

Antimicrobial Resistance and Intestinal Shedding of Non-typhoidal *Salmonella* among  
Children under Five Years and Carriage in Asymptomatic Hosts in Kenya

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# Outline

**01.** Introduction

**02.** Methods

**03.** Results

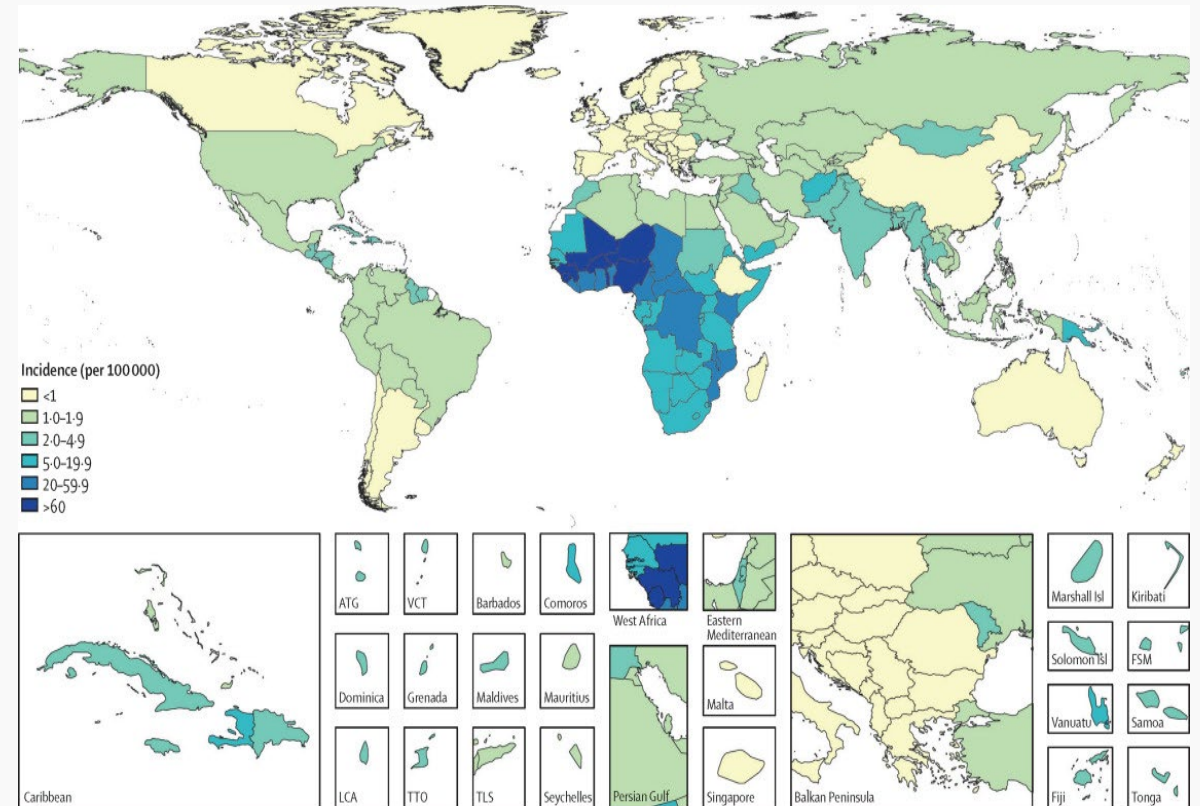
**04.** Key Findings

**05.** Conclusion

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# The challenge of Non-typhoidal *Salmonella* (NTS)

- NTS is one of the prominent causes of gastroenteritis and invasive disease.
- Most prevalent among Children < 5 Years.
- \*AMR limits the treatment options
- No vaccine is currently available

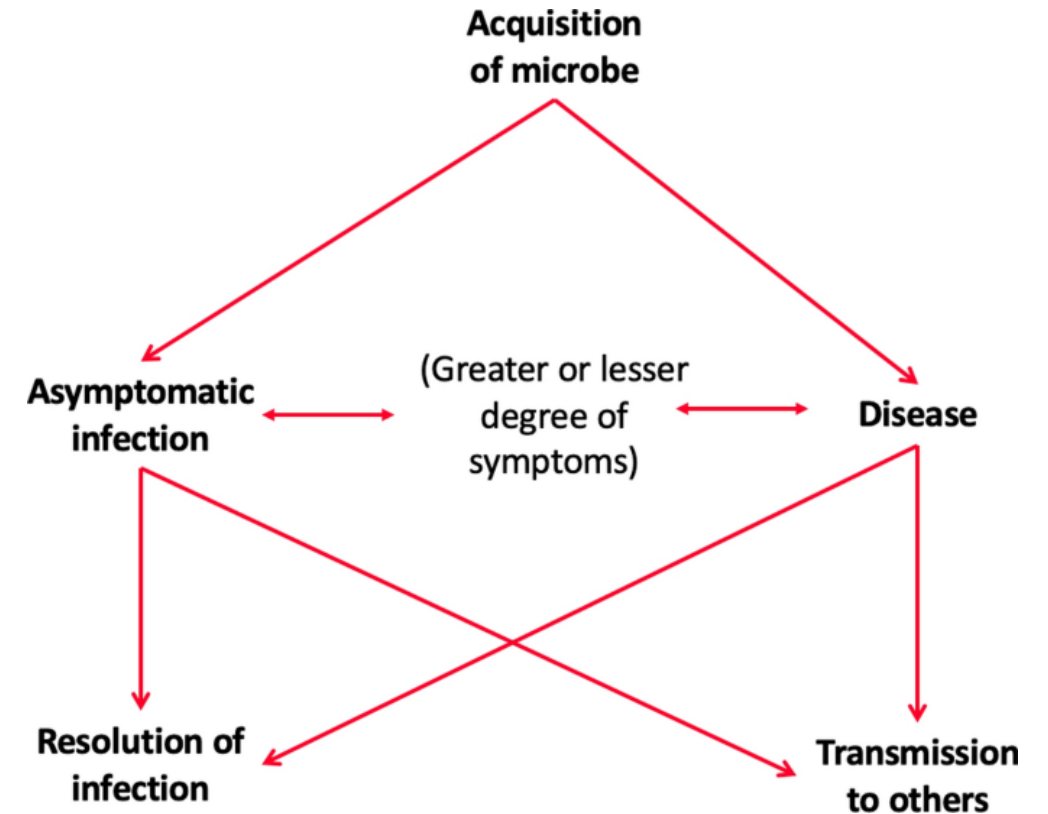


**\*\*NTS invasive disease incidence rates (per 100 000)**

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## Asymptomatic shedding

- NTS is primarily zoonotic in developed countries.
- In Sub-Saharan Africa transmission routes are unclear.
- It is hypothesized that humans are potential reservoirs.
- Asymptomatic shedding could be a source of new infections
- Shedding of Multi-drug resistant NTS complicates management.



Source: Jamrozik *et al.* 2020

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## Study definitions

- **Case:** A child ( $\leq 5$  years) presenting with the diarrhoeal and/or fever symptoms, recruited as a study participant in one of the recruiting clinics.
  - **NTS positive case/ patients:** A child presenting with diarrhoeal and fever symptoms, recruited into the study and with a lab confirmed culture positive sample for non-typhoidal salmonella.
  - **Contact:** Any individual who resides in the same household as the recruited case.
  - **Control:** A child who resides in a household **100M** away from the case household.
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## The study site



### Mukuru informal settlement

- Located 20Km east of Nairobi
  - Poor **housing** (10 ft. x 10 ft.)
  - Huge **population** (Over crowding)
  - Poor **WASH** infrastructure.
  - NTS disease **hotspot**, (Kariuki et al 2019)
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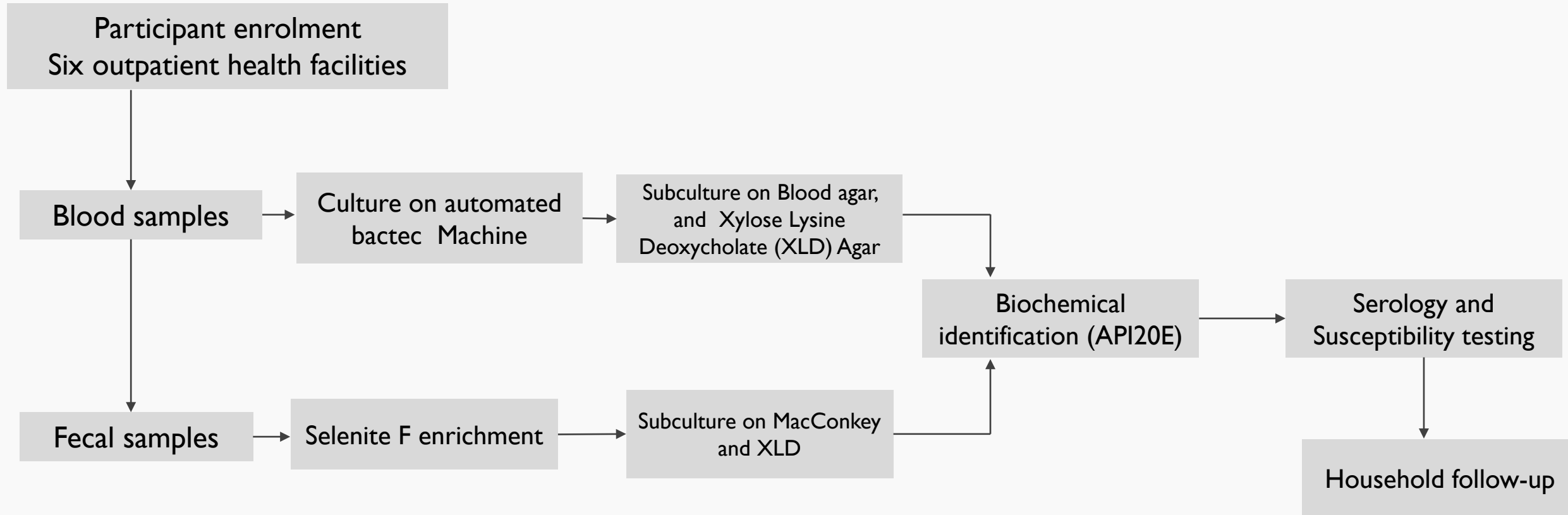
## Study objective

To determine prevalence and duration of post-convalescent shedding of Nontyphoidal *Salmonella* in children under five years of age and asymptomatic hosts in the community (household).

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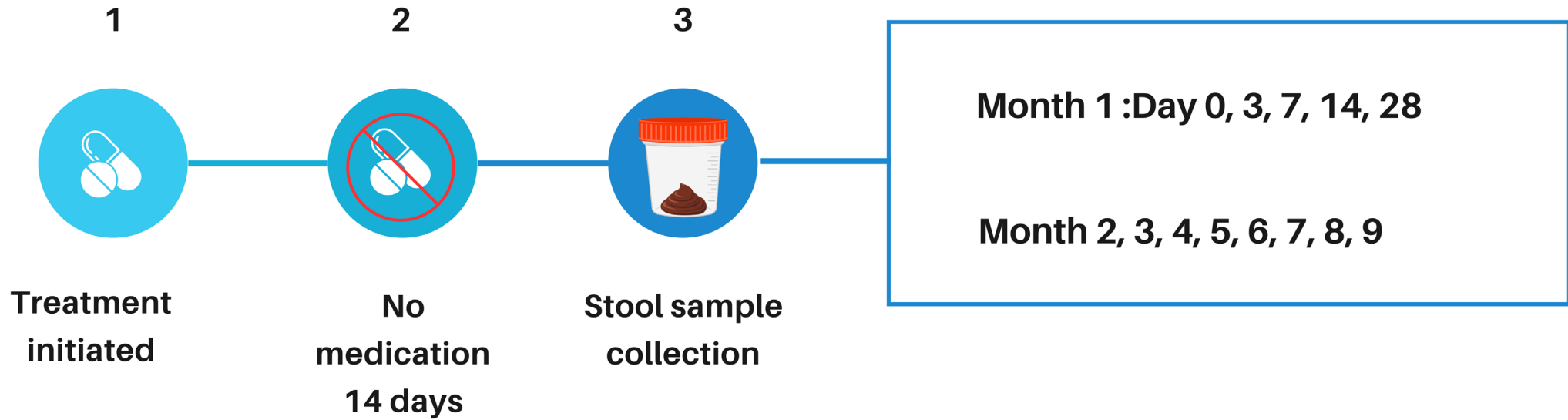
## 2. Methods





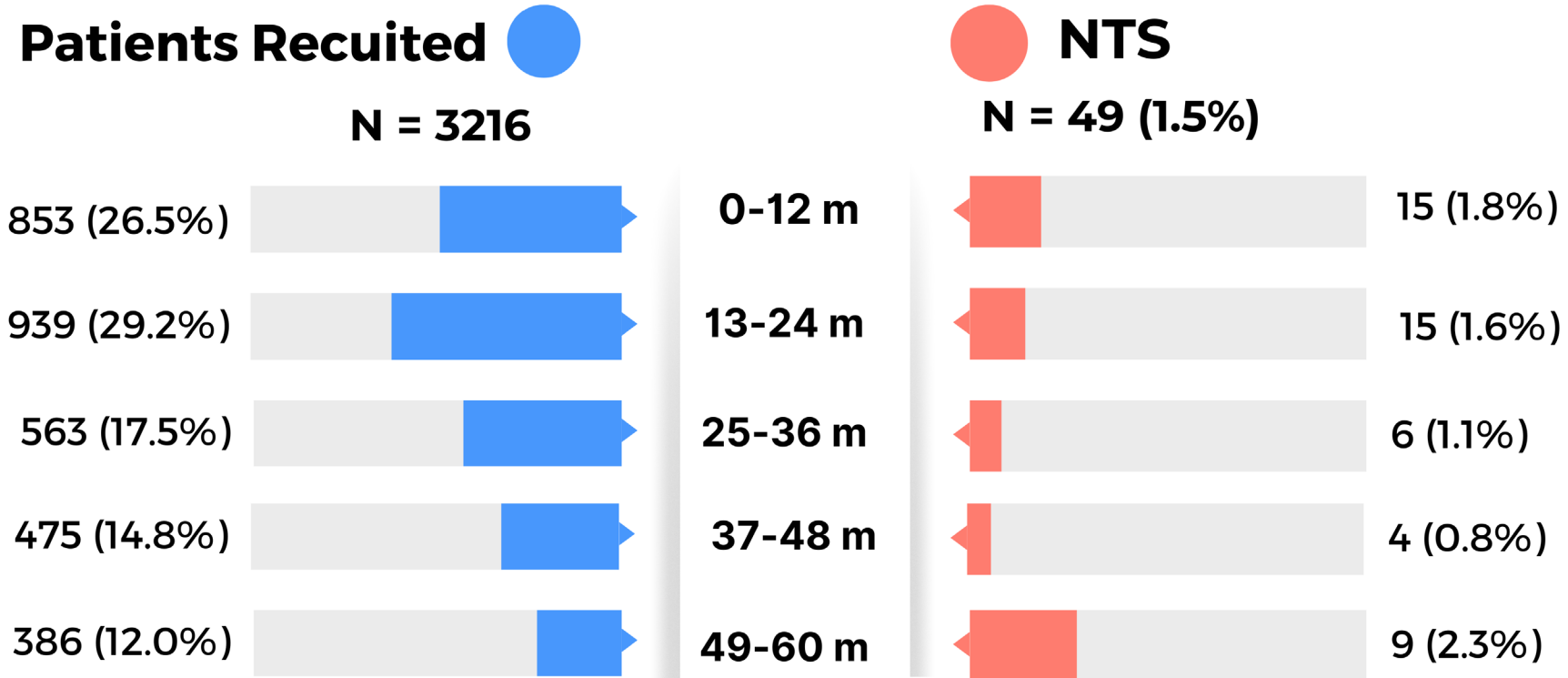
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# Patient follow up process

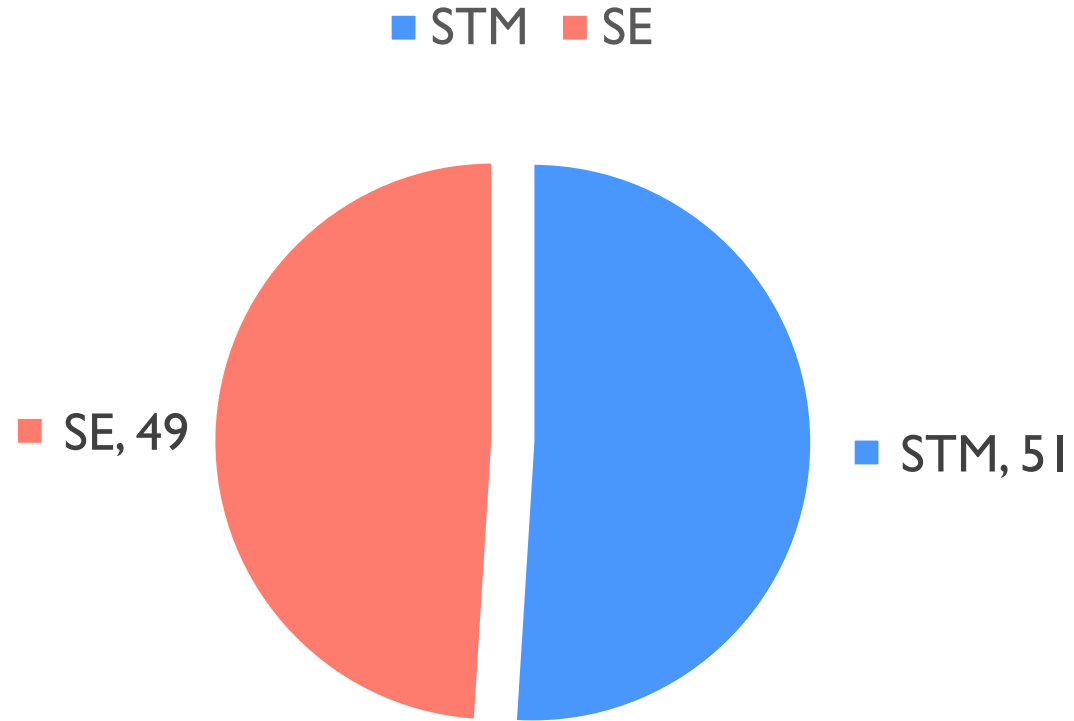


# 3. Results

## NTS Isolation rate among children under the age of 5 years



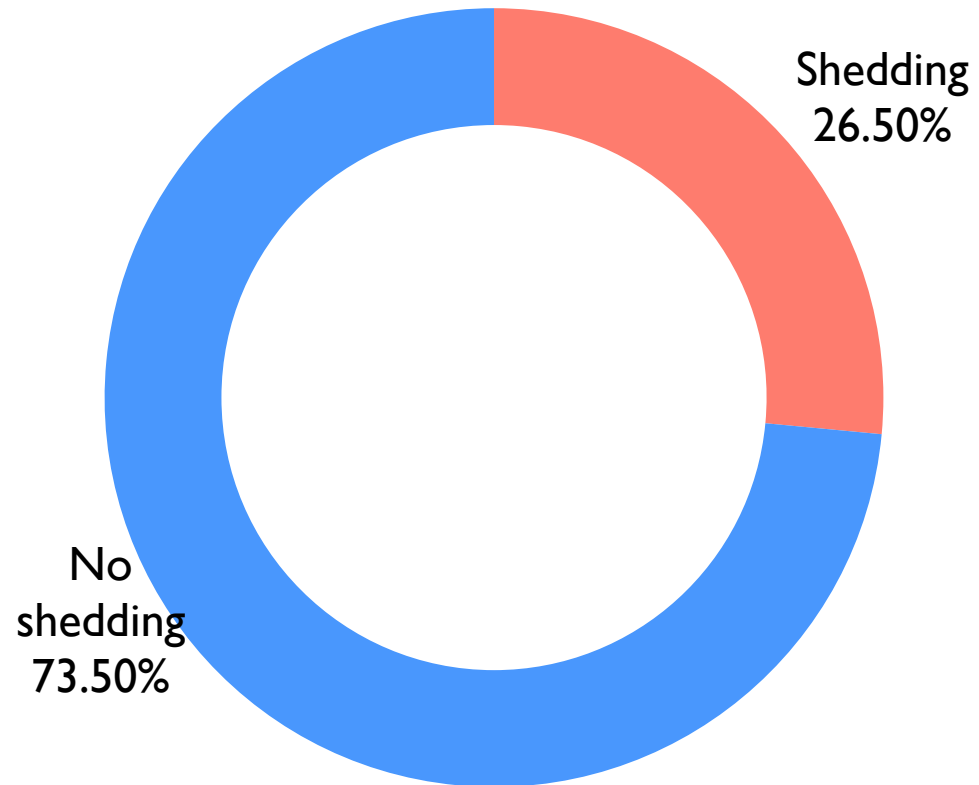
## NTS Serotypes isolated among children under the age of 5 years



- 51% (25/49) were *S. Typhimurium* (STM)
- 49% (24/49) were *S. Enteritidis* (SE)






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## Persistence Of NTS In Children Under Five Years



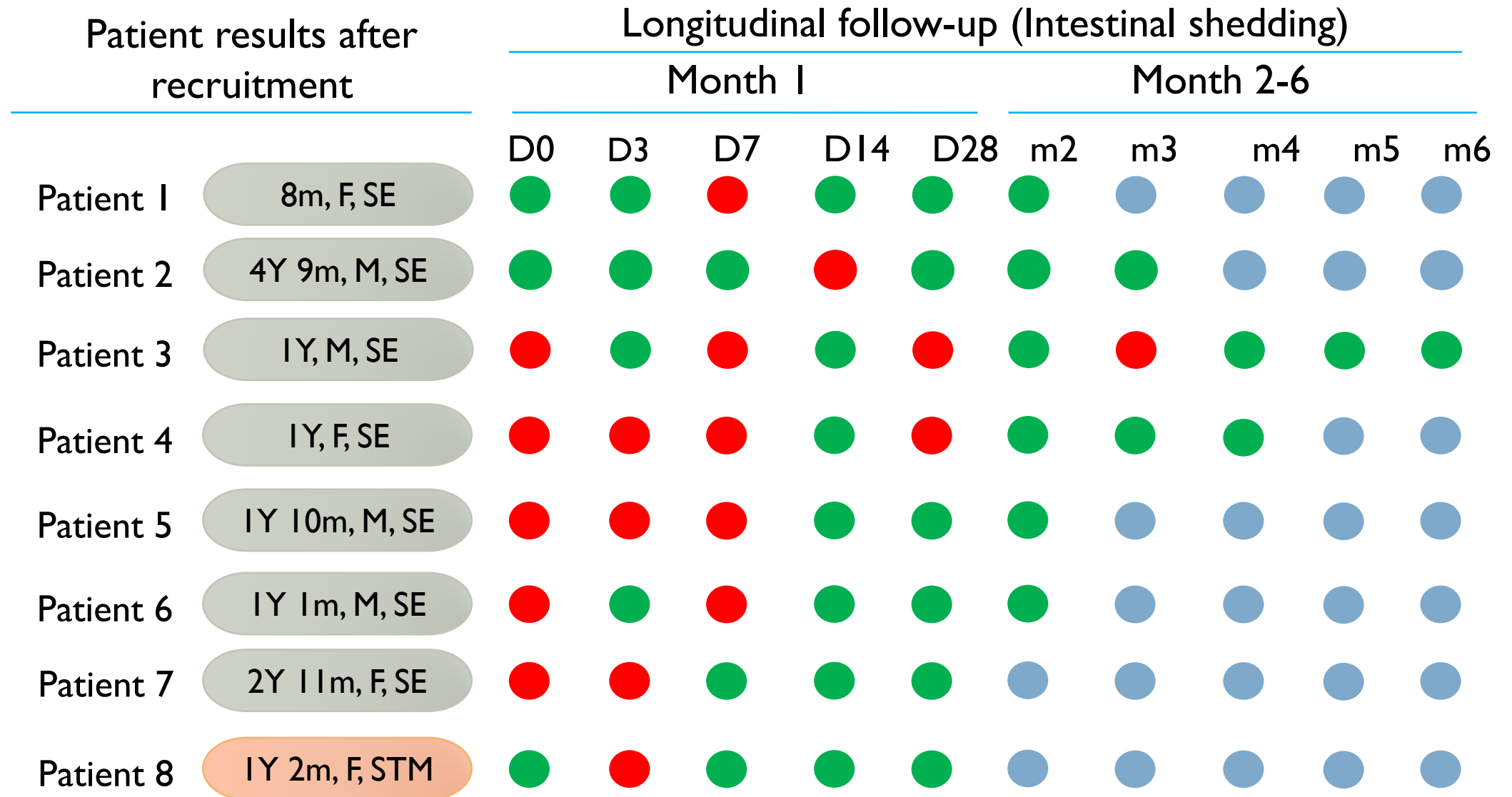
- Among the NTS positive cases 26.5 % (13/49) had shedding/ persistence of the pathogen.
  - Of the recruited healthy individuals 3.9% (7/190) had shedding (asymptomatic hosts).
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# Persistence Of NTS In Children Under Five Years

	<b>Age</b>	<b>Cases (N=49)</b>	<b>Carriers (N=13)</b>
	0 -12 m	15 (1.8%)	4
	13 -24 m	15 (1.6%)	6
	25 -36 m	6 (1.1%)	1
	37 -48 m	4 (0.8%)	1
	49- 60 m	9 (2.3%)	3

# Intestinal Shedding among cases

**A.**



● - Culture positive stool sample    ● - Culture negative stool sample    ● - Stool sample not collected

**B**

Patient results after recruitment		Longitudinal follow-up (Intestinal shedding)									
		Month 1					Month 2-6				
		D0	D3	D7	D14	D28	m2	m3	m4	m5	m6
Patient 9	1Y 2m, M, STM	●	●	●	●	●	●	●	●	●	●
Patient 10	1Y 2m, M, STM	●	●	●	●	●	●	●	●	●	●
Patient 11	1Y 4m, M, STM	●	●	●	●	●	●	●	●	●	●
Patient 12	1Y, M, STM	●	●	●	●	●	●	●	●	●	●
Patient 13	3Y, F, STM	●	●	●	●	●	●	●	●	●	●
Patient 14	4Y 8m, M, STM	●	●	●	●	●	●	●	●	●	●

Y- Year, m- month, M- Male, F- Female, STM- S. Typhimurium, SE- S. Enteritidis,

D- Day, Day 0- The start (first day) of longitudinal follow-up

● - Culture positive stool sample   ● - Culture negative stool sample   ● - Stool sample not collected

# Shedding in Healthy Individuals (Contacts and Controls)

## Shedding during Follow-up

		Month 1					Month 2-6				
		D0	D3	D7	D14	D28	m2	m3	m4	m5	m6
Contacts	Contact 1 5Y, F, STM	●	●	●	●	●	●	●	●	●	●
	Contact 2 24Y, F, SE	●	●	●	●	●	●	●	●	●	●
Controls	Control 1 2Y 11m, M, STM	●	●	●	●	●	●	●	●	●	●
	Control 2 4Y, F, SE	●	●	●	●	●	●	●	●	●	●
	Control 3 2Y 6m, F, SE	●	●	●	●	●	●	●	●	●	●
	Control 4 2Y 1m, F, SE	●	●	●	●	●	●	●	●	●	●
	Control 5 39Y 11m, F, SE	●	●	●	●	●	●	●	●	●	●

Y- Year, m- month, M- Male, F- Female, STM- S. Typhimurium, SE- S. Enteritidis

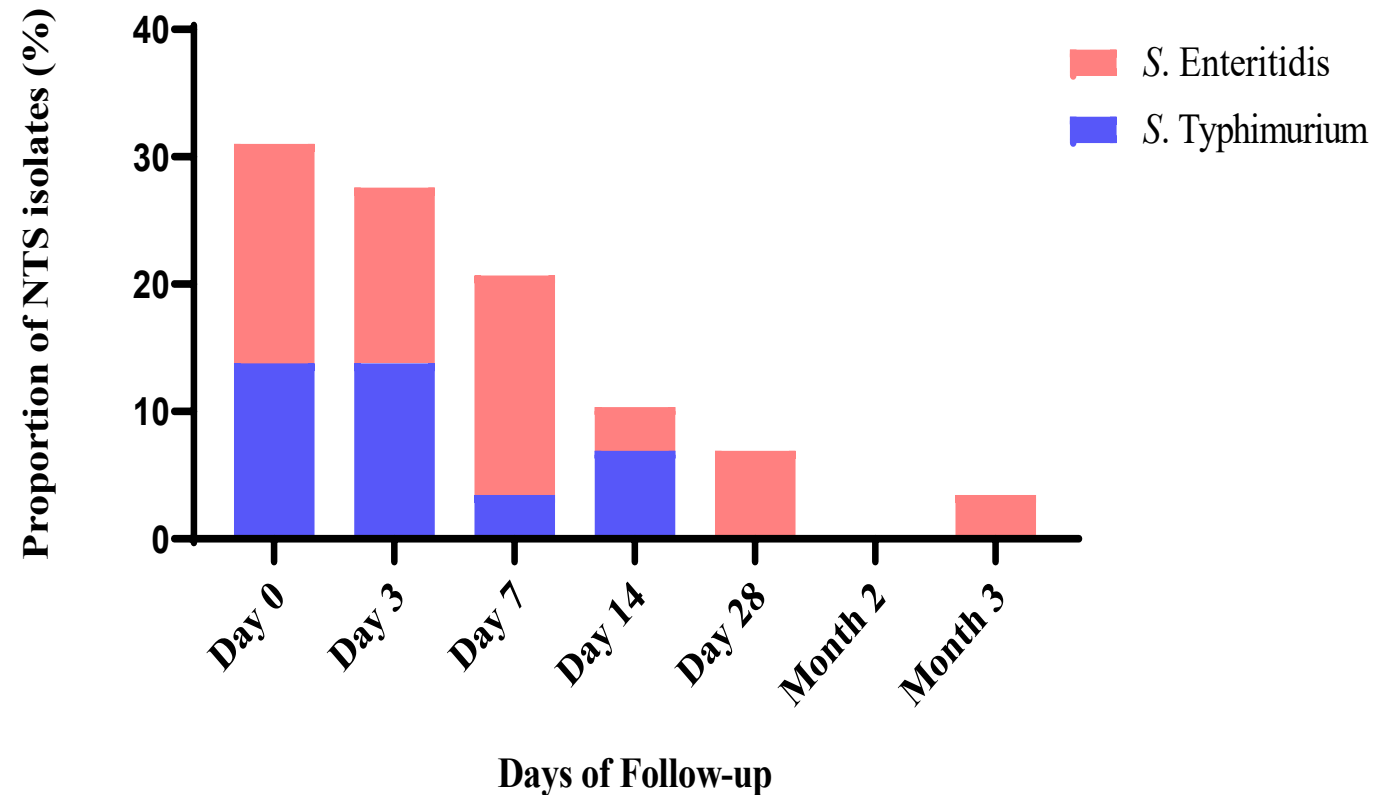
● -Culture Positive    ● -Culture Negative    ● -Sample not collected



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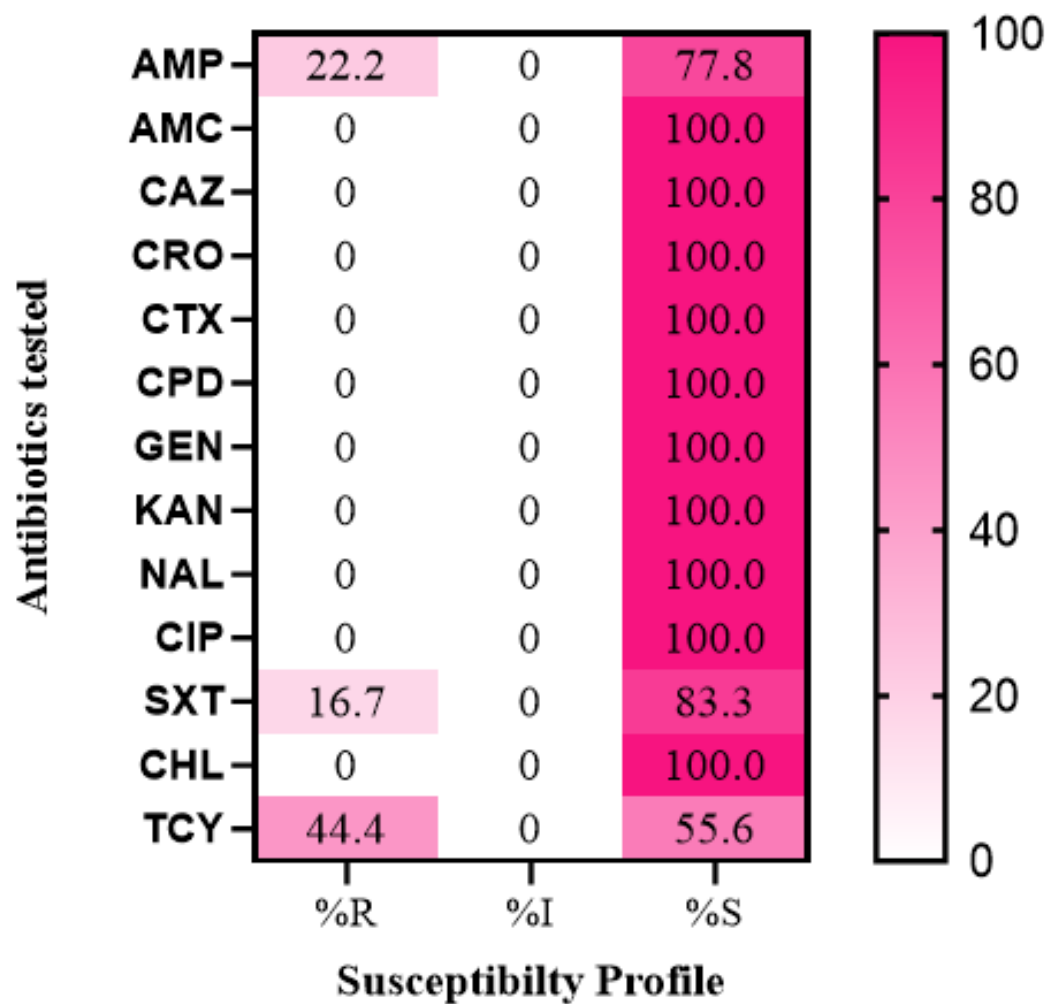
## Serotype distribution during Shedding

- 58.6% of cases were shedding *S. Enteritidis*.
- 71.4% of In healthy individuals were shedding *S. Enteritidis*.



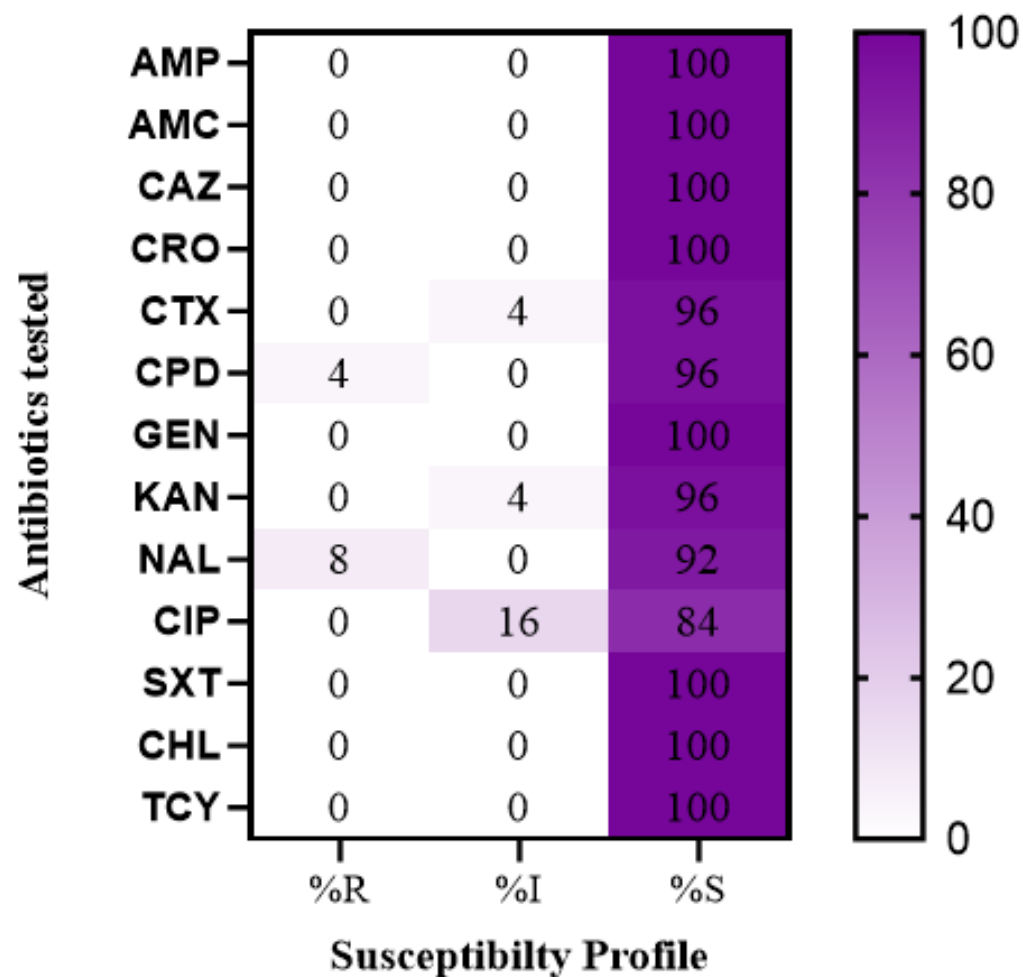
N=25

**S. Typhimurium**



N=24

**S. Enteritidis**



No MDR observed (Resistance to AMP, SXT and CHL)

## 4. Key Findings

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- The current NTS prevalence is 1.52% (49/3216), of these 26.5% were NTS carriers after follow-up.
  - Shedding among asymptomatic is at 3.9%
  - 76.9% of participants with shedding were children  $\leq 24$  months.
  - Intermittent and continuous shedding patterns observed among carriers.
    - **Are these patterns affected by limited culture sensitivity?**
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## 4. Key Findings

- Longest duration of carriage of carriage was **3 months**.
  - Majority, **(61%) of isolates recovered during shedding were S. Enteritidis**, in both patients and healthy individuals.
  - In one patient, the serotype (*S. Typhimurium*) isolated during acute infection was different from the one isolated during carriage (*S. Enteritidis*). **New infection or Co-infection?**
  - Although no MDR was observed reduced susceptibility to Azithromycin is alarming (>50% of isolates). **Increased use /misuse?**
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## 5. Conclusion

- This data points to the hypothesis of **person to person transmission of NTS** in SSA.
  - A **potential vaccine** could target children under the age of **24 months**.
  - **Surveillance** is key in monitoring carriers, duration of carriage and susceptibility patterns.
  - **Antimicrobial stewardship** is necessary to reduce AMR.
  - Improvement of Water, Sanitation and Hygiene (WaSH) infrastructure.
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# Acknowledgement



Principal Investigators

Study participants

Collaborators

Study personnel



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