
Water, Sanitation, and Hygiene in Outbreak Response

Daniele Lantagne, Ph.D., P.E.

Associate Professor, Tufts University



WASH Evidence in Outbreaks

- Systematic Review
 - 15,000 documents
 - Outcomes, impacts
- Evidence base is thin
 - High in water treatment
 - Low in hygiene/sanitation
 - Low in emergency only interventions
 - “CISUR”

Figure 0.1: WASH interventions in disease outbreaks – evidence map
Source: The research team



Current Research – Filling in Gaps

LAB

- Efficacy of bucket chlorination (R2HC)
- Efficacy of households spraying and household disinfection kits (R2HC)
- Cleaning jerricans cans and taps / biofilm (OFDA, Kohler)
- Fouling in membrane filters (Tufts)

FIELD

- Effectiveness of
 - Water trucking (OFDA)
 - Bucket chlorination (OFDA, R2HC)
 - Household spraying and household disinfection kits (R2HC)
 - Hygiene kits, cash transfers, shared latrines (UNICEF/Myanmar)

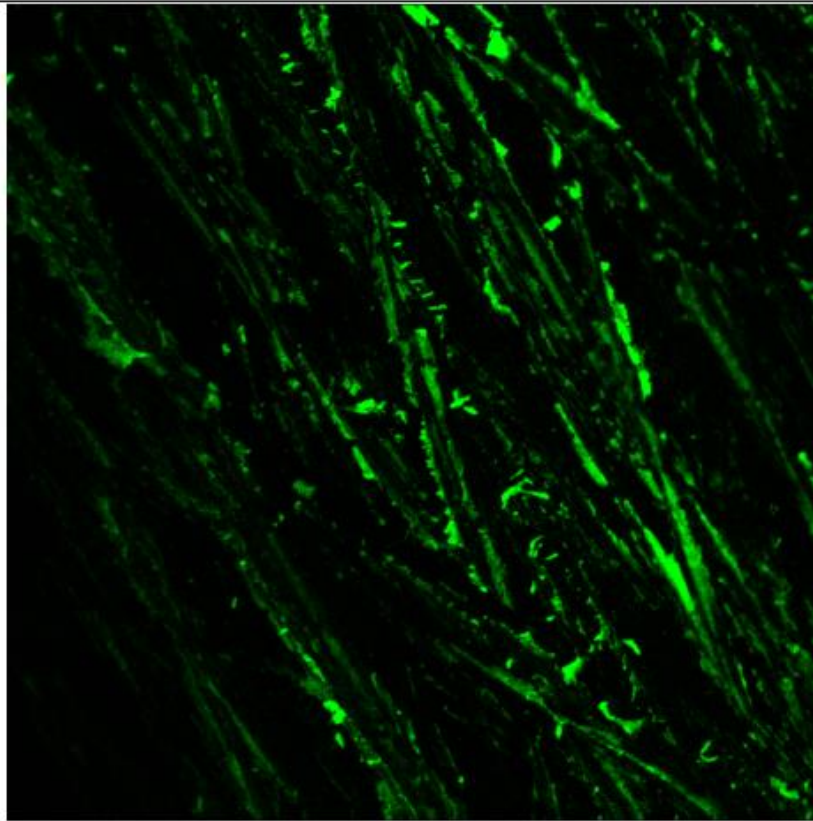
POLICY

- Chlorine tablet selection and alignment (OFDA)
- Impacts of coordination, quality in response (Cluster, Oxfam/SI)

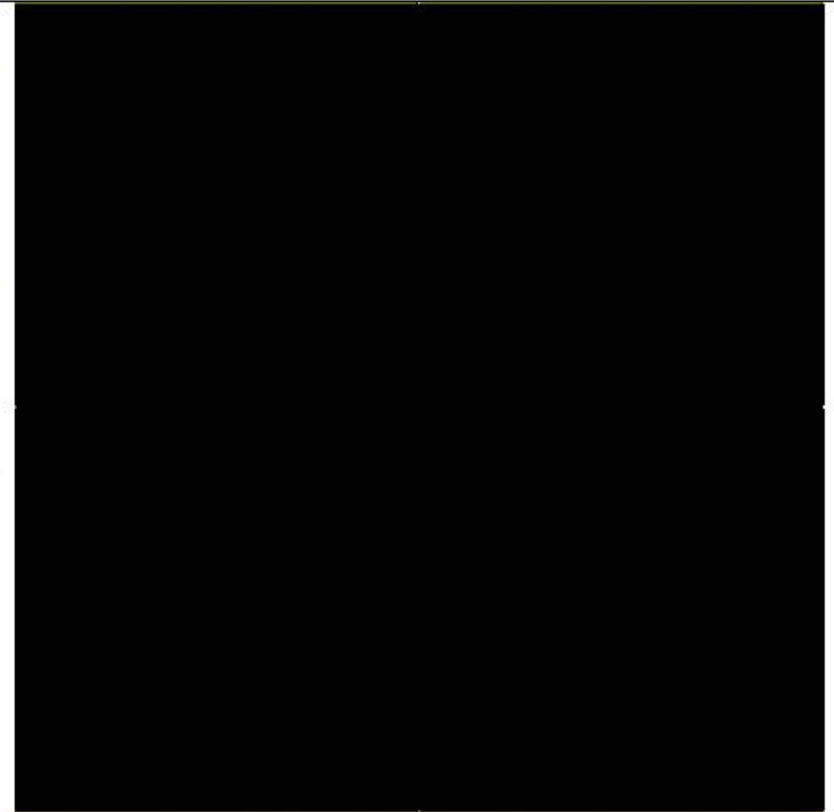
Lab - Biofilm



Lab - Biofilm



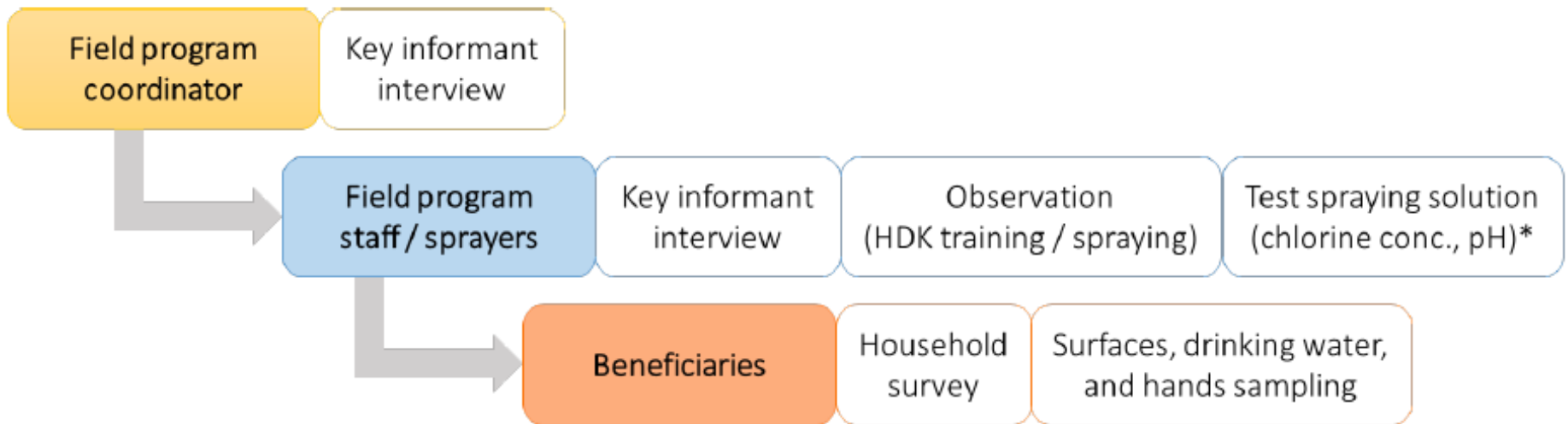
(a)



(b)

Figure 11: Biofilm on Spigots Cleaned with Boiled Water via (a) scrubbing assembled and (b) soaking assembled for five minutes

Field - Household Spraying - Protocol



**For household spraying only.*

Detection of culturable *V. cholerae* on surfaces

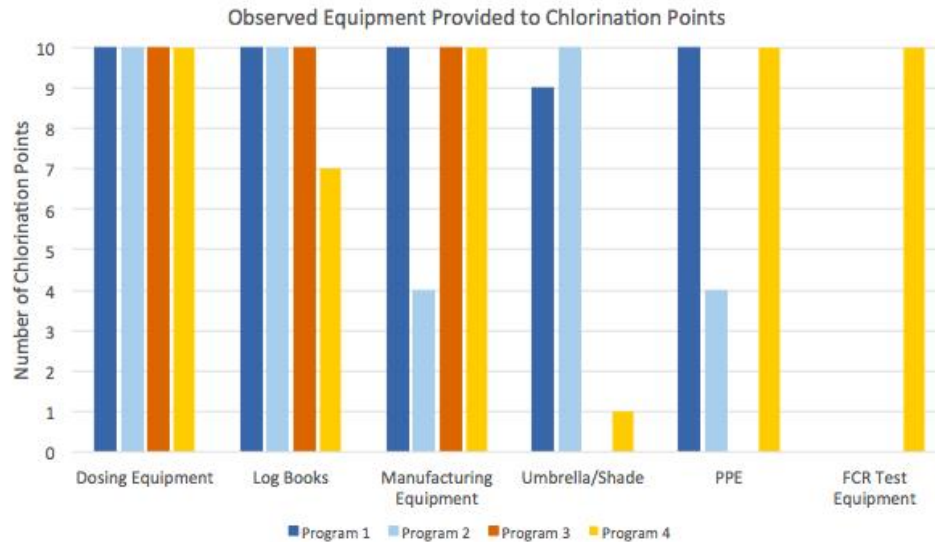
BEFORE					SURFACE	AFTER: 30 MINUTES					AFTER: 24 HOURS				
HH01	HH02	HH03	HH04	HH05		HH01	HH02	HH03	HH04	HH05	HH01	HH02	HH03	HH04	HH05
High	High	Intermediate	High	High	Kitchen / inside floor	Not detected	Not detected	Low	Low	High	Low	Intermediate	High	High	
High	Low	Intermediate	Not detected	Not detected	Latrine floor	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	
Low	Not detected	Low	Not detected	Low	Patient's bed	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Intermediate	Low	
Low	Not detected	Low	Not detected	Intermediate	Jerrycan	Not detected	Not detected	Not detected	Not detected	Low	Not detected	Not detected	Not detected	Not detected	
Intermediate	Not detected	Not detected	Low	Not detected	Wall	Not detected	Not detected	Not detected	Not detected	Low	Not detected	Not detected	Not detected	Not detected	
Not detected	Not detected	Not detected	Not detected	High	Furniture (table)	Not detected	Not detected	Not detected	Not detected	Low	Not detected	Not detected	Not detected	Not detected	
Not detected	Not detected	Not detected	Not detected	Intermediate	Curtains	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Low	
Low	Not detected	Not detected	Not detected	Not detected	Door	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	

BEFORE					SURFACE	AFTER: 30 MIN					AFTER: 24 HRS				
HH06	HH07	HH08	HH09	HH10		HH06	HH07	HH08	HH09	HH10	HH06	HH07	HH08	HH09	HH10
High	High	High	Low	High	Patient's bed	High	High	Low	Not detected	Intermediate	Low	High	Intermediate	High	
Not detected	High	High	High	High	Kitchen floor	Not detected	High	High	High	High	High	High	High	High	
Not detected	High	High	High	High	Latrine floor	Not detected	High	Not detected	Not detected	High	Not detected	High	High	High	
High	Not detected	Not detected	Intermediate	Not detected	Floor close to bed	High	Not detected	Not detected	Not detected	High	Not detected	Not detected	Intermediate	Not detected	
Not detected	High	Intermediate	Low	Low	Wall	High	Intermediate	Intermediate	Low	Not detected	Low	Intermediate	Low	Not detected	
Not detected	Intermediate	Intermediate	Not detected	Low	Curtain	Not detected	Low	Not detected	Not detected	Not detected	Low	Not detected	Not detected	Low	
Not detected	Low	Low	Not detected	Not detected	Jerrycan, container	Not detected	Not detected	Not detected	Not detected	Low	High	Not detected	Not detected	Low	
Not detected	Low	Low	Not detected	Not detected	Latrine door / wall	Not detected	Low	Not detected	Not detected	Not detected	Not detected	Not detected	Low	Low	
Not detected	Low	Not detected	Low	Not detected	Entrance door	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Not detected	Low	Intermediate	

High (>5000 CFU/100 cm ²)
Intermediate (200-5000 CFU/100 cm ²)
Low (<200 UCF/100 cm ²)
Not detected

Bucket Chlorination

Observations of Chlorination Points



- Two programs did not distribute umbrellas (or equivalent to shade agents and chlorine
- PPE (gloves, mask, goggles) was frequently shared between agents resulting in missing pieces
- Only one program expected agents to test their own free chlorine residual (FCR)



	Average Concentration [%]	Min. [%]	Max. [%]
Program 1	3	1.3	7.2
Program 2	0.78	0.13	1.19
Program 3	0.18	0.07	0.34
Program 4	0.51	0.28	0.78

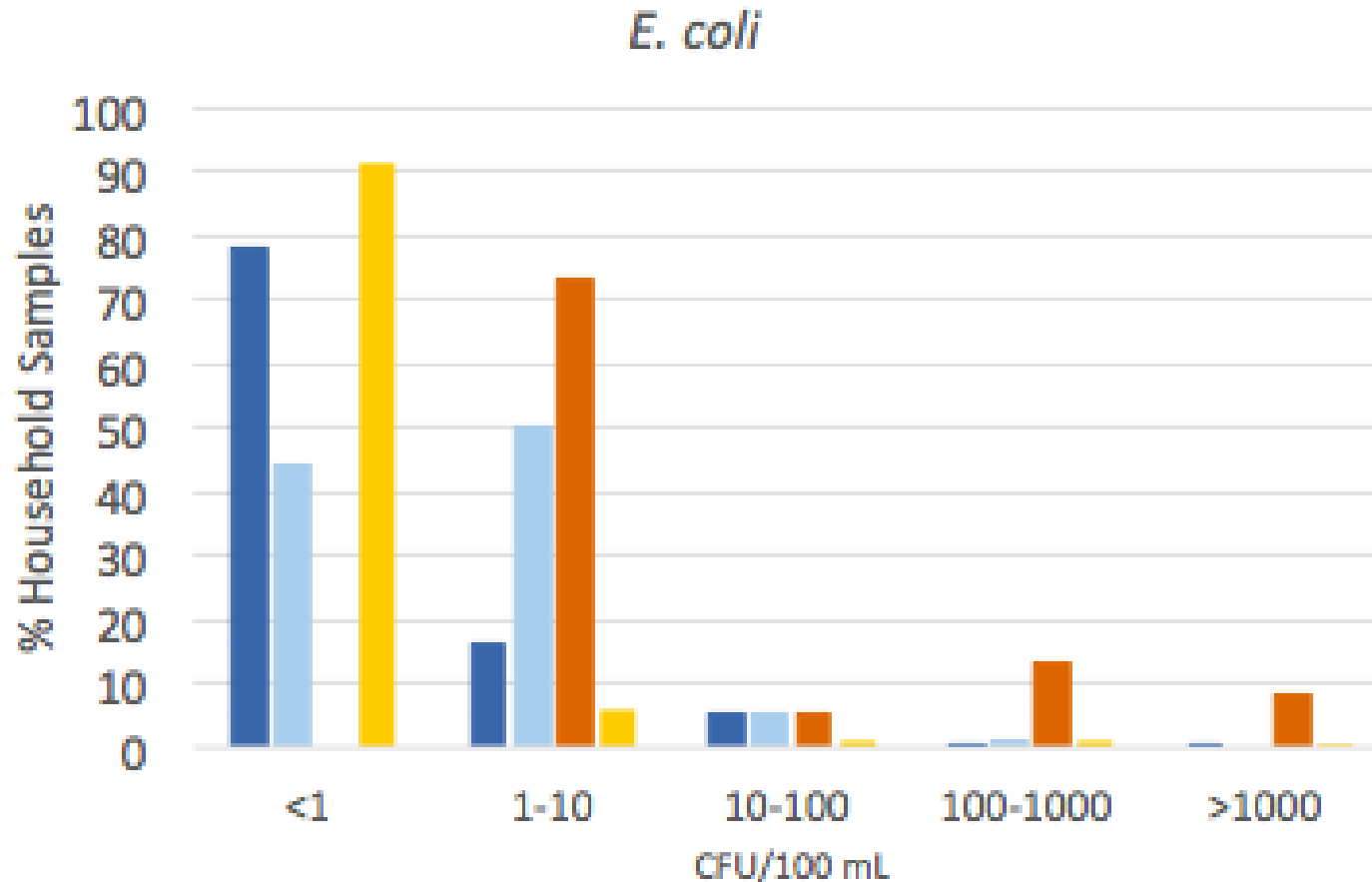
Bucket Chlorination - Solutions



Examples of chlorine stock solution preparation, storage, and dosing.

Slide credit: Gabrielle String

Bucket Chlorination – *E. coli* in household



Next steps

- What does this mean?
 - What are critical factors for success?
 - What are recommendations that come out of this?
 - What is relationship to WASH Package?
 - Eradication versus global?
 - Is there health impact?

Acknowledgements



- Travis Yates
 - Systematic Review
- Marta Domini / Patrick Mirindi
 - Biofilm
- Karin Gallandat
 - Household Spraying
- Gabrielle String
 - Bucket Chlorination



Research for health
in humanitarian crises

elrha



USAID
FROM THE AMERICAN PEOPLE

*Action Research on Common Under Researched WASH Interventions
Tufts University, in collaboration with response organizations*

