systems in other institutional sites and improve future donations.

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