Estimating cholera burden in Bangladesh

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with

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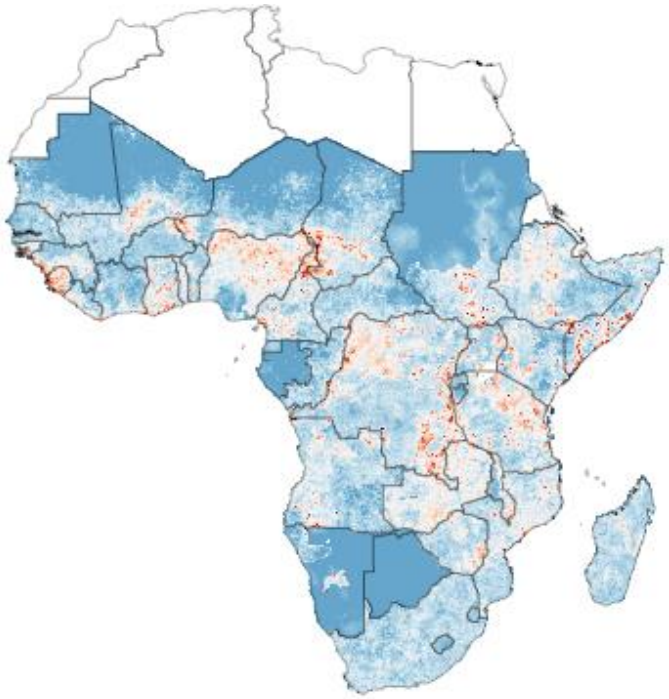
GTFCC Case Management Working Group 2019

CHOLERA DYNAMICS
TAXONOMY ~ BURDEN ~ MAPPING ~ MODELING
JOHNS HOPKINS BLOOMBERG SCHOOL of PUBLIC HEALTH
iddynamics.jhsph.edu/cholera

icddr,b

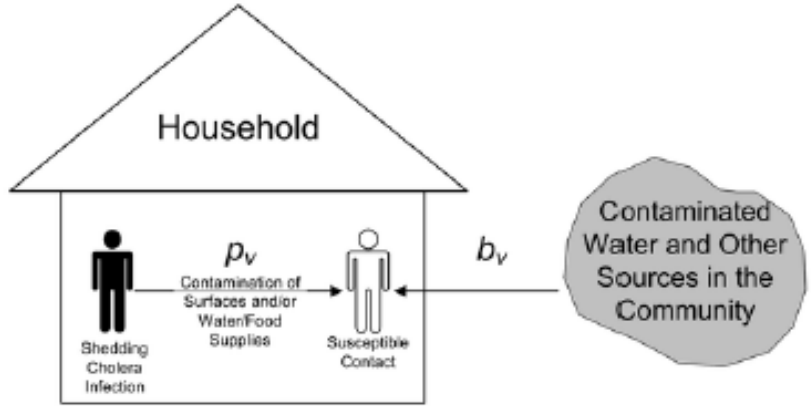
Counting cholera cases is important



Cholera risk and burden

Lessler et al, 2018, The Lancet

Intervention effectiveness and impact



Transmission dynamics

Sugimoto et al, 2015, PLoS NTD

Motivation

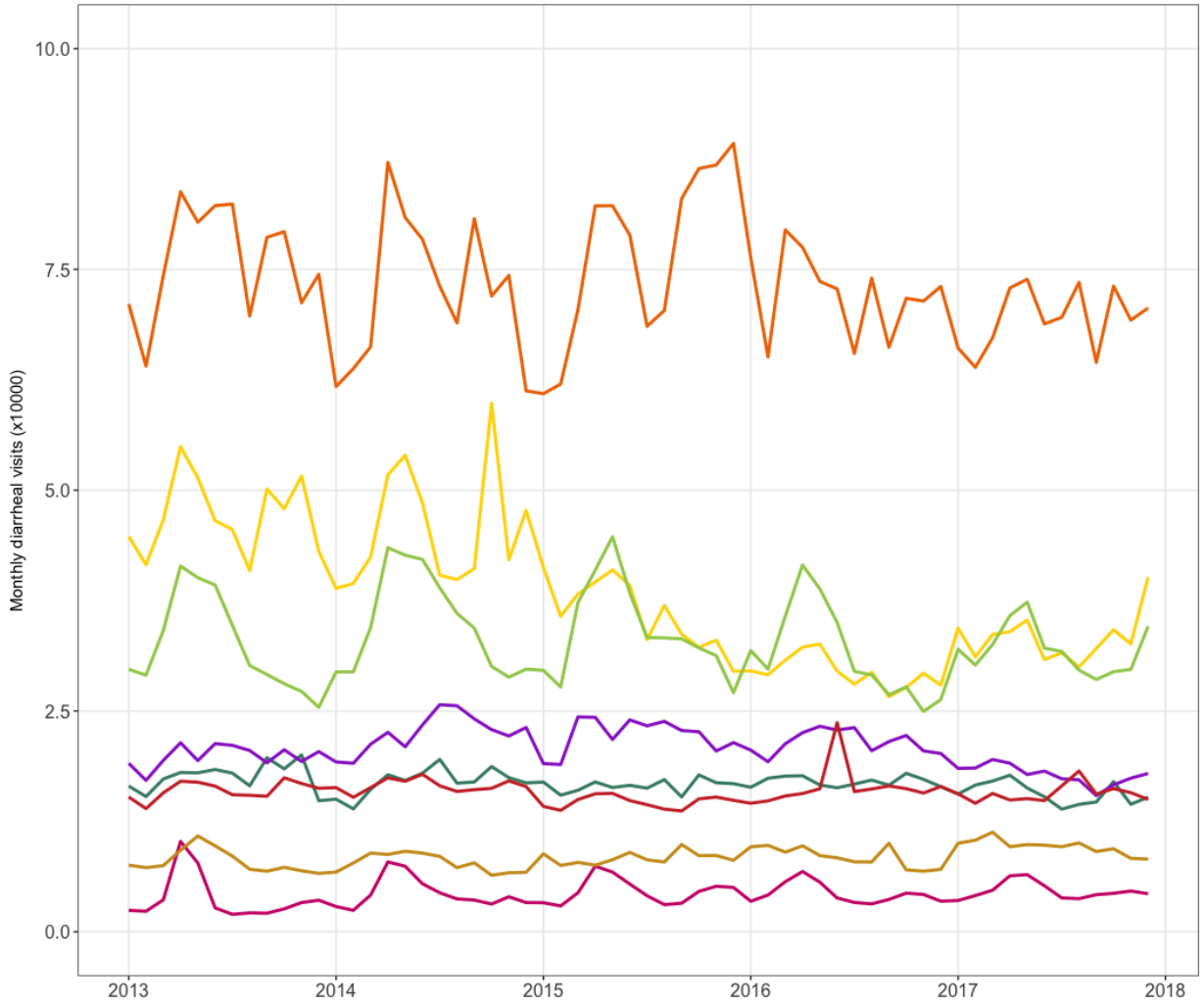
- Majority of cholera pandemics have originated in the Ganges Delta
- We need to know when, where and how much cholera there is in the region
- We know little about the true incidence and variability across Bangladesh
- Leveraging surveillance data sources and advances in Bayesian mapping techniques we can make smoothed maps of cholera incidence

Suspected cholera cases or AWD are often reported without systematic laboratory confirmation

Pr(Cholera | AWD) is variable in time and space

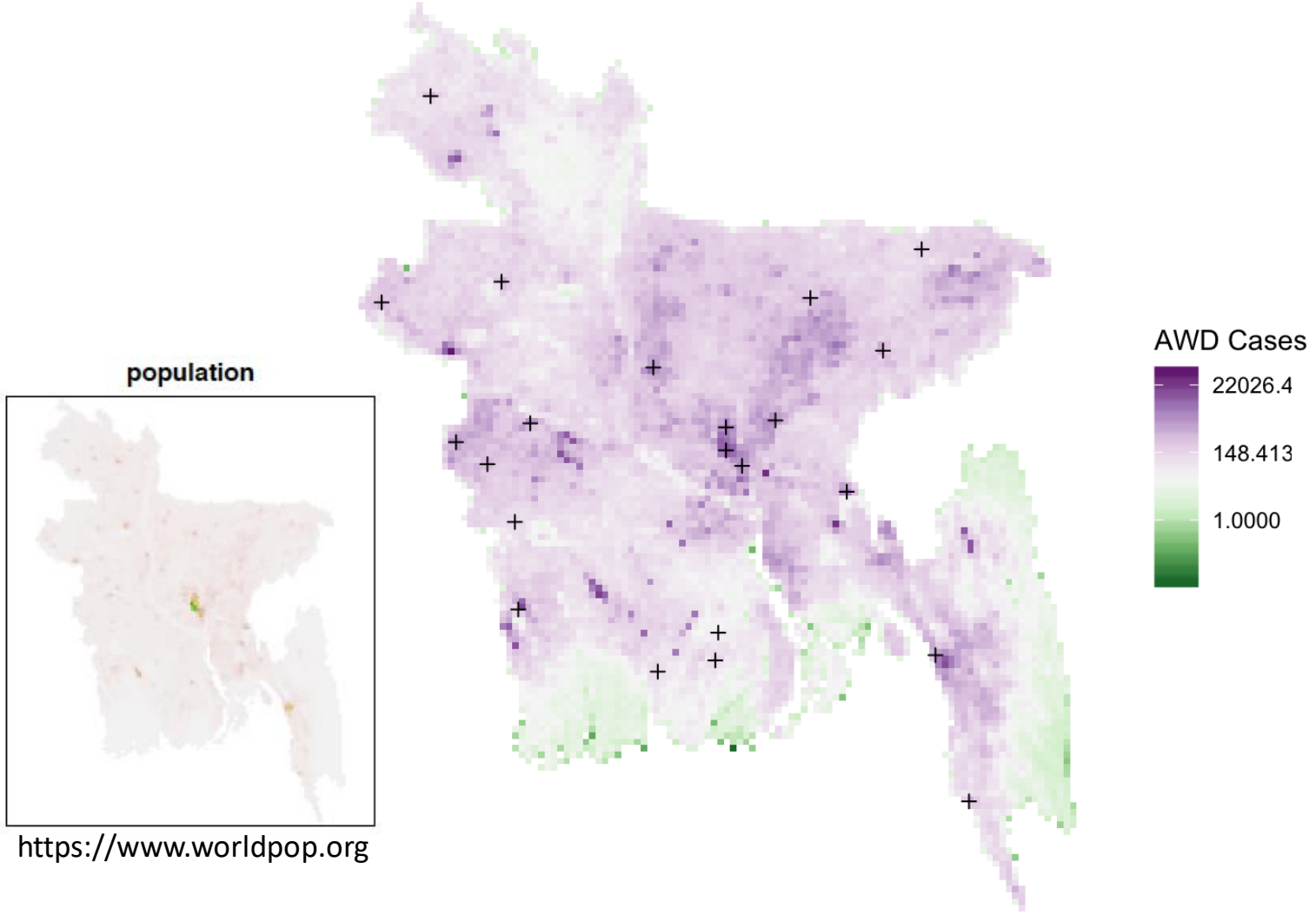
What data sources do we have in Bangladesh?

From the DGHS (MoH), we have monthly number of AWD visits by district from public and private hospitals



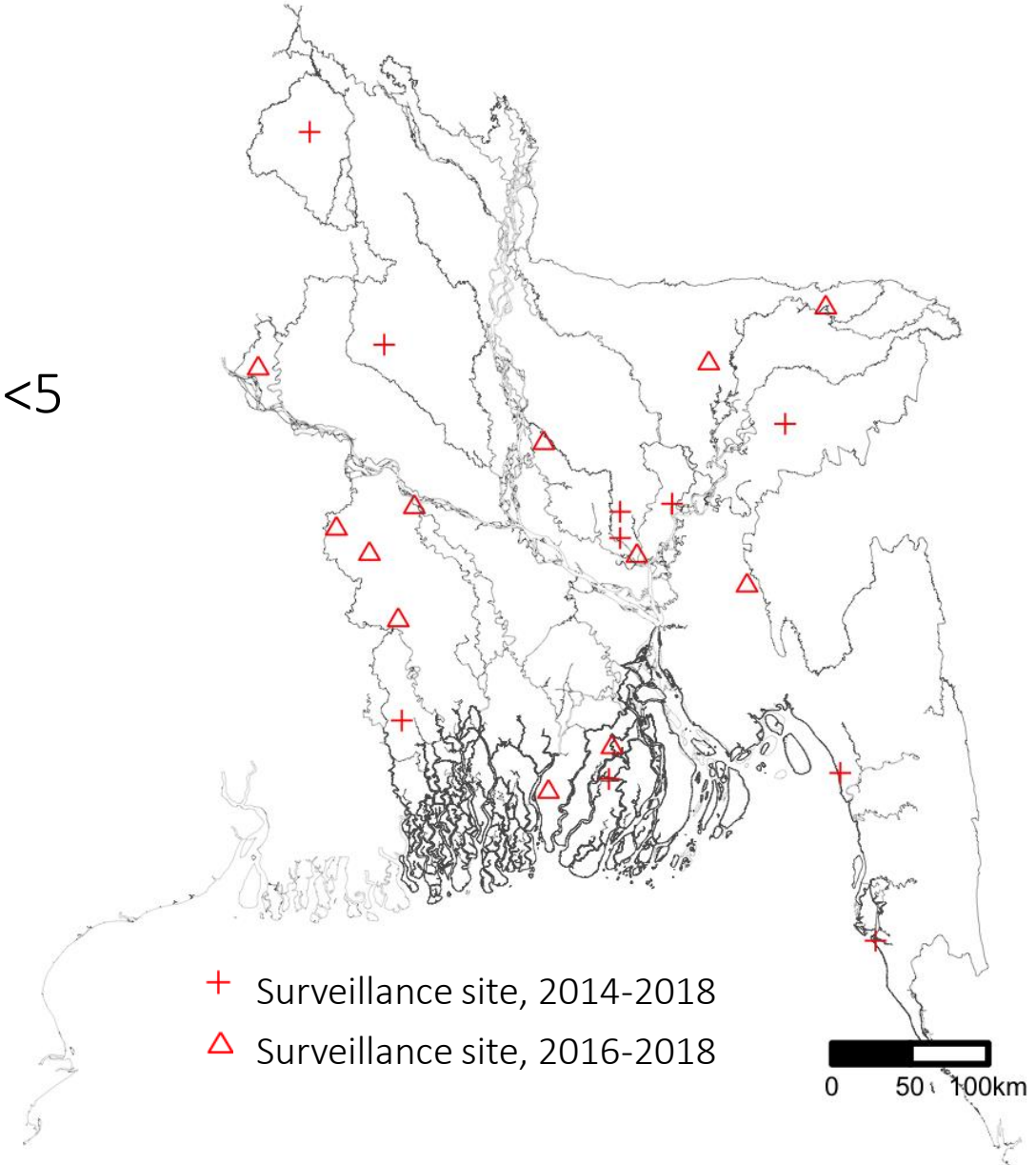
~ 2.5 million AWD cases per year

With DGHS AWD data and population estimates, we estimate AWD incidence and *number of AWD cases*

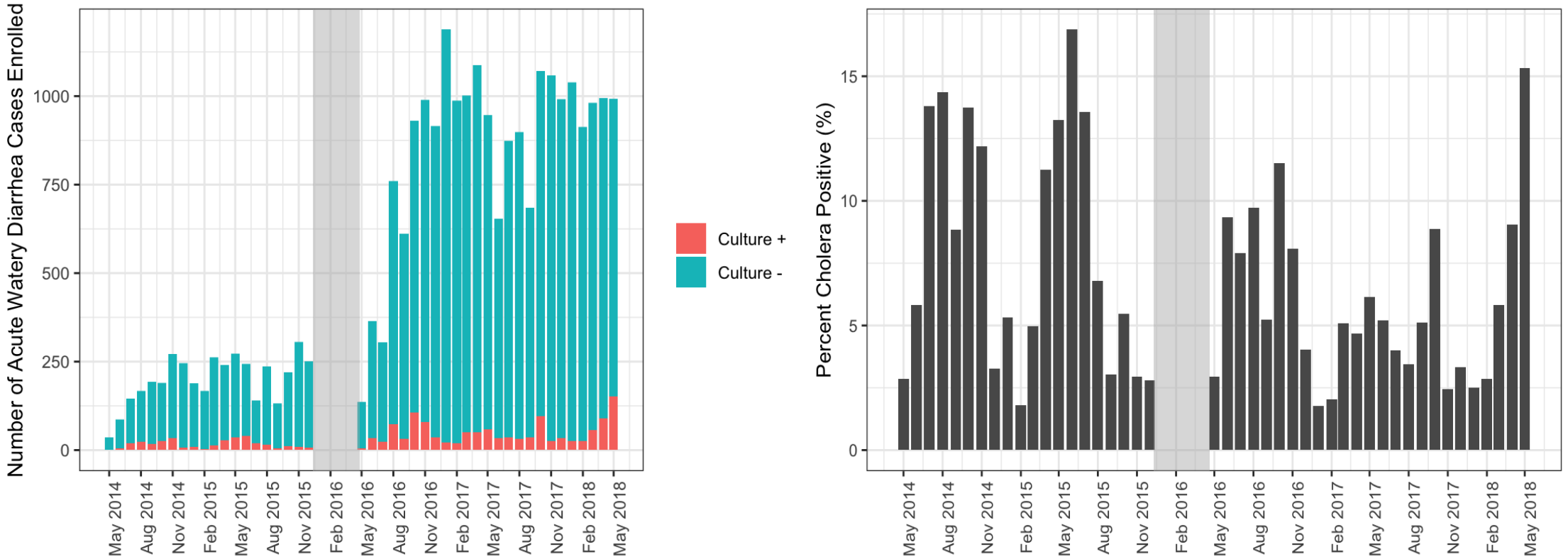


Sentinel cholera surveillance was established in 2014

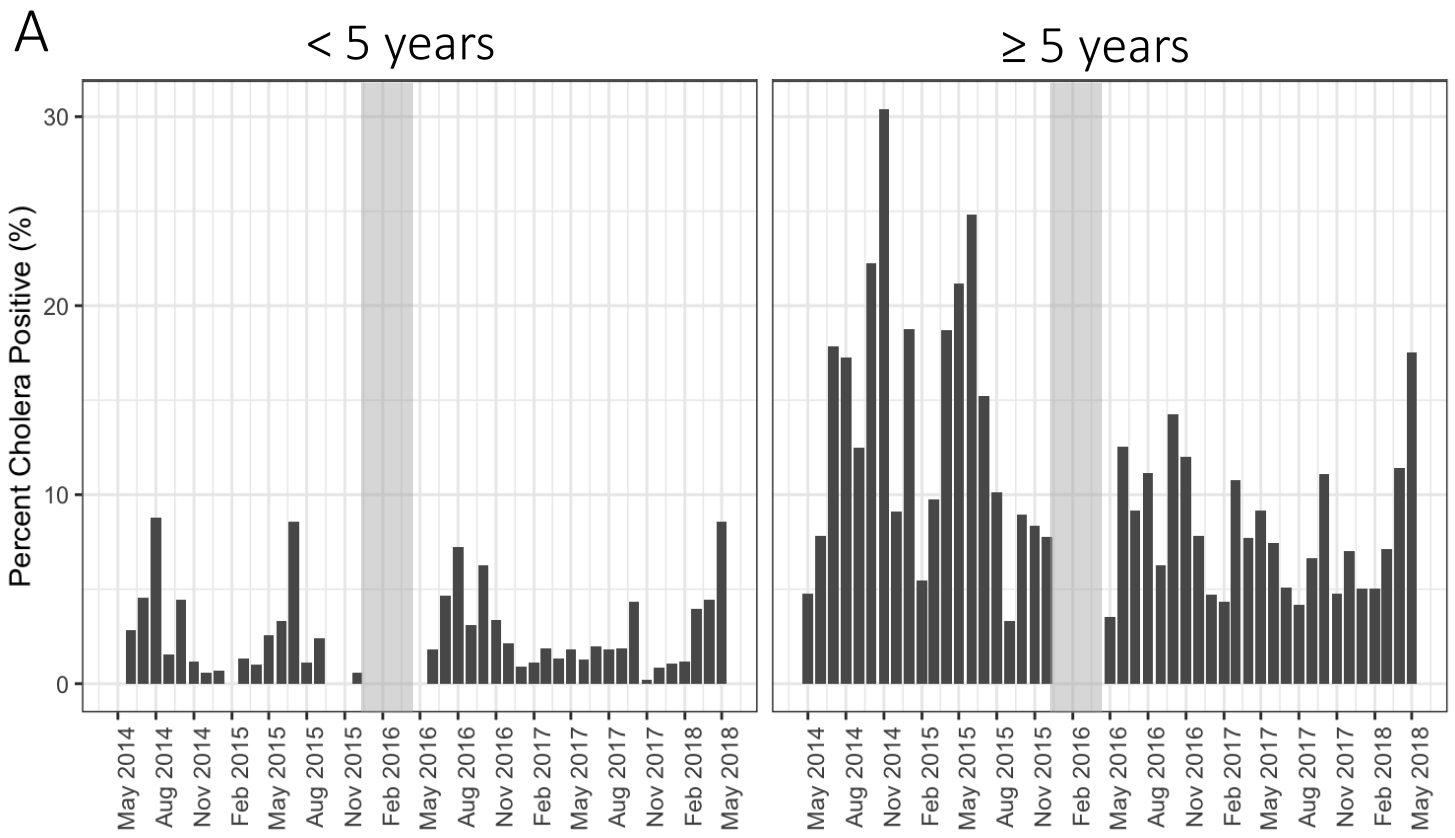
- 22 hospital sites
  - Tertiary care, district, and subdistrict
- Equal sampling probability of AWD patients <5 and ≥5 years for cholera testing
  - Inpatient and outpatient
- *V cholerae* culture test

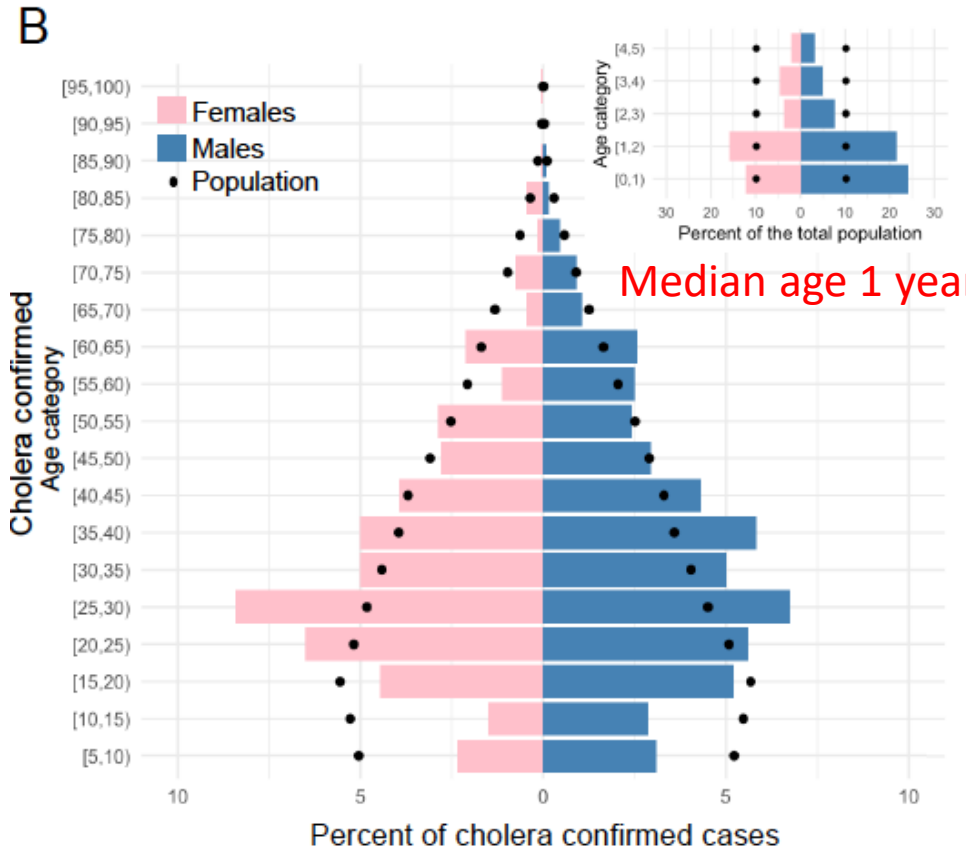


Sentinel sites give estimates of the fraction of AWD cases that are cholera positive through the year



…and the fraction cholera positive varies by age

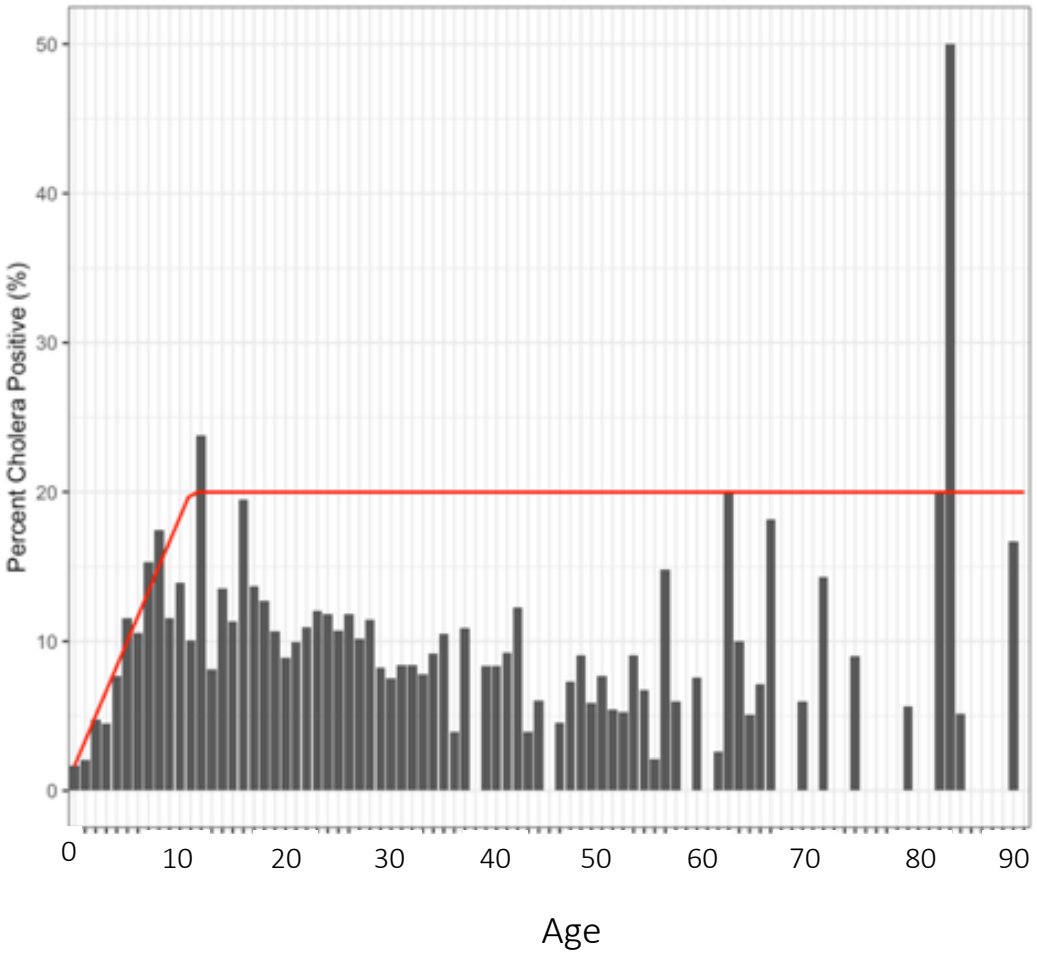


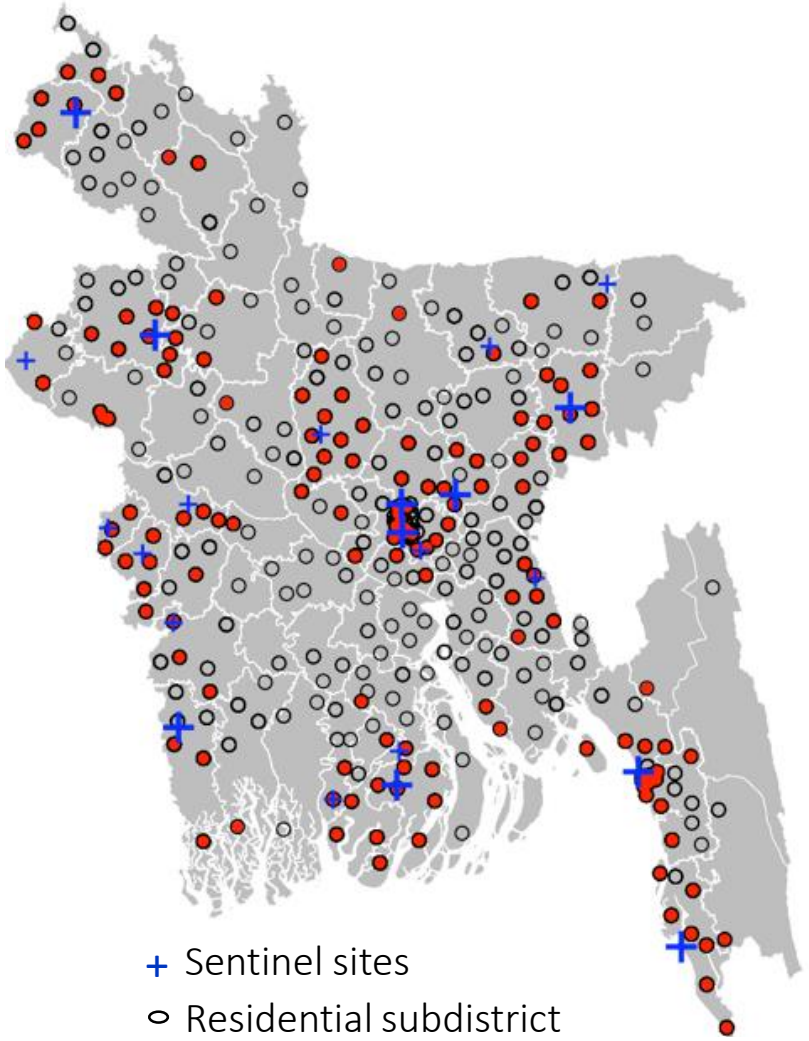


Median age 1 year

Median age 35 years

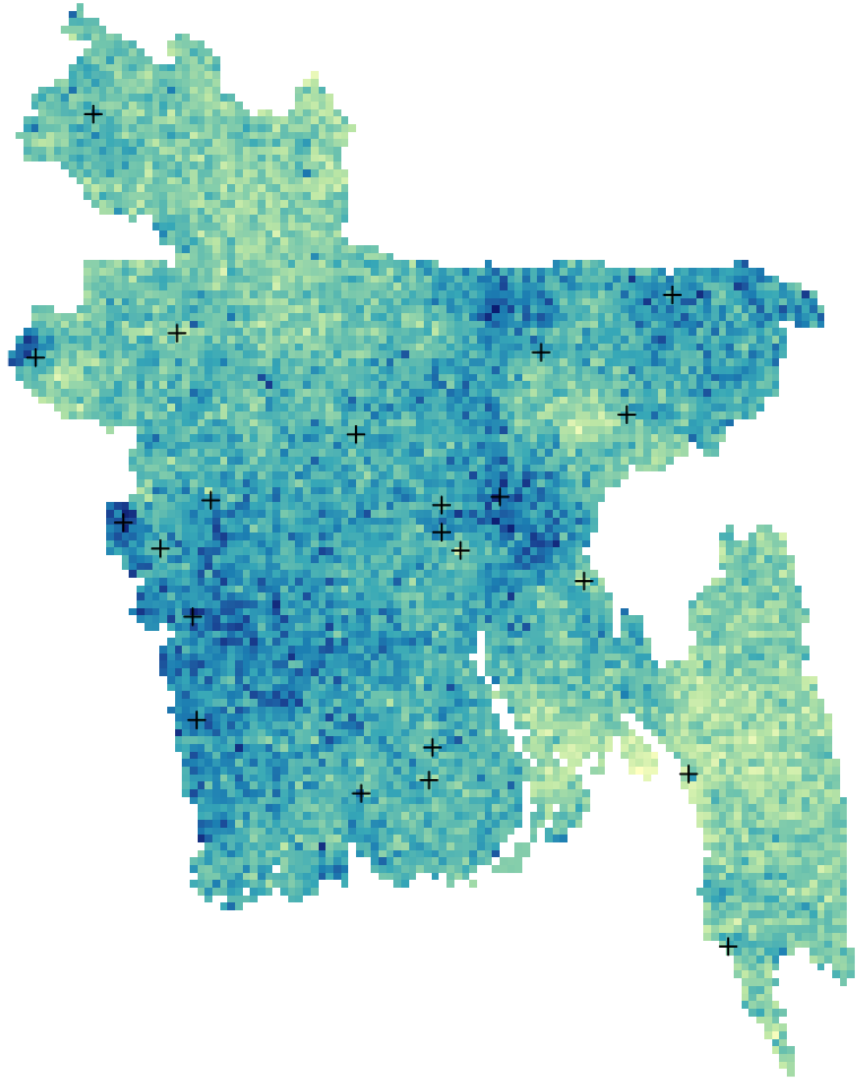
Knowing the linear relationship of age by Pr(Chol|AWD) and the residential location of patients, we predict cholera confirmation rate…

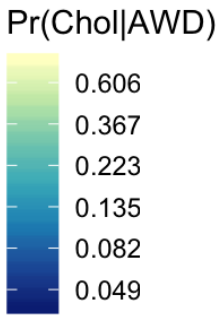




Cholera sentinel surveillance

Pr(Chol|AWD) adjusted for age





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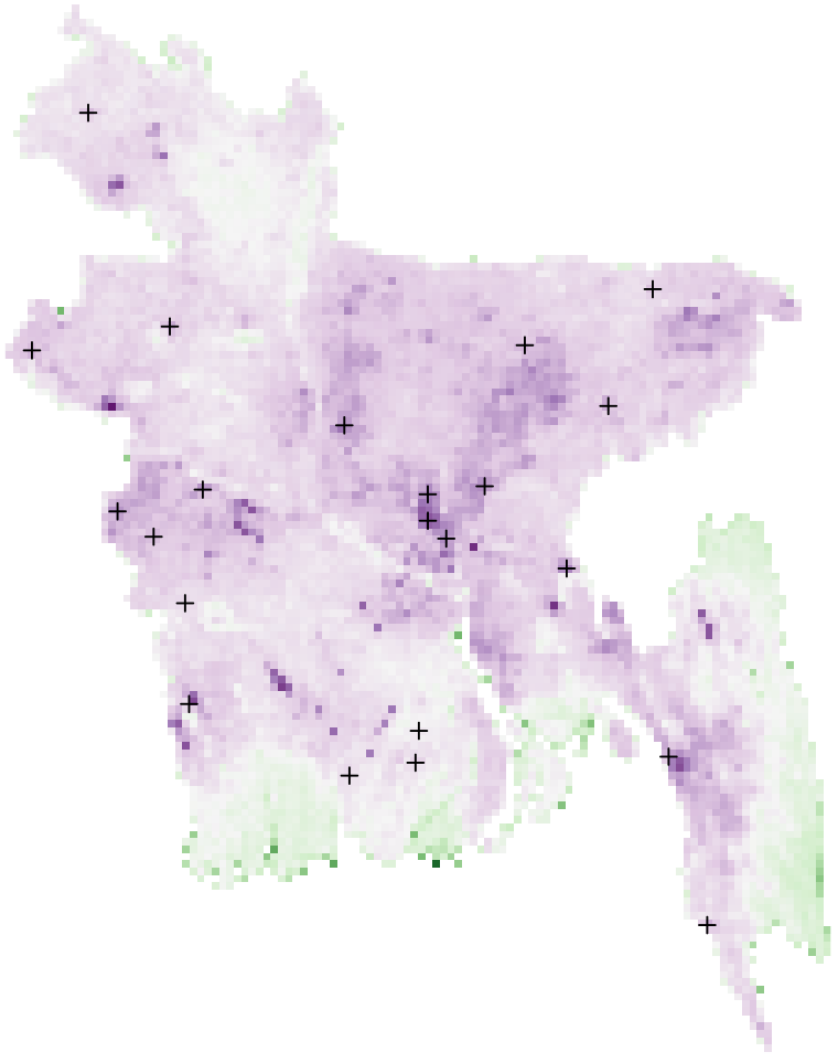
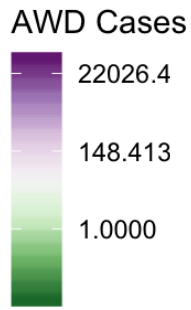
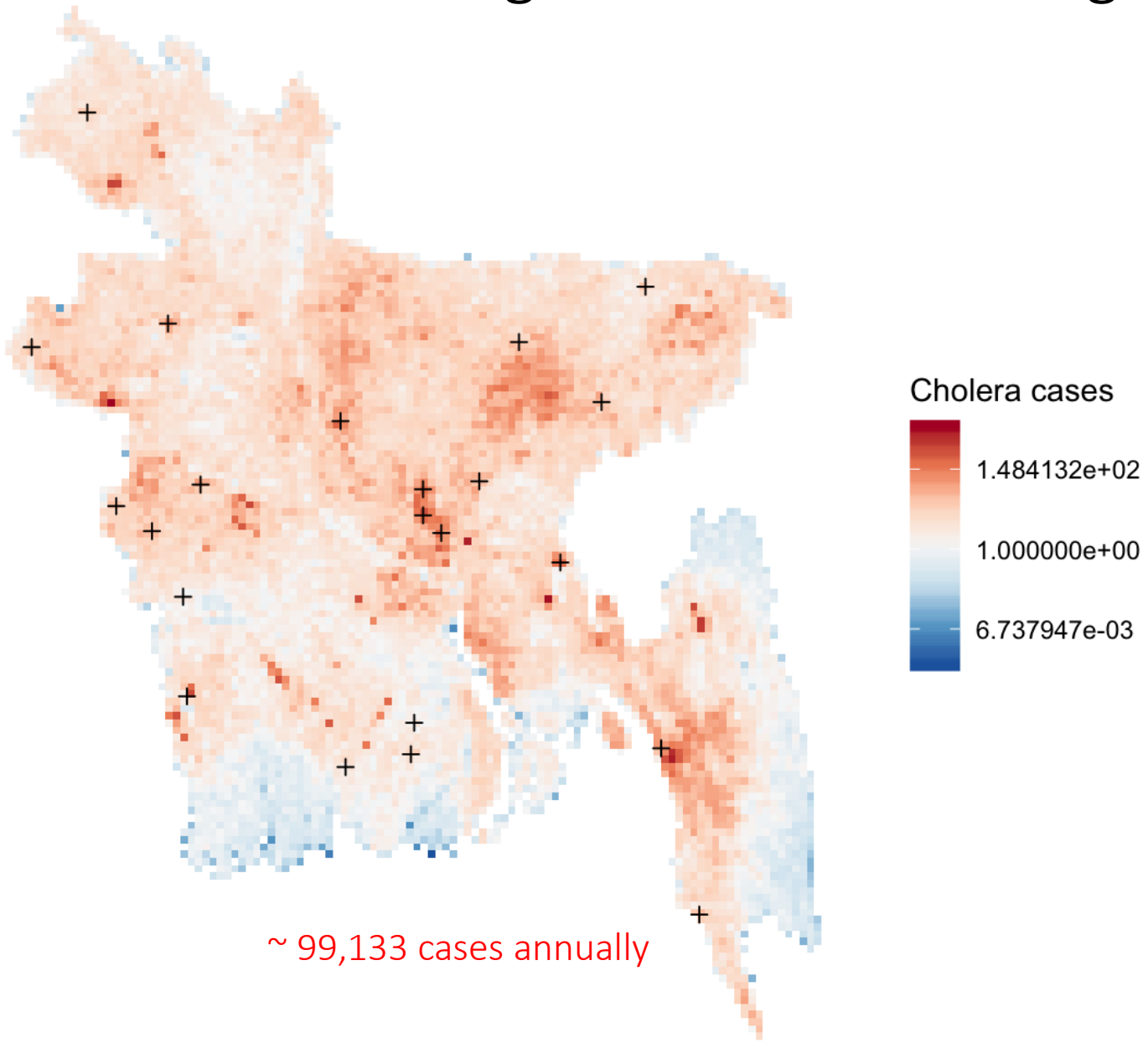
DGHS AWD surveillance

Number of AWD cases



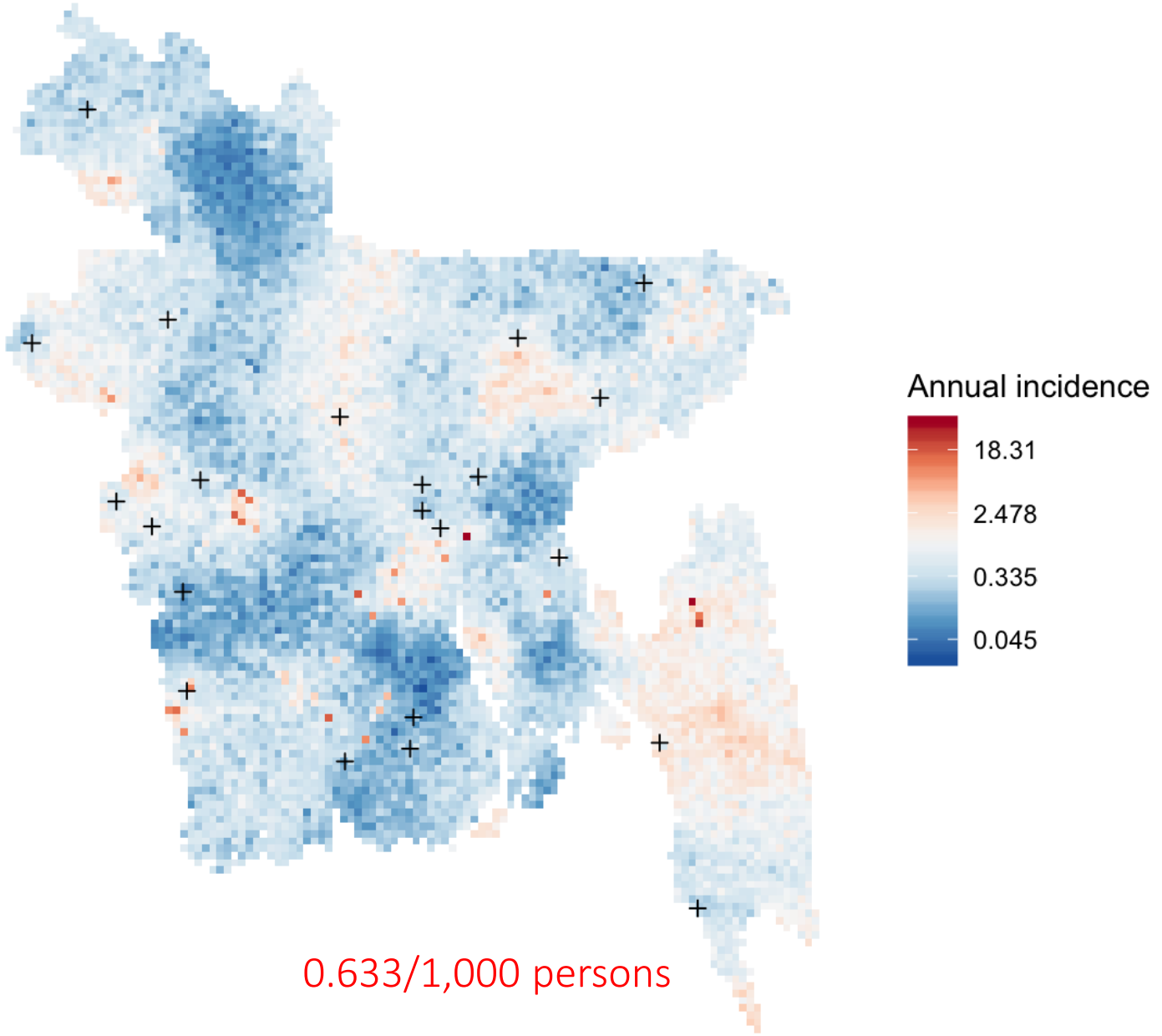


Number of cholera cases in Bangladesh at a 5 x5km grid resolution



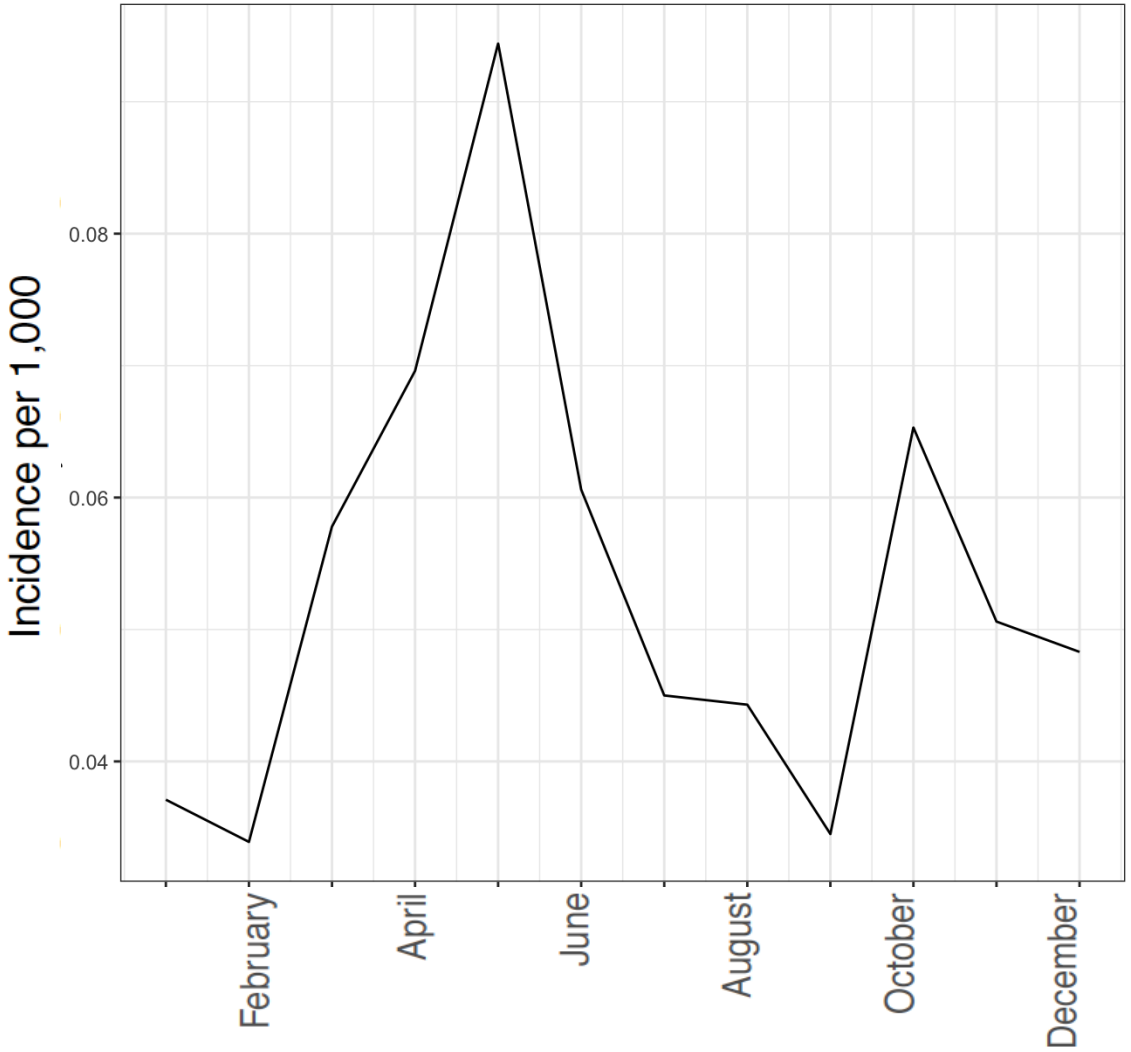
~ 99,133 cases annually

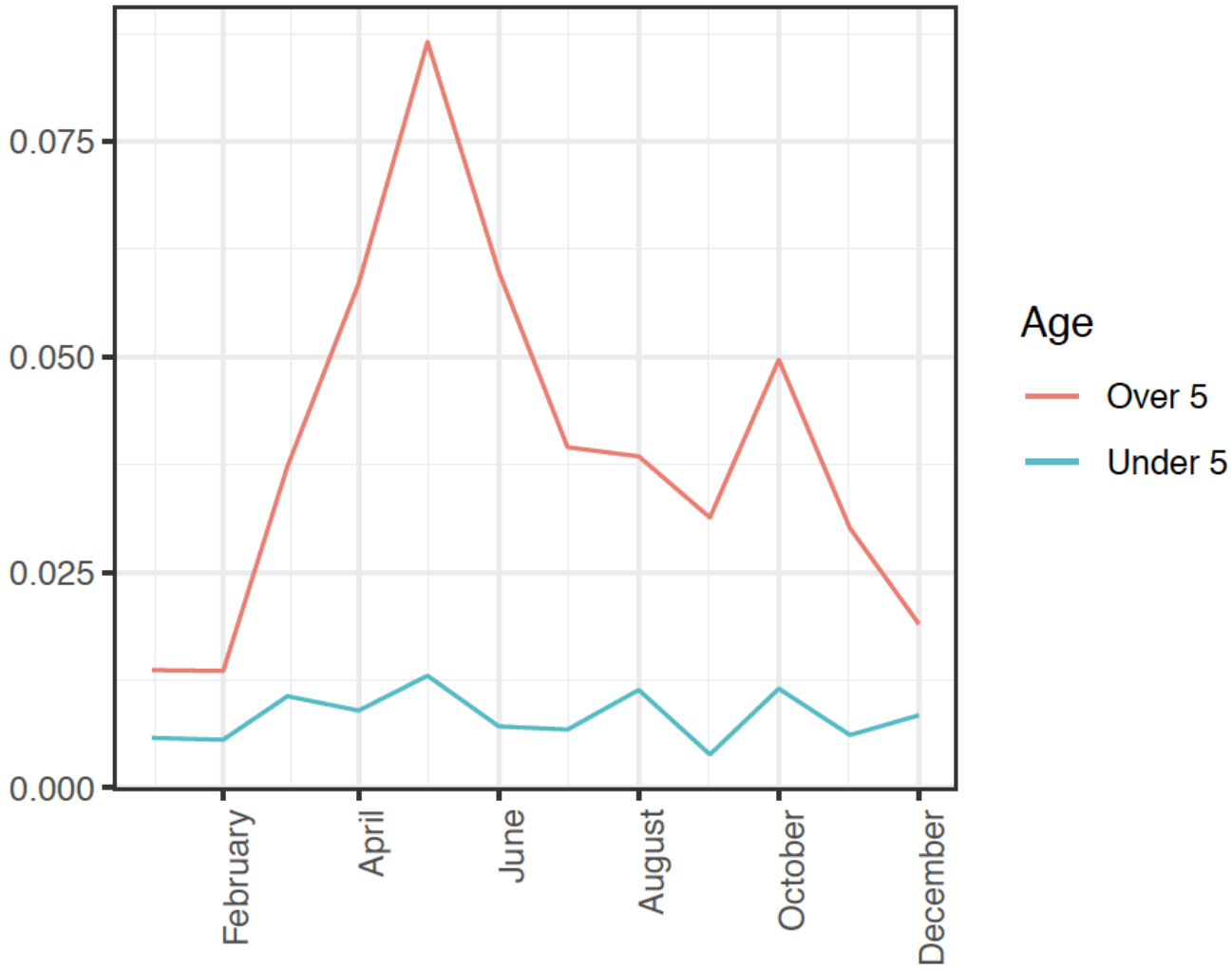
Annual incidence of cholera at a 5 x5km grid resolution



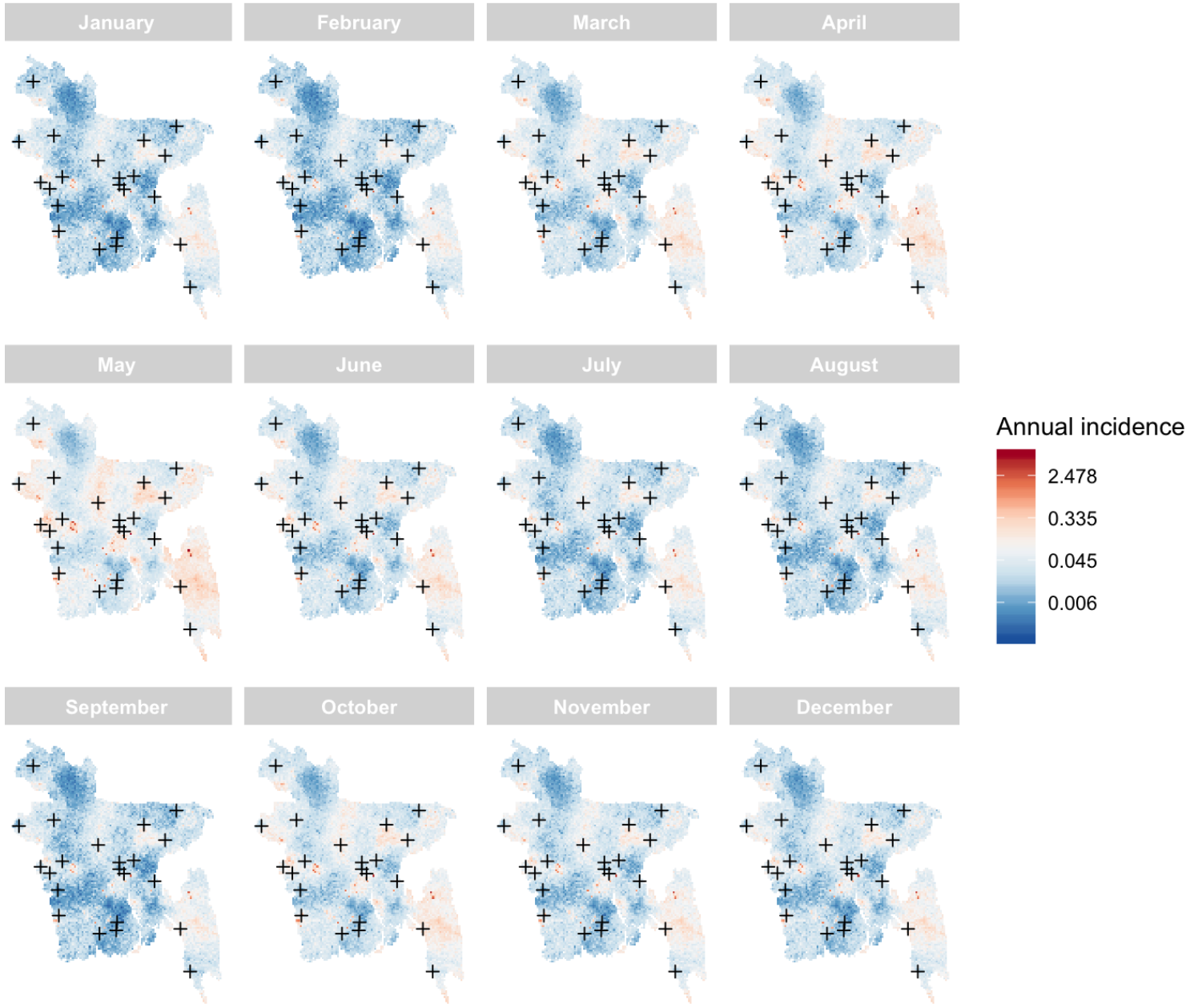
0.633/1,000 persons

Incidence of cholera is seasonal in Bangladesh



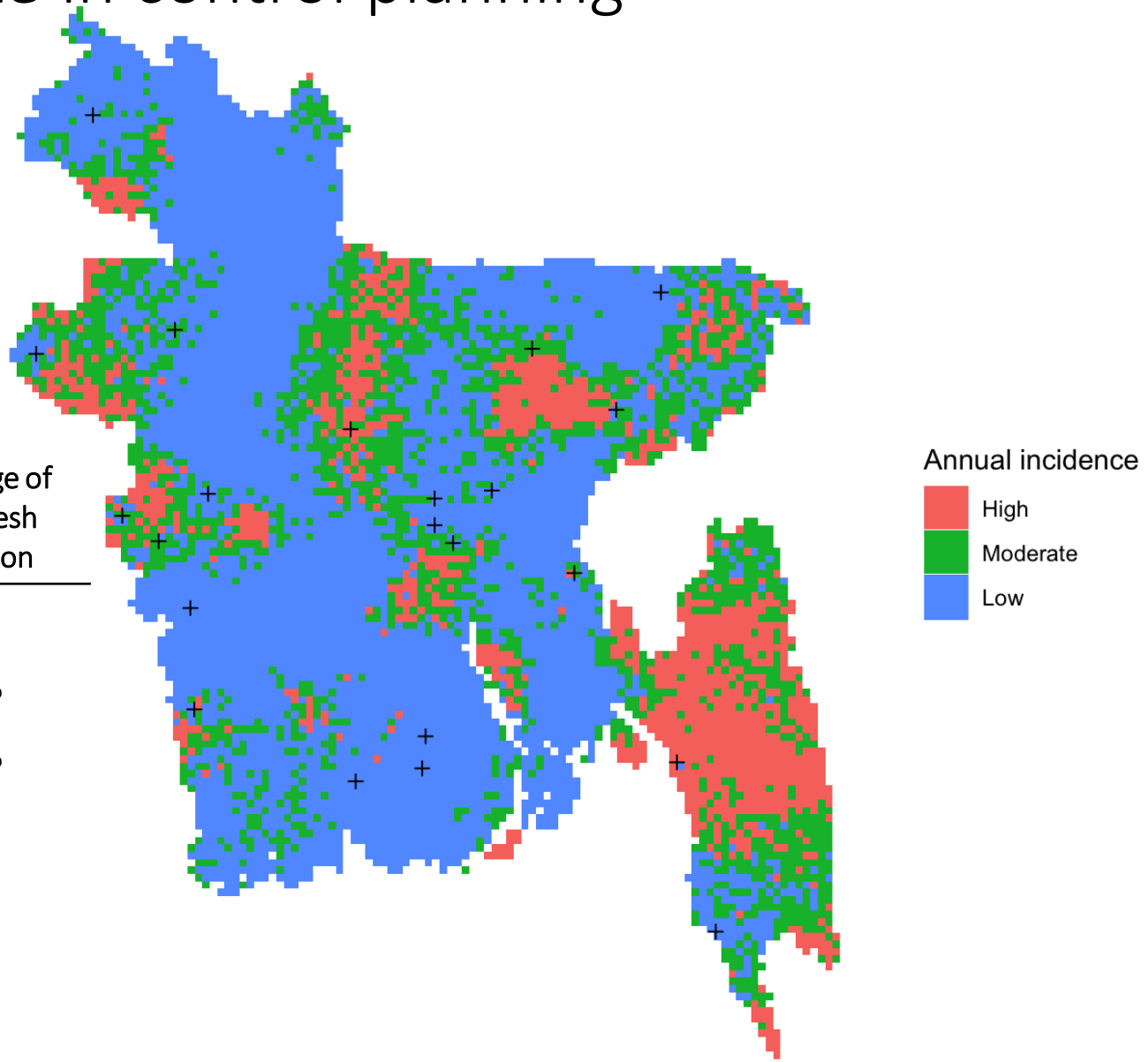


The same spatial heterogeneity exists across months

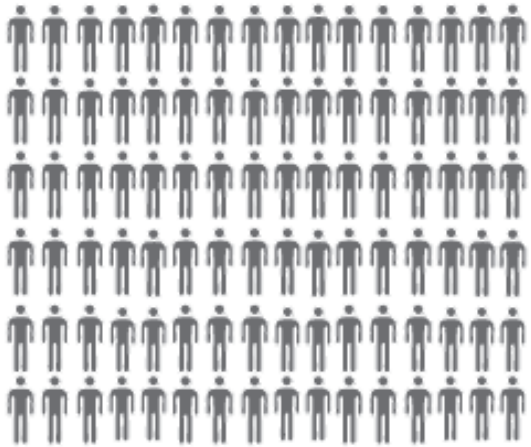


Geographically-resolved estimates allow us to identify high-risk areas to prioritize in control planning

Risk category	Incidence per 1,000 people	Number of people in these areas	Percentage of Bangladesh population
Low	< 0.5	98,442,599	63%
Moderate	0.5 to 1.0	33,882,905	21.6%
High	≥ 1.0	24,047,790	15.4%



There are challenges in reporting cholera



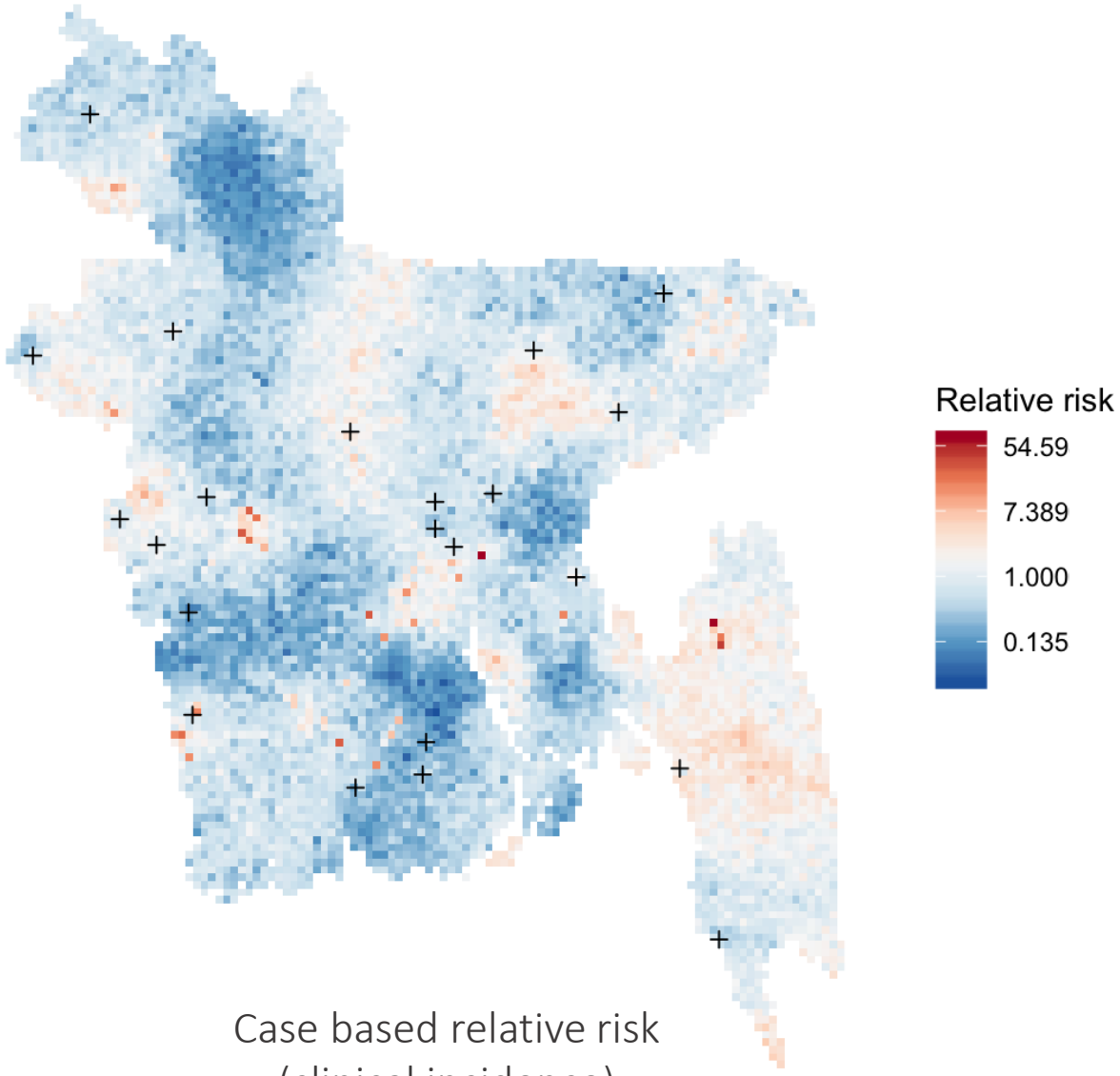
100 infected with *Vibrio Cholerae* 01

Symptomatic

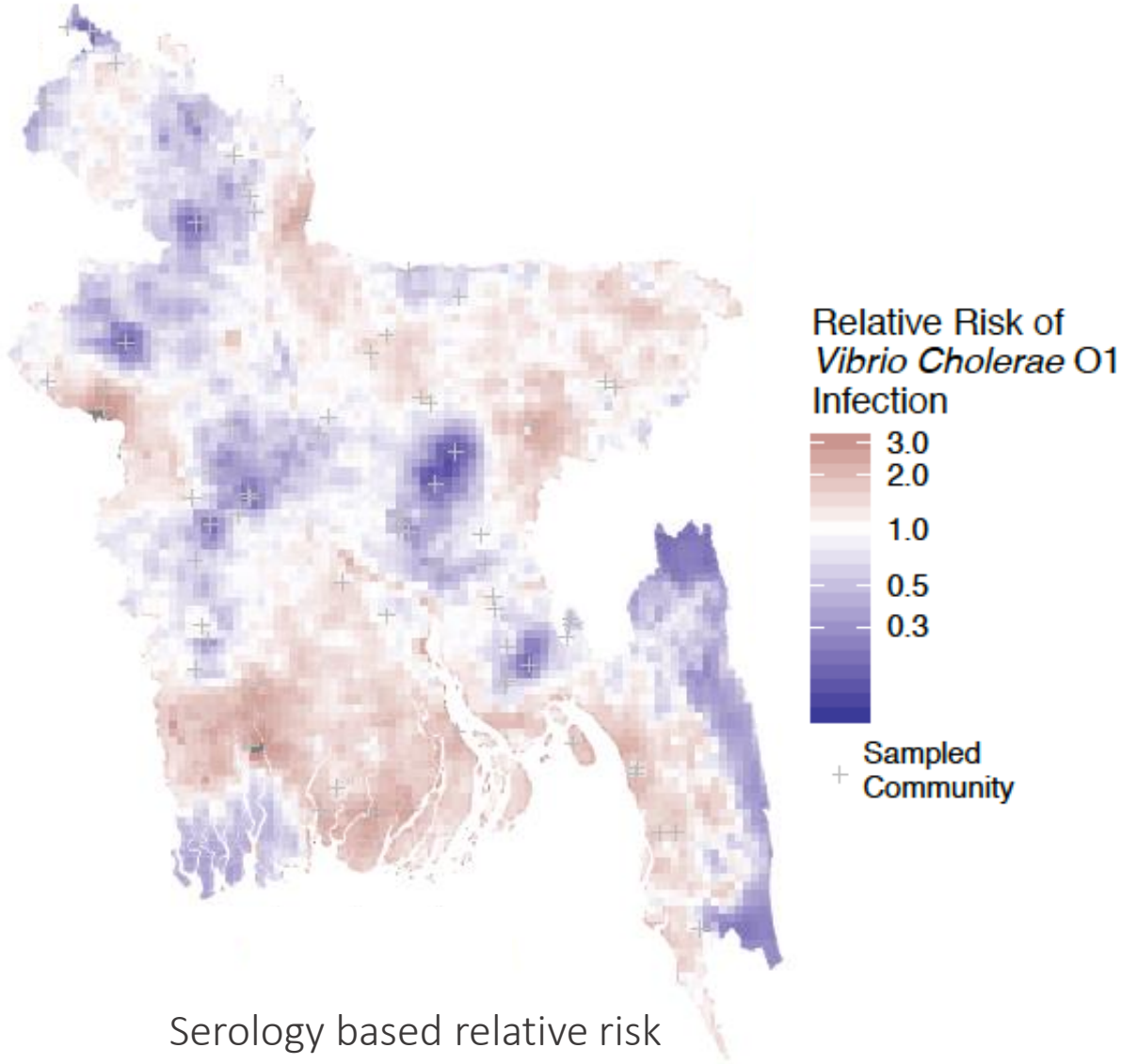
Seek care

Identified and reported as cholera

We can compare our clinical incidence to serology derived estimates…



Case based relative risk
(clinical incidence)



Serology based relative risk
(infection incidence)

Looking forward…

- Examine ecological drivers of risk to elucidate spatiotemporal variability
- Assess healthcare utilization and access
- Continuation of surveillance to monitor impact of interventions is critical
  - Sentinel surveillance with focused community sero-surveillance
  - RDTs with sub-sample of stool specimen for PCR
- Strengthening such systems to reach more vulnerable populations and estimate burden requires *funding*