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Using Syndromic Surveillance and Climatic Data to Detect High Intensity HFMD Seasons

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Objective

To assess the relationship between seasonal increases in emergency department (ED) and urgent care center (UCC) visits for hand, foot, and mouth disease (HFMD) among children 0-4 years old and average dew point temperatures in Virginia. To determine if this relationship can be used to develop an early warning tool for high intensity seasons of HFMD, allowing for earlier targeted public health action and communication to the community and local childcare centers during these high intensity seasons.

Introduction

Hand, foot, and mouth disease is a highly infectious disease common among early childhood populations caused by human enteroviruses (*Enterovirus* genus) [1]. The enteroviruses responsible for HFMD generally cause mild illness among children in the United States with symptoms of fever and rash/blisters, but have also been linked to small outbreaks of severe neurological disease such as meningitis, encephalitis, and acute flaccid myelitis [2].

Enteroviruses circulate year-round but increase in the summer-fall months across much of the United States [3]. The drivers of this seasonality are not fully understood, but research indicates climatic factors, rather than demographic ones, are most likely to drive the amplitude and timing of the seasonal peaks [3]. A recent CDC study on nonpolio enteroviruses identified dew point temperature as a strong predictor of local enterovirus seasonality, explaining around 30% of the variation in intensity of transmission across the United States [3].

Methods

Syndromic surveillance data on ED and UCC visits among 0-4 year olds in Virginia were analyzed from January 1, 2012 to August 31, 2018. Visits for HFMD were identified using the following chief complaint and discharge diagnosis terms: hand, foot, and mouth; HFM; fever with rash, lesions, or blisters; ICD- 10 code: B08.4; or SNOMED CT code: 266108008. Visits for HFMD among 0-4 year olds were aggregated by week and calculated as a proportion of all ED and UCC visits among this age group during the study period.

Hourly dew point readings from the Richmond International Airport from January 1, 2012 to August 31, 2018 were obtained from the National Oceanic and Atmospheric Administration (NOAA), National Climatic Data Center (NCDC). NOAA readings were averaged by week to establish a mean dew point for each week during the study period. Correlation analyses were performed on weekly dew point temperatures and weekly percent of HFMD visits. Weekly dew point averages were used to determine low-activity weeks at which to measure baseline percentages of HFMD visits. A low-activity week was defined as periods of two or more consecutive weeks in which each week had an average dew point temperature of less than 55.4 degrees Fahrenheit [3]. To assess if HFMD seasons varied in intensity from year to year, a Kruskal-Wallis test was used to assess significant differences by year among the mean weekly percent of HFMD visits during high- activity weeks.

An early warning threshold for a high intensity season was developed by calculating the mean percent of HFMD visits during low-activity weeks for the previous three years and adding two standard deviations. Threshold rates were calculated for years 2015 through 2018 and compared to the percentage of 0-4 year old HFMD visits during high-activity weeks. The week where percent of HFMD visits crossed the early warning threshold in 2018 was assessed to determine when public health notifications could have been made to alert the community about a high intensity (above threshold) HFMD season if this early warning tool had been utilized.

Results

Between January 1, 2012 and August 31, 2018, there were 27,181 visits for HFMD among children aged 0-4 years. Mean and median weekly percent of HFMD visits were 1.33% and 1.01% of total 0-4 year old visits, respectively, with a range from 0.18% to 5.32%. These visits were most prominent during the summer or fall each year, with annual peaks occurring between weeks 22-46.

Weekly percent of HFMD visits and average weekly dew point temperatures were significantly correlated ($r=0.562$, $p<.0001$). The mean weekly dew point temperature for high-activity weeks was 67.2 degrees Fahrenheit, with a range between 49.3 and 73.5 degrees. A Kruskal-Wallis test showed a significant difference in the mean weekly percent of visits by year for high-activity weeks ($p<.0001$).

Over the 4 years of data to which the threshold was applied, percent of HFMD visits crossed the threshold in 2016 and 2018, indicating both years experienced high intensity HFMD seasons (Fig. 1). Percent of HFMD visits never crossed the early warning threshold in 2015 nor 2017. In 2018, the threshold was met on Week 21 (week ending June 2, 2018) which was more than 3 weeks prior to when public health notifications were made using routine surveillance methods through ESSENCE.

Conclusions

Visits for HFMD among the young childhood population (0-4 year olds) in Virginia exhibit annual summer-fall seasonality with significant differences between the percent of visits from year to year. Seasons exhibiting a significantly higher percent of HFMD visits during high-activity weeks warrant a greater level of public health communication and outreach to educate parents, physicians and childcare centers about the disease and prevention measures. It can be difficult to differentiate high intensity seasons from low intensity seasons in the early weeks of increasing disease activity. Traditional syndromic surveillance methods using ESSENCE identify significant increases in HFMD visits from the previous 90 days, but do not readily alert on differences in seasonality from year to year. These results support the use of dew point temperature data to develop an early warning tool for high intensity seasons of HFMD. This early warning tool will allow for more efficient use of resources and targeted outreach during years with particularly high HFMD activity within the young childhood population. This early warning tool will be implemented by the Virginia Department of Health in 2019 to evaluate its effectiveness at identifying high HFMD activity in real-time.

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References

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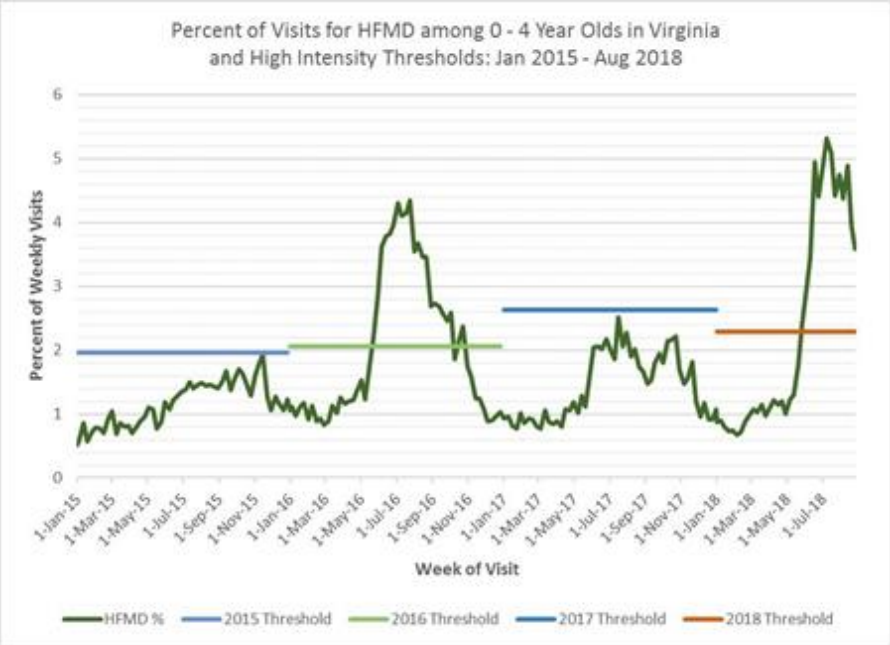

Figure 1