Geospatial findings of XDR typhoid Outbreak in Pakistan- Story of spread in two cities

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Outbreak investigation of XDR typhoid in Hyderabad, Pakistan I

• Largest outbreak of ceftriaxone-resistant S Typhi reported in Hyderabad in Nov 2016

• Clinical laboratory of Aga Khan University Hospital reported cases admitted at Aga Khan Maternal & Child Center Hyderabad with ceftriaxone resistant S. Typhi

• Outbreak investigation was initiated
Outbreak investigation of XDR typhoid in Hyderabad, Pakistan II

• Few therapeutic options are available
  • Azithromycin and
  • Carbapenems

• These are expensive and have little accessibility
Geospatial Mapping I

- Geospatial mapping of cases
  - Hyderabad city of Sindh (1.7 million)
    - Latifabad (0.67 million)
    - Qasimabad (0.3 million)

- Age distribution of cases
  - ≤ 5 yrs (≈60%)
  - 5-10 yrs (27%)
  - >10 yrs (13%)
Geospatial Mapping II

• Open street view map of Hyderabad was integrated in the Esri ArcGIS, version 10.5

• Important relevant landmarks, including paper-based map of the Hyderabad sewerage map was scanned and georeferenced in the Esri® ArcGIS software

• Coordinates were collected through the use of an in-house application form

• Color coding for both cases and controls and positive water samples
Pakistan

Northern Areas
K.P.K
Punjab
Baluchistan
Sindh
Hyderabad

Legend
Province boundary

Date: August 07, 2017
Karachi
Extracting Geospatial information from Lab Data I

List of culture positive XDR *S.typhi* is obtained from AKU diagnostic lab.

The list whether states the medical record (MR) number or the lab (L) number of patient

Different strategies are acquired to locate the coordinates.
Extracting Geospatial information from Lab Data I

List of Typhoid cases

AKU records to get addresses

System Script Search the Coordinates from Google map against addresses

If address not found on Lab#

Lab collection point location is considered as the nearer block the house of patient

Landmark
Block
Town
UC
House

3/26/19
11th International conference on Typhoid, 2019
Extracting Geospatial information from Lab Data I

Typhoid Cases Statistics

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<thead>
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<th>Total No. of Sensitive cases</th>
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Typhoid Cases Statistics

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Karachi
XDR cases
Ceftriaxone Resistance

Overview

Legend

- Collection point
- XDR Cases
  - status
    - Sep to Dec 2016 (3)
    - Karachi Town

Date: November 11, 2018
Ceftriaxone Resistance

Overview

Legend
- Collection point
- XDR Cases
  - status
    - Sep to Dec 2016 (3)
    - Jan to Apr 2017 (9)
    - May to Aug 2017 (23)
    - Sep to Dec 2017 (38)
    - Jan to Apr 2018 (114)
    - May to Aug 2018 (778)
    - Sep to Dec 2018 (456)
    - Jan to Mar 2019 (206)

Date: March 22, 2019

11th International conference on Typhoid, 2019
Study Limitation

• The culture positive cases are only Aga University Hospital main and satellite labs

• In process of getting culture positive XDR cases location information from other major labs in Karachi, Sindh and Pakistan.

• In liaison with government of Sindh
Next step I

• To generate Prediction models for spread of ceftriaxone-resistant Salmonella enterica serotype Typhi Outbreak in Pakistan using geospatial, genomic, environmental and sero-prevalence data

  — Collect geospatial data through different techniques and examine changes in the spatial distribution of incidence over time

  — To conduct a sero prevalence study on a sub population

  — Utilize genomic and other epidemiological data to understand the mechanism of spread across major cities of Pakistan

  — To investigate the transmission dynamics of typhoid by collecting in-depth information about the water, sanitation and hygiene practices of the population at risk
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Jason Andrews (Stanford)

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