

# Evaluating sustainability, impacts on child health, and the relationships between *E. coli*, H<sub>2</sub>S and diarrheal risk associated with water, sanitation, and hygiene interventions in rural Tamil Nadu, India

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# Background (health and sustainability)

- Only one study (from Bangladesh) has measured the long-term (5 yr) sustainability of combined water, sanitation and hygiene interventions<sup>1</sup>
  - 92% of water taps still functional
  - 64% of latrines still in use
  - Relative risk of diarrhea (intervention/control) = 0.51 (0.36 - 1.04)
- Between 2003 and 2007 WaterPartners International and Gramalaya launched comprehensive water, sanitation and handwashing interventions in 12 villages in rural Tamil Nadu, India.
  - Expand community water taps
  - Build household and community latrines
  - Handwashing education / groups
  - Women's self-help groups to manage loans for latrine and tap construction
  - Sanitation program expanded to more than 300 villages in 2008

1. Hoque BA, Juncker T, Sack RB, Ali M, Aziz KM. Sustainability of a water, sanitation and hygiene education project in rural Bangladesh: a 5-year follow-up. Bull World Health Organ 1996;74(4):431-7.

# Background (Water Quality Testing)

- The Hydrogen Sulfide (H<sub>2</sub>S) test is increasingly promoted as a low-cost assay for fecal contamination of drinking water, however, there are no large-scale comparisons between H<sub>2</sub>S results and E. coli levels or diarrhea prevalence.
  - A review of H<sub>2</sub>S performance evaluations commissioned by the World Health Organization concludes that the H<sub>2</sub>S should not be recommended for widespread use until more comprehensive and rigorous studies are completed<sup>1</sup>.
  - A recent study in Bangladesh indicates that the H<sub>2</sub>S is a promising alternative to E. coli testing in highly contaminated settings<sup>2</sup>.

1. Sobsey, M.D. and Pfaender, F.K. (2002). Evaluation of the H<sub>2</sub>S Method for Detection of Fecal Contamination of Drinking-Water. Geneva, Switzerland: World Health Organization

2. Gupta, S.K. et al. (2007). Usefulness of the hydrogen sulfide test for assessing water quality in Bangladesh. J. of Appl. Micro. 104: 388-395

# Our questions

- Health impacts and sustainability
  - Did the intervention lead to sustained improvement in water access, water quality, latrine coverage, and hygiene knowledge?
  - Has the intervention improved child health (diarrhea, respiratory infections, growth)?
  - Has the intervention had economic impacts related to time use and health expenditures (time spent gathering water or traveling to defecation sites, money spent on health care & medications)
- Water quality
  - Do H<sub>2</sub>S test results of household drinking water correlate with *E. coli* levels?
  - Do the H<sub>2</sub>S or *E. coli* results correlate with child diarrhea prevalence?

# Methods

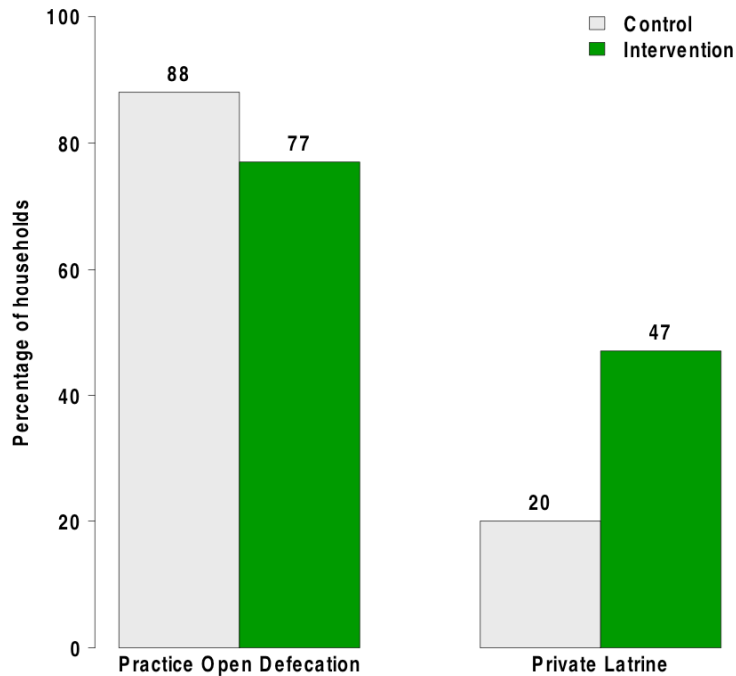
- We selected 13 Control villages from 195 potential villages in adjacent administrative blocks using a propensity score match
- Selected Control villages are highly similar to the Intervention villages based on important pre-intervention characteristics (sanitation coverage, water sources, income, educ.)
- In 2008, we randomly sampled up to 50 households per village with children < 5 years (total = 900 households, 1,173 children < 5)
- Drinking water samples were collected from a subset of households each month and tested for E. coli levels using membrane filtration and the presence/absence of H<sub>2</sub>S. ~ 2,000 water samples
- We are close to completing 12 months of follow-up

# Interviewers visit participating houses each month to collect child morbidity data

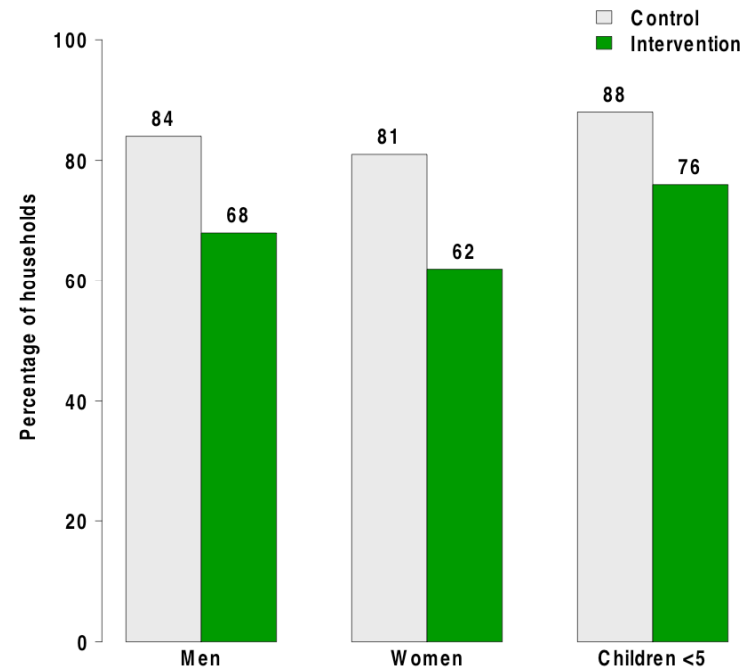


# The Intervention has reduced open defecation and increased access to latrines

## Open Defecation / Latrine Ownership



## Open Defecation by Demographic

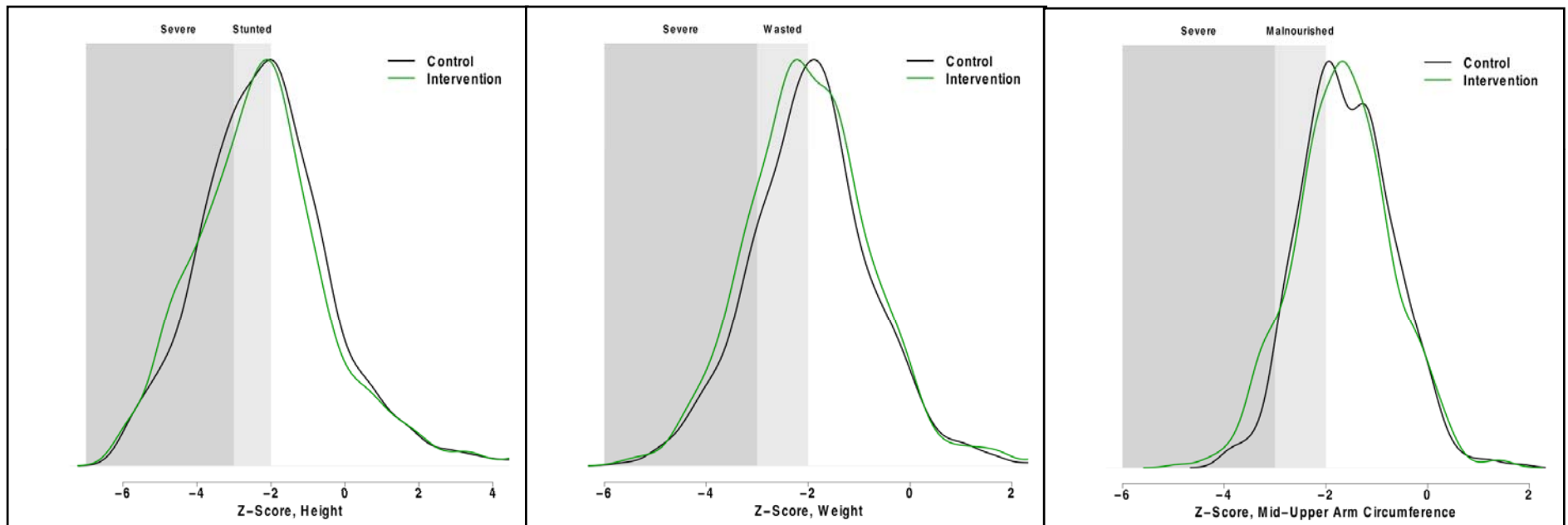


# We do not observe differences in child growth

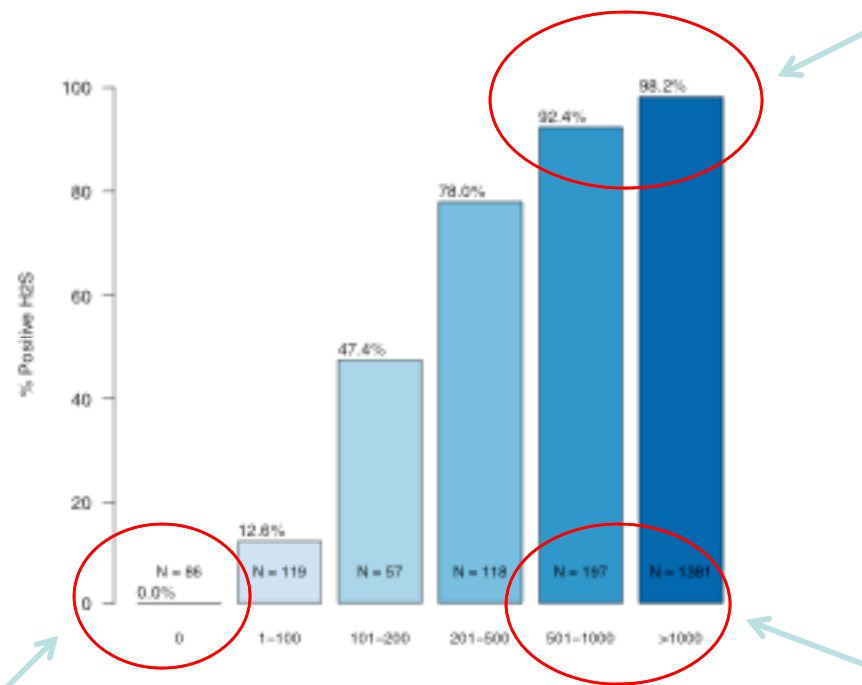
Height

Weight

Arm Circumference



# The H2S test is highly sensitive at >500 CFU E. coli/100mls

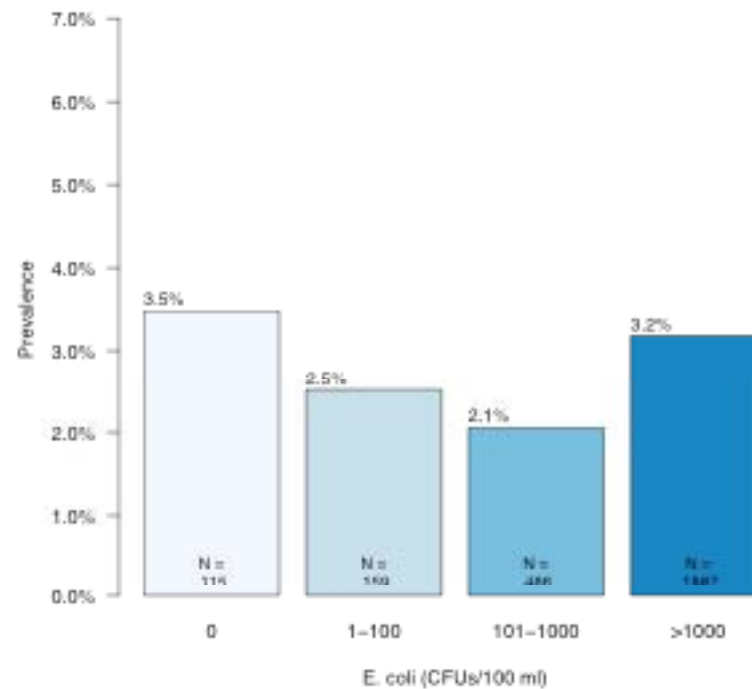


Low numbers of false negatives

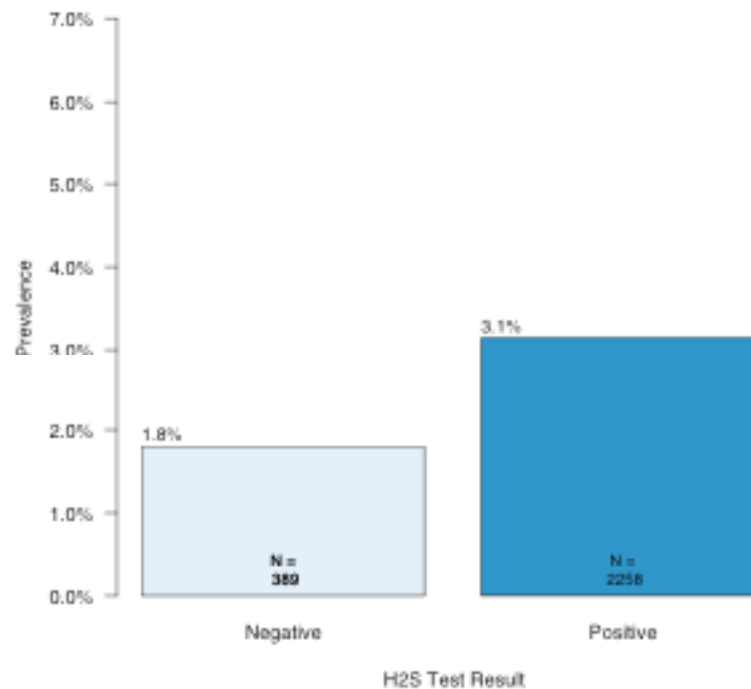
No false positives

81% of samples > 500 CFU E. coli/100mls

# *E. Coli* levels in household water samples do not correlate with child diarrhea prevalence



Diarrhea prevalence:  
3.1% among those with positive H<sub>2</sub>S tests  
vs. 1.8% for those with negative H<sub>2</sub>S tests,  
(p = 0.320)



# Discussion

- The water and sanitation improvements in the intervention villages occurred against much background development: Tamil Nadu is one of the most highly developed States in India<sup>1</sup>
- Tamil Nadu provides the best primary health care of all States<sup>1</sup>
- Due to these factors, we may not be able to discern significant program impacts.
- Strategies for targeting interventions to areas of greatest need are obviously important.

1. India Today (September 22, 2008). State of the States: A definitive Ranking of the Quality of Life Across India. pp 12-42