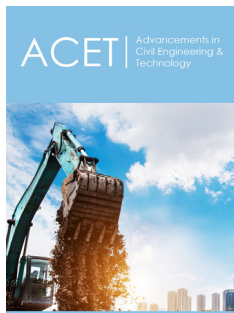


Effects of Population Density and Traffic Flow on Covid-19 Disasters in Florida

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Abstract

Based on the Covid-19 data in March 2020, analysis indicates that Northwest Florida region with low population density and less visitors has much less cases (only 3%). However, in the Northeast and South Florida regions with high population density and more travelers has much more numbers of cases (97%). Monitoring and managing traffic flow in both roadways and airliners, especially in populated cities, may be helpful for mitigating the disasters caused by the Covid-19 data. For potential hurricane impacts, evacuation and sheltering plan should be made with consideration of social distancing during the pandemic.

Introduction

Florida's earliest announced officially confirmed case occurred on March 14th. Center of Disease Control and Prevention (CDC) testing was limited in early March. The first two infected patients were in Manatee and Hillsborough, a 63-year-old man who had never been to a country where travel is restricted by the CDC and a 29-year-old woman who had traveled to Italy. Since then, the number of positive patients increased. On March 10, the Governor declared the state of emergency. By March 23, the total cases have increased to 379. Based on the geographic distributions of the confirmed COVID-19 cases in Florida as shown in Figure 1 (data obtained on March 23, 2020), it shows that much more cases are in northeast and south Florida region with high population density and tourists, and less cases in northwest Florida region with lower population density and tourists. Therefore, we divide the state into two regions for COVID-19 data analysis: Northwest Florida region, and Northeast and South Florida region as shown in Figure 1. Causes and distribution of the Covid-19 outbreak in those two regions are analyzed.

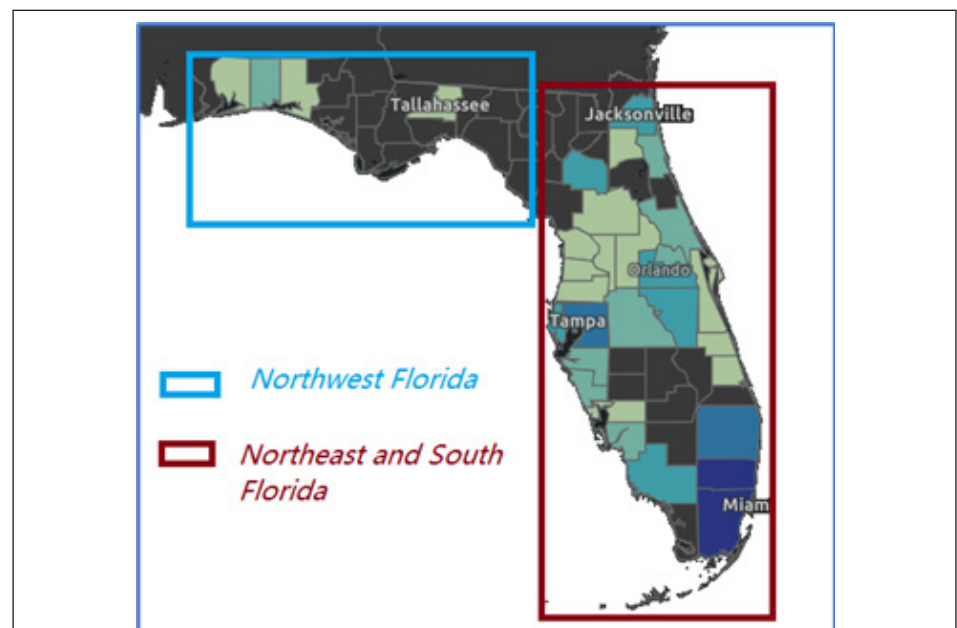


Figure 1: Geographic distributions of COVID-19 patients in different regions in Florida [1].

Analysis

In general, there are three important factors for virus spreading: the pathogen, the host and the route of transmission. Let's make a comprehensive assumption about the source of Covid-19. If the 63-year-old man in Manatee County of Florida is Patient Zero, we may need to consider whether Florida's native wildlife carries Covid-19. However, there is no evidence of a coronavirus origin in the continental United States. In the early days of the United States outbreak, the CDC ruled that no one should be tested without a history of travel or exposure of confirmed cases, probably leading to early cases not being detected. Additionally, until the state declared a state of emergency on March 10, more attention was paid to the outbreak of Covid-19 in Asia. However, some travel-related patients in Florida were related to travels from Europe. As is well-known, travelers flock to Florida for the sunshine every winter and spring. Travelers may have traveled to Europe in January or had

close contact with some coronavirus carriers. Then they became carriers themselves. They are likely to leave sources of the virus in restaurants, hotels and beach resorts, which may make it very difficult to accurately track if travelers have a history of traveling to Europe in a short period of time.

In the following analysis, we used recent data reported on March 23, 2020 to conduct statistical analysis of 1170 patients (1 patient was out of our consideration because of unknown residential and travel information) in Florida, as shown Table 1 & 2.

Table 1: The confirmed patient geographic distributions in two regions from data on data reported on March 23, 2020.

Region	Total	% in the State
Northwest Florida	35	2.99%
Northeast and South Florida	1135	97.01%

Table 2: Travel and non-travel related patients in each region from data on data reported on March 23, 2020.

Region	Travel related	Non-travel related	Travel Unknown	Total
Northwest Florida	22	8	5	35
	63%	23%	15%	100%
Northeast and South Florida	357	321	457	1135
	32%	28%	40%	100%

A. Northeast and South Florida region: The region has 97% of cases in Florida. Though it may cover 2/3 area of the whole state, the case quantity is more than the ratio of 2/3. 32% patients are travel related, which may be caused by the visitors to theme parks and beaches in northeast and south Florida. By referring to Florida population map [2], it shows that northeast and south region has a dense population distribution. Human-to-human transmission probability is higher than the low-population-density region in Northwest Florida. This is also why the area has a large number of patients with non-travel (28%) and unknown reason (40%). Therefore, the outbreak in coastal cities of south and northeast Florida may mainly due to the large visitors' flow rate and the high density of populations. As we can see, outbreaks across the United States have a common feature, which is that they first proliferate in large and densely populated cities at transportation hubs such as Los Angeles, San Francisco, San Diego, New York, etc. To control the outbreak and prevent it from continuing its explosive growth in Florida, the northeast and the south Florida region is the key area of concern.

B. Northwest Florida region: The number of patients this region in only accounts for 3% of that in Florida, only a small fraction of those in the Northeast and South Florida. This may due to low population density of northwest Florida, and the human-to-human transmission rate is low. Among those infected, 63% patients are travel related, and only 23% are confirmed non-travel related. By referring to the topographic map [3], most parts of the northwest Florida are covered by forests and farms. In general, tourists to northwest Florida are

much less than those to South Florida, and human traffic can be also lower than the coastal city. These characteristics may explain why the outbreak in northwest Florida appeared less severe than northeast and south Florida.

Hurricane Preparedness under COVID-19 Pandemic

Historically, more hurricanes have hit Florida than any other state in the US, with most landed in east Florida. Because most Florida populations are located along the coastal area [4], hurricane evacuation and sheltering may cause massive traffic flow and crowded shelters, which may cause the increase of infections. To address this issue, FEMA has provided a COVID-19 Pandemic Operational Guidance for the 2020 hurricane season [5]. It addresses a range of response and recovery considerations of emergency managers for addressing hurricanes and other natural disasters in the COVID environment. It outlines how FEMA plans to adapt response and recovery operations to the realities and risks of COVID-19. It allows emergency managers and officials to plan accordingly based on FEMA's operational posture and create a shared understanding of expectations between FEMA and state government prior to hurricane season.

Summary

The northeast and south Florida region consists of 97% of Florida COVID-19 patients, which is mainly due to the large number of visitors and relatively high-density populations. The northwest Florida region with low population density and fewer travelers than south Florida consists of only 3% of the total Florida patients, with 63% of patients are travel related. Monitoring and control

traffic flow in both roadways and airliners, especially in populated cities, may be a good measure for mitigating the disasters caused by the Covid-19 data. Under in the COVID environment, hurricane preparedness planning should be made by following FEMA's guidance.

Acknowledgement

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