Spatial and temporal patterns of gastrointestinal illness and their relationship with precipitation across the state of North Carolina

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INTRODUCTION
The quality of drinking water quality in the US is among the best in the world; however, pathogens are present in source waters that are used for drinking water. Water and floodwaters specifically can spread pathogens within watersheds by mobilizing pathogens and transporting them. Previous research has identified an association between gastrointestinal (GI) illness and heavy precipitation (Curriero et al., 2001 and Figure 1). SERCC (Southeast Regional Climate Center) & Dr. Maggie Sugg, ESE Department

METHODS: DATA SOURCES continued
...station maintained by a government organization to the ZIP code of residence. Demographic factors were collected both on the ZIP code and county levels from the US Census Bureau. Drinking water source data at the county level was collected from a previous UNC-CH study by Luh et al., 2015.

METHODS: LAG PERIODS AND PRECIPITATION
Using a 3-day and a 10-day lag period, the total population of ED visits was split into two samples based on the cumulative amount of precipitation (Table 2), wherein “heavy” rains were greater than 2 inches and “light” rains were less than 2 inches.

RESULTS: DEMOGRAPHIC
The youngest and oldest age groups are the most affected by GI illness (Figure 3), which aligns with results from previous studies (Drayna et al., 2010). There is significant clustering in proportions of children under age 15 (Figure 2).鉄% of the population under 15 years old and those > 64 years old have the highest rates of disease (Figure 3), separated by age group.

RESULTS: TEMPORAL
Overall ED visits show a peak in the winter months (Figure 2, top). However, given heavy rains in a 3-day lag, the signal for the year is different, with a peak in late summer months (Figure 2, bottom). Although not shown here, the 10-day lag after heavy rains presents the same summer-peak trend.

RESULTS: SPATIAL
Spatial patterns of overall GI illness at the ZIP code level reveal statistically significant clustering. The highest rates were revealed in rural areas in the coastal plain as well as portions of the Piedmont and the mountains (Figure 4). Over 20 other maps were generated at the county level to spatially analyze variables shown in Table 3.

CONCLUSIONS
• There are significant associations with GI illness and poverty/poverty elements in North Carolina
• There is significant clustering in proportions of disease after heavy rain at the county level
• There are otherwise unique spatial pockets of high rates of disease in NC after heavy rain

Figure 1. Relationships between heavy downpours and disease (NOAA)

Figure 4. North Carolina ZIP code-level gastrointestinal illness ED visits per 100,000 person-years from 2008-2012.

Figure 2. Top: Total counts of ED visits for GI by Month; Bottom: Percentage of total counts for the year after “heavy” rains by month, 3-day lag

Figure 3. GI ED visits per 100,000 person-years, separated by age group

Figure 5. 10-day lag: The average number of admissions per day per county for light and heavy precipitation (top) and the proportional difference values in the two rates (bottom).

Table 3. Correlations for rates of gastrointestinal illness per 100,000 person-years and demographic variables. A’ represents statistical significance.

CONFLICTS OF INTEREST
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REFERENCES