**Introduction**

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Typhoid is serious and information on the burden will be useful for many respects including guiding policy makers to prioritize allocating resources.

Global burden of typhoid fever has been

To estimate the burden of typhoid fever, used an approach where the size of the population at risk is estimated and multiply it by the. Existing studies differ in that how they interpret incidence data and estimate the size of the at-risk population. One study took the reported incidence rate of typhoid as they are and assumed that people in the developing countries are at risk. The most recent study assumed that actual incidence may be higher than adjusted the rate to account for low sensitivity of the standard test (i.e., blood culture). The study also assumed that not all but the population without access to clean water in the developing country is at risk of typhoid.

Recently, cartographic approaches have been applied to estimate the burden and refined spatial distribution of the disease [dengue, zika,,]. In these approaches, a geographic region is divided into grids (e.g., 5 km × 5 km in this study) and probability of occurrence and incidence rate is determined for each grid cell through the association with covariates that are also available on grids. In particular, unlike previous studies where population- or sentinel-based surveillance are applied to other regions of interest, occurrence data as well as incidence data are used in a more statistically sound framework.

In this paper, we re-evaluate the global distribution of the typhoid fever using a cartographic approach,

show that information on the disease occurrence also useful for estimating the burden of the disease. They show that the can be useful, coupled with the newly developed disease prediction methods (e.g., boosted regression trees)

**Methods**

Map of probability of occurrence

Probability of typhoid occurrence for each grid cell was determined by evaluating an association between environmental covariates and typhoid occurrence using a boosted regression tree (BRT) technique [Elith et al 2008].

Data

Typhoid occurrence data

Incidence rate from population- or sentinel-based surveilance

Boosted Regression Tree (BRT)

A boosted regression tree (BRT) modeling framework was used to produce probability of occurrence for typhoid. Two key components for this frame are georeferenced occurrence records for thyphoid our key in

Negative binomial regression using a Gaussian Process prior

Hamiltonian Monte Carlo

When assessed by calculating deviance (), BRT performed better than the other methods explored including Maxent, generalized linear model, Bayesian generalized linear model, support vector machine,

We used a boosted regression tree (BRT) modeling technique to predict the probability of typhoid occurrence, which is a binomial coefficient as is commonly used in a logistic regression.

A boosted regression tree (BRT) modelling framework was used to generate global predicted environmental risk maps for CL and VL.

**Discussion**

There are limitations of this study. First, like other cartographic analyses, explanatory covariates that we explored were limited to those that are available on grids. This means we were not able to examine impact of the well-known risk factors such as access to clean water or improved sanitation [ref] on the typhoid occurrence or incidence rates. This is also true for previous estimations of typhoid burden. And to partly account for this, we defined the population at risk of typhoid as being those who don’t have access to clean water as in previous studies. Second, there are many assumptions that go into the models when estimating the probability of occurrence and incidence rates and when interpreting typhoid occurrence data. Although we explored the impact of varying selected important assumptions, (see online appendix), there are still assumptions that we haven’t explored and might have an impact on our inference. Third,