

SAVED IN 5 MILES OR LESS

Assessing Access to Trauma Care for Shooting Victims on Chicago's South Side

Background

In 1988, the University of Chicago closed its adult level I trauma center. The center was one of the only trauma units serving south side residents, and its closure drastically decreased coverage in the city's southeast neighborhoods — creating what is now called a “trauma desert” (map on top left).

A level I trauma center is the only class of hospital that is equipped to handle the severity of injury from a gun wound. With gun violence in Chicago on the rise in recent years, activists have mobilized in demanding the University of Chicago to reopen its trauma unit. Their movement maintains that gun violence victims wounded more than 5 miles from a level I trauma center are more likely to experience longer ambulance transport times and higher rates of mortality than victims injured within the 5-mile radius. Their claims are substantiated by literature arguing that average transport times for victims shot outside of a trauma center's 5-mile radius are 16.6 minutes \pm 7.8 (vs. 10.3 \pm 6.5 minutes for victims within the 5-mile radius) and that mortality rates for victims outside 5-mile radius are 8.7% vs. 7% for victims within 5 miles.¹

In 2015, the University of Chicago announced it would partner with Mount Sinai to open a trauma center at Holy Cross Hospital by the end of 2018. The following project seeks to analyze the impact of the center on trauma coverage for the city's south side. First, I determine what percentage of shootings would be covered by the Holy Cross Center. Second, I perform a comparative network analysis on ambulance travel times before and after the center's opening.

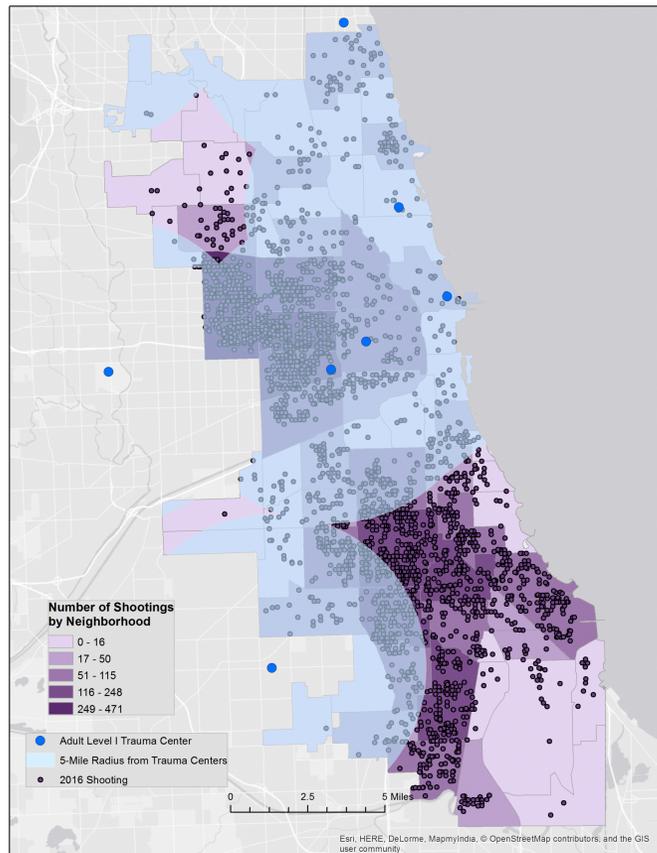
Methodology

I began by sourcing shooting data from the Chicago Tribune's crime database and joining this information with Chicago neighborhood polygons. I created a buffer two separate buffers— one dissolved buffer around 2016 trauma centers and one buffer around the Holy Cross Hospital. For maps on the left side, I employed the “select by location” between buffers and shooting locations to find the percent coverage (reported in results section).

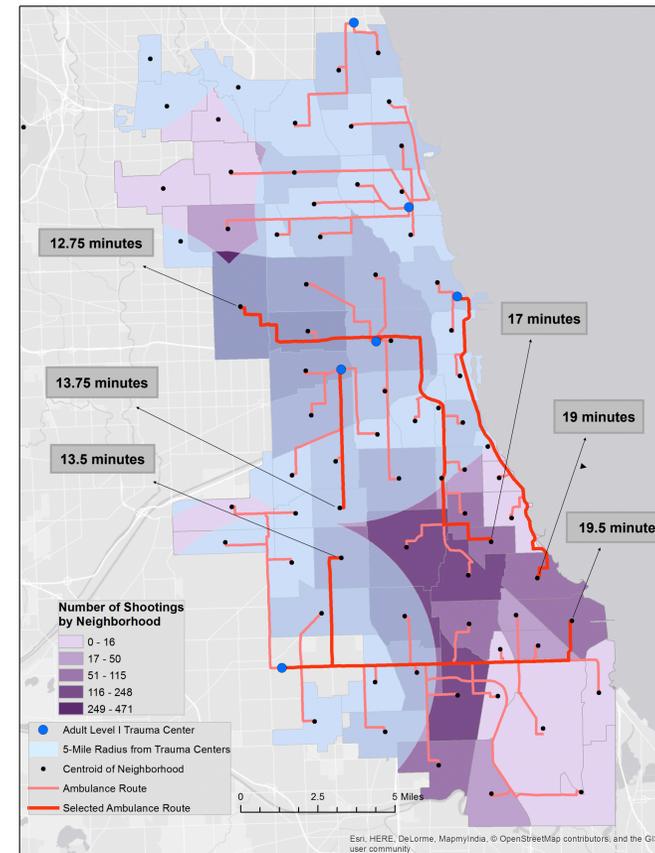
For the network analysis, I used a road network shapefile to construct possible routes from neighborhood centroids (calculated using each polygon's latitude/longitude data) and the hospitals. I ran two separate “Closest Facility” analyses based on travel time— one that included the Holy Cross Hospital and one that only included the 2016 trauma centers. The shapefile only had information on polygon line distances and corresponding speed limits. I approximated travel times by dividing distance (in miles) by the speed limit (in miles per hour). These calculations yielded a longer travel time for locations outside of a 5-mile radius, but transport times were shorter than expected and shorter than those reported in the study referenced above. To mitigate this issue, I added 5 minutes to each route's travel time, which gave averages very similar to those reported in the study.

I overlaid the analyses in one map (bottom right) to determine similarities and differences between travel time. Some times are reported directly on the map to give readers a sense of the relationships.

Trauma Coverage in 2016



Ambulance Routes from Neighborhoods in 2016



Results and Discussion

Results

Approximately 66% of shootings were covered within a 5-mile radius of the 2016 trauma centers. With the proposed Holy Cross center opening in 2018, roughly 84% of shootings would be covered. This represents a 18 percent increase in coverage for shootings, but it also leaves 16% of shootings underserved.

For the 2016 network analysis, the mean travel time from neighborhood centroids within a 5-mile radius of an existing trauma centers was 5.63 minutes. In contrast, the mean travel time for neighborhood centroids outside a 5-mile radius was 10.66 minutes. When accounting for the 5 minute addition to travel times, these figures became 10.63 minutes and 15.66 minutes respectively.

For the 2018 network analysis, an interesting piece of data was the reduction in travel time for neighborhood centroids whose routes were redirected to the proposed Holy Cross trauma center. When these neighborhoods were sent to 2016 trauma centers, they averaged an 8.87 minute travel time (or 13.87 when accounting for 5 minute addition). When directed to Holy Cross, however, they average a 4.58 minute travel time (or 9.58 minutes). This represents a 4.58 minute decrease in ambulance travel time.

Some neighborhoods were newly incorporated in Holy Cross's 5-mile radius, but they were not redirected to the center, indicating that their original route was still the fastest path to a hospital. In contrast, some neighborhoods outside of its radius found a quicker route to the new center. This data highlights the failure of the “5-mile radius” measure to fully predict increased access to trauma centers based on travel time.

Limitations

There are some errors in these analysis. Firstly, the ambulance travel times use distance and speed limits to make rough approximations of actual transport times. Information on traffic and travel speeds for ambulances (as opposed to citizen vehicles) would be helpful in better approximating these figures. Secondly, the network analysis ran ambulance routes from the centroids through common roads, which may or may not reflect actual ambulance itineraries. It is almost certain that ambulances exercise more flexibility in determining routes, which can positively or negatively influence time.

References

¹ Crandall, M., Sharp, D., Unger, E., Straus, D., Brasel, K., Hsia, R., & Esposito, T. (2013). Trauma Deserts: Distance From a Trauma Center, Transport Times, and Mortality From Gunshot Wounds in Chicago. *American Journal of Public Health*, 103(6), 1103–1109. <http://doi.org/10.2105/AJPH.2013.301223>

Data Sources

City of Chicago GIS Program; ESRI Data; Chicago Tribune Crime Database

Cartographic Information

Brian McGough

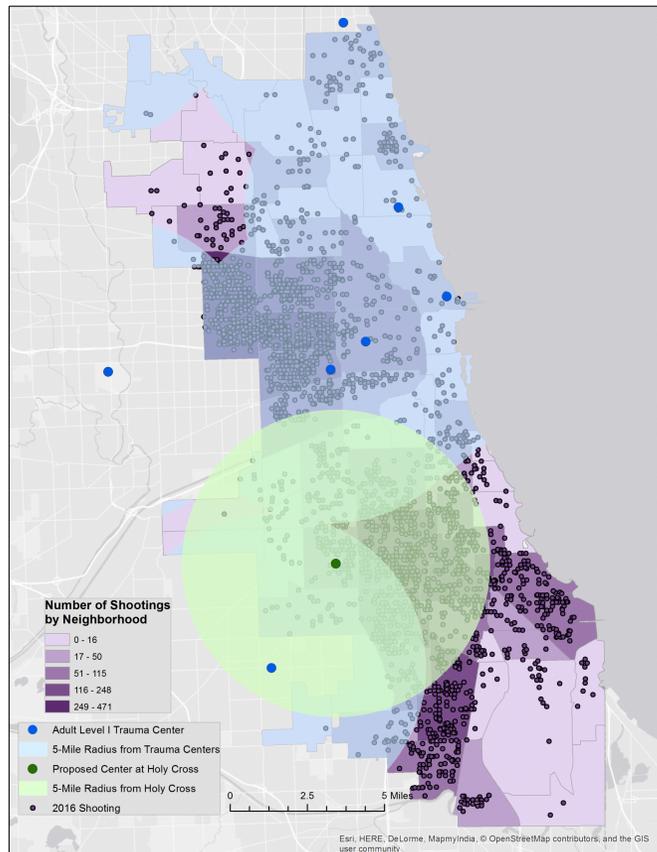
Introduction to GIS

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NAD 1983 StatePlane Illinois East

Transverse Mercator Projection

Trauma Coverage after Proposed Holy Cross Site



Ambulance Routes after Proposed Holy Cross Site

