Genomic Characterization of Invasive *Salmonella enterica* Isolated in Severe Typhoid In Africa Surveillance In Ibadan, Nigeria

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Background

- Typhoidal and invasive non-typhoidal *Salmonella* (iNTS) infections cause high morbidity and mortality in Africa (Smith *et al.,* 2016).
- Globally, iNTS causes 94 million cases of gastroenteritis (Majowicz *et al.,* 2010).
- An estimated 17.8 million cases of typhoid occur annually in low- and middle income countries (LMICs) annually (Antillon *et al.,* 2017).
- 26% of global typhoid mortality occurs in Africa (Mogasale *et al.,* 2014).

The Severe Typhoid in Africa (SETA) program

- High typhoid incidence in Africa (Jeon *et al.,* 2019)

- Nigeria had the highest proportion (4%) of investigated cases of typhoid intestinal perforation among SETA sites (Birkhold *et al.,* 2023)

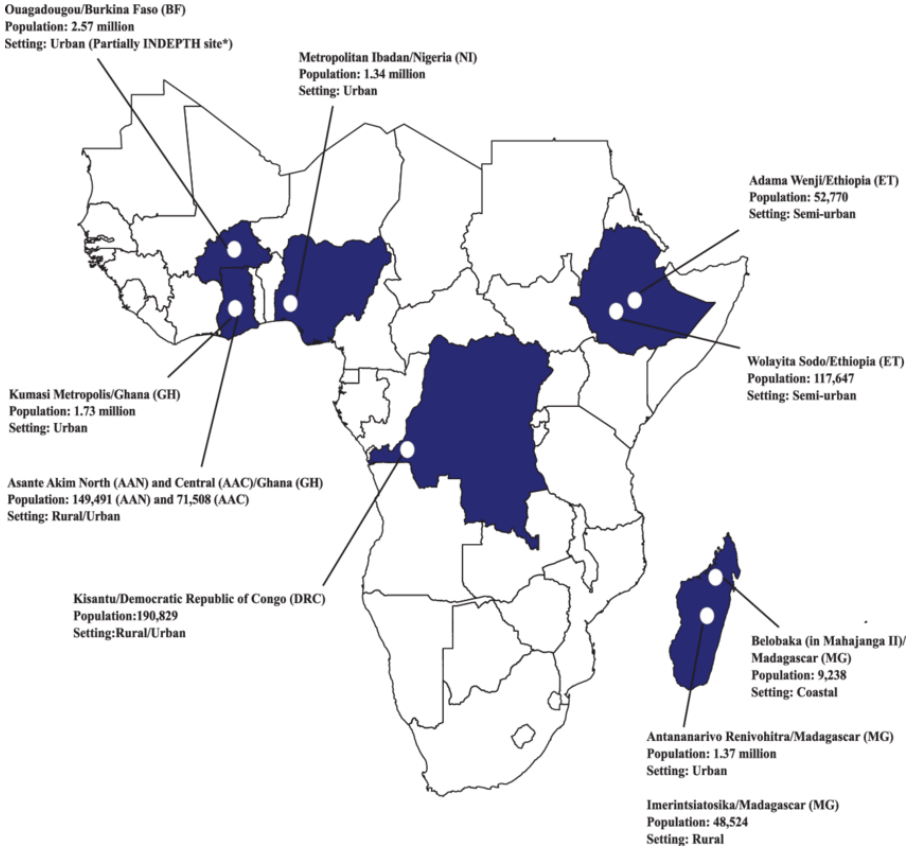
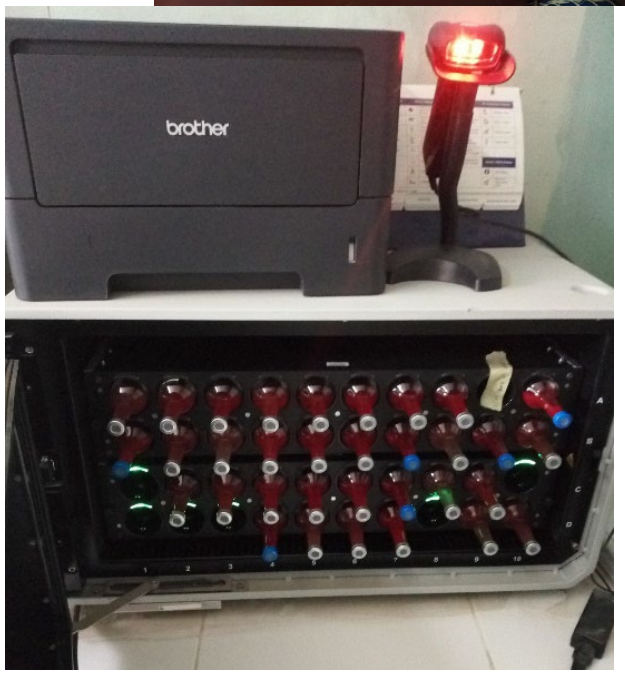


Figure 1: SETA country sites

SETA-Nigeria

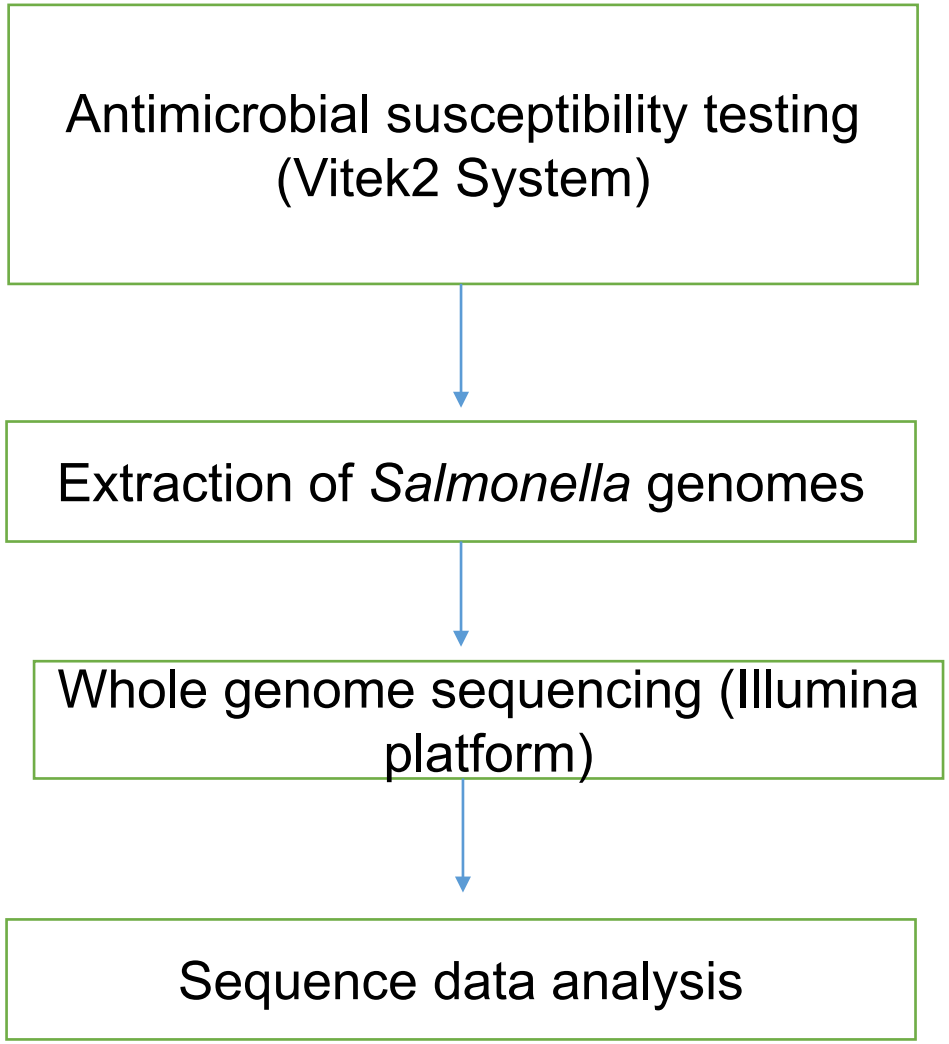
4 hospital facilities in Ibadan

- University College Hospital (UCH) –tertiary
- Our Lady Apostle (OLA) Hospital – secondary
- Adeoyo Maternity Teaching Hospital (AMTH) - secondary
- Kola Daisi Foundation (KDF) Hospital - primary



- Blood culture based surveillance is very useful to investigate/assess bacterial invasive infections (Ombelet *et al.,* 2019).
- Unfortunately, genomic surveillance of invasive *Salmonella* in Nigeria is insufficient (Ikhimiukor *et al.,* 2022)

Methodology



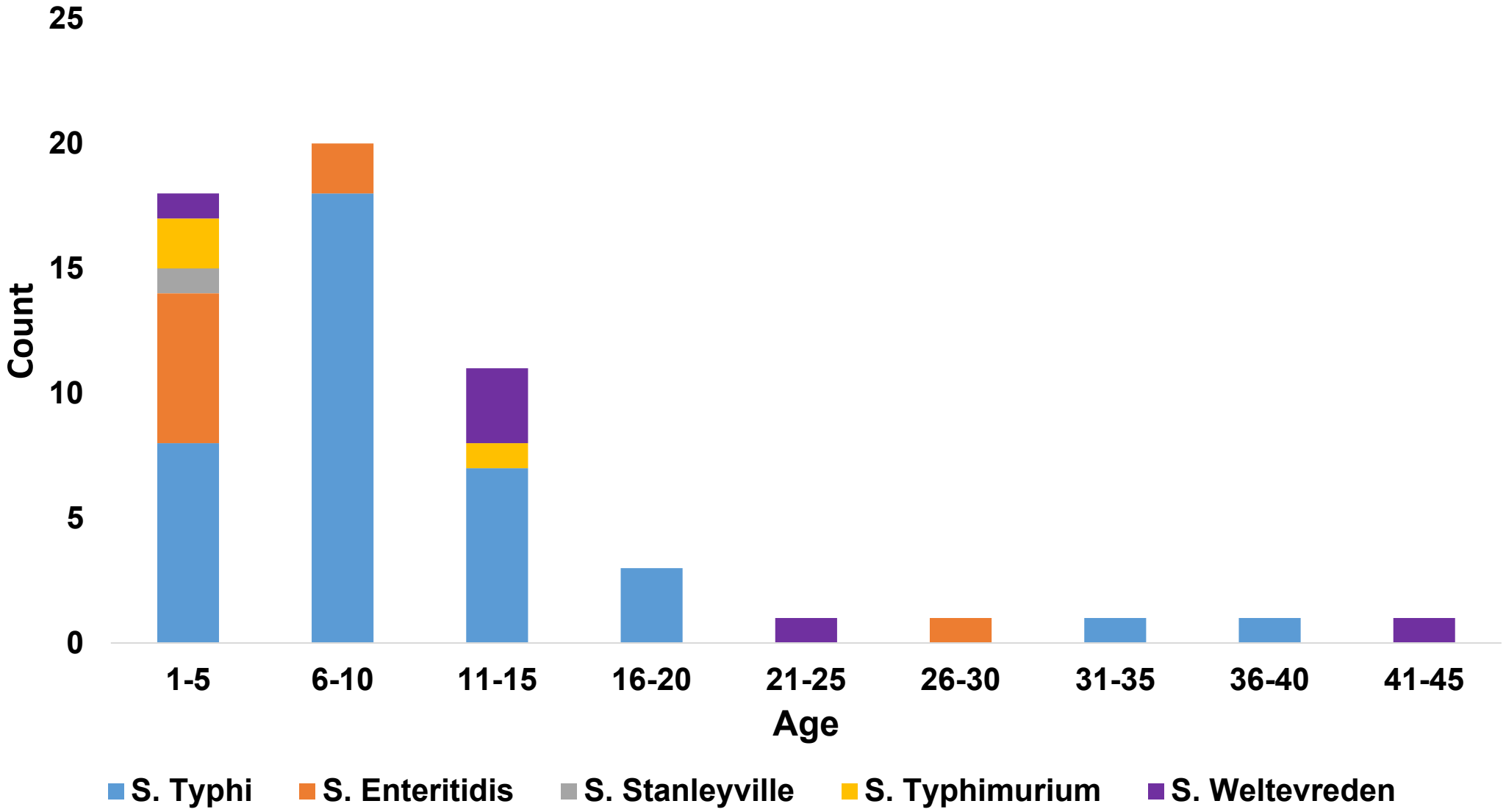


Figure 2: *Salmonella* serovars recovery across age groups

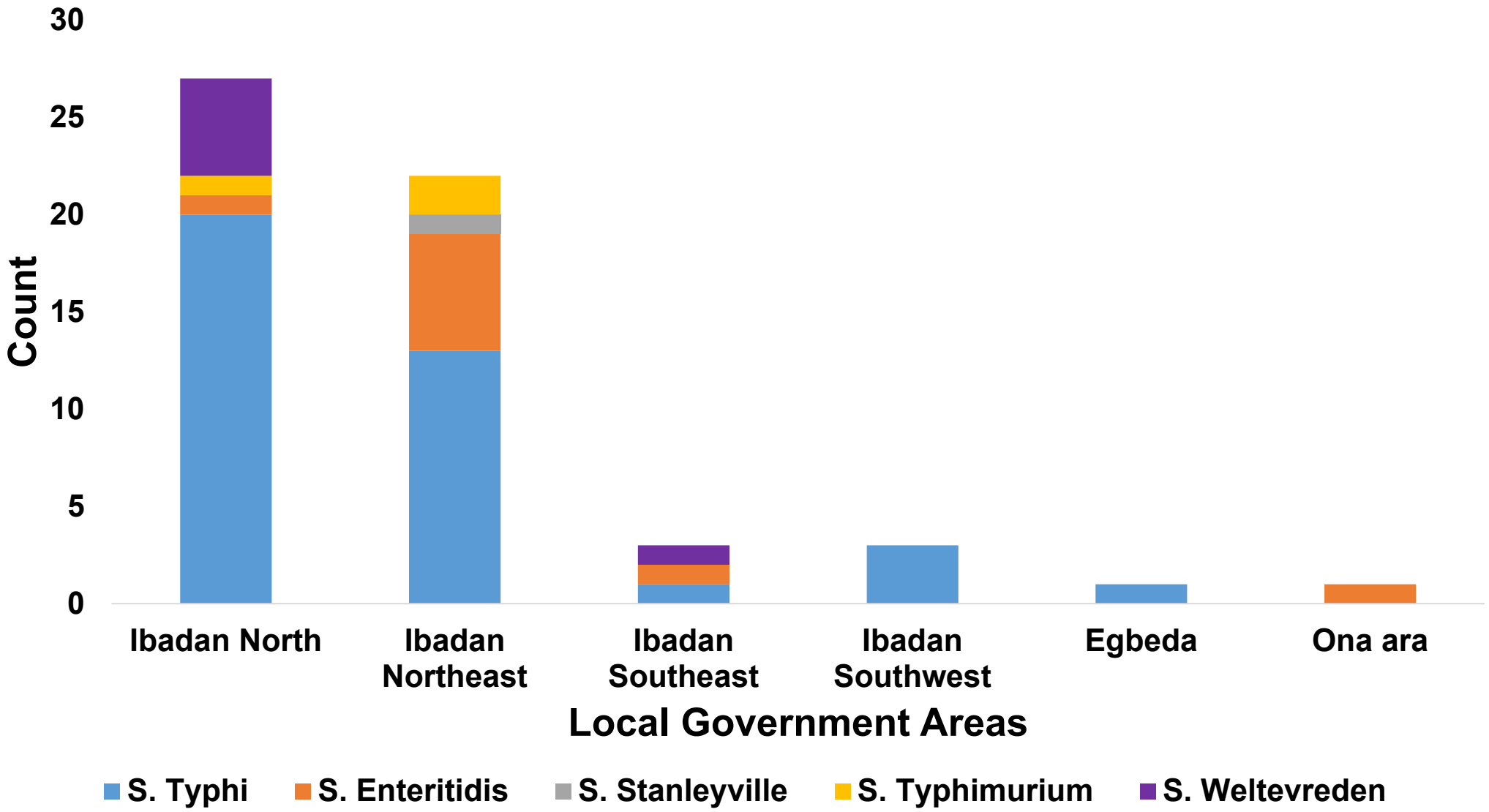


Figure 3: *Salmonella* serovars distribution across local government areas

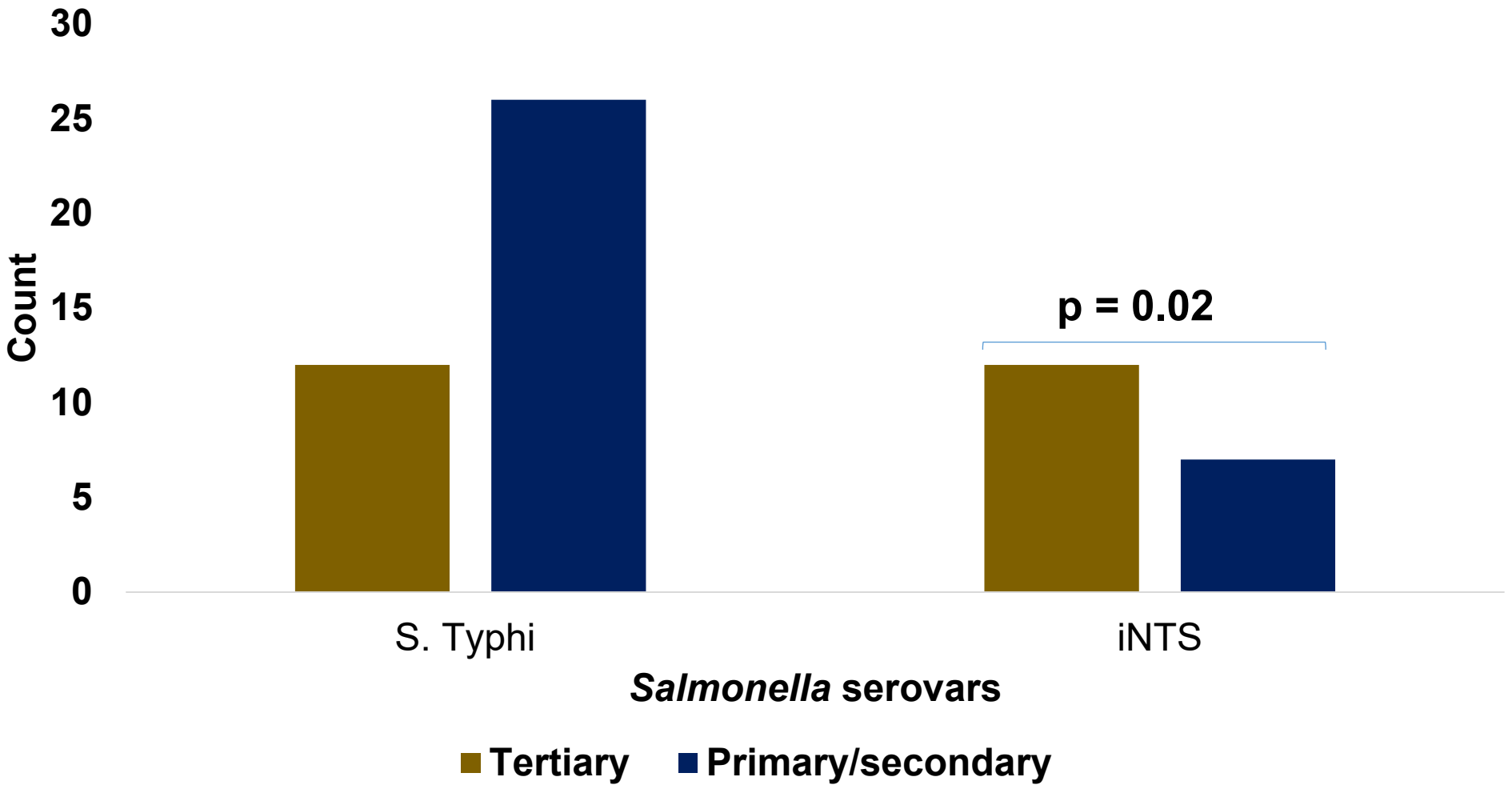
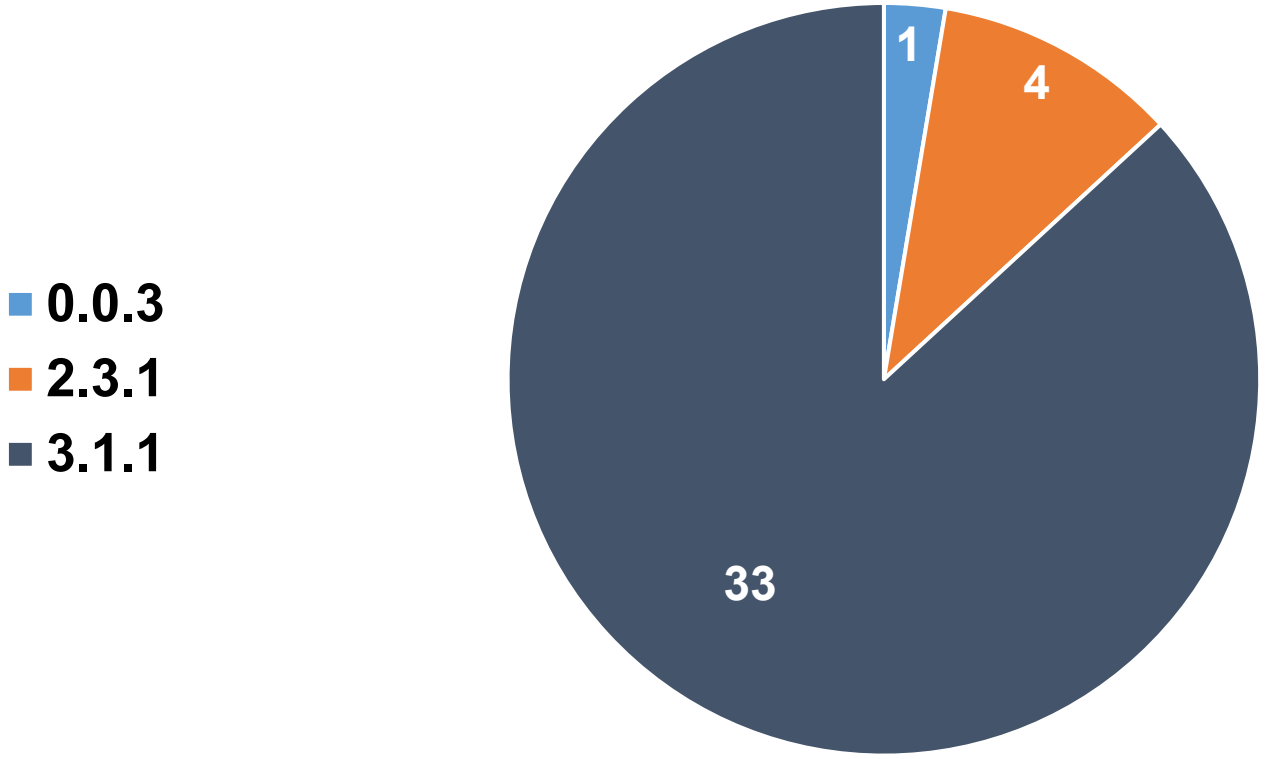


Figure 4: *S.* Typhi and iNTS recovery in tertiary versus primary/secondary facilities

Table 1: *Salmonella* lineages in Ibadan

Sequence Type	Serovar	Count
2	Typhi	38
11	Enteritidis	9
313	Typhimurium	3
365	Weltevreden	6
2562	Stanleyville	1



33/38 (86.8%) of the *S.* Typhi isolates are of the 3.1.1 genotype showing the predominance of the genotype among *S.* Typhi strains in Ibadan

Figure 5: *S.* Typhi genotypes distribution

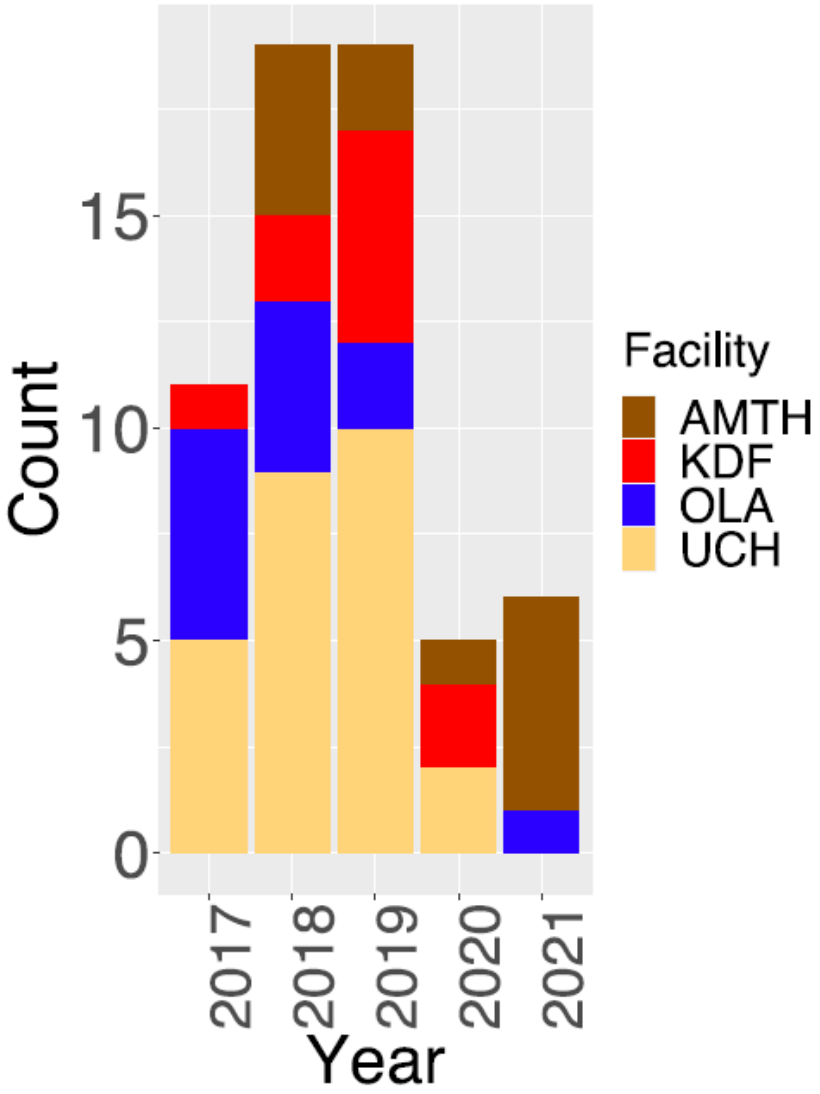


Figure 6a: Recruitment per year across facilities

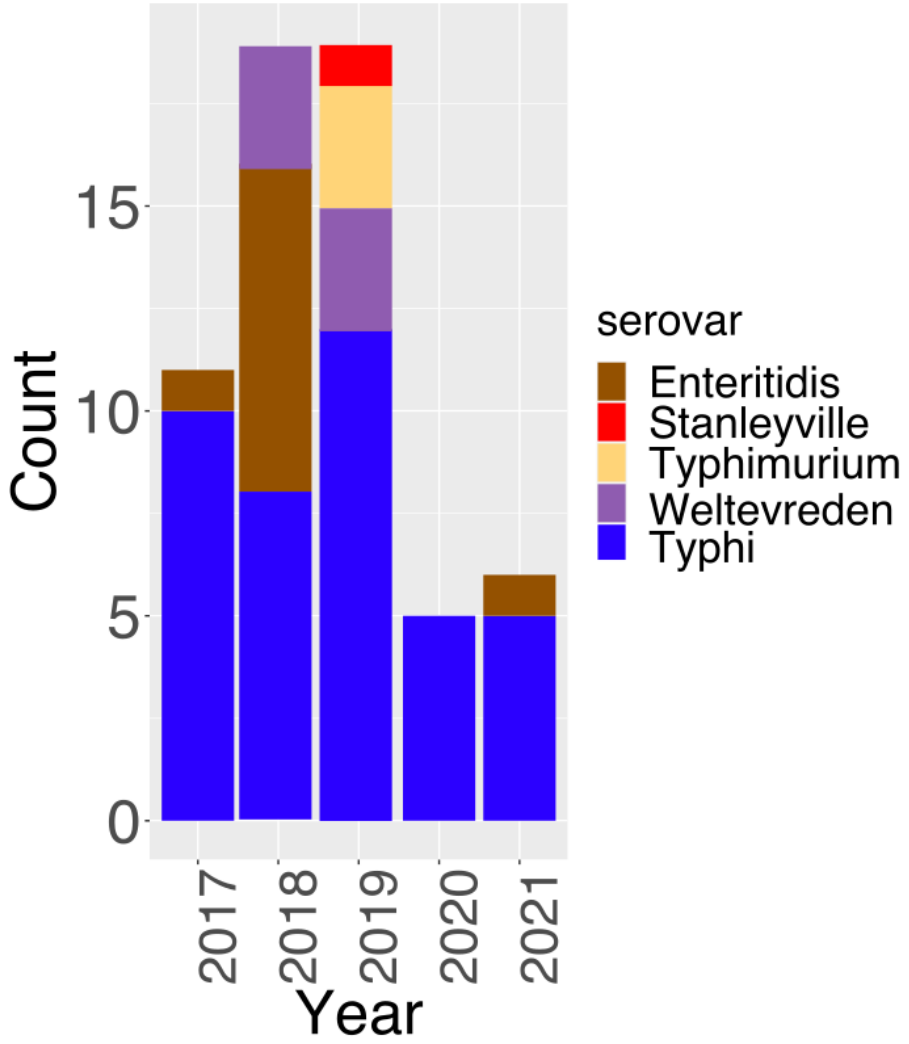


Figure 6b: *Salmonella* serovars recovery per year

Salmonella recovery was least in 2020. This is likely attributable to the hiatus in subject recruitment owing to COVID-19.

Majority of the recovered *Salmonella* were from UCH although none was recovered from UCH in 2021.

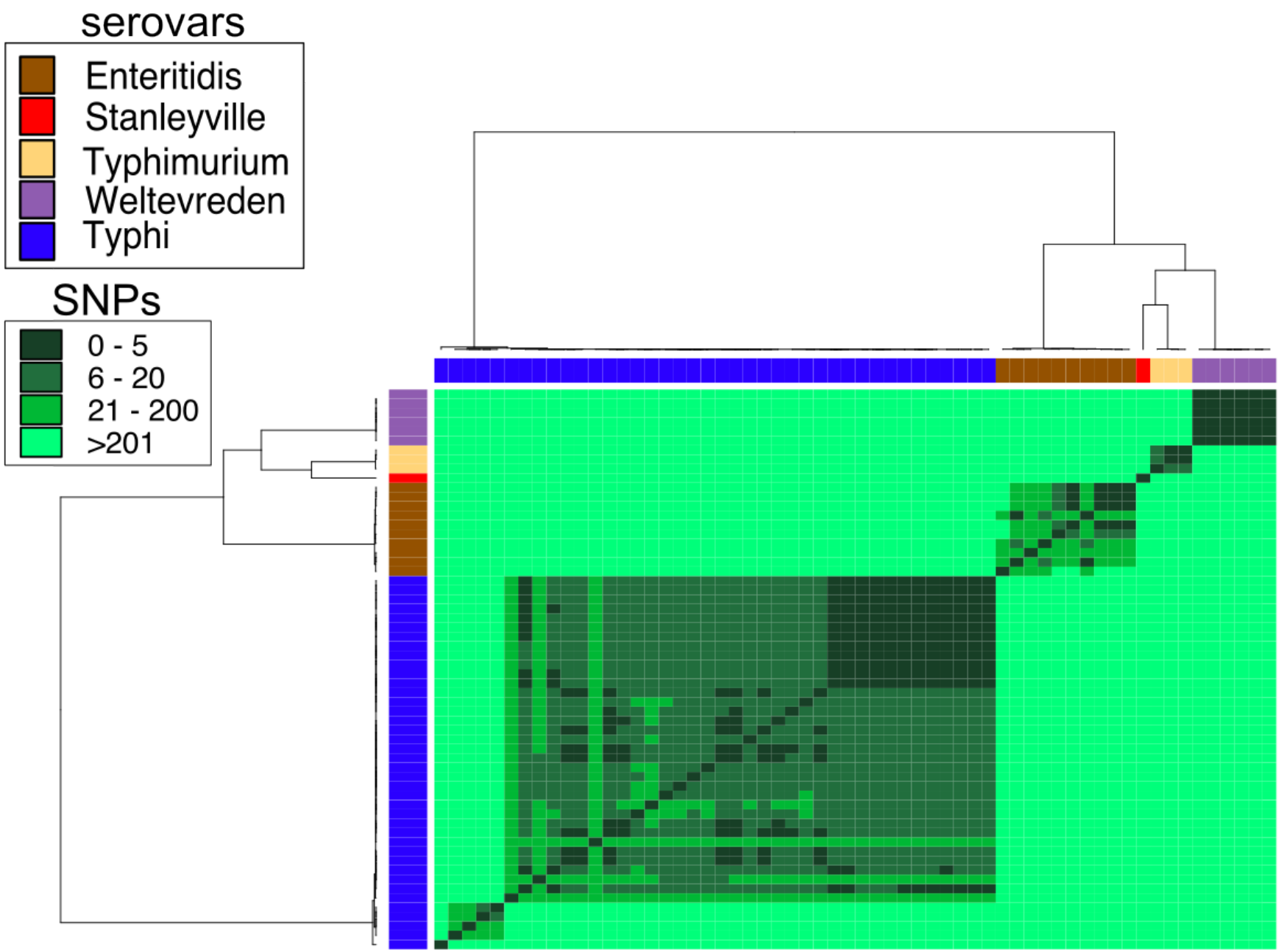


Figure 7: Pairwise core genome SNPs threshold of *Salmonella* serovars

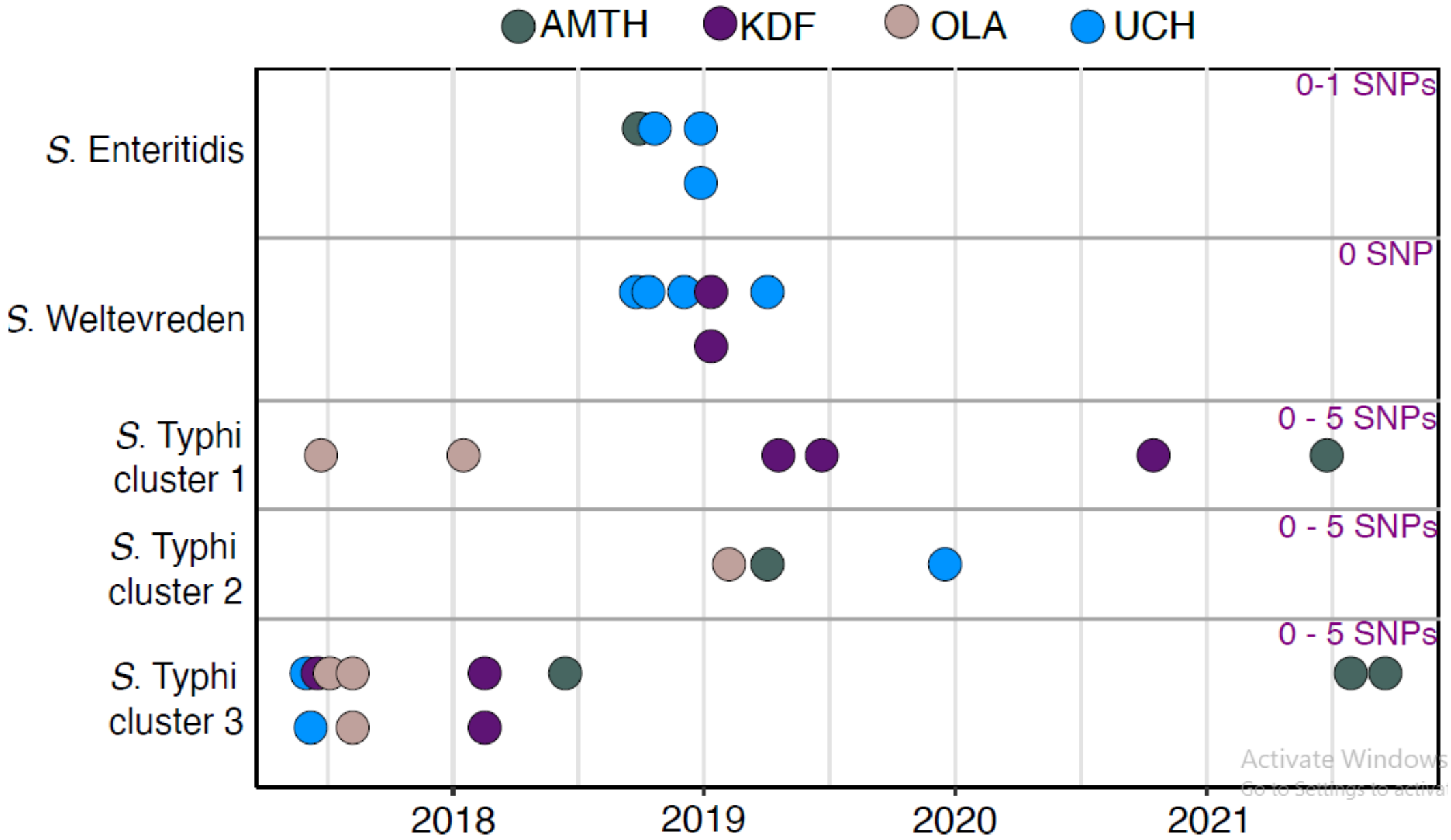


Figure 8: Potential clonal transmission timeline and clusters of *Salmonella* serovars across facilities

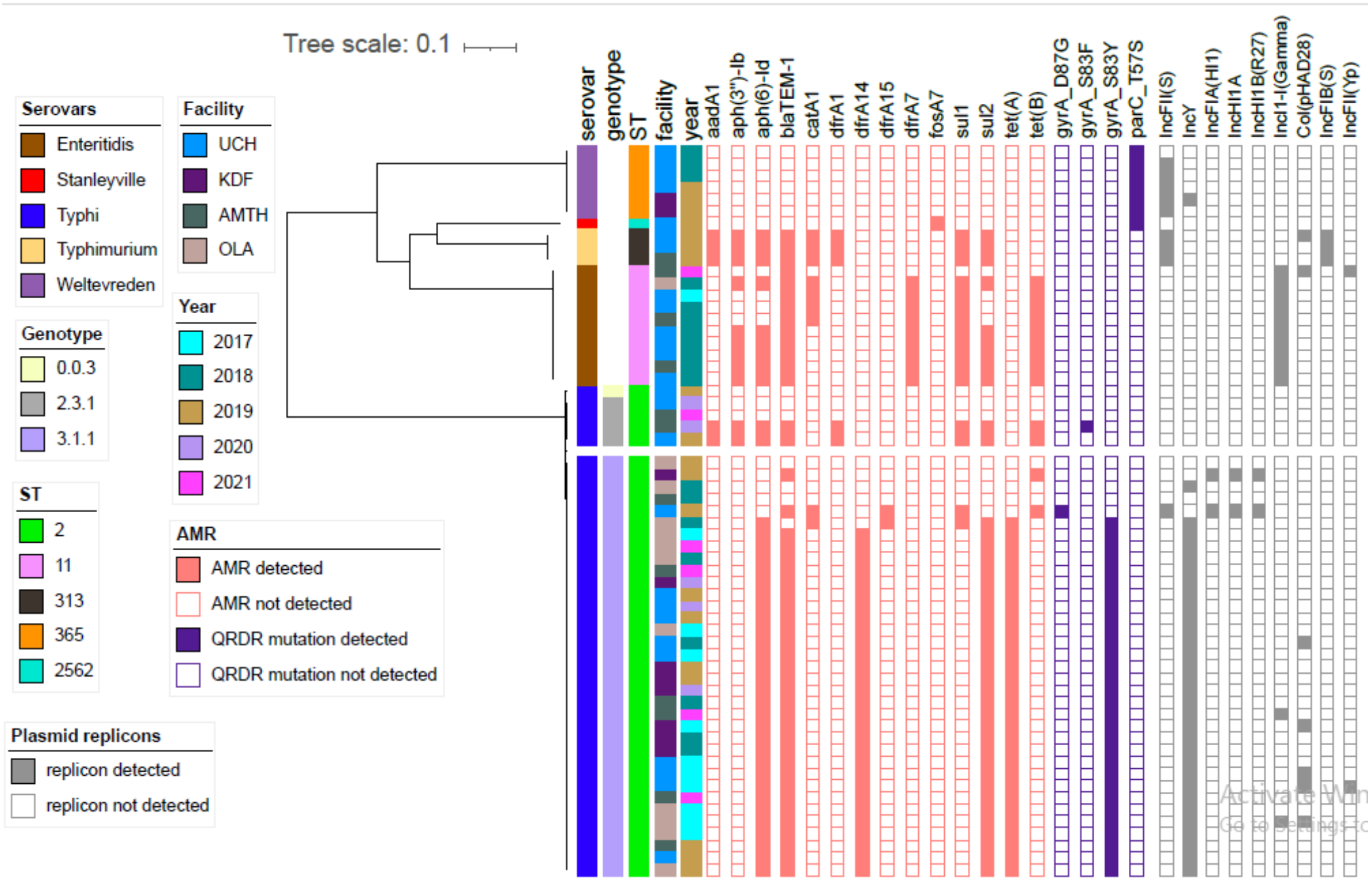


Figure 9: Antimicrobial resistance determinants, point mutations and plasmid replicons in *Salmonella* serovars

Conclusion

- The prominent *Salmonella* lineage in Ibadan is the genotype 3.1.1, sequence type (ST) 2.
- The alarming detection of quinolone resistance determining regions (QRDRs) in this lineage suggests that ciprofloxacin, often used for empiric treatment of typhoid fever, may soon become obsolete.
- The recovery of multidrug resistant *Salmonella* is worrisome particularly as some of the antimicrobial resistance combinations were associated with certain plasmid replicons and the possibility that *Salmonella* acquire resistance from circulating mobile elements.
- The endemicity of both *S.* Typhi and iNTS may be driven by mini-outbreaks from a point source.

Recommendations

- There is a need for more water, sanitation and hygiene (WASH) programmes in Ibadan to abate the risk of *Salmonella* infections.
- Nigeria needs to adopt typhoid conjugate vaccines especially as the therapeutic value of ciprofloxacin against typhoid fever is being threatened.
- Surveillance efforts should be intensified to ensure active monitoring of MDR *Salmonella* serovars in Ibadan.

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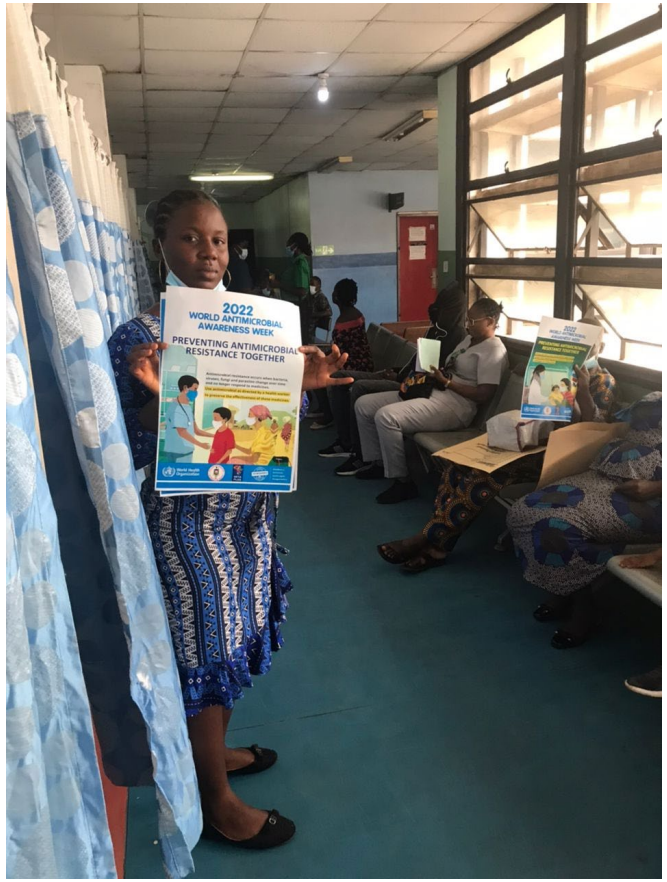
- University College Hospital, Ibadan.



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