

Disinfection of human excreta in emergency settings: a comparison  
of chlorine-based and hydrated lime-based disinfectant solutions.

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**University of Brighton**



# Project background

## WEST AFRICAN EBOLA VIRUS EPIDEMIC

MSF (2008), WHO (2014) and CDC (2015) WASH protocols

- Recommendation to treat Ebola patients excreta using **0.5 % CHLORINE SOLUTIONS**



- Treatment of patients excreta using **HYDRATED LIME** suspensions



Haiti 2010 cholera outbreak  
Treatment of hospital wastewaters using hydrated lime



## Applied Research on Disinfection to Prevent Ebola Transmission



Treatment of excreta using:

- **CHLORINE 0.5%** (NADCC, HTH, Bleach)
- **HYDRATED LIME** (10%, 20% and 30%)

MSF Cholera guidelines (2004):  
Treatment of excreta using **2% CHLORINE SOLUTIONS!!!**



**University of Brighton**



**MEDECINS SANS FRONTIERES  
DOCTORS WITHOUT BORDERS**

**(ARDHEES)**

**Applied research into the disinfection of human excreta in  
emergency settings using highly concentrated chlorine solutions**

## Project aim

To develop human excreta disinfection protocols that can be followed by MSF WatSan response staff in emergency settings so as to minimise the risks of on-going disease transmission and to improve safe working conditions for operators.

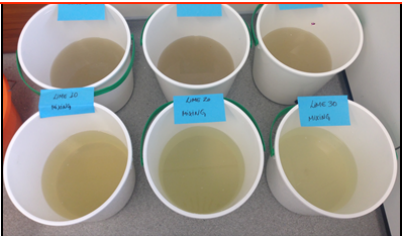
## Project Objectives

- Perform bucket-scale disinfection of human excreta using chlorine-based (0.5, 1 and 2%) and hydrated lime-based (30%) disinfectants.
- Assess overall disinfection efficacy (log reduction of bacterial and viral indicators at three contact times (Ct) and using three excreta matrices (EM))
- Compare disinfection efficacy between three contact times, namely Ct= 10 mins; Ct= 30 mins; and Ct= 60 mins.



# Methodology

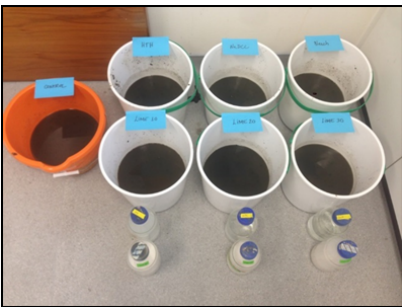
## EXCRETA MATRICES (wastewater + faecal sludge)



0% = 4,500mL WW

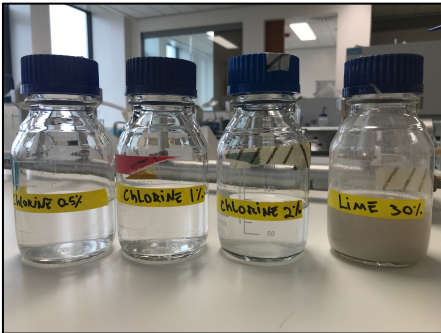


10% = 4,050mL WW + 450g FS



20% = 3,600mL WW + 900g FS

## DISINFECTANTS



125 mL  
Chlorine 0.5%,  
Chlorine 1 %  
Chlorine 2%  
Lime 30%

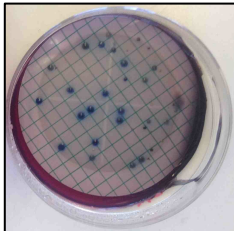


## BUCKET TREATMENT

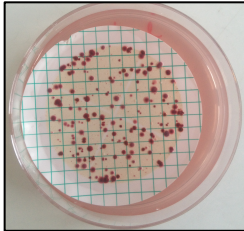


Contact time:  
10, 30 and 60 minutes

## TREATMENT EFFICACY Log reduction of FIO



Faecal coliforms



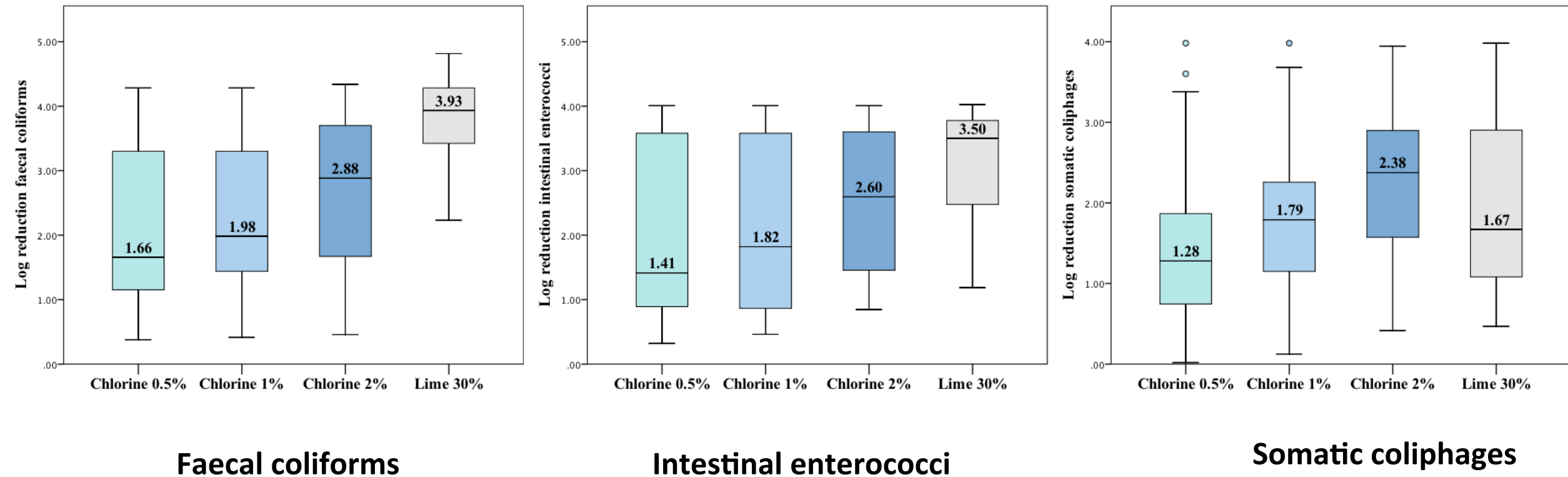
Intestinal enterococci



Somatic coliphages

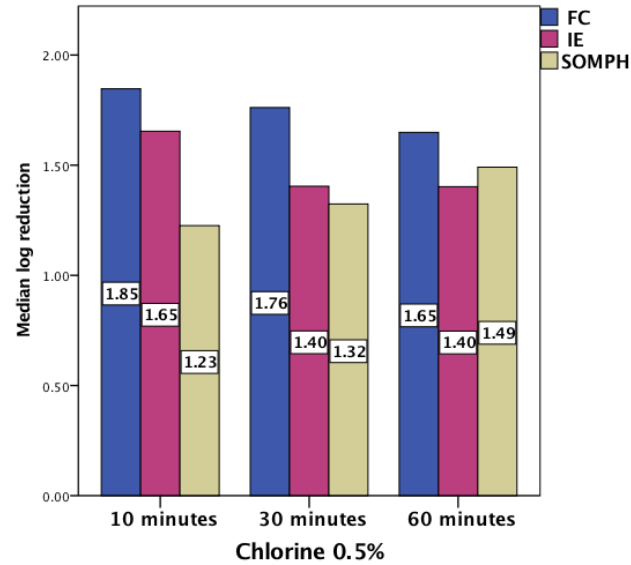
# Results: Overall treatment efficacy according to disinfectant

## Log reduction of bacterial and viral indicator organisms

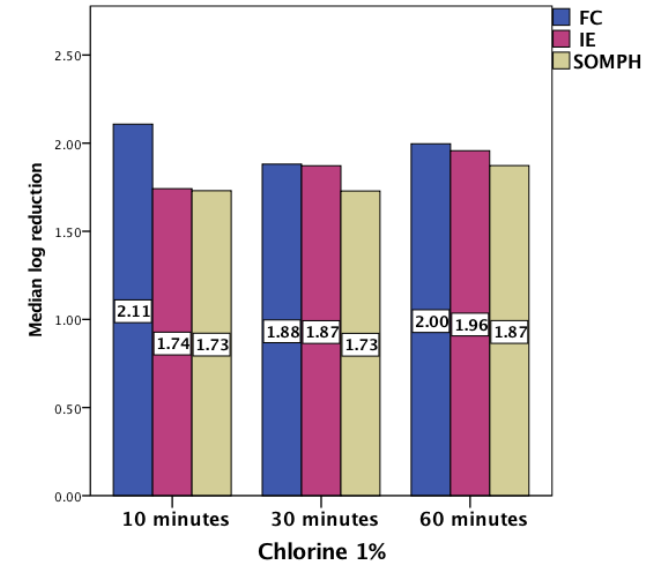


# Results: Treatment efficacy according to contact time

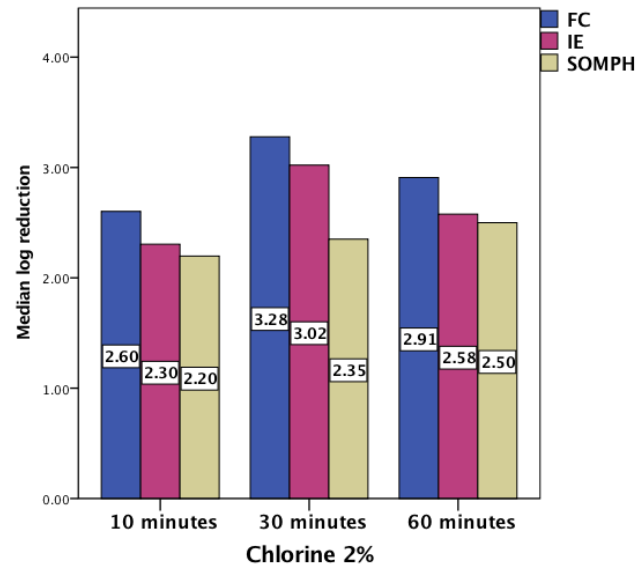
**Chlorine 0.5%**



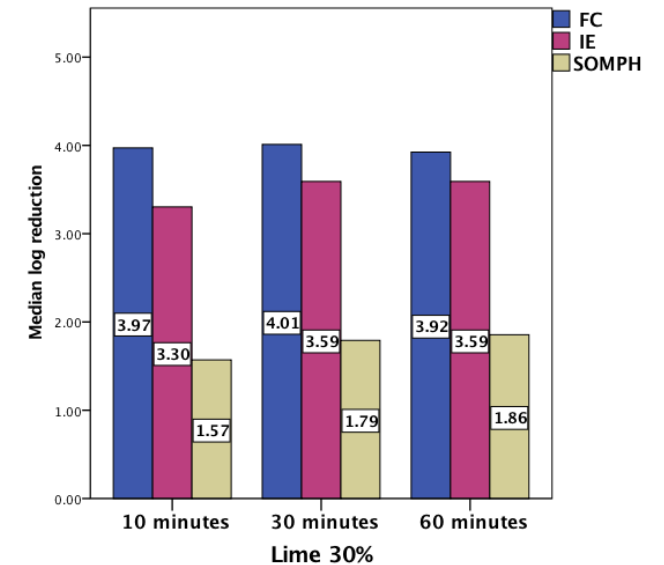
**Chlorine 1%**



**Chlorine 2%**

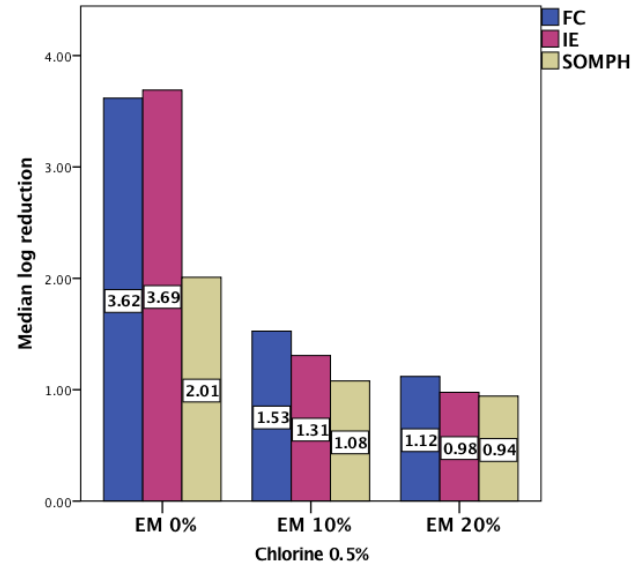


**Lime 30%**

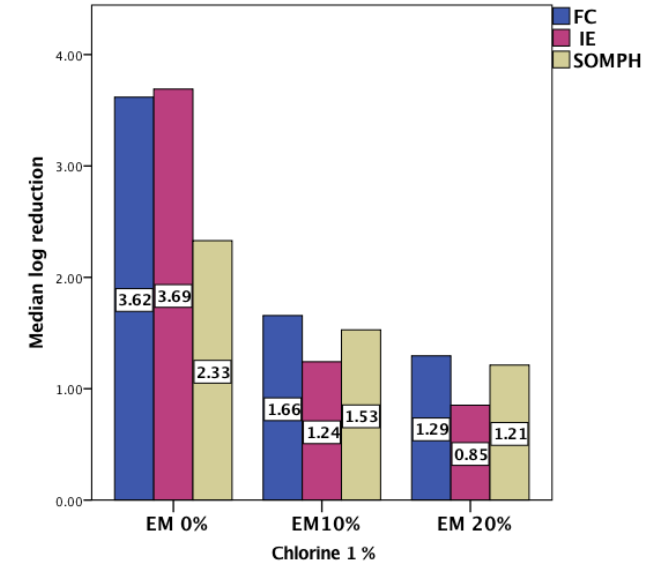


# Results: treatment efficacy according to excreta matrix

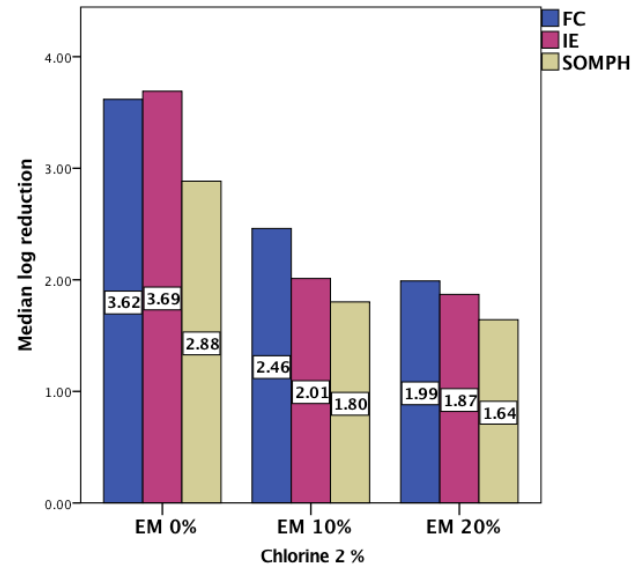
Chlorine 0.5%



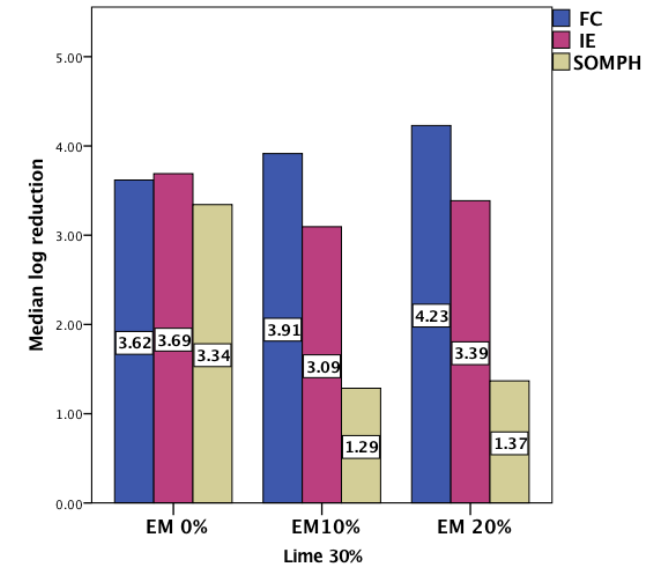
Chlorine 1%



Chlorine 2%



Lime 30%



# Conclusions

- Increasing the concentration of the chlorine solution increases its ability to disinfect excreta matrices.
- Hydrated lime (HL) demonstrated greater log reductions than the traditional chlorine-based methods for two of the three enteric indicator microorganisms investigated.
- Hydrated lime suspensions achieved greater disinfection efficacy than was achieved with the chlorine solutions.
- 0.5% and 1% chlorine solutions only performed well in the '0% excreta matrix' (pure wastewater).
- Contact times of 10, 30 and 60 minutes treatment efficacy not statistically significant
- 30% lime did not lose its disinfection capacity as the load of organic matter and suspended solids increased in the excreta matrices.
- Chlorine-based products appear to be considerably less effective at disinfecting more concentrated forms of human excreta containing greater concentrations of organic matter

# Recommendations and future research

- To include physico-chemical disinfection using hydrated lime in emergency WASH response protocols for dealing safely with human excreta.
- To include hydrated lime in inventory lists for emergency settings.
- Where hydrated lime is not available, to use 2% chlorine solution as an emergency excreta disinfection method.
- To continue research into excreta disinfection in order to elucidate ideal excreta disinfection protocols for a variety of emergency settings.

(i.e.: larger scale treatments, regrowth of microorganisms, production of toxic gases during treatment,...)

# Acknowledgements

The authors would like to thank Dr. James Ebdon, Dr. Florence Theberge, Christine Sinclair, Suzanne Armsden, (UoB), Prapamart Jackson (SW) and Southern Water (UK) for their support of this study.





# Dedication : Prof. Huw Taylor



*The authors would like to dedicate this report to our good friend and former collaborator Huw Taylor (Emeritus Professor of Microbial Ecology) at the University of Brighton, who sadly passed away during this project. Huw's enthusiasm and dedication was instrumental in establishing the body of research described herein. Huw dedicated his life to tackling pressing water and sanitation challenges in order to prevent the onward transmission of waterborne disease in low-resource and emergency settings.*