Molecular Surveillance of Non-Typhoidal *Salmonella* from Environmental Sources in Disease Endemic Informal Settlement in Nairobi, Kenya

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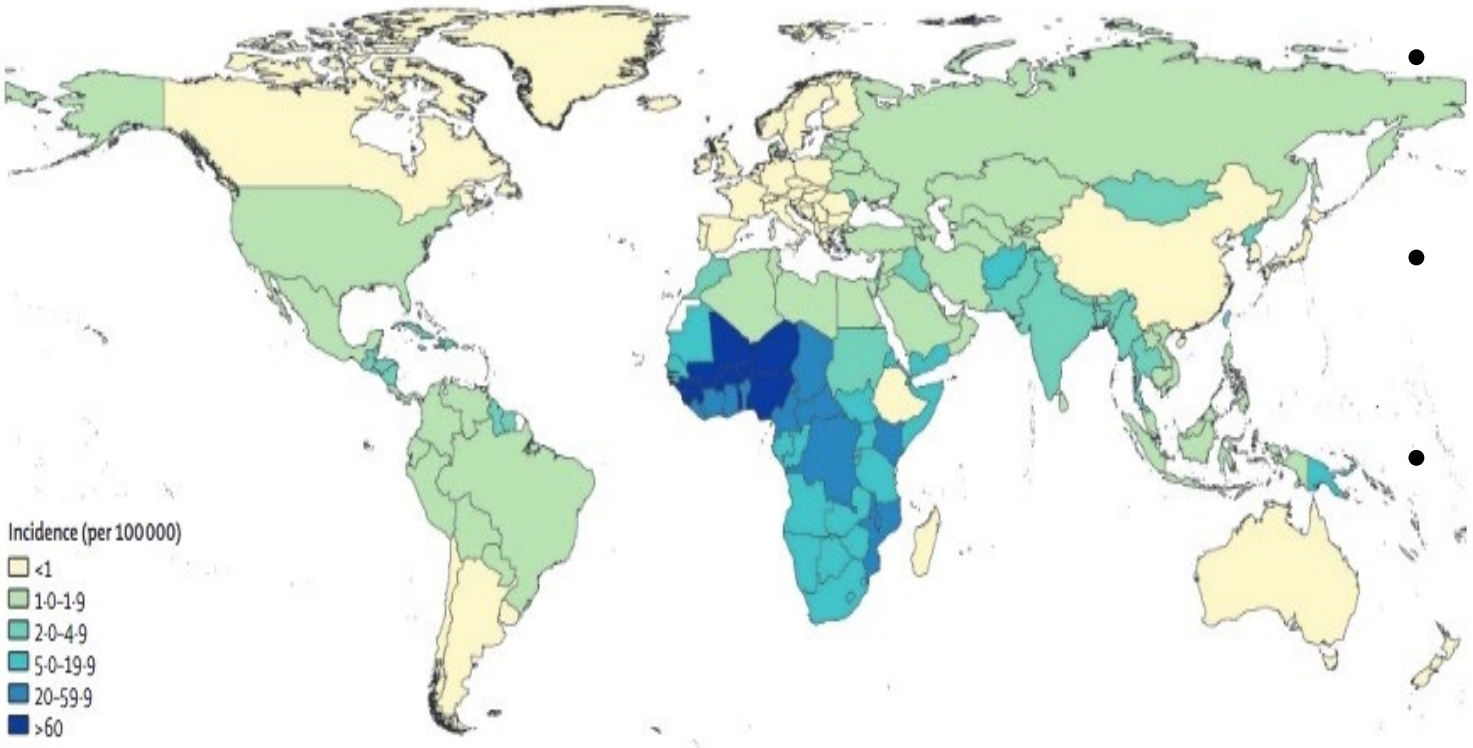
6th Dec 2023. Marriott Hotel, Kigali.

Introduction



- In HIC, NTS causes self-limiting gastroenteritis.
- In LMICs, associated with severe bacteremia.
- Over 94M cases of infections, and 155,000 fatalities *(Stanaway et al., 2019; WHO, 2018).*

NTS disease incidence rates/100,000, by country, in 2017

Source: GBD 2017 Non-Typhoidal Salmonella Invasive Disease Collaborators

Gaps in our knowledge on environmental contamination

our understanding of the potential role of the environment as a reservoir for community transmission of NTS in disease-endemic settings is limited.

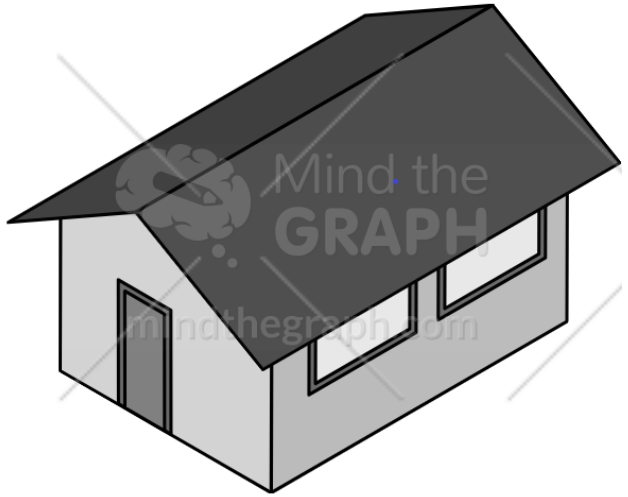
Study Objectives

- ✓ To screen for NTS in various environmental samples (drinking water, effluent, soil, and raw sewers).
- ✓ To assess fecal contamination of the environmental samples (drinking water, effluent, soil, and raw sewers).
- ✓ To investigate the seasonal variations in detection of NTS in disease-endemic settings.

Mukuru Informal settlements

- Mukuru an area 5km^2 with over 300,000
- Poor sanitation and inadequate access to clean drinking water, creates a significant hotspot for the fast spread of NTS in slums.

Methodology



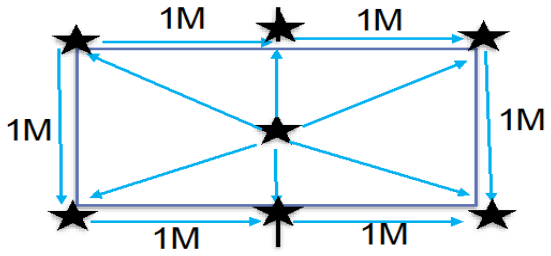
Case-Contact HH

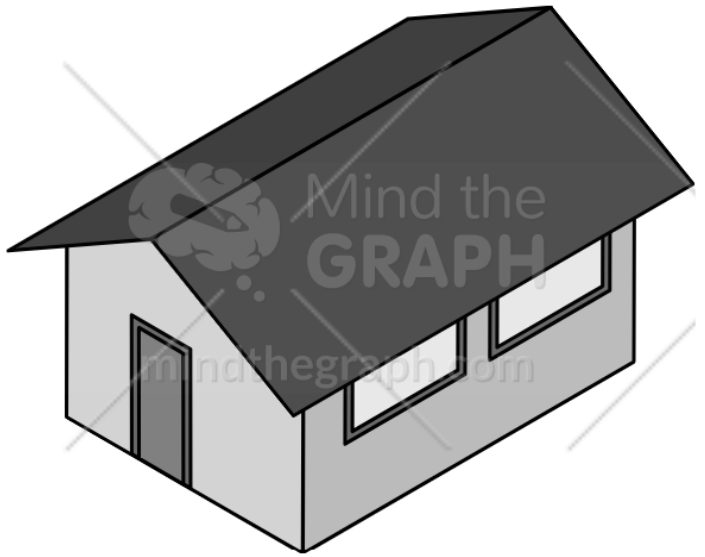
Samples	Sample ID
Soil	038495_S
Effluent (Open sewer)	038495_E
Drinking water	038495_D

100M

- ✓ **Raw sewer** *(from convergence point)*

Soil Sampling





Control HH

Samples	Sample ID
Soil	038495_T_S
Effluent (Open sewer)	038495_T_E
Drinking water	038495_T_D

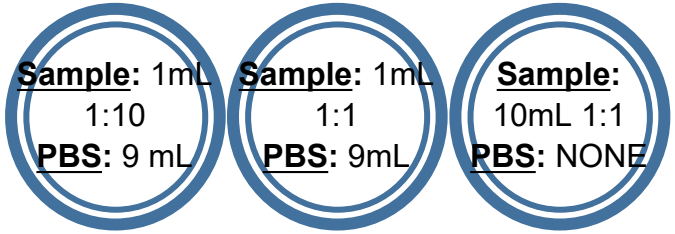
Sample Processing

FIELDWORK

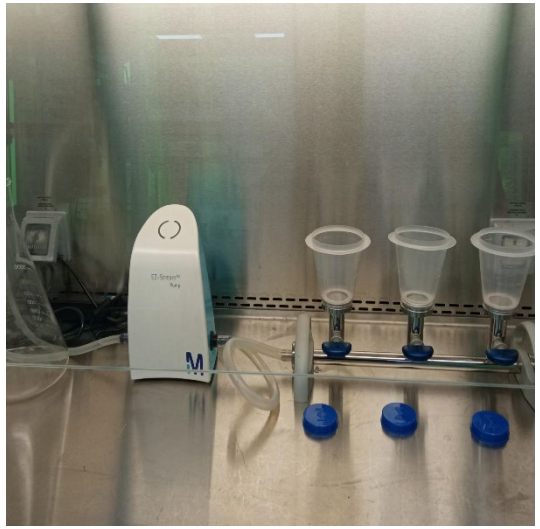
LABWORK

Environmental Sample

Fecal contamination detection



***E. coli* assay**



NTS detection

Sample concentration

DNA extraction

NTS assay

PCR

Specific primers (safA- S. Ent' and fliA-IS200 S. TM)

Metagenomic Analysis

➢ *Phase on going*

Results: Detection of Fecal contamination

Study area	Sample Type	Fecal contamination detection				
		Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Total
Mukuru	Drinking Water	16/30 *(53.3%)*	16/20 *(80.0%)*	14/22 *(63.6%)*	9/14 *(64.3%)*	55/86 *(63.9%)*
	Effluent	20/22 ***(90.9%)***	29/30 ***(96.7%)***	20/20 ***(100%)***	14/14 ***(100%)***	83/86 ***(96.5%)***
	Soil	17/22 (77.3%)	28/30 ***(93.3%)***	20/20 ***(100%)***	11/14 ***(78.6%)***	79/86 ***(91.7%)***
	Raw Sewer	4/4 ***(100%)***	4/4 ***(100%)***	4/4 ***(100%)***	4/4 ***(100%)***	16/16 ***(100%)***

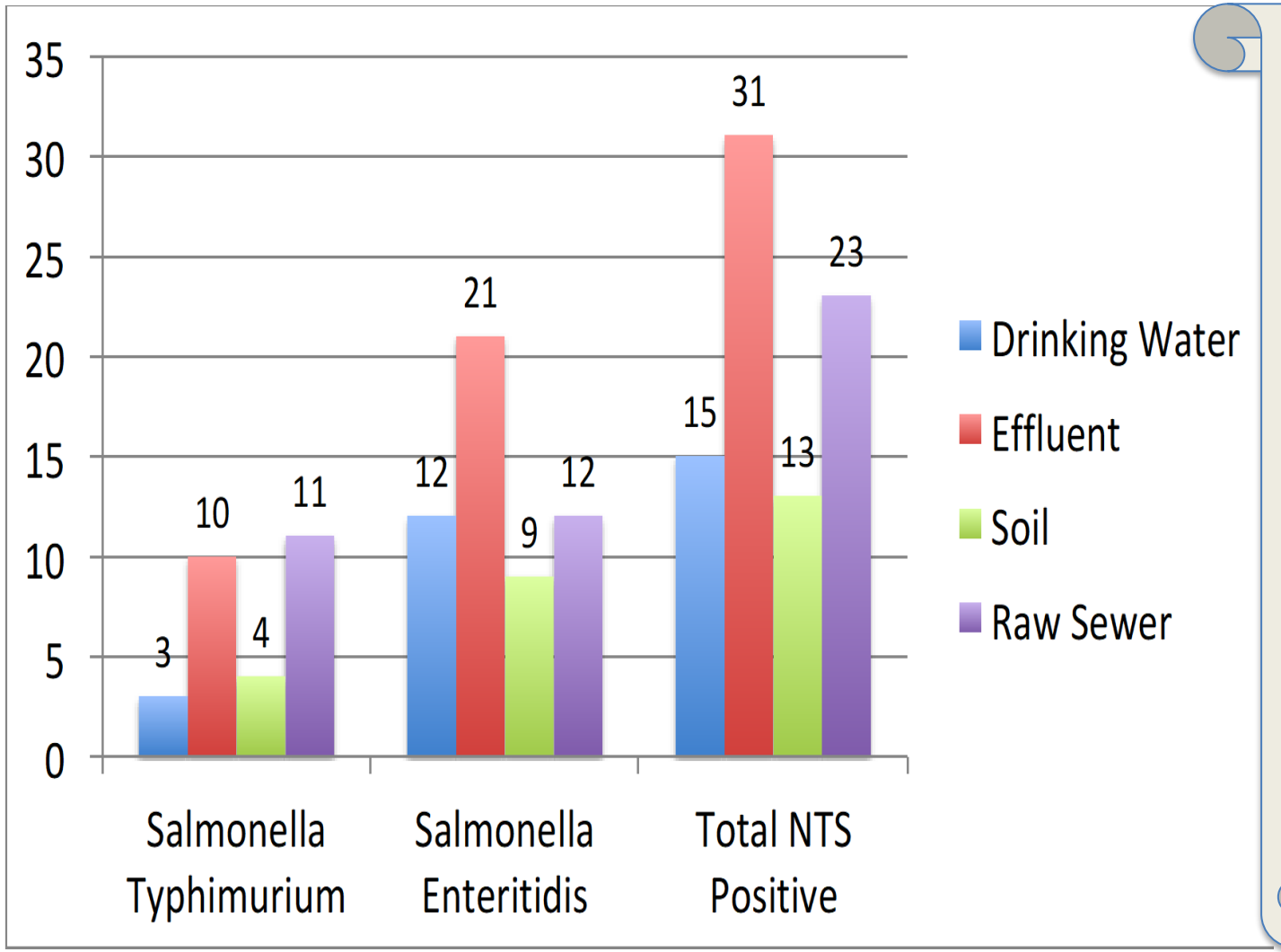
- An indicator of ***fecal contamination***
- High fecal contamination especially in drinking water
- May indicate likelihood of environmental contamination by NTS and other coliforms

Detection of NTS

Study area	Sample Type	No: of Samples collected	Non-Typhoidal *Salmonella* (NTS) Distribution per Sample Type		
			***Salmonella* Typhimurium**	***Salmonella* Enteritidis**	**Total NTS Positive**
Mukuru Informal Settlement	Drinking Water	86 **(31.4%)**	**3 *(3.5%)***	**12 *(14%)***	15
	Effluent	86 **(31.4%)**	**10 *(11.6%)***	**21 *(24.4%)***	31
	Soil	86 **(31.4%)**	**4 *(4.7%)***	**9 *(10.5%)***	13
	Raw Sewer	16 **(5.8%)**	**11 *(68.8%)***	**12 *(75.0%)***	23
Total		**n=274**	**28 *(10.2%)***	**54 *(19.7%)***	**82 *(29.9%)***

- 29.9% detection rate of NTS from the environmental samples.
- *S.* Enteritidis was the most ubiquitous compared to *S.* Typhimurium .
- To Note : 4 NTS were isolated by culture:
  - ✓ S. En & STm from drinking water of cases
  - ✓ S. En from effluent & sewer
- This as an indicator of potential NTS dissemination from environment

Proportions of serotypes from environmental sources

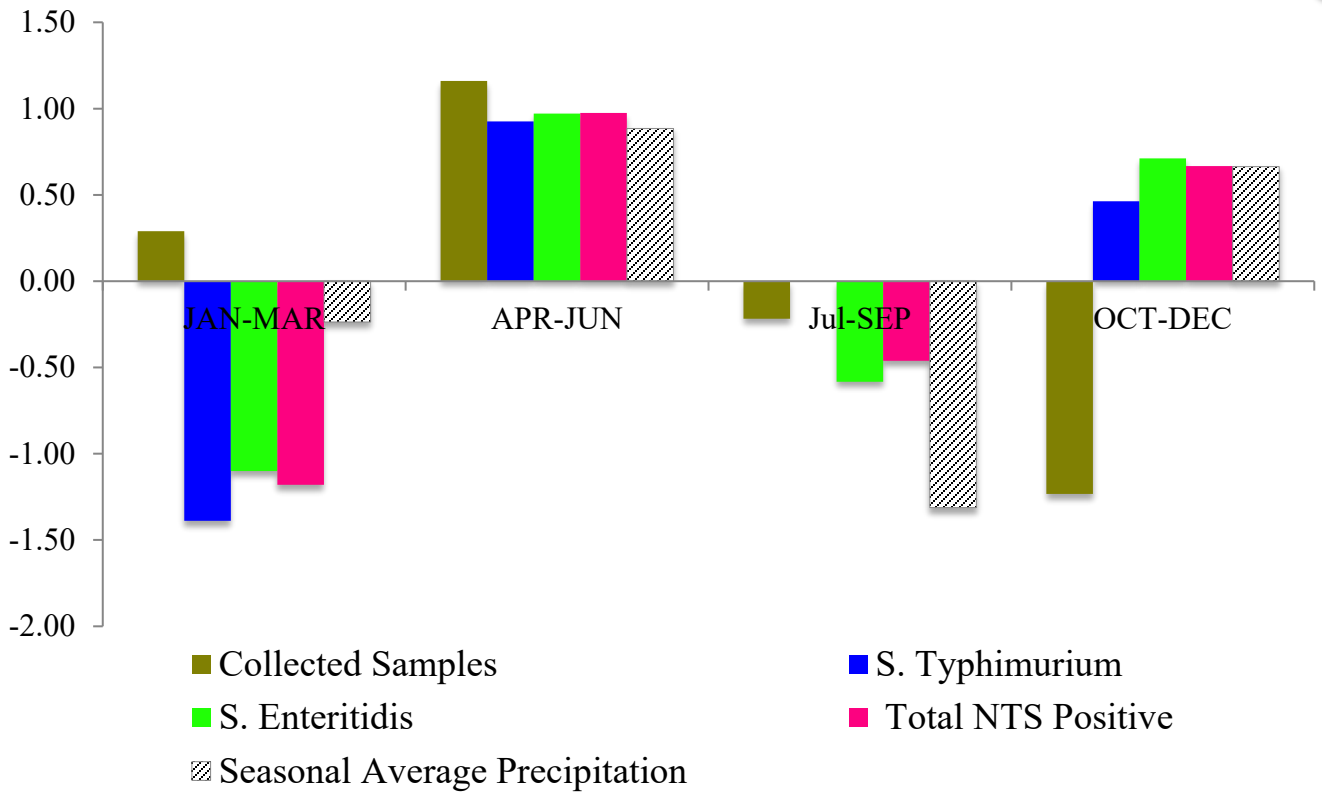


- Proportionately, contamination was higher in:
  - ✓ effluent
  - ✓ raw sewer
  - ✓ drinking water
  - ✓ Soil

Discussion: Environmental contamination

- The relatively high levels of NTS contamination in raw sewers and household effluent may be due to fecal contamination.
- This demonstrates that fecal contamination may be the primary cause of environmental NTS contamination
- NTS contamination in drinking water and soil is of concern due to their potential to facilitate uncontrolled NTS spread in the community;
  - ✓ *more so to children due to their indiscriminate outdoor activities that may expose them to contaminated water, open drains, and soil.*

Seasonal Variation in Non-Typhoidal *Salmonella* in environmental Carriage



- Both *S.* Typhimurium and *S.* Enteritidis displayed decrease in detection in 1st & 3rd quarter of the year,
- Increase in detection was observed in the 2nd & 4th quarter, *coinciding with wet seasons*

Normalized data. Variables represented in relation to their respective baseline values. Positive values indicate an increase in NTS detection. Precipitation included for reference.

Conclusion and recommendation

- Establishing a comprehensive NTS surveillance *(including WGS & metagenomic approach*) key in:
  - ✓ Monitoring NTS genotypes and distribution at the interface between the humans and - environment:
    a. *to gain insights into the dynamics of NTS transmission,*
    b. *to develop effective prevention and control strategies to mitigate its spread within the community.*

Acknowledgement

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