### RESEARCH QUESTIONS:

**What is the spatial extent of cholera incidence around CMC Vellore?**

**What were key trends within cholera incidence clusters in 2000-2014?**

### INTRODUCTION:

Case tracking and source epidemiology provide much needed data to understand the underlying patterns driving emergence, spread and persistence of infectious disease. Detailed, reliable and timely surveillance data can enable rapid source identification and interventions to prevent a local event from spreading. Modern surveillance systems can also be effectively utilized for disease control and study spatiotemporal patterns of transmission in disease endemic regions. In the state of Tamil Nadu, India, intestinal infection by Vibrio cholerae is endemic. The causative agent of cholera, has been established in collaboration with the Christian Medical College of Vellore (CMC) and Tufts University since 2012. Routine regional environmental and health monitoring activities also gather valuable data on the presence of pathogenic OS and O139 V. cholerae in heavy use water bodies in and around Vellore. Christian Medical College is a destination for patients from all regions of the country seeking medical care. Thus, patients’ self-reported addresses do not necessarily reflect the place of exposure. As such, connecting patterns of outbreak in clinical disease to prevailing environmental conditions may demonstrate which patterns do not capture or accurately characterize the driver of disease outbreak. This study attempts to define the spatiotemporal extent of the Vellore cholera cluster to define a radius of most likely exposure for cholera patients in CMC Vellore, and identify temporal trends within this cluster in 2000-2014.

### METHODS:

**Data Collection**

A total of 1915 cases of cholera were documented during 1992, 1996-1999, and 2000-2014 from electronic databases and logsheets available at CMC during a team research trip to Vellore in January 2015. The following fields were recorded: date received at CMC, patient town and region, age, sex, and pathogenic strain of Vibrio cholera. All the documented cases exhibited diarrhoeal disease with cholera-presenting symptoms, and verified V. cholerae isolates (O1, O19); and Non-Oflaginating. Data cleaning | All data were pre-processed for analysis. Anonymity was expanded, correct state information attributed, and ages standardized. Records with missing Date Received and Patient Region fields were discarded. This left 1777 remaining records, which were mapped in the analysis.

**ArcGIS statistical analysis**

All points were used to generate a Spatial Weights Matrix, based on a space-time window of 30 days and an experimental distance threshold of 300 km. This matrix was used with the following tools: Cluster and Outlier Analysis (Anselin Local Morans I), Cluster and Outlier Analysis - Optimized Hot Spot Analysis and Rendering Analysis. This analysis is the first step towards a collaborative paper regarding the following clustering trends:

- The smallest, most localized cluster around CMC Vellore has a radius of 32 km.
- The largest cluster, which includes the lower portion of Tamil Nadu state, has a radius of 250 km. The cases in all three clusters exceeded expected values, and had a relative risk of 6 or greater.
- Therefore, individuals in these three spatial clusters are most likely to come to CMC Vellore for cholera treatment, compared to the other clusters.

**SaTScan statistical analysis**

SaTScan™ is a free software that analyzes spatial, temporal, or space-time clustering patterns in disease incidence. In the state of Tamil Nadu, India, 2000-2014, the causative agent of cholera, has been established in collaboration with the Christian Medical College of Vellore (CMC) and Tufts University since 2012. Routine regional environmental and health monitoring activities also gather valuable data on the presence of pathogenic OS and O139 V. cholerae in heavy use water bodies in and around Vellore. Christian Medical College is a destination for patients from all regions of the country seeking medical care. Thus, patients’ self-reported addresses do not necessarily reflect the place of exposure. As such, connecting patterns of outbreak in clinical disease to prevailing environmental conditions may demonstrate which patterns do not capture or accurately characterize the driver of disease outbreak. This study attempts to define the spatiotemporal extent of the Vellore cholera cluster to define a radius of most likely exposure for cholera patients in CMC Vellore, and identify temporal trends within this cluster in 2000-2014.

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### RESULTS:

Based on both ArcGIS and SaTScan results, it can be concluded that Vellore’s “cholera radius” extends to about 175 km from CMC. Thus, the probability of patients traveling from states as far as West Bengal, Assam, Tripura, and Sikkim to CMC for cholera treatment is very low. Patients from these regions are more likely to have been traveling within this radius, where they may have acquired cholera and sought hospitalization at CMC Vellore. It is important to note that some cholera cases may arise from the cholera foci in the other north-eastern states.

**Simple Hot Spot Analysis**

One major High-High cluster is observed in West Bengal, and a few High-Low clusters are observed around Vellore. However, this does not reflect the highly localized cluster around CMC Vellore, which would be predicted to be a High-High cluster.

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**SPATIO-TEMPORAL ANALYSIS OF CHOLERA A CASE STUDY IN VELLORE, INDIA, 2000-2014**

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**PROJECT LOCATION**

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**ARCMAP CLUSTERING ANALYSIS**

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**PURELY TEMPORAL CLUSTERING**

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**SPACE-TIME CLUSTERING**

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**ACKNOWLEDGEMENTS:**

CMC Vellore?

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**DATA SOURCES:**

Christian Medical College Vellore hospital records | Kulldorff M. and Information Management Services, Inc. SaTScan™ v8.0: Software for the spatial and space-time scan statistics. http://www.satscan.org/, 2009 |