# ASSESSING THE EFFECT OF IMPROVED RURAL SANITATION ON DIARRHOEA AND HELMINTH INFECTION: A CLUSTER-RANDOMIZED TRIAL IN ORISSA, INDIA

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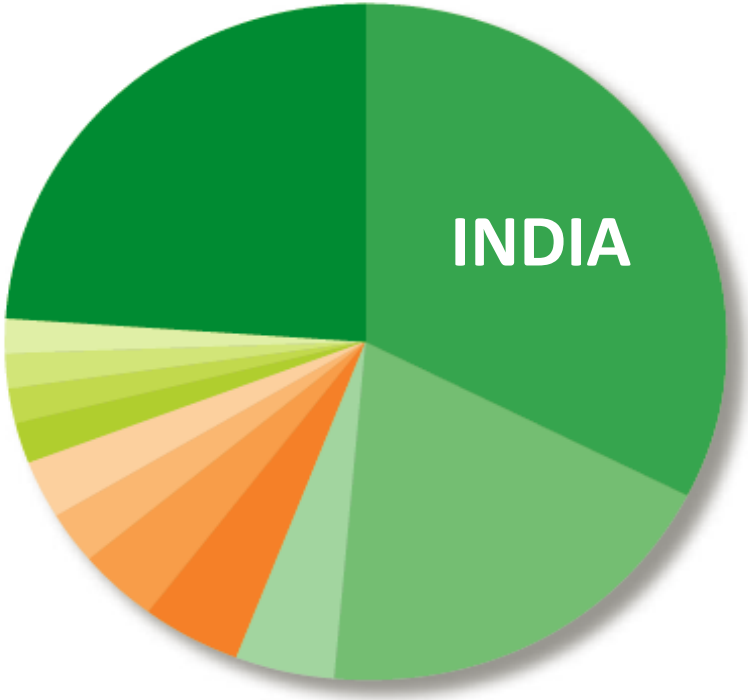
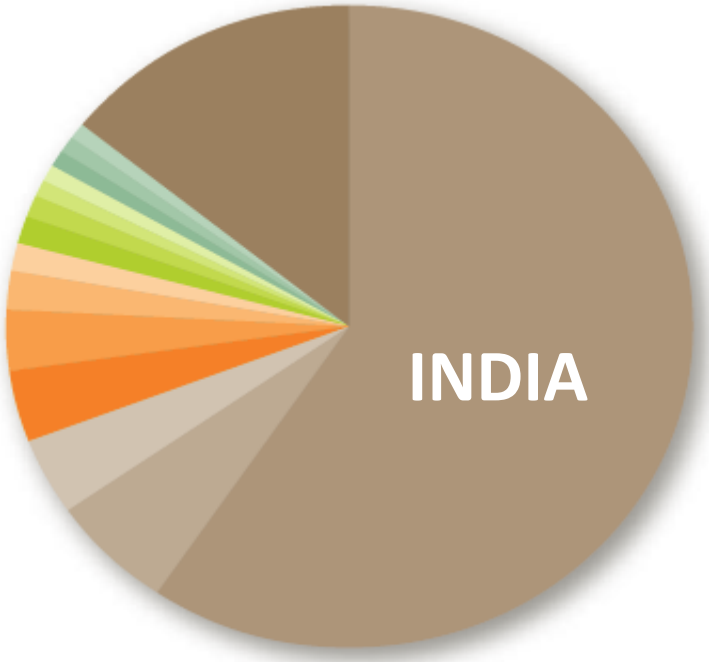
# Global Prevalence of Unimproved Sanitation




MILLIONS

- REST OF WORLD 604
- INDIA 814
- CHINA 477
- INDONESIA 110
- NIGERIA 109
- PAKISTAN 91
- BANGLADESH 66
- ETHIOPIA 66
- DEMOCRATIC REPUBLIC OF THE CO
- RUSSIAN FEDERATION 43
- UNITED REPUBLIC OF TANZANIA 40
- BRAZIL 40

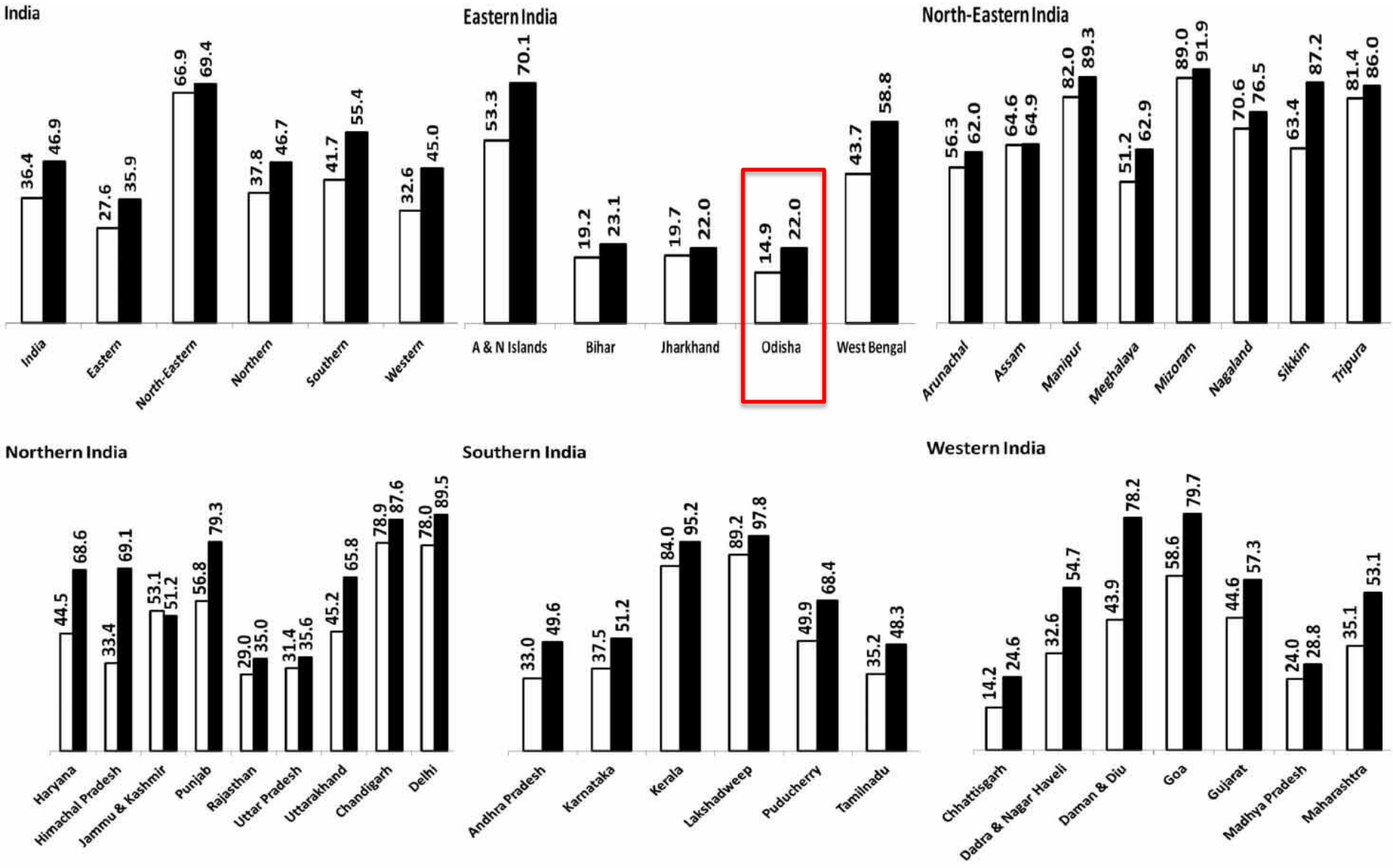
# Global Prevalence of Open Defecation




MILLIONS

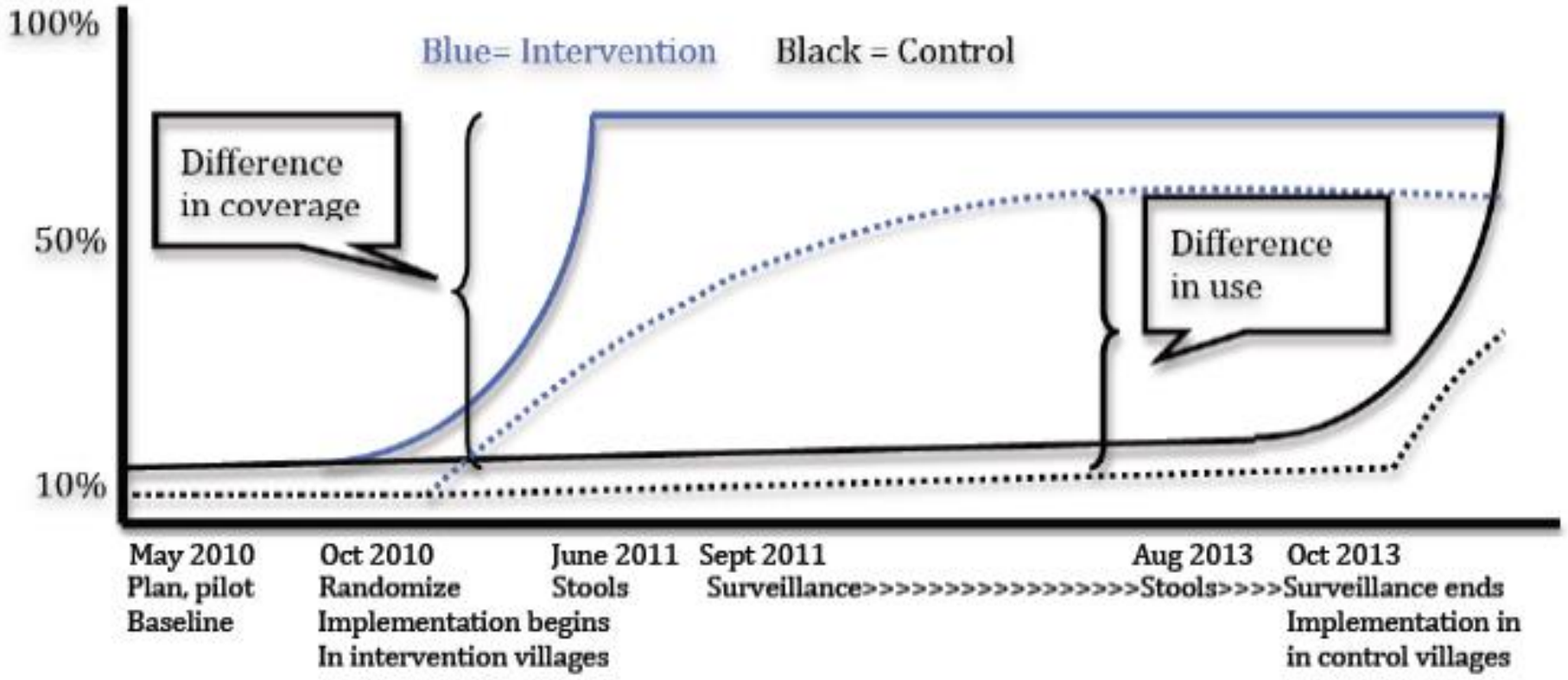
- REST OF WORLD 150
- INDIA 626
- INDONESIA 63
- PAKISTAN 40
- ETHIOPIA 38
- NIGERIA 34
- SUDAN 19
- NEPAL 15
- CHINA 14
- NIGER 12
- BURKINA FASO 9.7
- MOZAMBIQUE 9.5
- CAMBODIA 8.6
- MADAGASCAR 7.7
- BRAZIL 7.2

JMP 2012

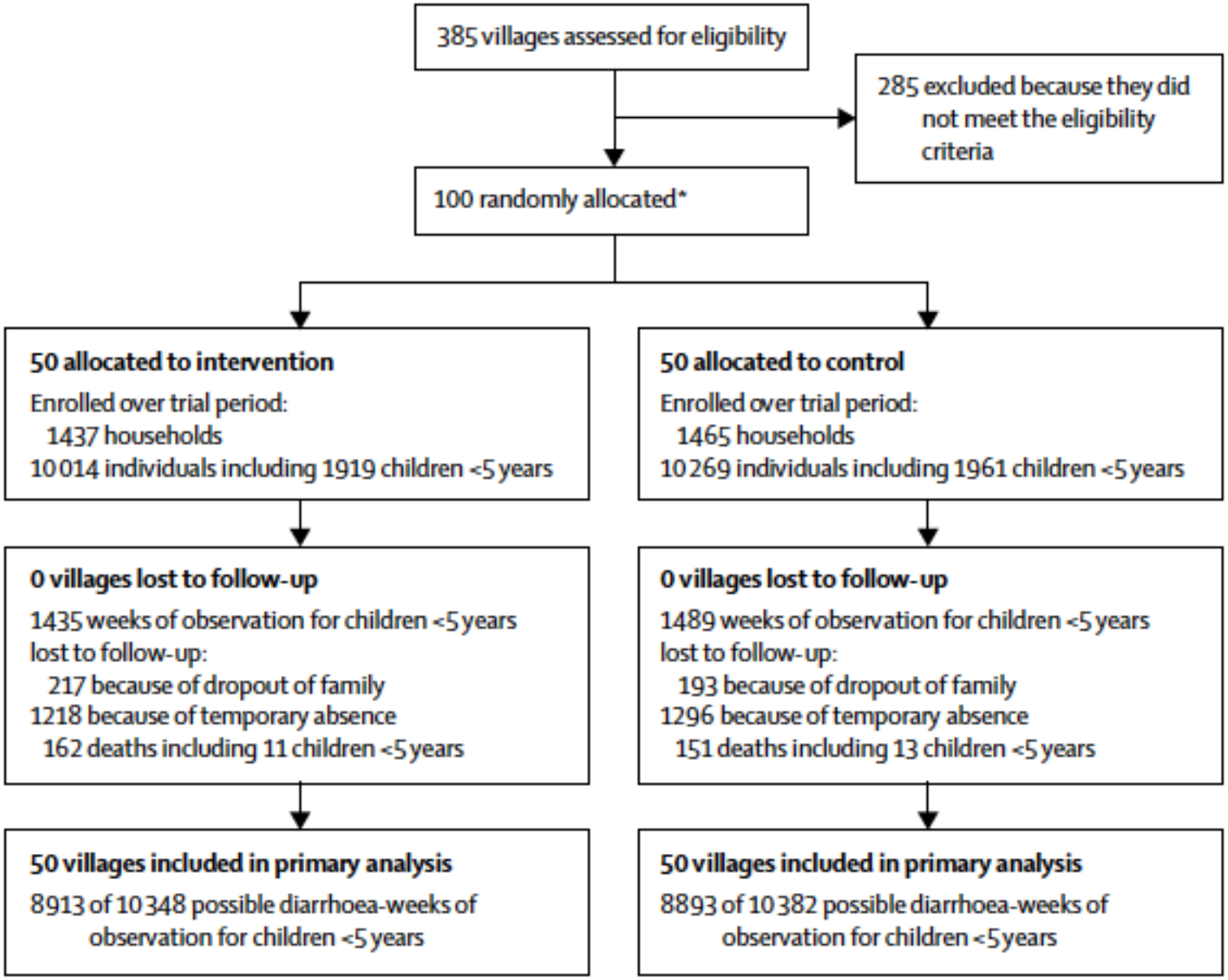



Ghosh & Cairncross 2014

# Study Design

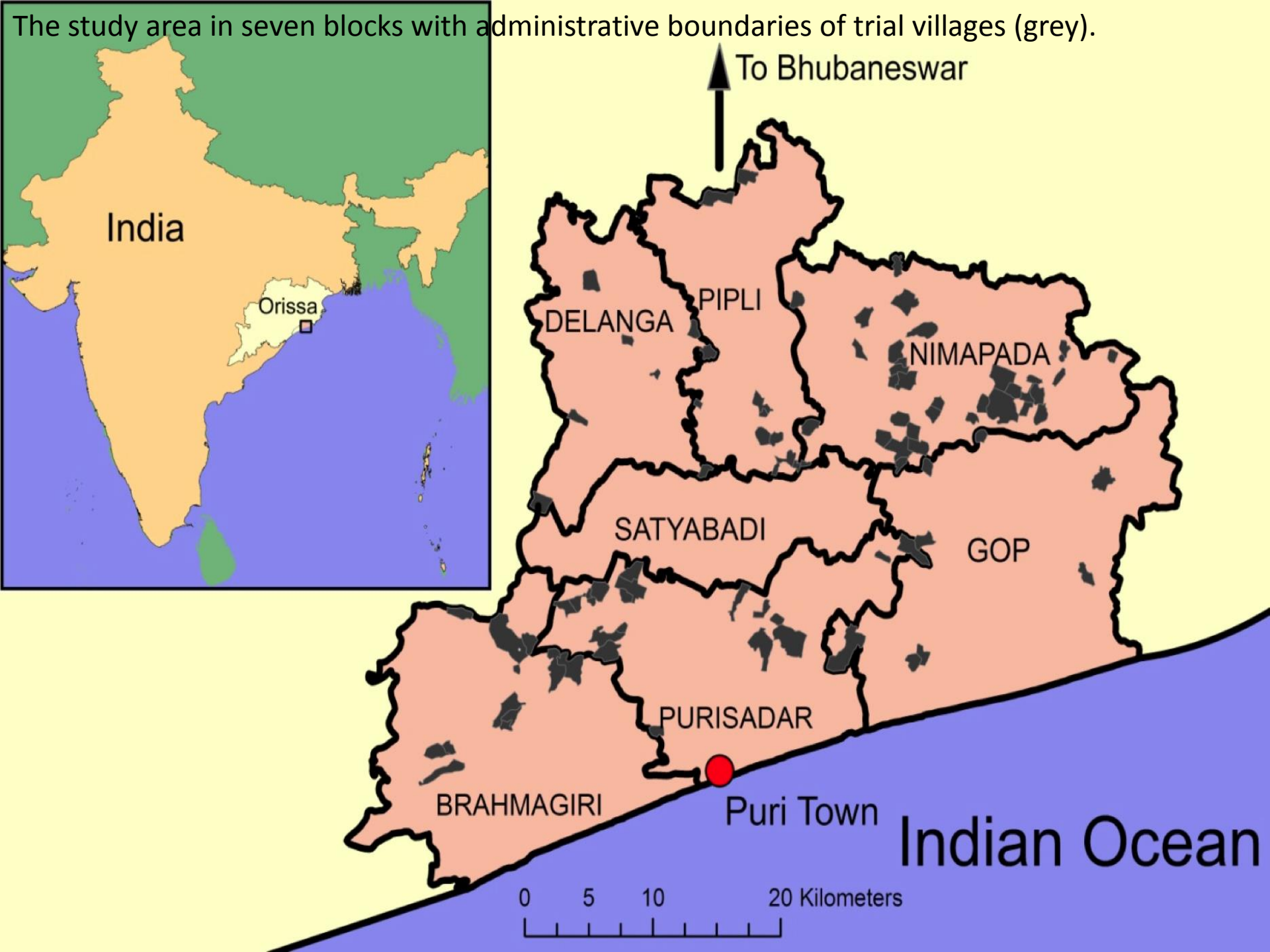



Clasen T, Boisson S, Freeman M, Jenkins M, Routray P, Bell M, Ensink J, Schmidt W. Assessing the effectiveness of rural sanitation to prevent diarrhoea and helminth infection: a cluster-randomized, controlled trial in Orissa, India. Emerging Themes in Epidemiology 9:7 (13 November 2012)



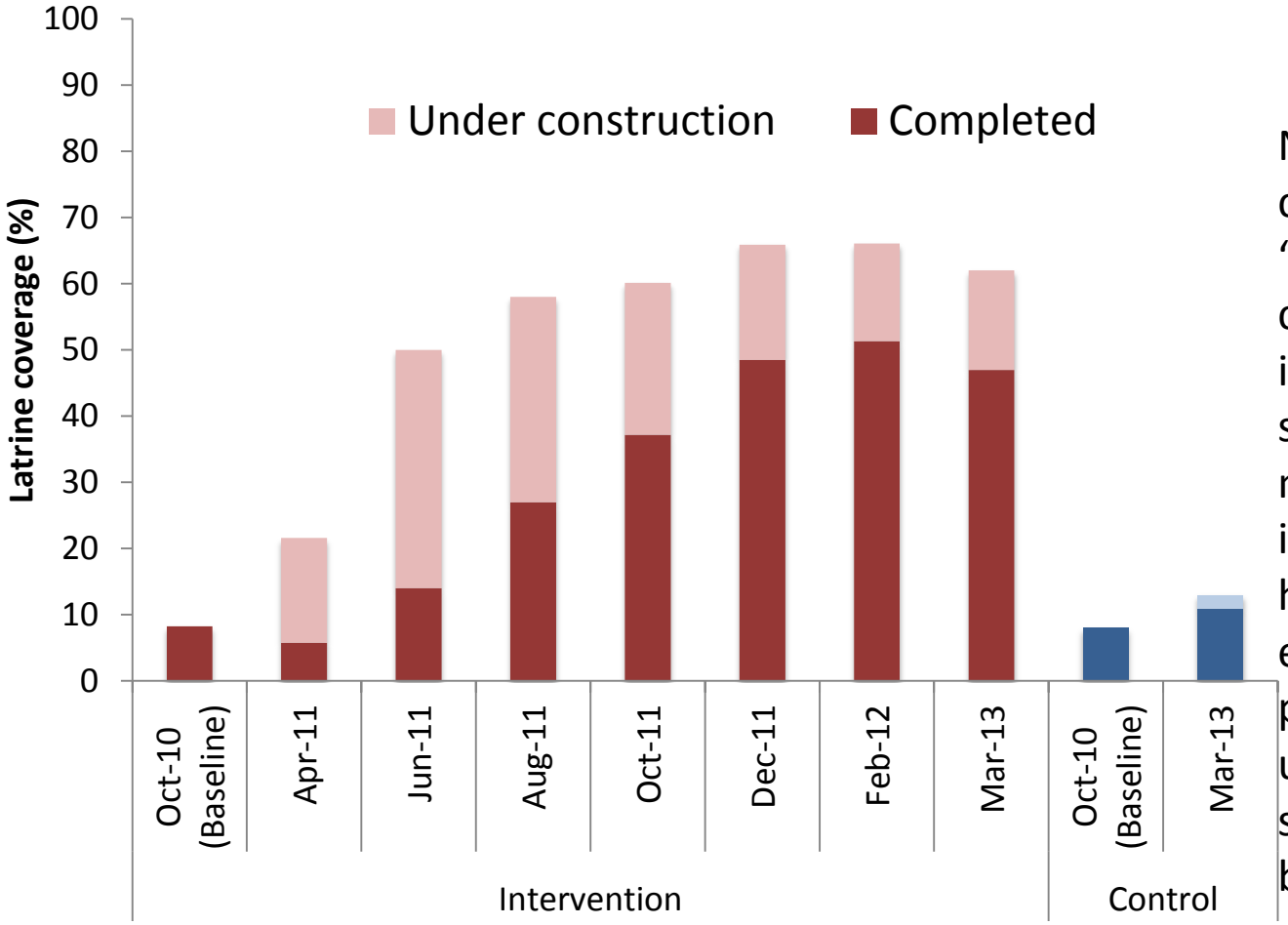

Clasen T, Boisson S, Routray P, Torondel B, Bell M, Cumming O, Ensink J, Freeman M, Jenkins M, Odagiri M, Ray S, *Sinha A, Suar M, Schmidt W-P(2014). The effectiveness of a rural sanitation programme in Odisha, India on diarrhoea, soil-transmitted helminth infection and child malnutrition: A cluster-randomized trial. Lancet Global Health DOI: 10.1016/S2214-109X(14)70307-9

The study area in seven blocks with administrative boundaries of trial villages (grey).



# Intervention Hardware

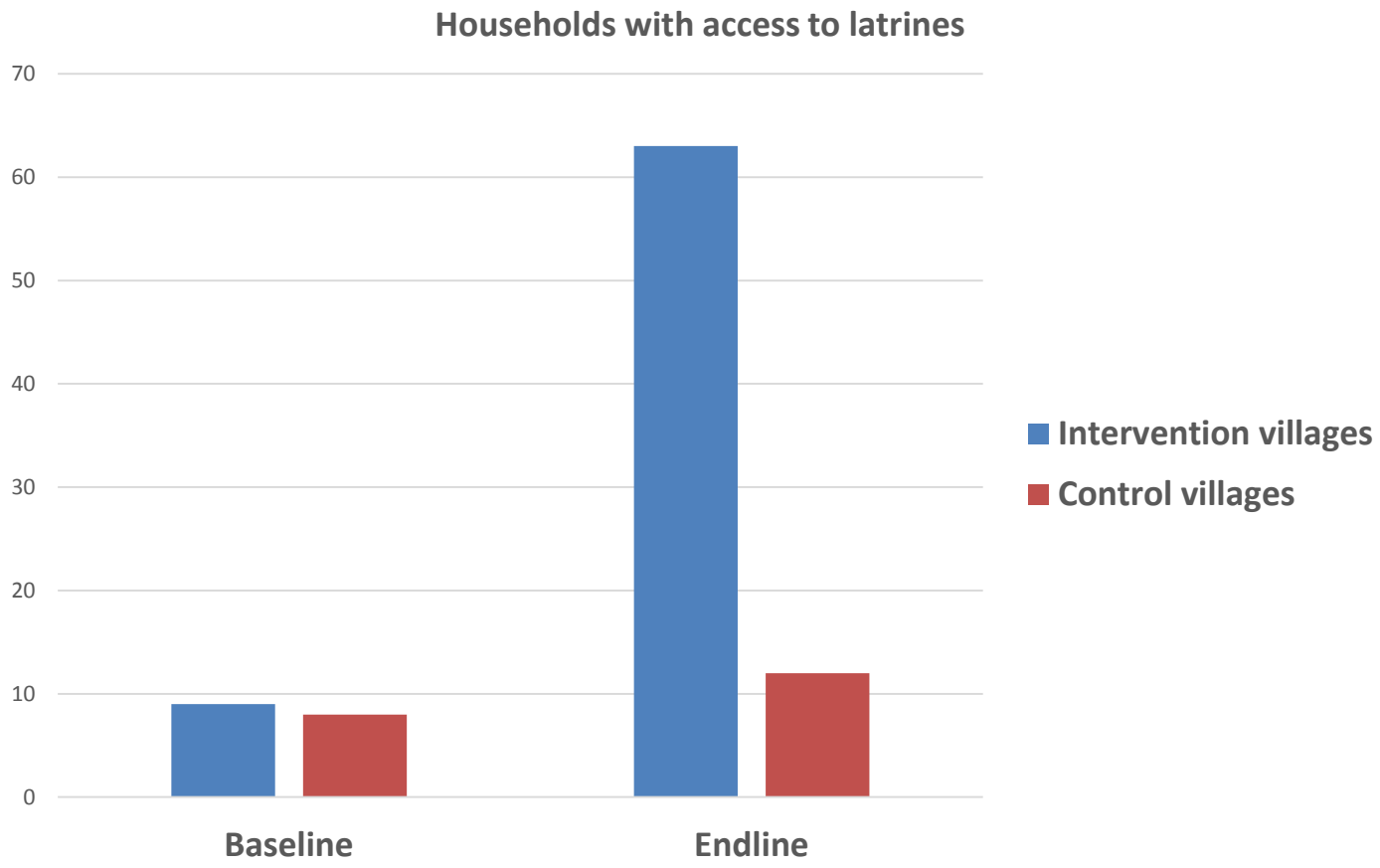
# Latrine Construction



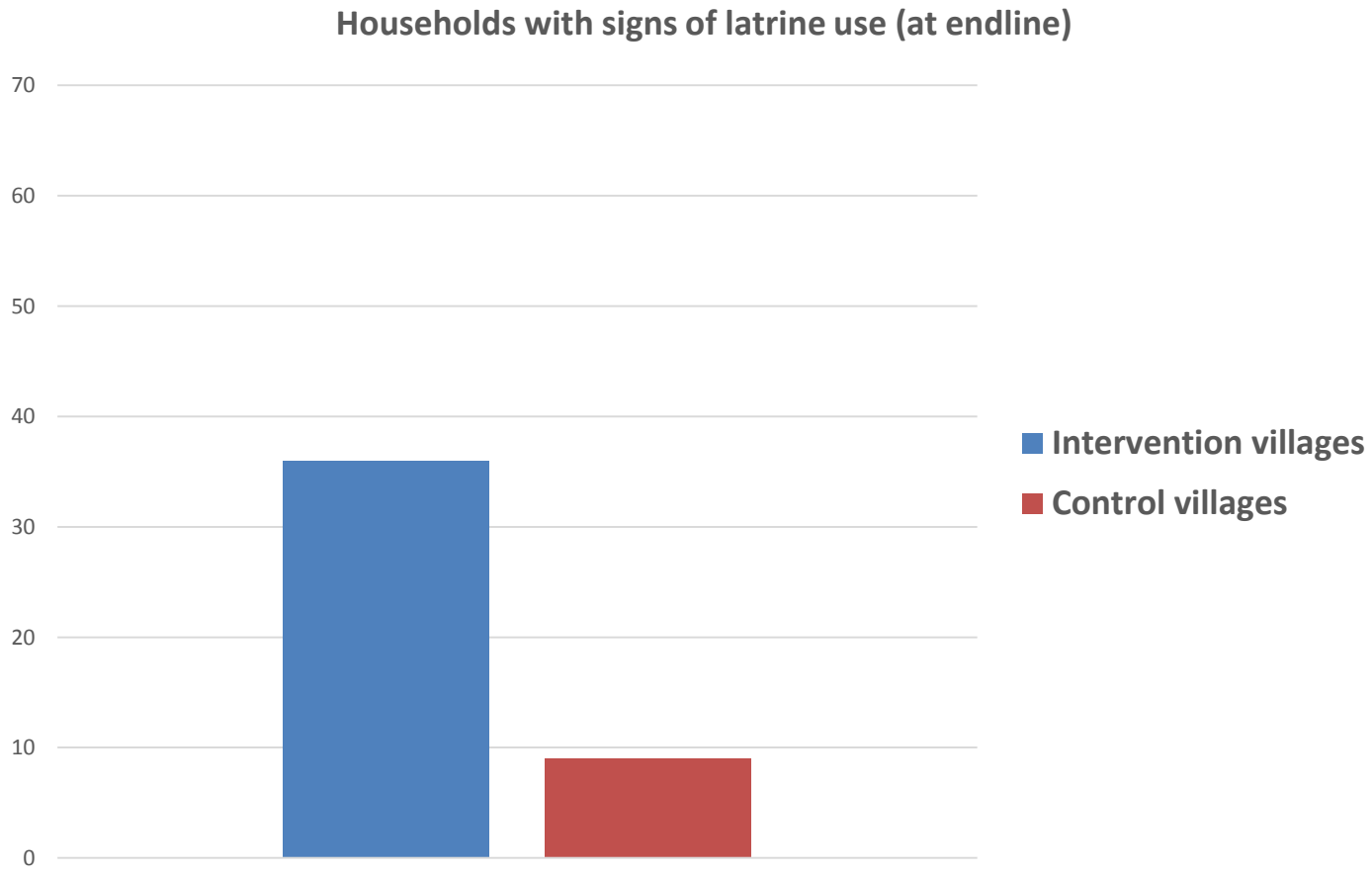

NB: Latrine classified as "under construction" if it did not meet spec (e.g., missing door, insufficient wall height, etc.) even if it was potentially usable and showed signs of being used

Boisson S, Peppin S, Ray S, Routray P, Torondel B, Schmidt W-P, Bhanja B, Clasen T (2014). Promoting latrine construction and use in rural villages practicing open defecation: process evaluation in connection with a randomized controlled trial in Orissa, India. BMC Research Notes 7:486

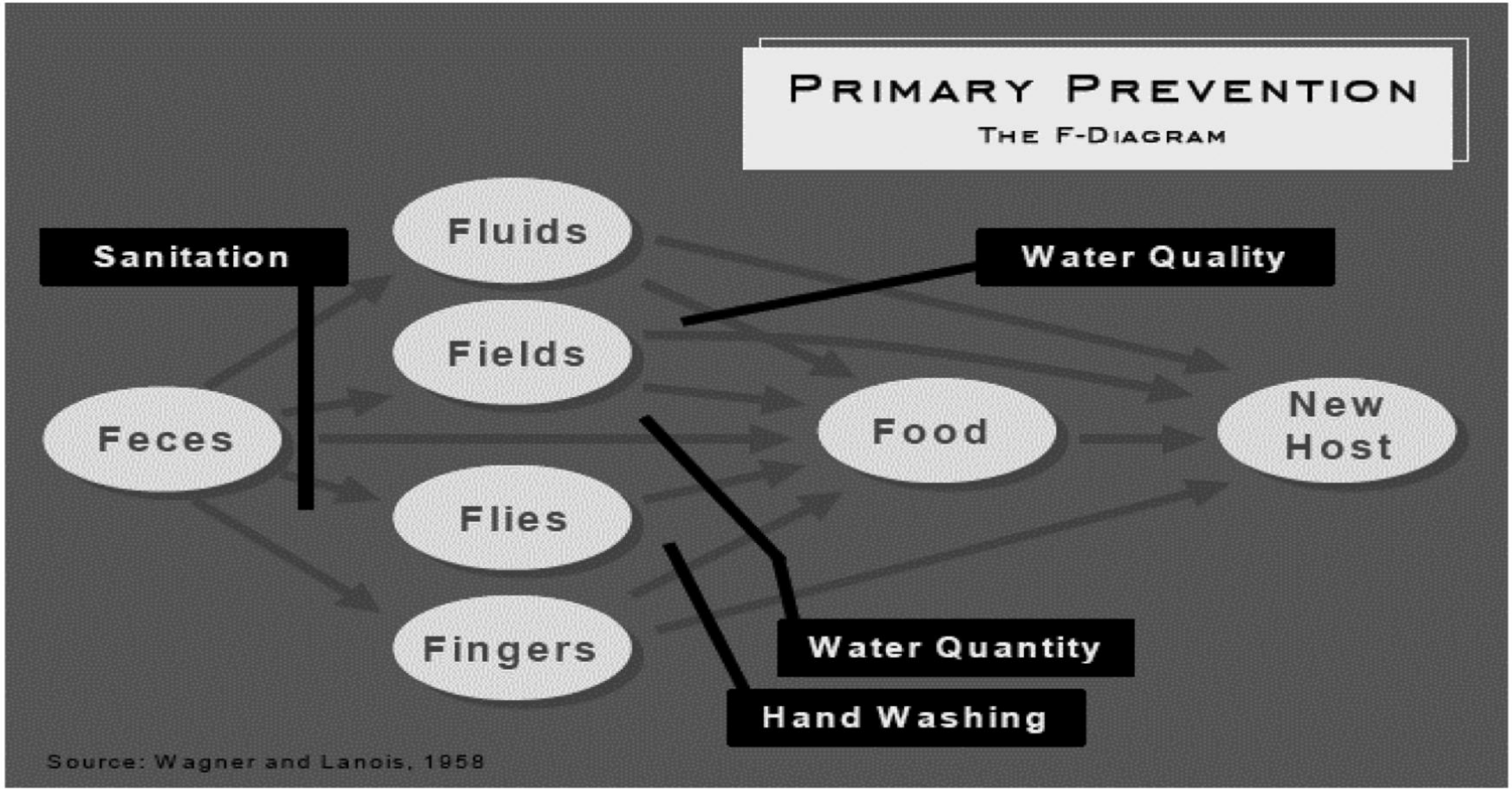
# Access to latrines



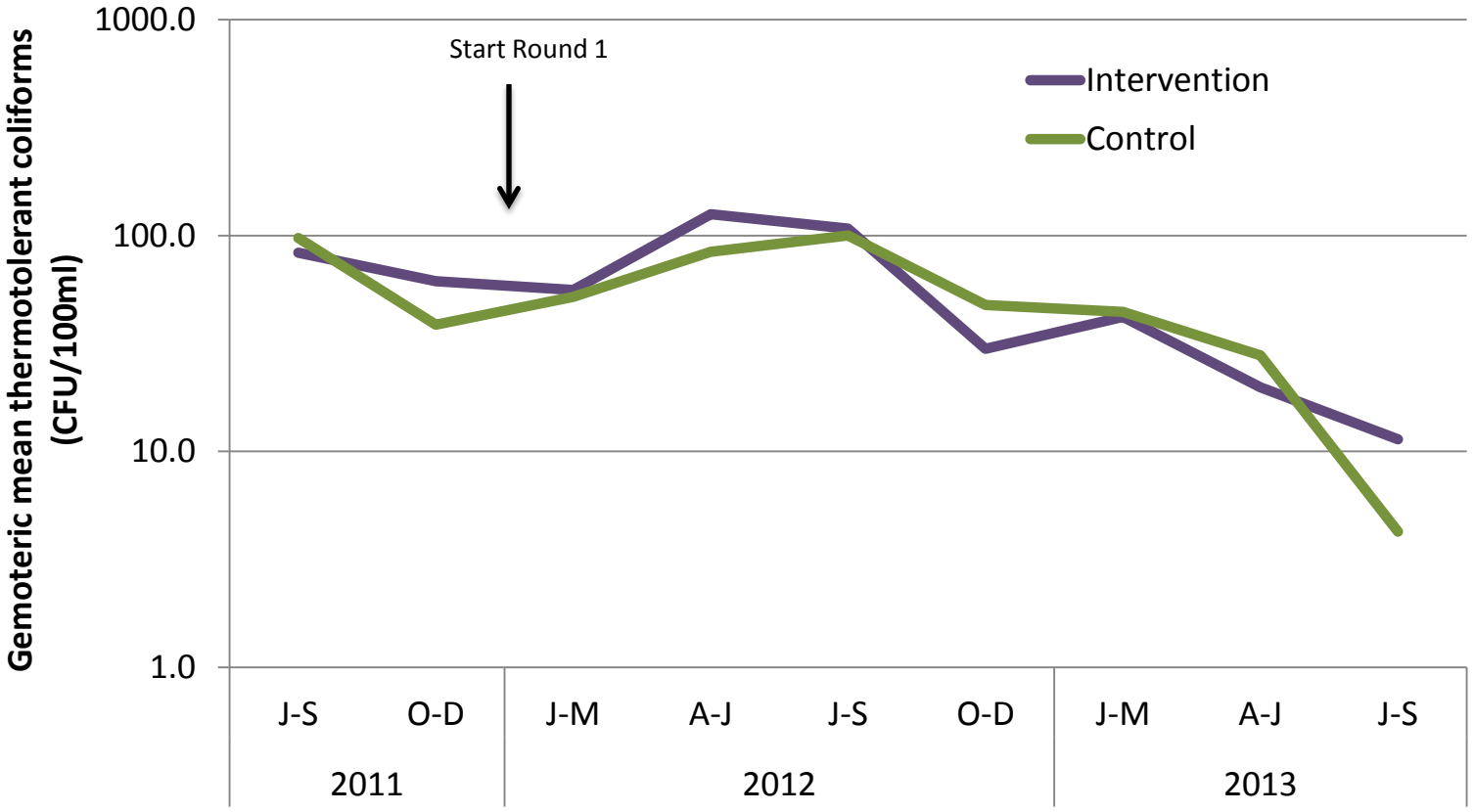
# Use of latrines



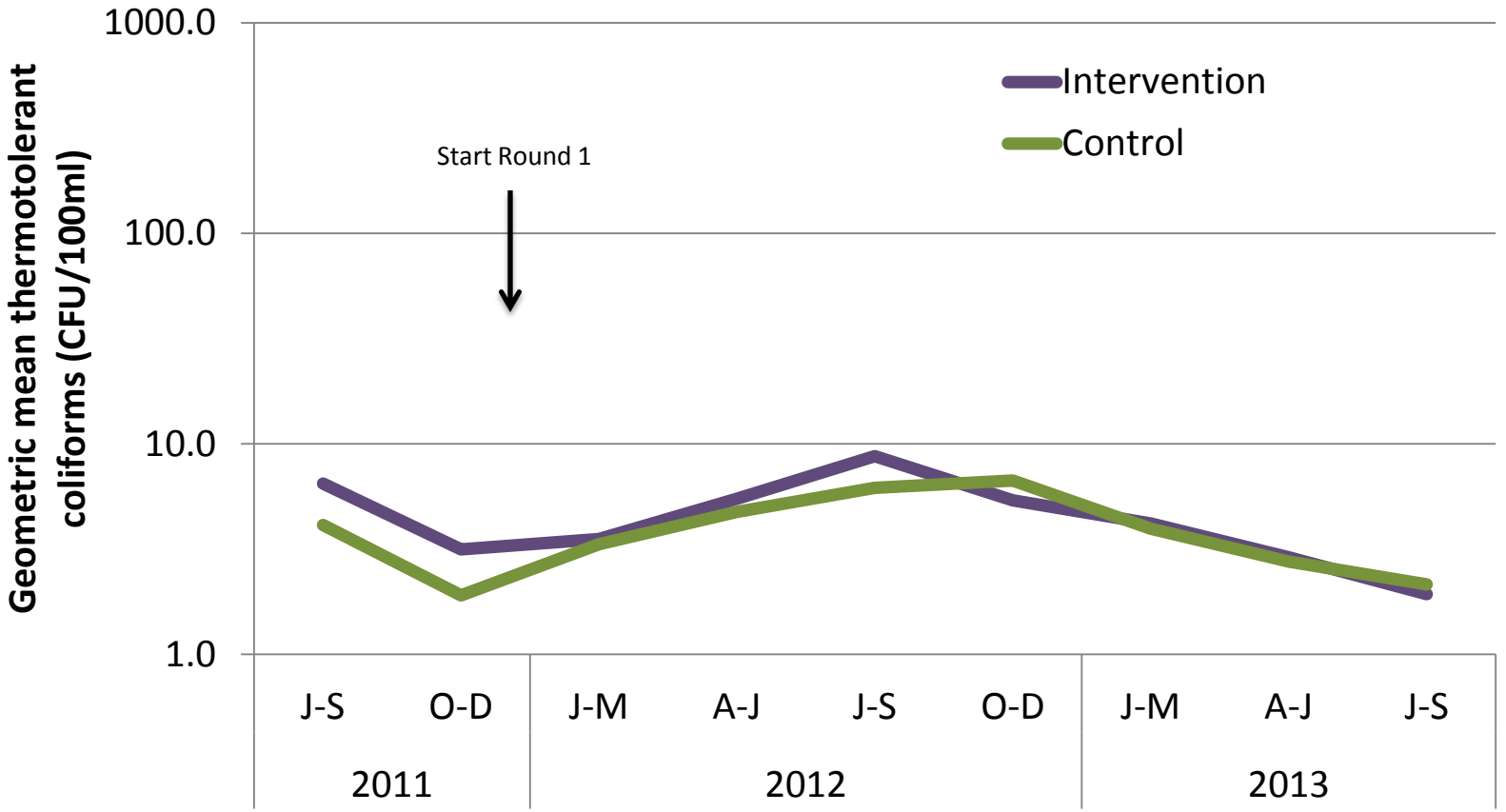
# Assessing Intermediate Outcomes of Improved Sanitation



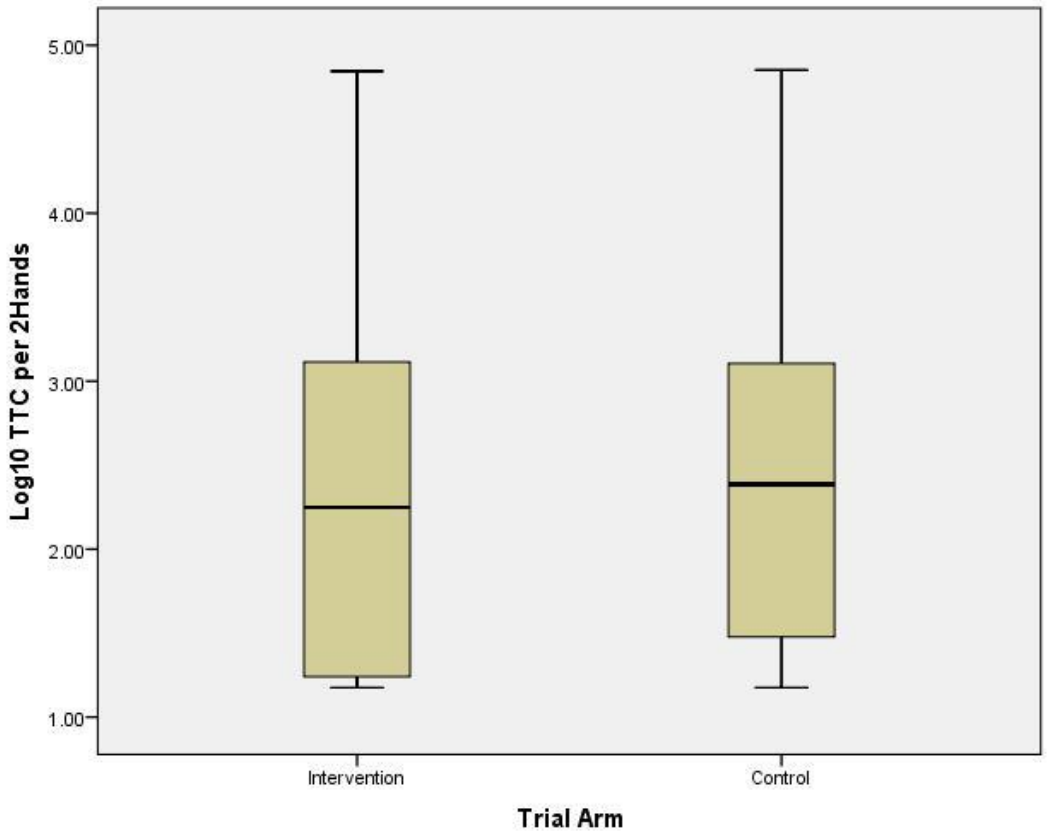
# Household water quality over time (n=3,823)



# Source water quality over time (n=3,029)

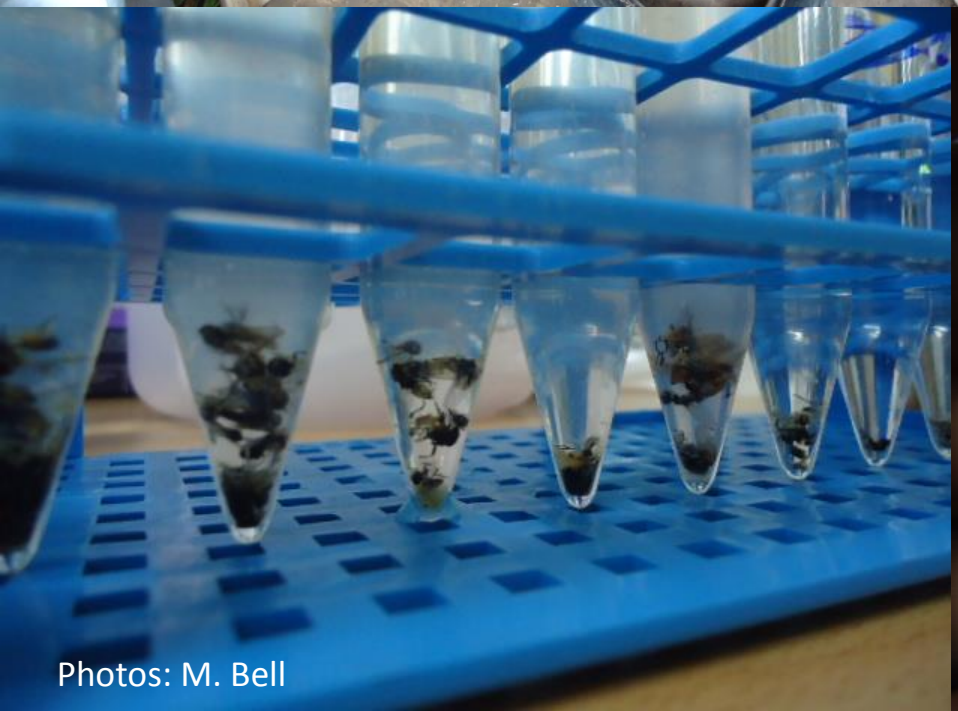


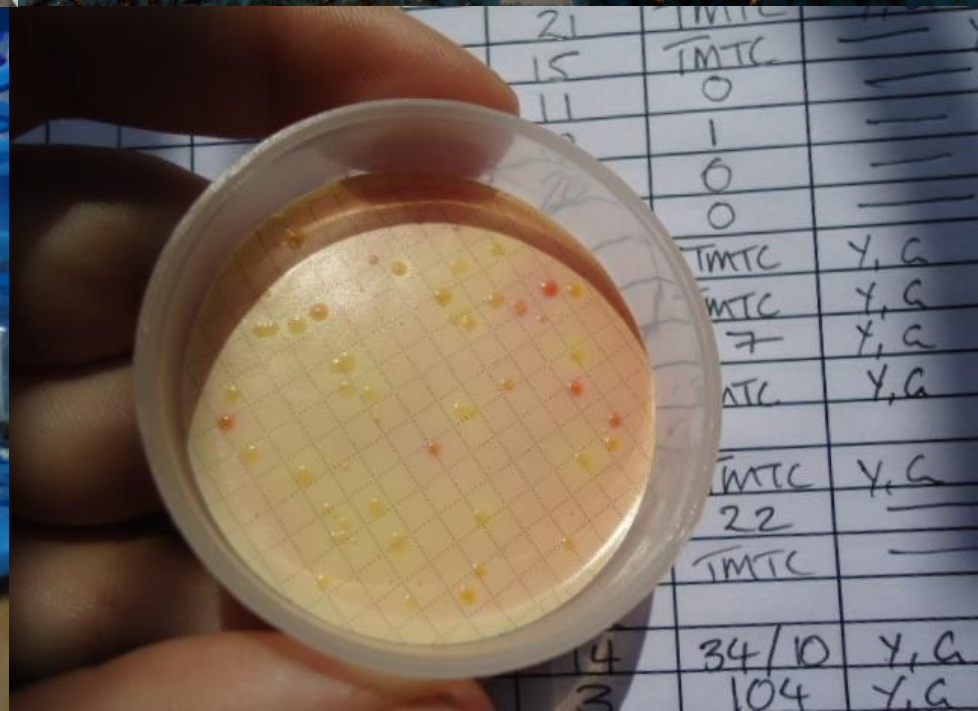
# TTC on Hands - descriptive results




| ARM | N | $Log_{10}$ TTC / 2 hands - Mean [SD] |
|---|---|---|
| Intervention | 336 | 2.32 |
| Control | 338 | 2.40 |
| Total | 674 | 2.36 |

# Synanthropic flies

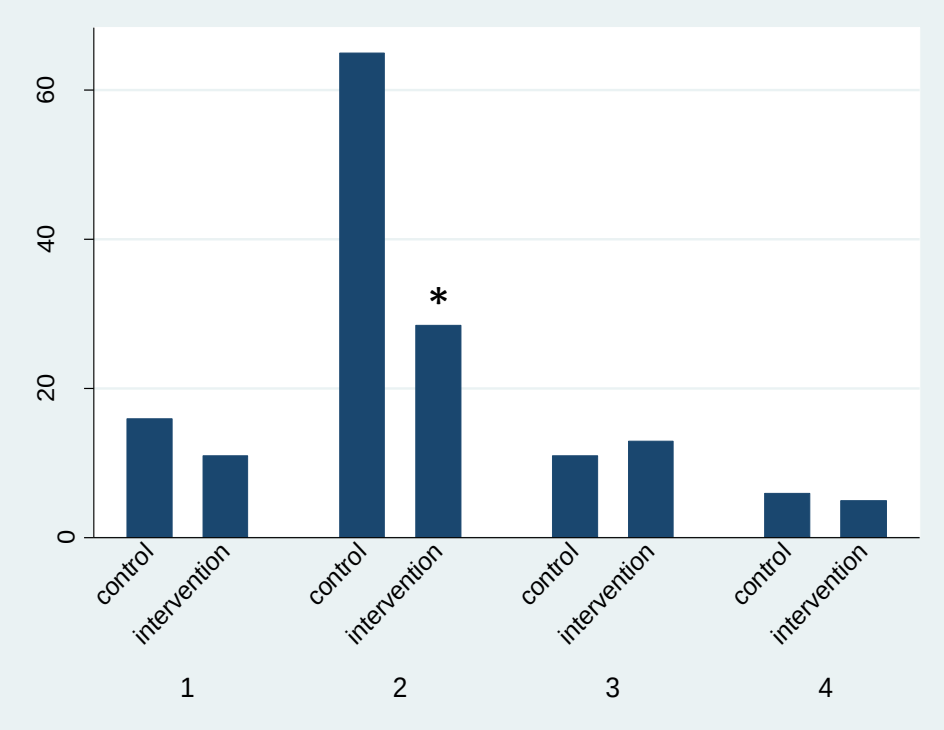





Photos: M. Bell

| | N | Median | IQR |
|---|---|---|---|
| **Control** | **852** | **13.5*** | **3-57** |
| **Intervention** | **864** | **12** | **2-43** |

*denotes a significant difference in the mean collection of synanthropic flies between control and intervention villages, p = 0.004




Overall, slightly more flies collected in control villages compared to intervention villages, with difference mainly attributable to round 2 – monsoon season

| | ***Escherichia coli* 0157** | **Salmonella spp.** | **Shigella spp.** | ***Vibrio cholerae*** |
|---|---|---|---|---|
| **Control (%)** | 304 (45) | 129 (19) | 53 (8) | 165 (25) |
| **Intervention (%)** | 290 (44) | 116 (18) | 46 (7) | 137 (21) |

Similar numbers of flies carried bacteria in both control and intervention villages

# Health Outcomes

# Diarrhoea (LP) by study arm and round


***Figure 2:*** **7-day prevalence of diarrhoea in children younger than 5 years (solid lines) and individuals aged 5 years and older (dashed lines) over seven rounds of follow-up, by intervention status**

# Anthropometry

| | Denominator (individuals) | | Mean Z-score, STH prevalence, or mean STH egg count | | Effect size (95% CI) |
|---|---|---|---|---|---|
| | Intervention | Control | Intervention | Control | |
| **Weight-for-age Z score‡** | | | | | |
| Intention-to-treat analysis | | | | | |
| Children <5 years at baseline | 1462 | 1490 | −1·48 | −1·43 | 0·02§ (−0·04 to 0·08) |
| Children <2 years at baseline | 650 | 637 | −1·46 | −1·32 | −0·01§ (−0·12 to 0·09) |
| Per-protocol analysis (children <5 years at baseline) | | | | | |
| Villages with functional latrine coverage ≥50% | 324 | 1490 | −1·36 | −1·43 | 0·10§ (0·003 to 0·20) |
| Households with functional latrine | 683 | 1274 | −1·32 | −1·50 | 0·12§ (0·05 to 0·20) |
| **Height-for-age Z score‡** | | | | | |
| Intention-to-treat analysis | 350 | 337 | -1·56 | −1·36 | −0·10§ (−0·22–0·02) |
| Per-protocol analysis | | | | | |
| Villages with functional latrine coverage ≥50% | 75 | 337 | −1·45 | −1·37 | −0·04§ (−0·24 to 0·16) |
| Households with functional latrine | 161 | 294 | −1·42 | −1·39 | −0·06§ (−0·27 to 0·15) |

STH=soil-transmitted helminth. *Log-binomial models, clustering by village accounted for by use of generalised estimating equations. †Random-effects linear regression. ‡We excluded children with *Z* scores greater than 5 or of 5 and lower. §Negative binomial regression of sum of village-level egg counts with number of samples in village as exposure.

# Possible reasons for lack of effect

- Insufficient coverage?
- Insufficient use?
- Intervention did not impact all transmission pathways (e.g., hands after defecation, child faeces) or sources of exposure (animal faeces)?
- Sources of exposure persist too long to see impact in 21-month follow up period?
- Intervention did not contain excreta?

# What's next

- Complete sub-studies
  - Methods for assessing use
  - Determinants of use
  - Spatial analysis
  - Microbial source tracking
- Dissemination of results in India
- Secondary analyses to explore impact (if any) based on compliance and other factors
- Gram Vikas evaluation

# Acknowledgements


- Implementing Partners
  - WaterAid
  - United Artists
- Funding Partners
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  - International Initiative for Impact Evaluation (3ie)
  - DFID-funded SHARE Research Consortium
- Research Partners
  - Xavier Institute of Management, Bhubaneswar
  - Asian Institute of Public Health
  - Loyola Hospital
  - Kalinga Institute of Technology, Biotechnology Center
  - LSHTM
  - Emory University
  - UC Berkeley
  - Yale University/IPA
  - UC Davis