Linking typhoid transmission to the water distribution system in Katmandu, Nepal

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and others....
Combined high-resolution genotyping and geospatial analysis reveals modes of endemic urban typhoid fever transmission

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What are the main factors for transmission?
Does where you live change your risk?
Do specific haplotypes circulate and how?

Household GPS mapping of cases and controls
Study local patterns of disease
Epidemiological factors of infection

Genotyping of all S. Typhi
Identify dominant haplotypes / circulating organisms
Study temporal and spatial haplotype patterns

How generalizable is this setting and our findings?
- Spatiotemporal case clustering for both serovars
- Highest risk in low lying areas
- Paratyphi A more diffuse

- 14 Typhi clades (68% H58)
- H58 clonal expansion
- Random haplotype distribution

- Water spout proximity highest risk
- Household transmission events evident
- 3 times more likely to be infected with a different organism

- What role does local the water play?
What is the role of the water supply? Does it differ between locations? What is the extent of the contamination?

10 locations sampled for one year
Chemistry, coliforms, pathogens
Typhi, Paratyphi A, 16S rRNA

Performed multifaceted analysis
Compared PCR profiles and other variables
Study temporal and spatial bacterial populations

How can this help control typhoid?
• Iron, nitrate ammonia contamination
• Location specific contamination
• Likely driven by air contamination and fecal waste

• Nitrate correlated with coliforms and rainfall
• Coliforms ranged from 0.001 to $2.5 \times 10^6$ CFU/ml
• Spouts > Wells > Piped

• No Typhi / Para A cultured
• 80 % PCR positive
• Typhi > Para A

• Fecal contamination / Typhi associated with rainfall
Samples contain a diverse array of fecal organisms
However 5 OTUs represent >80% variation
These show spatiotemporal patterns

5 can segregate well water from spout water
Can predict the location with 80% certainty
Highly localized contamination

The water quality in Kathmandu is poor
This is a major Typhoid / Public health issue
Substantial investment is required

Household based interventions are likely to be the most suitable in the short term
With thanks