Methods
Two metrics of vegetation will be used in the spatial analysis of TB. NDVI is widely used in ecological studies to estimate vegetation using visible spectrum (VIS) and near infrared (NIR) raster band data from satellites. NDVI is calculated as follows:

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\text{NDVI} = \frac{\text{VIS} - \text{NIR}}{\text{VIS} + \text{NIR}}
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NDVI slope is a derivative of NDVI that uses adjacent cells to determine the percent change in NDVI though out the landscape. This goal of this metric is to assess whether those who live at the interface of the urban and periurban environment are more likely to contract TB. This increased risk is based on the presence of large populations of migrant, displaced and/or low-income people at periurban interfaces such as those observed in Bastion Popular. It is believed that these areas will concurrently display a higher NDVI slope due to the transition from urban to more vegetative land cover.

Introduction
Remote sensing using Geographical Information Systems (GIS) can serve as a valuable tool when assessing spatial covariates of infectious diseases in resource poor or time-constrained settings. Small samplings of disease prevalence can be extrapolated to much larger areas or populations using robust geostatistical software tools such as kriging. Normalized Difference Vegetation Index (NDVI) is one such covariate that can be acquired extensively to predict the habitats of many communicable disease carrying vectors such as mosquitoes carrying West Nile Virus. However, current literature regarding the use of NDVI for tuberculosis (TB), caused by Mycobacterium tuberculosis for which humans are the only reservoir, is lacking. Much research regarding the autocorrelative geospatial distribution of TB has been undertaken, often focusing on clusters in settings classically associated with TB such as correctional facilities and residences with many people living in close quarters. Additionally, it may be difficult to ascertain the true role of vegetation in the urban environment due to the potentially atypical distribution of vegetation within and around urban areas. For this reason, a derivative of NDVI, NDVI slope, will be used in an effort to elucidate more complex spatial relationships. The true nature of the role that NDVI plays in the spatial distribution of TB may prove to be a valuable tool when considering where to administer targeted interventions, especially in resource poor settings.

Objectives
1. To determine and quantify the spatial relationship, if any, between NDVI and the occurrence of TB in Guayaquil, Ecuador.
2. To develop and utilize the NDVI derivative, NDVI slope, in order to elucidate other possible spatial relationships between TB and the unique distribution of vegetation in an urban environment.
3. To determine if TB in Guayaquil, Ecuador follows a pattern of spatial autocorrelation and clustering as has been observed in other studies.

Results
Multiple regression yielded parameter values of -10.46 (p=.10) and 1.12 (p=.81) for the covariates NDVI and NDVI slope on the occurrence and intensity of TB hot spots. The results of this study indicate that TB does display autocorrelation as has been suggested by studies in other settings. This is likely related to the mode of transmission of TB which requires contact with infective respiratory droplets in close quarters. Thus the infective range is limited by geographic and physical proximity. The results of the multiple regression suggest that NDVI and NDVI slope are not significant covariates when attempting to predict the spatial distribution of TB in an urban and periurban environment. This may be explained by the complicated ecological role that vegetation plays in the urban environment and by the fact that TB carried only by humans and not other vectors which may be more subject to the affects of vegetative variation. Limitations of this study included a maximum resolution of 240m/pixel for all raster data used in NDVI and NDVI slope calculations. This low resolution may have limited the robustness of the covariates used in the predictive model. Future studies using higher resolution raster and case data may lead to improvements in the predictive power of NDVI and NDVI slope for TB. Additionally, the external validity of this study may be limited because it only considered two of the many possible variables which may be of varying influence depending on the unique ecology of each locality affected by TB.