Urban risk factors associated with enteric infection in children:

The role of toilets, FSM, and flooding in a low-income neighborhood of Vellore, India

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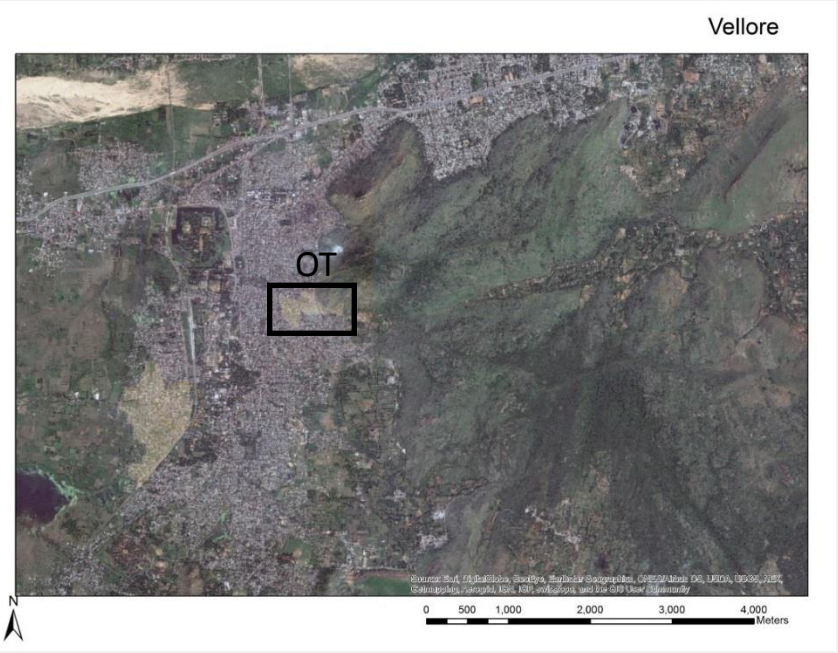
Background

- Open drains are a common conveyance for fecal waste in urban areas
- They are often the most “visible” fecal sludge present in the neighborhood
- Risks/benefits often not assessed
- Some QMRAs (Katukiza et al. 2013, Labite et al. 2010) have shown them to be risk factors for pathogen transmission from contact
  - Linked to contact rates, but not flooding

Research goals

- To examine the relationship between household toilet presence and enteric infection risk in young children in a low-income, dense, urban environment
- To examine how the FSM associated with the toilet might affect this relationship
- To assess how rainfall and potential flooding from open drains might affect young children in households in the community at-large ("downstream")

Study site: Vellore, India



- Old Town neighborhood (OT)
- Christian Medical College (CMC), Vellore
  - The Interactions of Malnutrition and Enteric Infections: Consequences for Child Health and Development (MAL-ED) Study
- SaniPath study

MAL-ED

SaniPath

http://www.gked.in/images/ContactUs-LocationMapInIndia.jpg

Methods

- Outcomes
  - Stool specimen collection during first 2 years of life (2010-2014)
    - 230 children in Old Town (OT)
      - Routine and diarrheal stool collection
      - Monthly during 1st year of life, every 3 months during 2nd year
    - Tested for panel of enteropathogens (including bacteria, helminths, protozoa, and viruses)

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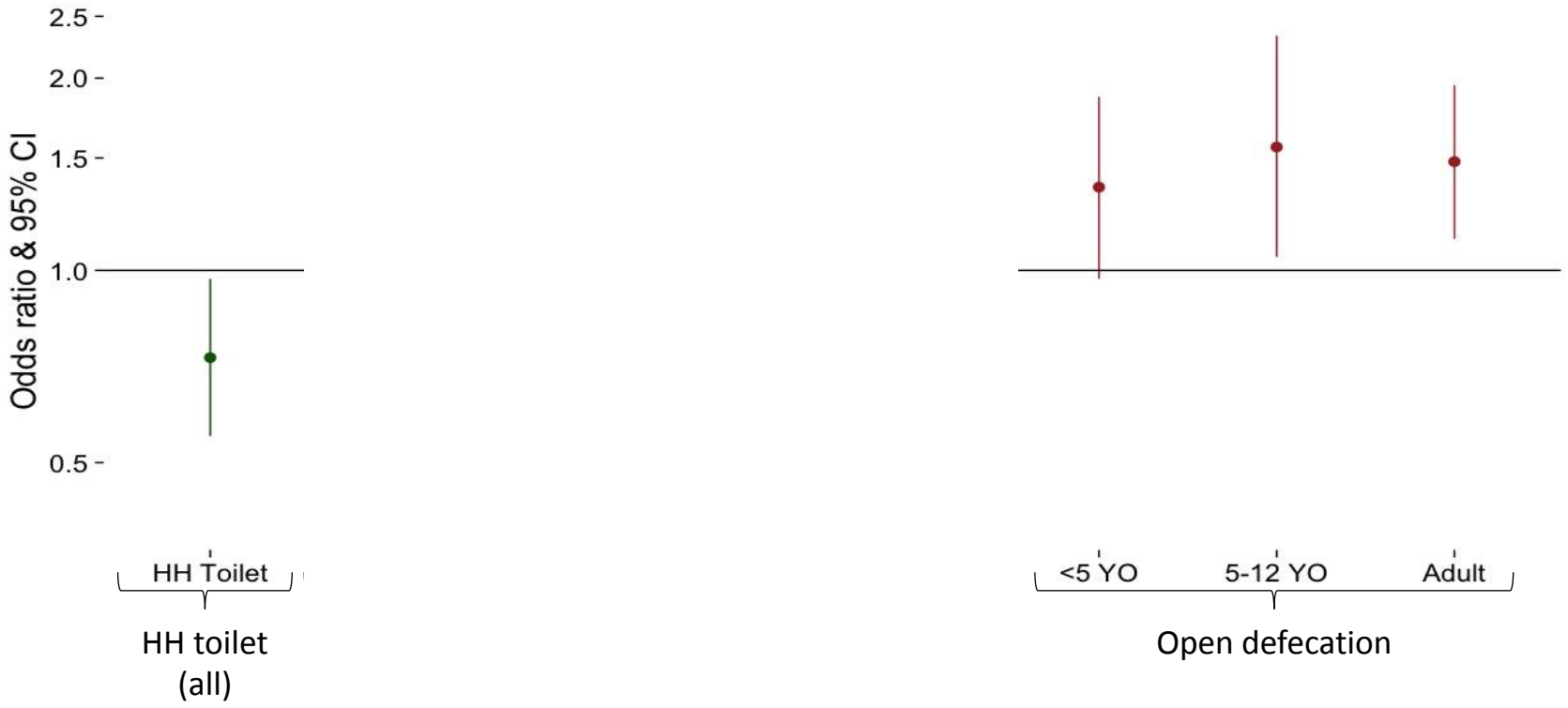
- Exposures
  - Household surveys (100 households in Old Town, Feb. 2014)
    - Sanitation characteristics
      - Presence of a toilet
      - Immediate fate of toilet waste: to drain, contained onsite, etc.
    - Presence of and interaction with open drains
      - Frequency of reported contact
      - Reported flooding
  - Rainfall data (estimated rainfall per month (cm), Jan. 2010 – Dec. 2014)
    - India Meteorological Dept., Ministry of Earth Sciences, Government of India

Main outcome	Percent of children's stool specimens
Enteric pathogens in asymp. stool	67%
Enteric pathogens in diarrheal stool	80%
Exposures	Number of households (%)
Sanitation	
Household toilet	33 (33.0%)
->Empties to drain	27 (82.0%)
->Contained onsite	3 (9.0%)
->Other	3 (9.0%)
Flooding	
Reported drain flooding	57 (57.6%)
Reported house flooding	23 (23.0%)
Behaviors	
Open defecation (<5 YO)	80 (80.0%)
Open defecation (5-12 YO)	45 (78.9%)
Open defecation (adult)	68 (68.0%)
Reported water treatment	32 (32.0%)
Monthly frequency of contact with:	
Drain water: Any, High (>10x)	86 (86.0%), 15 (15.0%)
Flood water: Any, High (>10x)	82 (82.0%), 26 (26.0%)
Public toilets: Any, High (>10x)	46 (46.0%), 13 (13.0%)

Children with toilets within the household were less likely to have an enteric infection

Risk of enteric infection with toilet use, FSM of toilet, and open defecation

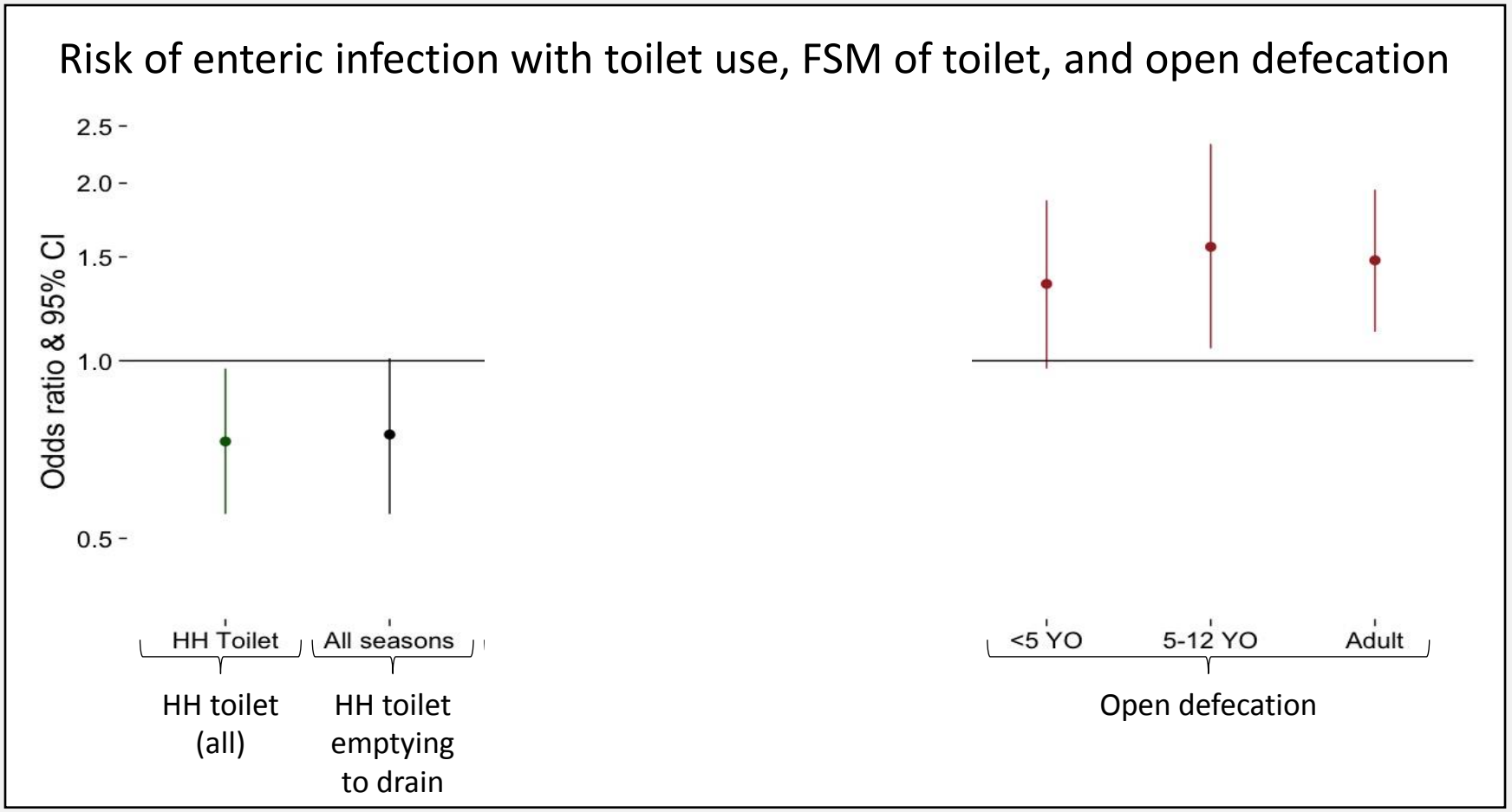


HH toilet (all)

Open defecation

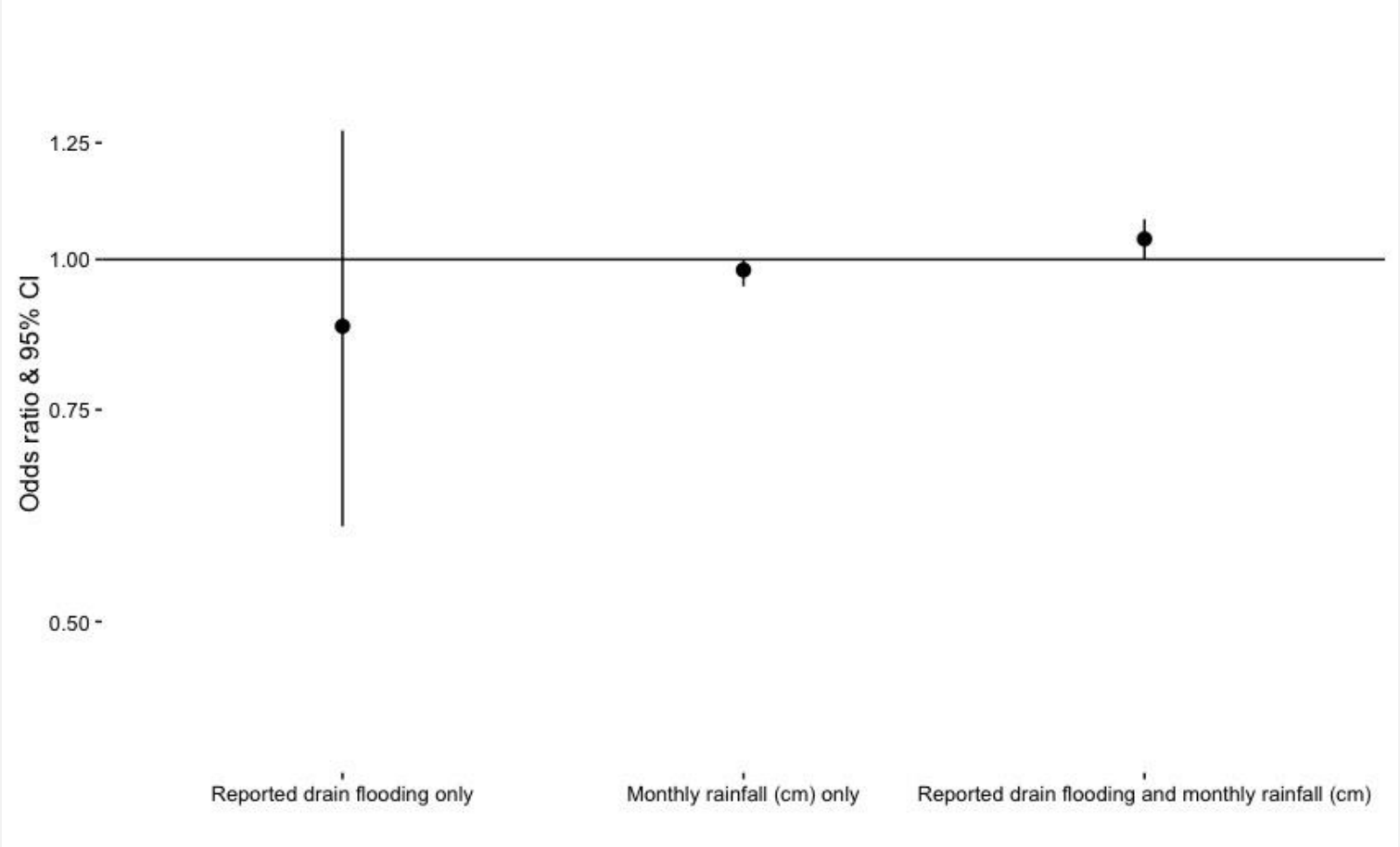
Models adjusted for season and type of stool collected (routine/diarrheal);

During the rainiest season, children with toilets that discharged to drains **did not have lower risk of enteric infection**



Models adjusted for season and type of stool collected (routine/diarrheal);

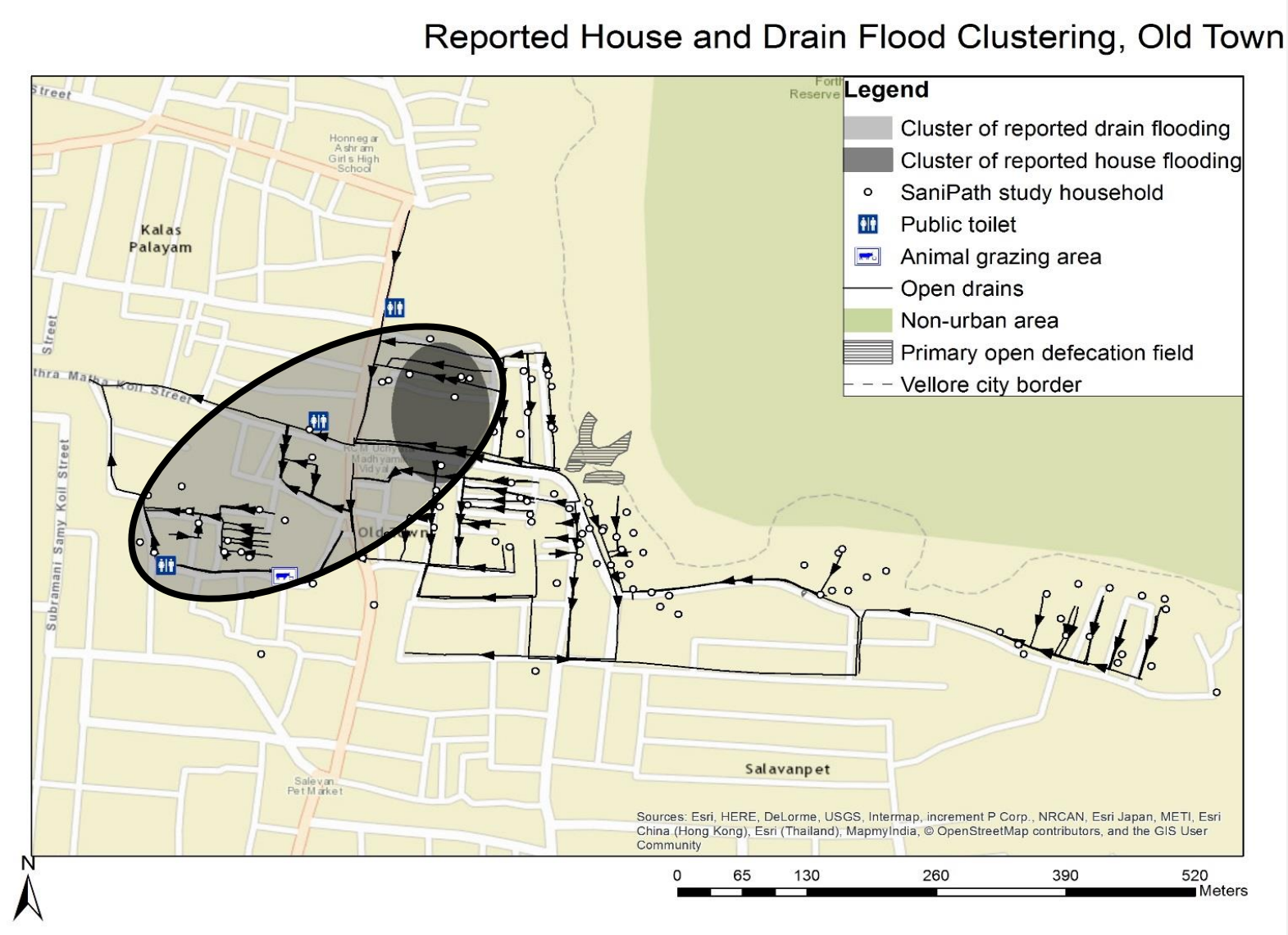
Children in households reporting that their drain flooded had increased risk of enteric infection with increasing rainfall



4% increased risk of enteric infection per cm monthly rainfall

> 10cm/month during monsoon = **40% increased risk**

Cluster of reported drain flooding “downstream” in the neighborhood



Children living in households in the cluster of reported drain flooding had further increased risk of enteric infection with increasing rainfall

5% increased risk of enteric infection per cm monthly rainfall

> 10cm/month during monsoon = **50% increased risk**

Increased risk <u>not</u> based on behavior, only **geographic location** of the household

Strengths and Limitations

- Strengths
  - Objective outcome measures
    - Ability to look at symptomatic vs. asymptomatic stool, etiologic agents
- Limitations
  - Sample size
  - Timing of behavior (exposure) and stool specimen collection (outcome)
  - Lack of data measuring hygiene behaviors and animal contact
  - Spatial distribution of sample

Conclusions

- Presence of a household toilet was associated with lower enteric infection risk
  - Toilets emptying directly to drains were not effective in reducing enteric infection risk during the heaviest rains (NE monsoon)
- Living in an area of drain flooding was associated with increased enteric infection risk with rainfall
  - Households risk due to location, environmental, and weather-related factors, not behavior
  - Neighborhood geography + poor neighborhood-level FSM affects everyone

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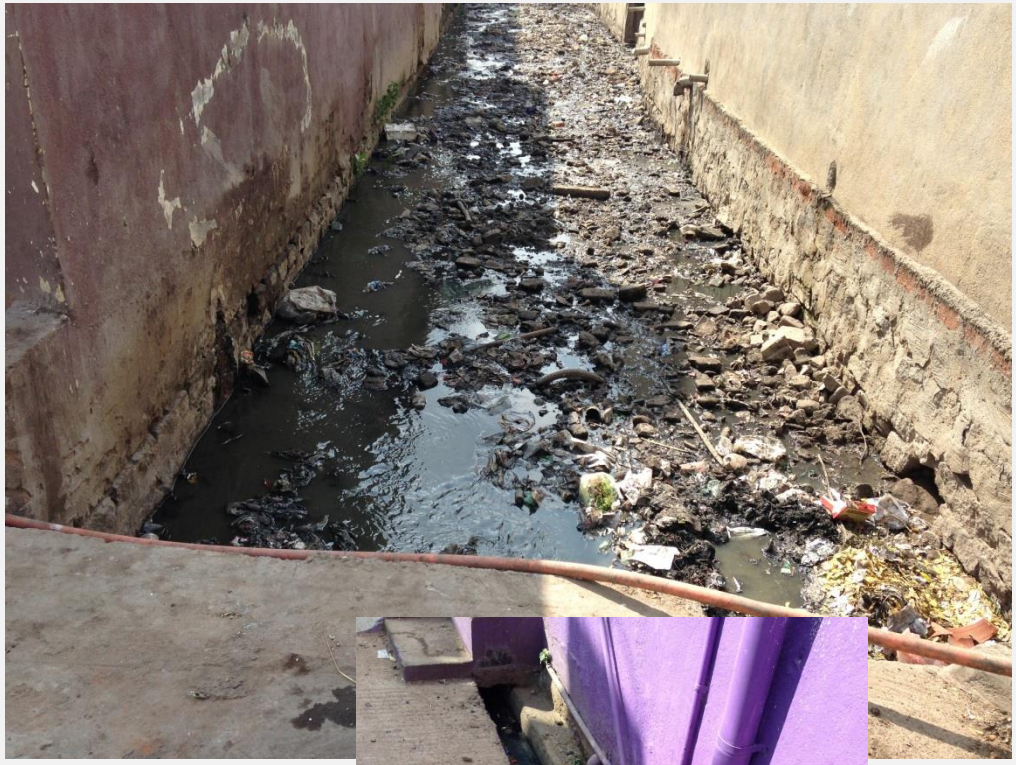
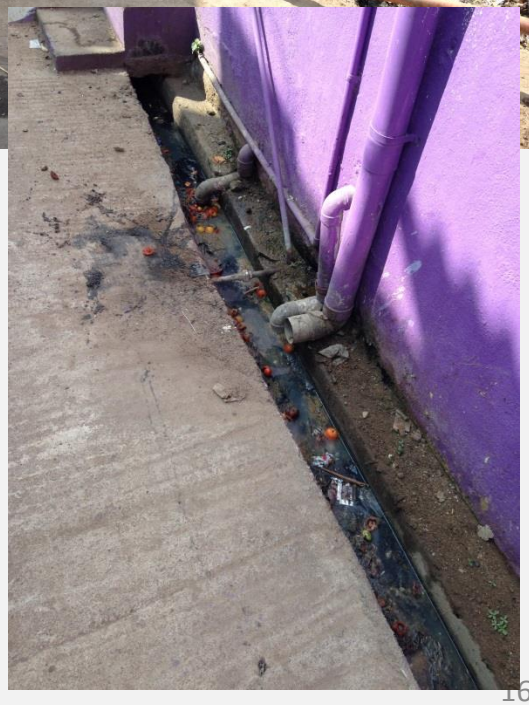
Questions?





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