Tucson Public Transportation and Healthcare Access: Healthcare Desierto

How Healthcare is Accessible to Those Who Rely on Public Transportation in the Urban Tucson Area

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Introduction

Transportation has often been a blockage when it comes to receiving healthcare access. People may not have ways to travel to things like doctors appointments or regular checkups, which can lead to them not getting the care that they need. The transportation issue is one that is understood in Tucson, as the Transit Choices Report from the Pima Association of Governments states that "ACS data suggest that nearly one in ten people in the Tucson region live in zero-vehicle households" (Pima Association of Government, 2018). And according to Data USA, as of 2023, approximately 15.8 thousand people in Tucson, Arizona do not own a vehicle (Data USA, n.d.). Because of this, it is imperative that there is a grasp on how this issue affects the residents of Tucson when it comes to their ability to access transportation to reach something as critical as healthcare. The purpose of this research and analysis is to determine whether the free public transportation that is currently available in Tucson is effective in helping citizens reach healthcare facilities. This report will continue with our literature review where we will discuss existing research, our methodology where we expand on how our research was conducted, our findings and results, a discussion of them where we will interpret and contextualize our results, and will conclude with key findings.

Literature Review

Part of our research included informing ourselves on the current understanding of how transportation affects healthcare access. We read and searched for these articles as it related to the US and Tucson specifically, and found that "in 2017, 5.8 million persons in the United States (1.8%) delayed medical care because they did not have transportation" (Wolfe et al., 2020, 815). This same study also found that "Hispanic people, those living below the poverty threshold, Medicaid recipients, and people with a functional limitation had greater odds of reporting a transportation barrier" (Wolfe et al., 2020, 815). This study used different analyses to find trends and correlations between these factors and transportation barriers, and noted significant issues among certain groups. We also looked at how non-emergency medical transportation (NEMT) services may affect healthcare access and found that there are a few different providers in the Tucson area such as HealthLift NEMT of Arizona, Uber Health, Southwest NEMT, and the Pascua Yaqui Tribe Transportation Program. A report by the Medicaid and CHIP Payment and Access Commission found that in groups who have, or are caring for someone with medical needs, they noted that "most participants use NEMT at least weekly, and some use it daily. A few participants use NEMT infrequently" (Medicaid and CHIP Payment and Access Commission, 2021). Many other articles agreed that transportation is a barrier when it comes to healthcare access, but there were not any that were focused on the urban Tucson area. However, reading these articles helped us understand how acknowledged this issue is not only in Tucson, but in the United States as a whole.

Methodology

For our research, we gathered data from publicly available records published online by Pima county, the City of Tucson, as well as utilizing Google Maps APIs. The datasets that were used for our analysis included datasets about buildings with addresses and permit activity, zip codes, SunTran bus stops, and building unit identification for address and permit activity. With these datasets, we were able to gather information about healthcare facility locations and identify where bus stops and routes are. The majority of our data is qualitative, as we mainly looked at coordinates, zip codes, and data about the bus stops and routes. Their proximity to healthcare facilities in regards to walking time and distance however, are quantitative. This data is relevant for our research as it allowed us to find where healthcare facilities are located, and areas where the public bus goes. Understanding this was necessary to answer our research question and determine the effectiveness of public transportation and healthcare accessibility.

To prepare the data for our analysis, we cleaned it by removing unnecessary columns and empty rows. Any columns that were irrelevant to geographic location or indicated that explicitly stated a specific building was not used for healthcare purposes were removed. To actually create our visualizations, we used Python and R and used several different libraries and packages such as GeoPy, MatPlotLib, json, requests, time, openpyxl, itertools, tidyverse, dplyr, ggplot2, and Pandas. Other necessary tools that were used was the Google Maps API as it gathered facility, ZIP code, and building information. All of these tools were utilized as they aided in effectively cleaning the data and in extracting what parts of the data were needed. They also helped in creating our visualizations and ensuring that they are interpretable.

The initial healthcare facility data was retrieved using the Google Places API with a keyword-based search centered on Tucson, Arizona. A filtering function retained only facilities listed as “OPERATIONAL” according to Google, and duplicate entries were removed based on identical place id values and location coordinates.

After the initial facility data was collected and cleaned, the dataset was exported to a spreadsheet for manual review. Facilities were reviewed individually and either retained or flagged for removal based on their classification. Facilities not related to hospital or primary care services were manually highlighted for exclusion.

Each facility was then categorized using color-coded highlights: facilities marked in blue were designated as primary care, and those in orange were marked as hospitals. A custom function was created to read the Excel worksheet, detect the highlight color of each row, and return a final filtered dataset containing only the categorized facilities. This step ensured the dataset reflected only the two targeted types of healthcare services.

The cleaned facility list was saved to a CSV and manually reviewed to exclude locations that were not hospitals or primary care facilities, which were the focus of this analysis. Additional facility details were then retrieved using a second Google API call to enrich each entry with attributes such as address, phone number, and business hours.

To assess public transportation access, walking distances from each facility to the nearest bus stop were calculated using the Google Distance Matrix API, while straight-line (Haversine) distances were also computed for reference. Each facility was matched to its closest bus stop, and accessibility was defined as being within 1,312 feet (1/4 mile).

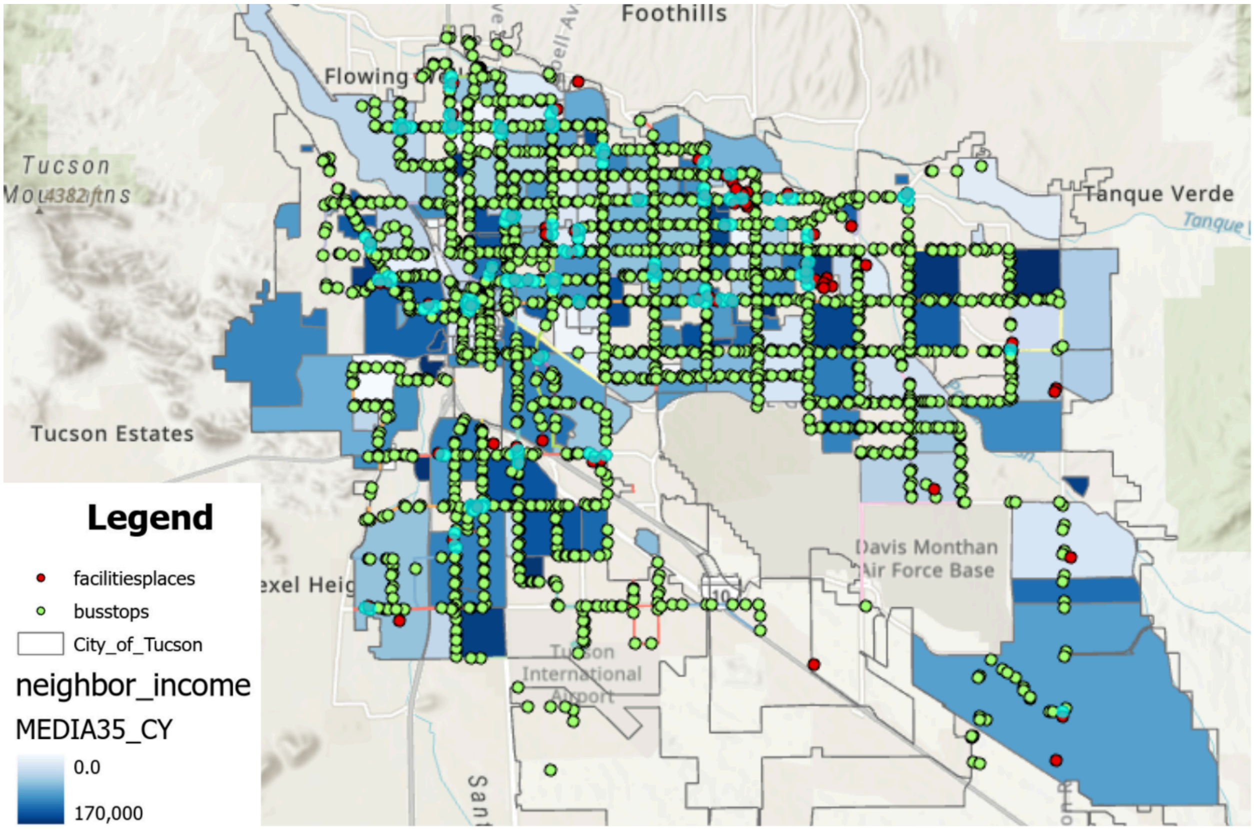
The cleaned and enriched facility data was merged with cleaned bus stop data and saved to a CSV. From this combined dataset, summary statistics were calculated and exported for use in visualizations created in RStudio, including a stacked bar chart, pie chart, and a summary statistics table.

For the heatmaps, the datasets about the Sun Tran Bus Stops from Tucson Open Data and ZIP codes were read into Python and cleaned with the Pandas library. The ZIP code dataset was cleaned by dropping every row whose city was not listed as Tucson. For the Sun Tran dataset, unnecessary columns were dropped, as well as the last two rows, that did not have any values for the latitude and longitude columns, and are necessary components to create the heatmap. Using the Google Maps API, these coordinates were converted to find the ZIP codes of each bus stop. Five ZIP codes were unable to be located by the API, so these were checked manually by looking up the coordinates on Google Maps. To ensure that all bus stops were only in Tucson, these ZIP codes were compared against the ones from the ZIP code dataset. The frequency of each ZIP code was calculated and made into a heatmap using MatPlotLib. The second heatmap was created by using the Google Maps API and writing some HTML to display the ZIP code boundaries, bus stops, and the location of the healthcare facilities.

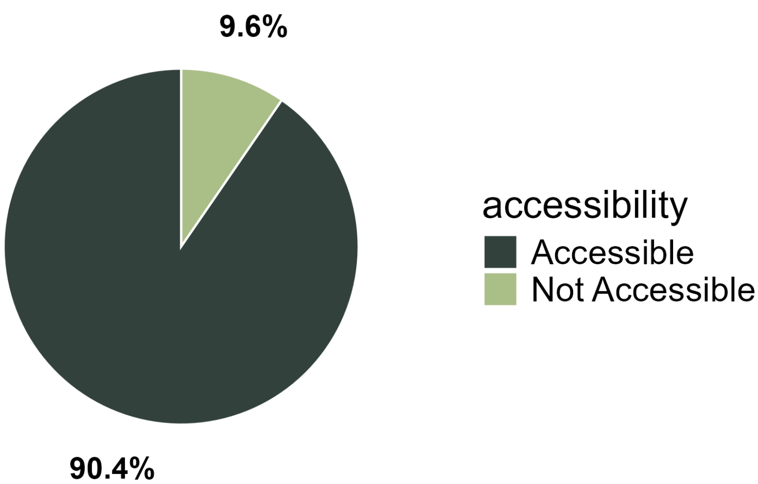
Findings/Results

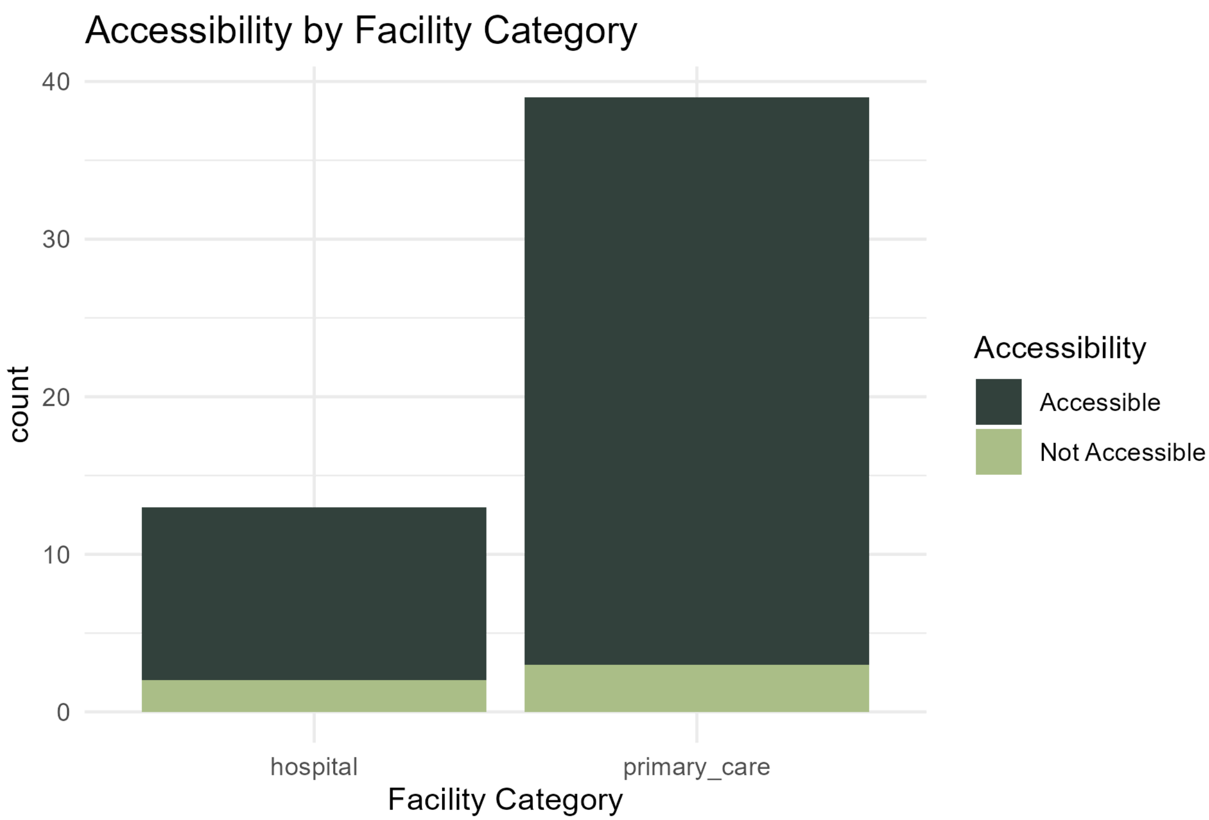
After calculating the summary statistics, we found the percentage of accessibility to healthcare facilities by bus was 90.4%. In total there were 5 healthcare facilities, 4 hospitals and 1 primary care facility, that were located farther than the accepted threshold. The hospital facility that was farthest away from a bus stop was Carondelet St. Raphael's Emergency Center, which was located approximately 7,440 feet away from the nearest bus stop. The primary care facility that was the farthest away from a bus stop was Tucson Family Care, located approximately 2,572 feet.

Through our analysis, we were also able to find that one of the sparser areas included the Southwest region of Tucson. This area has less bus stops and healthcare facilities compared to other regions. Specifically in the 85713, 85745, 85757, and 85746 ZIP codes, which is where South Tucson, Drexel Heights, and Valencia West are located.



Overall Healthcare Accessibility by Bus




Accessibility by Facility Category
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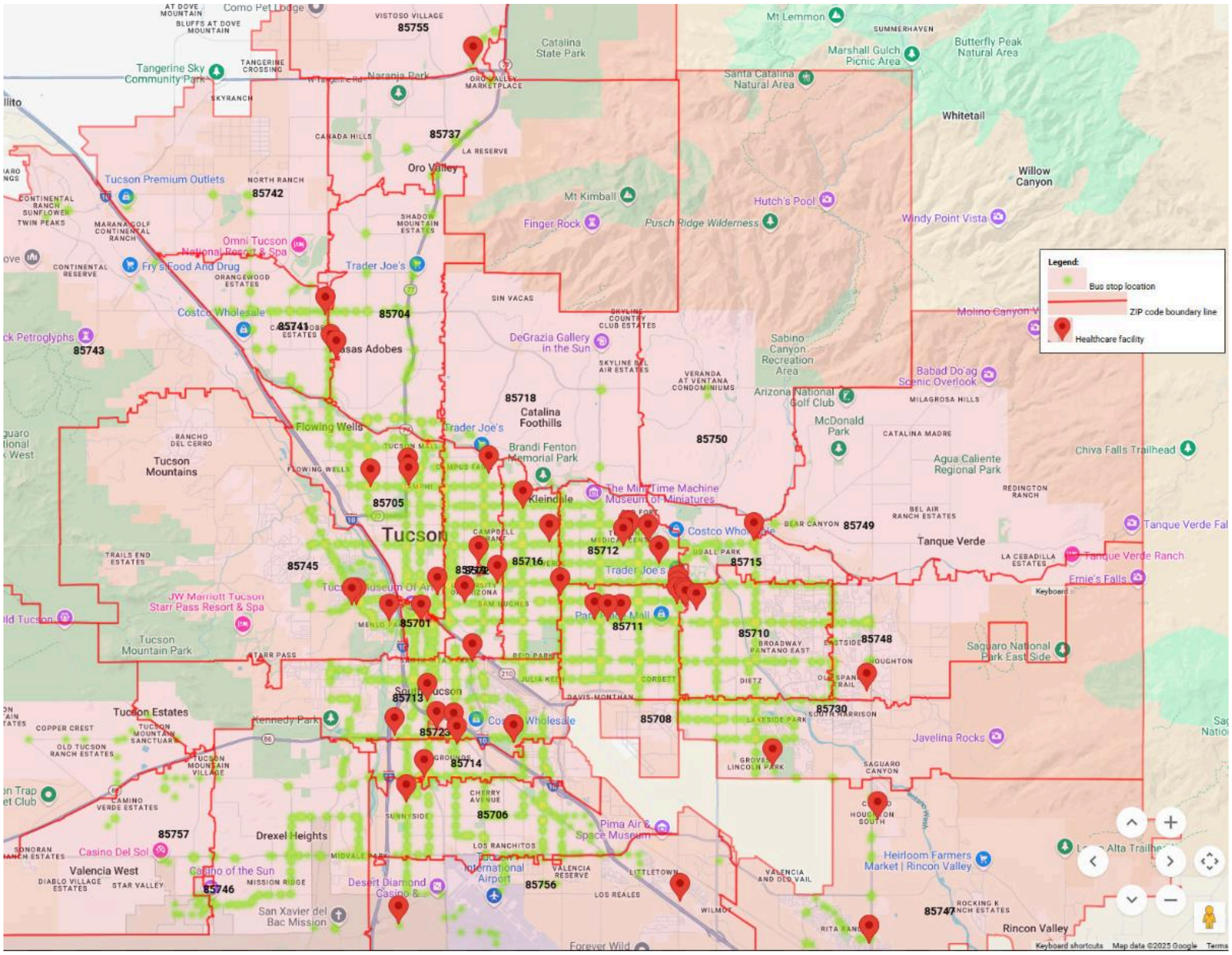

Discussion

Based on our findings, the overall accessibility of transportation to healthcare facilities is positive, meaning there seems to be sufficient transportation to the majority of Tucson citizens. Our findings show that the overall accessibility is rather high in Tucson, with primary care having a higher accessibility than hospitals. According to an informal conversation with a representative from Sun Tran, bus stop locations and routes are reevaluated every 6-12 months based on several factors, such as trends the city notices, feedback from the community, etc. It is also important to note that this representative highlighted that transportation via city bus requires planning. as travel times take longer than they would by car because of construction and indirect routes which lead riders typically needing to take more than one bus to get to their destination. While our current findings show that there is a high accessibility, these insights suggest that access to healthcare facilities may change over time.

Conclusion

In our research to determine accessibility of healthcare facilities via public transportation, we found that while the overall accessibility and distribution of public transportation to healthcare facilities is high, knowing that bus routes and stops can change in the future means those reliant on public transportation must be vigilant about any changes to their routes. These changes highlight that Sun Tran and the City of Tucson must continue to work together to listen to the needs of their residents, and ensure that access to healthcare facilities remains equitable and reliable as Tucson continues to grow.

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