BARRIERS TO DENTAL CARE FOR CHILDREN WITH MEDICAL ASSISTANCE

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ABSTRACT

Disparities in access to dental care between children with private dental insurance and children with Medical Assistance (MA) exist. This was highlighted in the 2000 Surgeon General's report on Oral Health, and there have been efforts to get more children with MA to the dentist yearly. Since 2009 Medicaid and CHIP are required to provide dental insurance to children enrolled in their plans. This has raised the rates of children with MA who see a dentist each year from 36% to ~50%. This is well below the ~90% of children with private dental insurance who see a dentist yearly. This raises the question: why does this disparity exist when children with MA have dental insurance? This study sought to determine if secret shopper surveys and geospatial analysis could be utilized to determine barriers to dental care for children with MA.

Ninety-eight dental practices in Allegheny County were identified as accepting MA, providing access to 205 dentists and 6,839.5 hours of availability each week. Many of these dental practices had incorrect information on Managed Care Organization websites, and some dental practices actively limit when children with MA can be seen.

This study also sought to determine if access by proximity is a barrier. A geospatial analysis was used to determine if children have access to care based on a distance of 15 miles, or 30-minute drive or transit time. This analysis showed that if children rely on public transportation to see a dentist, then children in certain zip codes throughout the county do not have adequate access. An analysis of how dentists and hours would need to be redistributed

throughout the county to provide equal access showed that the zip codes with the most children with MA have access to the least number of dentists and hours needed. This was by distance, drive, and transit times.

The public health importance of this study is that secret shopper and geospatial analysis can be used to identify potential barriers to dental care. It identified that proximity may be one of the biggest limiting factors, especially for children who rely on public transportation.

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PREFACE

Throughout this paper the phrase Medical Assistance is frequently used. When encountering this phrase, the reader should note that Medical Assistance encompasses all types of public option dental insurance for children <19 years of age. These include dental plans provided by all Managed Care Organizations operating in Allegheny County in 2017 as well dental plans provided through the Children's Health Insurance Program. Data were collected and analyzed with this generalization in mind, and no distinction is made when looking at the numbers of children in each zip code in Allegheny County and the type of public insurance they utilize.

I would like to thank Erika Fricke and Allies for Children. Without them this project would not have been possible, through their work children in Allegheny County have a more equitable chance in life.

1.0 INTRODUCTION

Humans have practiced dental care in some form for millennia. There is evidence that somewhere between 6,500 and 5,000 B.C humans began to perform dental procedures on those in need (American Dental Association 2019; Oxilia et al 2015). Most of this dental work was likely rudimentary by today's standards, but even in these earlier times it was recognized that when someone is suffering from dental discomfort it should be addressed. Since this time efforts have been made across the globe to fix dental problems. From the early days of dental exploration, the field of dentistry grew until in 1840 the first formal school of dentistry was founded in Baltimore, MD (Otto 2017). There were efforts in these first years to integrate oral health into the larger medical field, and to make oral health part of the educational process for all clinicians (Otto 2017). These efforts failed, and since the mid-1800s oral health and dental hygiene have been separate from other areas of medicine.

The early separation that kept dental practitioners from the rest of medicine continues today. It has shaped the way that insurance is provided and has molded the way that dentists are educated and the skills that they learn. It has also directly impacted how they go into practice and the decisions they make about where to have offices and what types of patients to see. For most dentists there is no option of joining an established practice or working in a facility comparable to a hospital. Dentists must find the funding to open a practice and become established, which directly impacts the insurances that dentists accept and subsequently who can

seek care at their practices. In many parts of the United States this process has created areas that have few, or in some instances no dentists (Health Resources and Services Administration 2019). These "dental deserts" are not confined to rural areas of the country or to urban areas. In Pennsylvania alone there are currently 166 dental shortage areas affecting more than two million people (Henry J Kaiser Family Health Foundation 2018). They can happen anywhere, sometimes even when a practicing dentist is close by but does not accept the dental insurance that someone has. In Allegheny County alone 12 areas are designated as dental health professional shortage areas by the Health Resources and Services Administration (Health Resources and Services Administration 2019).

There have long been disparities in access to and utilization of preventative care between individuals who receive their insurance through a public option, like Medical Assistance, and individuals who receive their insurance through the private insurance market. One group for whom these disparities are particularly broad is among children who utilize Medical Assistance for their dental insurance (Lave 2010; Mouradian et al. 2000; U.S. Department of Health and Human Services 2000; U.S Government Accountability Office 2010). Some chronic diseases are associated with poor oral hygiene (Edelstein and Ng 2015; Kassenbaum et al. 2017; Mouradiam et al. 2000; Oluwagbemigun et al. 2015; Ricardo et al. 2015), and disparities in access to dental care in childhood may be one of the reasons for disparities observed in chronic diseases in adulthood. Until the reasons for these disparities can be determined, policy changes cannot be implemented to address and eliminate these gaps in preventative care access and utilization.

This study was conducted to determine what barriers to dental care exist for children with Medical Assistance and if they are a cause of disparities observed in access to and utilization of preventative dental care. To do this secret shopper surveys were conducted to determine the

accuracy of Managed Care Organization databases and to quantify the number of dental practices, dentists, and hours of availability for children who utilize Medical Assistance. This information was utilized for a geospatial analysis to calculate true accessibility to Medical Assistance accepting dental practices, for children in Allegheny County who utilize Medical Assistance, based on distance, drive time, and public transit time from where the children live throughout the county. Finally, a what-if-analysis was performed using the true accessibility to elucidate how dentists and hours of availability would have to be redistributed throughout the county to provide equal dental access to children who use Medical Assistance.

2.0 BACKGROUND

For most of human existence dental care was done to simply rid someone of the pain that dental caries causes. A tooth was extracted, a glass bead was inserted into a hole in a tooth, or some type of metal was used to fill the carie and the problem was solved (ADA 2019; Oxilia et al 2015). This has changed in recent decades; a growing body of evidence now suggests a link between poor oral hygiene and chronic disease. This includes coronary artery disease, arthritis, and some forms of cancer to name a few (Edelstein and Ng 2015; Kassenbaum et al. 2017; Mouradiam et al. 2000; Oluwagbemigun et al. 2015; Ricardo et al. 2015). Evidence also suggests that if oral health is poor enough it can lead to an increase in mortality (Kassenbaum et al. 2017). While many of these diseases become problematic in adulthood, there is now evidence that the foundations for these diseases begin when someone is a child, and particularly children with poor oral health (Edelstein and Ng 2015; Mouradiam et al. 2000; Ricardo et al. 2015). One of the larger public health problems in our country is that children living in the lowest socio-economic class are those with the highest likelihood of having poor oral health (Mouradian et al. 2000; U.S. Department of Health and Human Services 2000; U.S Government Accountability Office 2010). In many cases health disparities seen in childhood turn into health disparities observed in adulthood.

The history of dental care being excluded from general medicine has led to oral health services being underutilized, even in modern times. Historically, public option insurance plans

did not cover dental services. It was not until the Surgeon General Report on the State of Oral Health in the United States was released in 2000 that this began to change (U.S. Department of Health and Human Services 2000). Many private and work sponsored insurance included dental care at this point, but government sponsored health insurance did not cover dental care when this report was released (U.S. Department of Health and Human Services 2000; U.S Government Accountability Office 2010). In 2000 when the first oral health report was issued, roughly 23.2% of children with Medical Assistance received preventative dental services each year (Steinmetz et al. 2014).

In 2009 the government decided to make a change and started requiring the States Children Health Insurance Program and pediatric Medicaid plans to provide dental coverage for enrollees (U.S Government Accountability Office 2010). This has had the impact of increased rates of children who see a dentist each year, and children with Medical Assistance now see a dentist each year at a rate of almost 50% (Healthy People 2019; NCQA 2019). Even though the number of children who have Medical Assistance and see a dentist each year has continued to increase, the rates of dental visits for children with Medical Assistance are still well below the rates of children with private insurance who see a dentist each year (CDC 2017; Healthy People 2019). This indicates that children with Medical Assistance may face barriers to dental care that children with private dental insurance do not. The questions remain, what are those barriers, and what can be done to remove them?

In a study conducted by RAND in 2013, Allegheny County, Pennsylvania, was found to have one of the highest numbers of dentists per capita in the state (Baird et al. 2016). It not only has a high number of general dentists, but also has one of the highest rates per capita of pediatric dentists who accept Medicaid (Baird et al. 2016). However, even with this high number of

Medicaid accepting pediatric dentists, a report published online by the Pennsylvania Medicaid Policy Center at the University of Pittsburgh Graduate School of Public Health in 2010 found that in 2009 only 42.8% of children enrolled in Medical Assistance had an annual dental visit (Lave 2010). This is slightly above the numbers reported in a 2016 report from Centers for Medicare and Medicaid Services (CMS) that used a baseline value in 2011 of only 36% of Medicaid enrollees aged 1-20 enrolled for 90 consecutive days who received a preventative dental visit (CMS 2016). These numbers have been increasing each year and in 2015, the last year that was reported, the percentage of Medicaid enrollees aged 1-20 with 90 days of consecutive enrollment who saw a dentist for a preventative visit stood at 44% (CMS 2016).

The goal for Pennsylvania by 2018 was set at 46%, but this is still below the national average observed in 2017 that ranged from 41.8% for children aged 2-3 to 66.5% of children aged 7-10 (NCQA 2019). It is difficult to determine the exact number of children who had a dental visit in 2017, but the five-year average of children with Medical Assistance, from 2013-2017, shows that 66,967 children in Allegheny were utilizing Medical Assistance (IPUMS 2019). If 46%, the 2018 target for dental visits, is applied to the number of children in the county last year with Medical Assistance, it would mean that there were still potentially 36,163 children in Allegheny County with Medical Assistance who did not see a dentist in 2018.

Compare this to a 2015 Centers for Disease Control and Prevention (CDC 2017) survey that found that 84.7% of children with private insurance had a dental visit in the last year. The number of children under 21 in Allegheny County in 2017 was 142,559. Subtracting the number of children receiving Medical Assistance from the total population of children in the county in 2017, approximately 75,572 children in the county are on private insurance. If Allegheny County follows the average that the CDC found for the percent of children on private insurance

that have been to the dentist in the past year, only 11,563 children in this group did not receive dental services last year. That equates to more than three times the number children not receiving dental care when utilizing state sponsored dental insurance compared to children on private insurance.

As of today, the real reasons have not been identified why children with Medical Assistance are not getting the preventative services that are so vital, not only to their health and wellbeing now but for the rest of their lives. While previous studies have suggested that Allegheny County as a whole has sufficient dentists who accept Medical Assistance to cover the pediatric population that utilizes Medical Assistance, to the author's knowledge there has never been a study that has set out to determine what access to these Medical Assistance accepting dentists looks like for the children who need their services and what barriers exist when these children seek preventative care. This study set out to determine if secret shopper methodologies combined with a geospatial analysis identifying locations of Medical Assistance accepting dental practices relative to the population of pediatric Medical Assistance enrollees could be utilized to determine what true access to dental care looks like in the county and what some of the barriers are to accessing this care.

3.0 METHODS OF DATA COLLECTION AND ANALYSIS

Two separate and connected methods were employed to determine access and barriers to dental care for pediatric population utilizing Medical Assistance. The first method was a secret shopper survey performed to determine the accuracy of information retrieved from the websites of MCOs that service Allegheny County. This information was also used to quantify the number of dental practices, number of dentists, and hours of availability for children with Medical Assistance to be seen by a dentist. The second method was a geospatial analysis performed to determine what the true access is to these dental practices based off Medical Assistance enrollment across the county relative to these dental practices based on distance, drive time, and transit time.

3.1 SECRET SHOPPER SURVEY

Secret shopper surveys are a tool that have been used to determine what patient populations are experiencing when looking for care and to determine the accuracy of information that is available to the public (Bond et al. 2017; Chaudhry et al. 2012, Gould and Kuo 2003; Haeder et al. 2016; Polsky et al. 2015). The information collected through these surveys provides an honest and accurate accounting of the extent and capacity of provider networks. This is especially true for looking at adequacy of networks that provide for individuals who utilize Medical Assistance. If you identify yourself as someone who is collecting information for a

study the person you are talking to might provide information that they think you want to hear, and not the information that they would provide to a patient that is calling for an appointment. Using secret shopper surveys allows for not only accurate data collection, but an insight to challenges that patients face that cannot be identified in another manner. For this secret shopper survey, only dental practices that were listed as serving pediatric patients, could be found in the databases of MCOs serving Allegheny County, and were located in Allegheny County, were surveyed. To find these dental practices the dental provider databases of UPMC for You, Gateway Health Plan, Aetna Better Health of Pennsylvania, and United Healthcare were searched in May and June of 2017. The search parameters used were used as follows: Pittsburgh as the city, 50 miles as the proximity, and pediatric as the type of dentist. To ensure that all practices were surveyed no distinction was made between dentists who were currently accepting patients and those listed as not accepting new patients. Of note, the search engines on all the MOC websites have changed since these searches were performed. They same type of search can be performed; however, there could be slight differences in how to enter information to retrieve the same results. Also, since this survey was done in 2017 it is likely the number of dentists accepting Medical Assistance has changed, since United Healthcare no longer operates in Allegheny County and has been replaced by AmeriHealth Caritas. This could also have an impact on the dentists found conducting this same search.

Provider information from all practices was entered into a single database to ensure that there was no duplication in the dentists surveyed. The information stored in this database included, the address of the dental practice, the MCO website(s) that the information was found on (up to all four MCOs), the phone number in each of the MCO databases the provider was listed in, the days and hours of operation listed on each database if available, the dentists who

were listed as working at the practice, the name of the practice, and if listed, what type of dental practice they were. The type of dental practice was included to ensure that even practices that specialized, such as orthodontics or oral surgery, were questioned about any other type of dental services that they might provide so no providers of general dentistry were missed.

The information collected was used to make the secret shopper phone calls in July and August 2017; all calls were made by Kevin Stoner during the hours listed for the practice's hours of operation. Calls were made Monday through Friday as no practices were listed as being open only on Saturday. If a practice did not have hours of operation listed, and no hours could be found through internet searches, the practice was contacted on multiple days of the week and at various times between the hours of 10:00 a.m. and 2:00 p.m. Practices were contacted up to five times on different days of the week and at varying times. If no contact was made during these five calls, the practice was marked as "unable to contact" and no further attempts were made to collect information.

In making the calls, the following method was used for consistency and accuracy of information collection. When the calls were answered the caller identified himself as the parent of a seven-year-old who was looking for a new dental practice. The caller then said that they were in the process of getting new Medicaid insurance and asked what types of insurance that they accepted. The next question was if they were accepting new patients; this question was not asked before this point to ensure collection of dental insurance acceptance information. Practices were then questioned about what days of the week and hours they were open. Next, they were asked how long it would be until the caller's child would be able to be seen. And finally, they were asked if there was a limitation of days or hours that the child could be seen since they have Medical Assistance for their dental insurance.

3.1.1 Collection and Interoperation of Survey Data

For standardization of survey data, collection forms were prepared prior to calls being made. These forms contained the practice name and phone number, the days and hours of operation if known, what MCO databases the practice was found in, space to record the dates and times each of the practices were called, space to record if they are accepting new patients and how long until the child could be seen, a section to record the days and hours of operation, space to note if there were appointment restrictions, and space to write notes on anything that might have been pertinent to the call.

Information collected from these calls was entered into the same database as the practice information. This information was then used to determine the accuracy of the MCO provider databases and how many dental practices and dentists in Allegheny County serve the pediatric Medical Assistance utilizing population. This information was also used to quantify the availability of these providers by the number of hours and days of the week that they are open. The information on which providers accept Medical Assistance, how many dentists are at these practices and the hours of operation at these practices was then used to determine accuracy of MCO databases and for the second part of the analysis. For determining the accuracy of the MCO databases the information was compared to what was originally found from each of the four organizations' websites; differences in information were noted.

3.2 GEOSPATIAL ANALYSIS

Simply determining the days and hours of operation does not provide a full understanding of what true access to care is for children with Medical Assistance in Allegheny County. To do this a geospatial analysis was performed to determine how accessible Medical Assistance accepting dental practices are to the children who live in Allegheny County and utilize this type of dental insurance. For this analysis several steps were performed, in order to ensure that the information was accurate and consistent.

3.2.1 Collection of Distance, Drive Times, and Transit Times

The first step was to determine the distance, drive time and transit time to each of the Medical Assistance accepting dental practices from each of the zip codes in Allegheny County. The first part of this process was to determine the geo-centroid for 100 of the unique zip codes in the county. The latitude and longitude of each of these zip codes was obtained from GitHubGist.com (GitHubGist 2013) and were reverse geocoded using LatLong.net (LatLong.net 2018) to determine the corresponding address of these latitudes and longitudes. Once the address for the geo-centroids was obtained, Google Maps (Google Maps 2018) was utilized to obtain the distance, drive times, and transit times between each geocentroid and each of the Medical Assistance accepting dental practices. This information was collected from September to December 2018. To ensure consistency of this information the distance, drive, and transit times were collected after 8:00 p.m. Monday-Friday. If there was an accident or road closure that affected the drive time, that address combination was skipped and returned to later. Also, an assumption was made that if a parent utilizes Medical Assistance for their child's dental

insurance, they are less likely to drive on a toll road when another route is available. When drive time measurements were collected, routes with a toll were not utilized and the next fastest route without a toll was used to determine the distance and drive time for that address combination.

Once collected, this information was entered into an excel database; 100 zip codes and 98 dental practices were entered resulting in 9,800 unique address combinations. This information was checked to ensure that there was not a travel time that seemed too short or long in relation to distance. When a travel time was found to be too short or long, this information was checked again, under the same parameters, to determine if a mistake had been made when capturing the information. This information was then updated in the database before further analysis was done.

3.2.2 Determining access to dental care

There were several steps in determining what access to dental care really is for children with Medical Assistance in Allegheny County. As mentioned above it is not enough to simply calculate the hours of availability, the next step was to determine the proximity for patients who will utilize the care. For this part of the study the distance, drive and transit times were utilized, in conjunction with the number of dentists and hours of operation, and with the number of children utilizing some type of Medical Assistance. The number of children utilizing Medical Assistance was retrieved form IPUMS NHGIS (IPMUS).

The information about distance, drive time, and transit time was separated into three Microsoft Excel files. These files were constructed so one column consisted of 100 zip codes over 100 rows, the second column was the address of the geocentroid of each of the zip codes, and the remaining 98 columns were the 98 dental practices that accept Medical Assistance that

are located in Allegheny County. The information from each of the matched pairs was entered into these files, resulting in a file matrix with 9,800 distances between each of the zip code geocentroids and each dental practice, a file matrix with the 9,800 drive times between each of the geocentroids and each of the dental practices, and a file matrix with the 9,800 transit times between each of the geocentroids and each of the dental practices.

To determine access, it was decided that a distance of 15 miles should be used when looking at this parameter, and that 30 minutes was an appropriate threshold when looking at drive time or transit time. Each of the Excel file matrixes weas weighted binomially based on the distance, drive time, or transit time. The distance matrix was weighted so the distances from a matched pair that were 15 miles or less were weighted as 1, or available to that zip code, and each of the matched pairs that were over 15 miles were weighted as 0, or unavailable to that zip code. The same was done for the drive matrix and transit matrix, but there was a value of 30 minutes used. This weighting was done using the following module in excel:

```
Sub FindReplace()
'Update 20150423
Dim Rng As Range
Dim WorkRng As Range
On Error Resume Next
xTitleId = "KutoolsforExcel"
Set WorkRng = Application.Selection
Set WorkRng = Application.InputBox("Range", xTitleId, WorkRng.Address, Type:=8)
For Each Rng In WorkRng
   If Rng.Value < or > x Then
      Rng.Value = 0 or 1
   End If
Next
End Sub
```

where < and an x value of 15.1 was used in combination with 1, and > and an x value of 15 was used in combination with 0. This was the same method used for the drive and transit files with x values of < 31 and > 30.

This weighting provided matrixes for each of the parameters; distance, drive and transit times consisting of only 0s and 1s. To determine the number of dentists and the number of appointment hours available to each of the zip codes Excel was also used. Each of the weighted matrixes was saved twice, one file for the number of dentists and one file for the number of hours. In each of these files a row was inserted below each of the weighted rows that consisted of the available number of dentists at each of the dental practices in the dentist file and the available number of hours available at each of the dental practices for the hours file. The weighting information was then used to keep the information for that practice if there was a 1 or replace the information with 0 there was a weighting of 0. This created six matrixes that had values remaining for each of the zip codes only when they were below the threshold and weighted as 1. The total number of available dentists and the total number of available hours were then tallied for each of the zip codes.

3.2.3 Modeling what dentist distribution should be

The second part of the geospatial analysis was to determine what dentist distribution would look like if Medical Assistance accepting dentists in Allegheny County were distributed equally to provide equal access to the children they serve. For this "what if" analysis, calculations were done to determine number of dentists and number of hours that would need to be available to, or moved away from, each of the zip codes relative to the number of children with Medical Assistance.

This was done by first determining the total number of dentists and the aggregate number of hours available to the children across the county. This number was calculated by adding total number of dentists or total number of hours available to each of the zip codes. These numbers exceed the number of dentists or hours since the same practice can be available from multiple zip codes and would be counted multiple times since they are accessible to each of the zip codes. The number of children living in each of the zip codes was divided by the total number of children with Medical Assistance living in the county. This provided the proportion of children living in each of the zip codes. The total number of available dentists and hours was multiplied by this proportion to determine what the expected number of dentists or hours would be if the children in each zip code were afforded equal access. The expected numbers were subtracted from the observed numbers to determine the overage or deficiency of dentists or hours available to children in each of the zip codes. What resulted were six sets of numbers, one with the overage or deficiency of number of dentists needed based on distance being less than 15 miles, then a similar redistribution based off number of hours. This was repeated with the drive time being less than 30 minutes and the transit time being less than 30 minutes. When there were too many dentists or hours in a zip code, this resulted in a positive value proportional to the overage of either of these parameters. When there were too few dentists or hours in a zip code, the result was a negative value proportional to how many dentists or hours would need to become available in a particular zip code for the children living there to have equal access.

3.3 STATISTICAL ANALYSIS

To determine if there were significantly too many or too few dentists or hours available to the children that utilize Medical Assistance in the county, a chi squared analysis was done based on the number of available number of dentists or hours compared to the expected number of dentists or hours and proportional to the number of children with Medical Assistance living in each of the zip codes. A p-value of 0.05 or lower was considered significant. The mean squared deviation was calculated for number of dentists and number of hours based on distance, drive time, and transit time using the following equation:

$$MSD = \sum_{i=1}^{N} p_i \frac{(access_i - equal_i)^2}{equal_i}$$

where p_i is the proportion of all children in the county with Medical Assistance in a zip code, $access_i$ is the available number of dentists or hours to a zip code, and $equal_i$ is the expected number of dentists or hours if access was equal to all children with Medical Assistance in the county.

4.0 RESULTS

4.1 SECRET SHOPPER DATA

According to the databases for the MCOs operating in Allegheny County, as of 2017, 227 dental practices were identified as being in Allegheny County and accepting at least one type of Medical Assistance. The managed care plans offered at the time of the time of data collection were provided by UPMC, United Healthcare, Gateway Health, and Aetna. Provider practices were included in the survey regardless if they were listed as a general practice, a practice that specializes in something like surgery or orthodontics or had no listing in the databases. This was to ensure that all the general dental practices in the county were included and to identify any inaccurate information on how a provider is listed on the MCO websites.

Contact was made with 198 of the 227 dental practices, a rate of 87.2%. Of these 198 practices 145 (73.2%) were general dentists; 98 (67.6%) of these accepted Medical Assistance. Figure 1 is a map of the 98 dental practices that accept Medical Assistance and their distribution throughout Allegheny County.

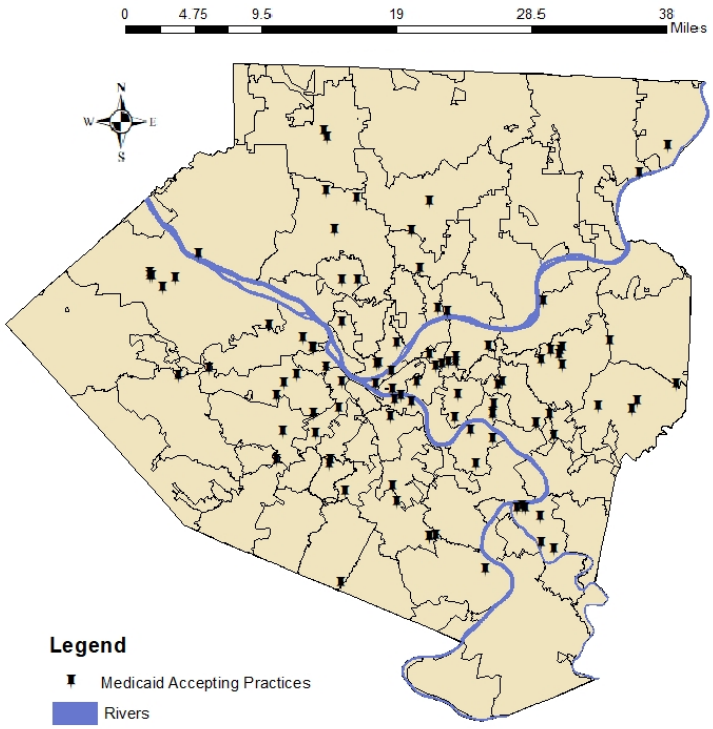

Figure 1 The Distribution of Medical Assistance Accepting Dental Practices in Allegheny County Pennsylvania

Of these 98 practices three (3.1%) stated that they used to accept Medical Assistance, but recently stopped accepting new Medical Assistance patients, 84 (85.7%) of the practices accept UPMC, 76 (77.6%) accept Gateway, 72 (73.5%) accept United, and 55 (56.1%) accept Aetna. When asked about appointment wait time, 28 (28.5%) stated that the wait time was one week or less, 47 (48%) stated a wait time of two to four weeks, 13 (13.3%) had a wait time of five to eight weeks, nine (9.2%) had a wait time of eight or more weeks, and one (1%) would not say how long. The range of wait times was same-day appointment to 17 weeks. Out of these 98 practices, incorrect hours and/or days of operation were listed in the databases for 59 (60.2%).

However, 13 practices did not list their days or hours so a more accurate number would be 59 of 85 or 69.4% had inaccurate information listed. Six (6.1%) of these practices stated that they actively limit the days and hours that Medical Assistance patients can be seen.

Thirty-two (16.2%) practices were a specialty dentist, and 24 (75%) of these were not listed as a specialty office in the MOC databases. They were either listed as a general practice, pediatric dentist, or were listed as NA; the remaining eight (25%) were listed correctly as oral surgery or orthodontics. Fifteen (6.6%) numbers were called that never reached an actual person. In these instances, there was always an answering machine, even when called during listed business hours. Of the 227 dental practices identified two (0.9%) practices do not see pediatric patients, and a third practice sees children only over the age of 16. Fourteen (6.2%) phone numbers did not work and seven (3.1%) did not go to a dentist office. Two (0.9%) practices were not in Allegheny County. One practice wanted to know all the questions that needed answered, and then stated that someone would have to call back with the answers. This practice never called back and was not contacted again.

The 98 practices that accept Medicaid are open for a combined 6839.5 hours per week. Two hundred five dentists were identified as working at these locations. However, 27 (13.2%) of these dentists are located at dental clinics throughout the county accounting for 1,290 (18.7%) of weekly available hours for pediatric patients with Medical Assistance. The least number of dentists at a practice was one and the most was 11, with a median of one dentist per practice. The maximum number of 11 was from one of the Allegheny County Health Department dental clinics and could be a daily overestimate since all the dentists at that practice may not be there every day. The lowest number of practice hours available a week was two and the highest of 550, the median number of hours available per week was 38. As with the number of dentists, the

550 hours are available at one of the Health Department's dental clinics and may be an over estimate.

Some comments from the survey are worth noting. One clinic stated that they "had not had a dentist in 10 years but they won't take their number off the website." Most of the people were very polite, but some people seemed bothered when questions were asked and were reluctant to take time to answer questions. Many of the offices that did not accept Medicaid apologized for not doing so. Three of the people spoken to suggested calling the number on my card and they would tell me what dentist to go to. Three different offices gave numbers of practices that could be called because they know that they accept Medicaid. Some larger dental practices with several locations do not accept Medicaid at all their locations. Three dentists answered the phone themselves when called; one said he may be retiring by the time an appointment was needed (three months) but they were not sure.

4.2 GEOSPATIAL ANALYSIS RESULTS

There was a tremendous amount of variation in what the geospatial analysis showed. When looking at the 100 zip codes in Allegheny County compared to the distribution of the 98 Medical Assistance accepting dental practices, the number of dentists based on distance, drive time, and transit time resulted in a minimum number of eight, 18, and 0 respectively. The most dentists based on distance, drive time, and transit time were 178, 204, and 95 respectively. This information along with the median number of dentists and the standard deviations can be seen in Table 1.

Table 1 Access to Dental Practices in Each Zip Code Based on Distance, Drive Time, and Transit Time

	Median	Standard Deviation	Minimum	Maximum
Number of Dentists Based on Distance	118.5	56.2	8	178
Number of Hours Based in Distance	4022.25	1941.9	287.5	6055.5
Number of Dentists based on Drive Time	149.5	50.5	18	204
Number of Hours Based on Drive Time	5114	1665.8	541.5	6799.5
Number of Dentists Based on Transit Time	4	20.1	0	95
Number of Hours Based on Transit Time	129	727.2	0	3481.5

When the number of available hours for Medical Assistance accepting practices was looked at in the same manner it was observed that the lowest number of available hours was 287.5 hours based on distance, 541.5 hours based on drive time, and 0 hours based on transit time. Looking at the most hours available, 6055.5 hours are available based on distance, 6799.5 hours are available based on drive time, and 3481.5 hours are available based on transit time (see Table 1).

The distribution of available dentists based on distance, drive time, and transit time in relation to the number of children in each zip code with Medical Assistance can be seen in Figure 2A. The distribution of available hours based on distance, drive time, and transit time in relation to the number of children in each zip code with Medical Assistance can be seen in Figure 2B. Overall, the median distance was 15.3 miles, the median drive time was 26 minutes, and the median transit time was 51 minutes.

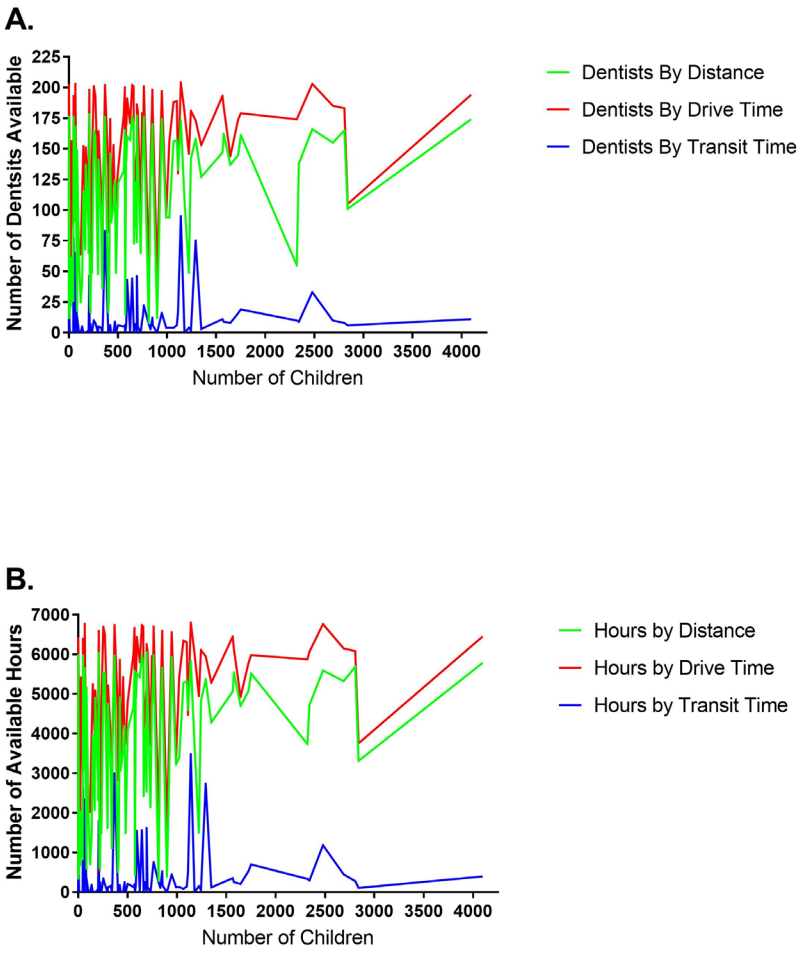

Figure 2 Available Number of Dentists and Hours

Figure 2: A) the number of available dentists in relation to the number of children in each zip code based off a distance of 15 miles and a 30-minute drive or transit time B) the number of available hours in relation to the number of children in each zip code based off a distance of 15 miles and a 30-minute drive or transit time

Along with the number of dentists and hours that are available by direct measurement of distance, drive, and transit times, the number of dentists and hours that would be needed to provide equal access to dental care for all children with Medical Assistance living in the county was measured through a what-if analysis. The total number of dentists and hours calculated using distance as a measure was 10,320 and 351,136.5 respectively. A total of 14,038 dentists and 475,375.5 hours were available when drive time was used as the measure, and 1105 dentists

and 38,513.5 hours were available using transit time as the measure. These values were then used for the reallocation of dentists and hours to each of the zip codes based on the proportion of total children in Allegheny County with Medical Assistance living in those zip codes. A summary of the results can be seen in Table 2.

Table 2 Reallocation of Number of Dentists or Number of Hours to Provide Equal Access to All Children with Medical Assistance in Allegheny County

	Median	Standard Deviation	Minimum	Maximum
Reallocation of Dentists Needed Based on Distance and MA Recipients	20.1	106.9	-457.4	117.0
Reallocation of Hours Needed Based on Distance and MA Recipients	665.3	3594.6	-15695.8	6005.5
Reallocation of Dentists Needed Based on Drive Time and MA Recipients	39.2	147.2	-664.8	202
Reallocation of Hours Needed Based on Drive Time and MA Recipients	1256.8	4981.4	-22628.2	6410.5
Reallocation of Dentists Needed Based on Transit Time and MA Recipients	-2.4	22.8	-56.6	81
Reallocation of Hours Needed Based on Transit Time and MA Recipients	-92.8	817.3	-1957.7	2950

All three of the measures showed that there is a disproportionate distribution of dentists and hours throughout the county and each of the measures identified some zip codes with too many dentists and hours and some with too few. The measure that resulted in the largest number of zip codes in need of dentists and hours being reallocated to them was a transit time of 30 minutes or less. Figure 3 shows the reallocation needed for equal access based off the number of children in each of the zip codes.

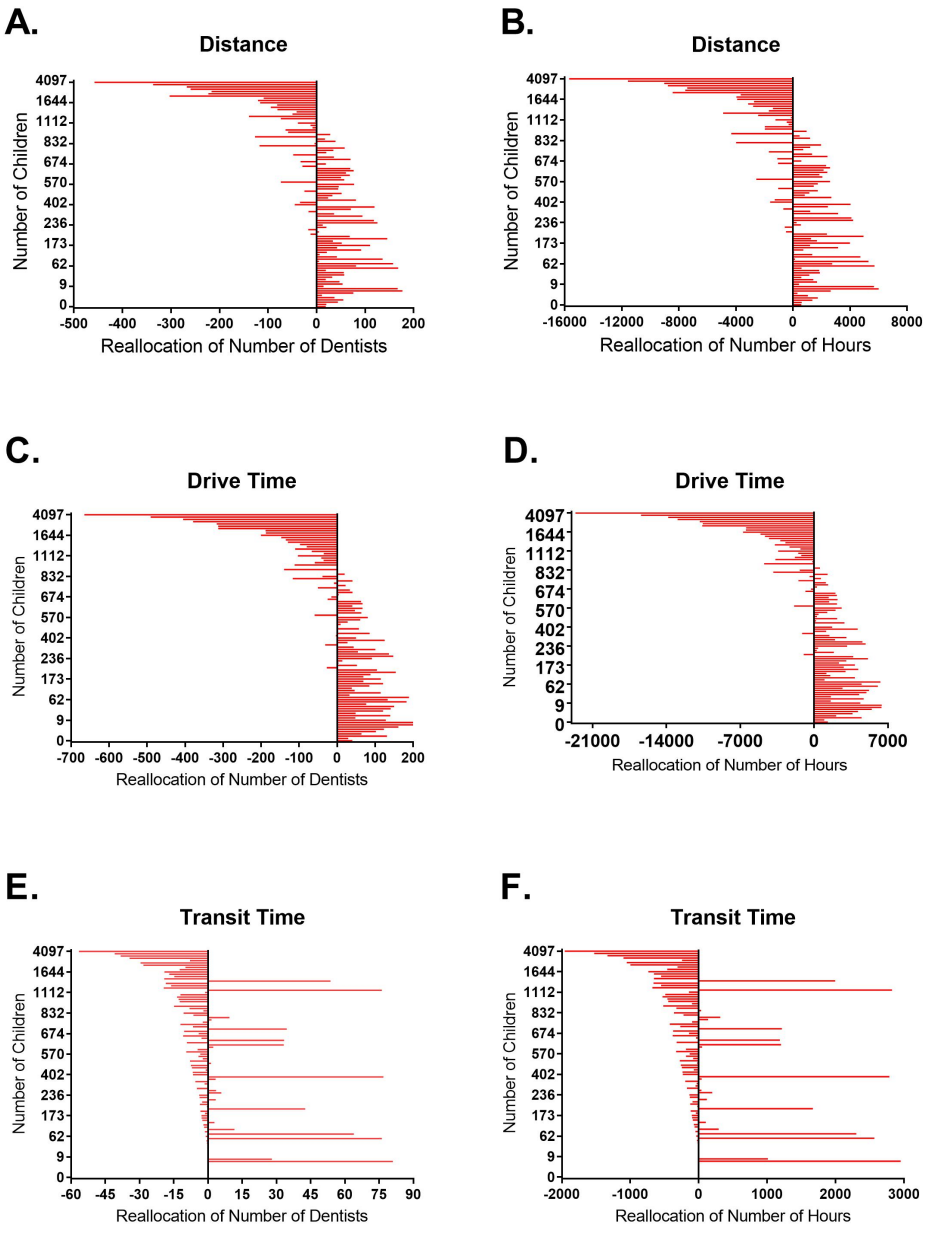

Figure 3 Reallocation of Number of Dentists or Number of Hours

Figure 3: A) reallocation of dentists based off distance B) reallocation of hours based on distance C) reallocation of dentists based off 30-minute drive time D) reallocation of hours based off 30-minute drive time E) reallocation of dentists based off 30-minute transit time F) reallocation of hours based off 30-minute transit time in relation to the number of children residing in each zip code

Figure 4 is a map that shows that location of the 98 dental practices that were identified as accepting Medical Assistance in relation to the public transit routes that are in the county.

This map also shows the distribution of children with Medical Assistance throughout Allegheny County. Thirty-nine zip codes in Allegheny County do not have access to a dental practice within a 30-minute transit ride. Further, 26 zip codes were identified as not having access to public transit at all when using the zip code geocentroid addresses.

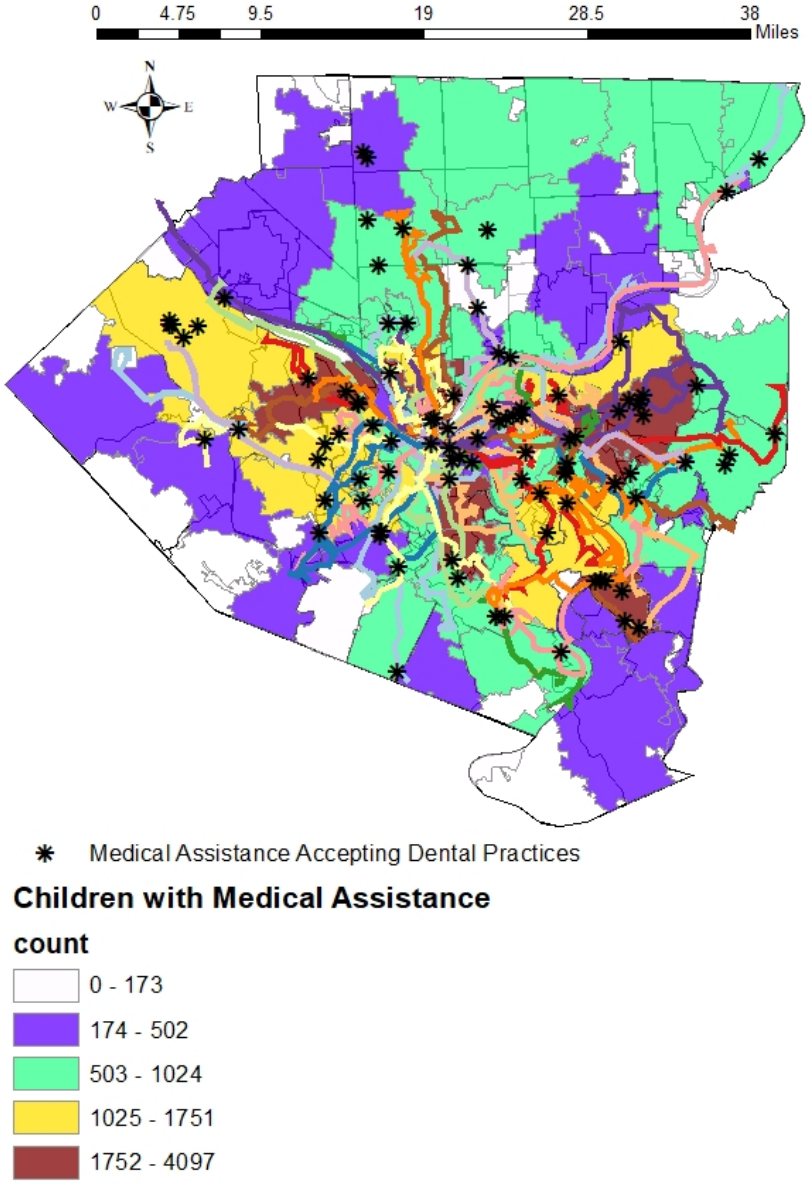

Figure 4 Distribution of Medical Assistance Accepting Dental Practices in Allegheny County Relative to Public Transit Routes and Children with Medical Assistance

The chi squared analysis showed that there was not a significant difference in the number of dentists accessible to zip codes compared to the number of expected dentists when a distance or transit time was used as the metric for availability. However, there was a significant difference in the number of observed dentists or hours when looking at available hours by distance, $p < 0.001$, number of available dentists by drive time, $p = 0.003$ and available hours by drive time $p < 0.001$, and the number of hours available by public transit, $p < 0.001$.

5.0 DISCUSSION

This study identified and quantified some of the potential barriers to dental care for children who live in Allegheny County and utilize Medical Assistance. To this author's knowledge this is the first time an analysis of dental access for children with Medical Assistance who live in Allegheny County has been done. Without taking a multi-pronged approach when looking at access to care, some of the potential barriers that were identified in this study would be missed.

If only the secret shopper survey was utilized to determine access to number of dentists and hours of availability, it would look like there are ample dentists and hours for children who utilize Medical Assistance. However, total number of dentists and total number of hours are only a small part in determining access and identifying potential barriers. Looking at only the sheer number of dentists or hours of operation assumes that children who utilize Medical Assistance for their dental insurance could make it to any of the dental practices in the county that currently accept these insurance plans. Aside from the hours of operations data that the secret shopper survey provided, information was collected that cannot be described by simply collecting numbers. Many of the dental practices had inaccurate information listed on-line, which could make it difficult to contact a dentist if someone does not know the correct operating hours. Even if someone has access to a computer, they may find it difficult to locate a provider when the information is wrong, including phone number, inaccurate hours and days of operation, or phones that are not answered.

The process of making the phone calls took close to 100 hours to complete. While potential patients would not be calling the same number of dental practices, it is still a time-consuming process. If someone is continually frustrated by inaccurate information, wrong numbers, or answering machines they may give up looking for a dentist for their child. This could result in a child going much longer than recommended without seeing a dentist, or even a trip to the emergency room. When individuals do not have ready access to primary care they often turn to emergency rooms for the care they need. A study conducted from 2008-2010 (Allareddy et al. 2014) found that more than 1.3 million emergency room visits occur each year because of dental problems, accounting for more than 1% of emergency department visits. Most of these visits were by individuals who utilize some type of Medical Assistance (Allareddy et al. 2014). Some of these visits are likely unavoidable and are with cause, but many of them could be avoided if everyone had access to primary dental care.

A second potential barrier that the secret shopper survey identified was how dental practice staff communicate with potential patients. While many dental practices were helpful and readily provided the information needed, other practices would not answer the questions or provided the information only after repeatedly asking the questions. If there was an actual need to find a new dentist this process could become frustrating and demoralizing quickly depending on the person on the other end of the phone. It is impossible to know what every parent deals with when trying to find a dentist for their child; depending on who they get on the other end of the phone it might be an easy process or incredibly difficult.

In looking at the distribution of insurance acceptance and wait time, no barriers were identified. Dental practices across the county accepted multiple insurance plans, and almost all the practices accepted at least two. Wait time varied from practice to practice, but with the

longest wait being 17 weeks, if a child is able to get to one of the dental practices they would not have to go for an excessively long time without an appointment.

Simply looking at total hours creates another problem. It provides a gross overestimation of the true number of hours available to many people. Even if an office does not actively limit when a child can be seen, if only one dentist accepts Medicaid at a practice and is only in that office one day a week, then that in itself is a limiting factor. If the one dentist is at the practice only on Tuesdays from 10 a.m.-4 p.m., and this is the only dental practice within reasonable proximity to a population of children with Medical Assistance, then it would be difficult for these children to be seen at this dental practice unless a parent is able to take off work or find someone to take their child. Some practices have hours on Saturday, but with the thousands of children who may need to be seen during these hours it is not realistic that all the children would be able to get Saturday hours.

While the secret shopper survey provided information on practice hours of operation, it was not designed to provide information on what actual access is across the county. Utilizing only the number of dentists or hours of operation ignores the fact that many children who utilize state sponsored health insurance also rely on public transportation as their primary mode of transportation. A recent study found that individuals who live in poverty take about three times as many transit rides as individuals from higher income groups (FHWA NHTS 2014). In the city of Pittsburgh 11.2% of households do not own a car, and among families that identify as black this number is 35.8% (National Equity Atlas 2015). This means that five of the dental practices surveyed are inaccessible to these children since they are not on a bus line. In addition, many zip codes in the county do not have ready access to public transit or are not within a reasonable transit ride to a dental practice. This uneven access to public transit, or even a transit ride to a

dental practice within a reasonable time, is likely to act as a barrier that keeps parents from seeking dental care for their children.

The geospatial analysis showed that most of the children who have Medical Assistance in the county have access to some level of dental care, but it was not ubiquitous. When looking at a distance of 15 miles or a 30-minute drive, all children would at least have the opportunity to make it to a dental practice since every zip code had some level of availability based on these metrics. As stated above, one of the bigger issues is access to public transit in certain areas, but the geospatial analysis by itself does not provide all the information on equity of access. The what-if analysis showed that children who live in some areas of the county have more than enough access to dental care no matter what metric is used (Figure 3). It also showed that many children living in the county do not have equitable access to dentists or hours of availability. This is especially true for zip codes that have a high number of children who utilize Medical Assistance. This analysis shows that there are not enough Medical Assistance dental practices in the areas that need them most. In this case, it does not matter if you are in close proximity by distance, car or transit. Parents of children who live in these areas may still find it difficult to schedule an appointment since there are so many children and not enough dentists or hours of operation.

These data provide some insights into the barriers that parents may face when they are trying to get their children to the dentist. It is looking at only a few aspects of the problem, but did identify some issues, like county-wide access to public transportation, that if addressed might increase the rates of children with Medical Assistance that see a dentist each year. Other issues remain that need to be studied to determine other barriers to care so 100% of children can be in the position to see a dentist each year.

5.1 FUTURE AREAS OF EVALUATION

This evaluation of access to dental care for children with Medical Assistance is only one step in the process. It may not be realistic to assume that there is the capacity to perform the type of evaluation that was done in this study for all counties, but information can be collected in other ways to inform discussions on dental access.

One of the most effective ways is by using focus group studies with parents of children who utilize Medical Assistance for dental insurance. These studies can be designed in a way to elicit information on the knowledge that parents have about taking their children to the dentist and about barriers they have encountered when trying to take their children to the dentist. If designed properly they can identify why many children with Medical Assistance are not taken to the dentist, such as lack of education, and identify how barriers can be mitigated by changes to policies surrounding Medical Assistance.

Another type of study that could provide useful information is surveys and interviews with dentists who do and do not accept Medical Assistance. This can help inform the conversation about what is and is not working with Medical Assistance. It can also provide information on how public dental insurance could be changed to entice more dentists to accept these types of insurance plans. Surveys and interviews with pediatricians located in areas that do not have access to dental care to explore what dental services they provide. These surveys and interviews can provide information on how informed pediatricians are about the need for dental care for their patients.

Finally, if a more expansive geospatial analysis was performed, it should include all dental practices in the county. Along with this, the entire population of children who live in Allegheny County, regardless of insurance type, could be included to present a more holistic

picture of the availability of dental practices across the county is. This information, combined with what was found in this study, can help paint a complete picture of dental care in the county and provide information on access to dental care for all children.

6.0 CONCLUSIONS

This study demonstrated that secret shopper surveys, in combination with a geospatial analysis and a what-if analysis can be used to identify barriers to dental care for children with Medical Assistance. The secret shopper surveys allowed for an accurate accounting of how many dental practices accept Medical Assistance in Allegheny County, how many hours they operate each week, how some limit visits by children who utilize Medical Assistance, and how many mistakes there are in the MCO databases.

Ninety-eight dental practices providing access to 205 dentists and 6,839.5 hours a week seems to be adequate to provide care for the 66,967children who utilize Medical Assistance in the county, but this was about more than numbers. Most of the dental practices had mistakes in their online listings. This included days and hours of operation, wrong numbers, and practices that were not listed as specialty offices. This combination might be frustrating when trying to find a dental home. It could be as simple as "calling the number on the back of your card" as one dental practice suggested, but this does not consider other challenges that someone may have in getting to a particular dental practice.

The geospatial analysis showed that access to dental practices is more complicated than picking one that accepts your insurance plan and going to it. Where practices are located in relation to the children who would be receiving dental care must be taken into consideration. When looking at distance and drive time, all children who utilize Medical Assistance would have

some level of access to dental care. This is misleading, since 26 of the zip codes in the county do not have access to public transit (Figure 4), and an additional 13 zip codes do not have access to a dental practice within a 30-minute transit ride. With more than 11% of families, and more than 35% of African American families, not having access to a car in the city of Pittsburgh (National Equity Atlas 2015), there may not be a dental practice that these parents can take their children to. This study does not identify all the children affected by the lack of public transit, but it does show that lack of public transit could be a barrier to dental care.

The what-if analysis showed that there is unequal distribution and access to dental care in Allegheny County for children who utilize Medical Assistance. Looking at distance, drive time, and transit time showed that the zip codes that have the highest number of children who utilize Medical Assistance have the largest deficit of both access to dentists and hours of operation. It is not reasonable to think that an option would be for these families to relocate, but what is an option is more dental practices that these families would be able to access. This could be through opening more practices or persuading more dental practices to accept Medical Assistance. Either way there are tens of thousands of children that live in Allegheny County and do not have equitable access to dental care.

This study provides information on barriers to dental care for low income children, but there are some limitations to the information collected. Contact was not established with all 227 dental practices. Some of these practices are likely to accept Medical Assistance, which would change the number of dentists and hours that are available. Another limitation is that only Medical Assistance accepting dental practices are listed in MCO databases. To achieve a full accounting of access to dental care in Allegheny County all dental practices should be surveyed. This information, along with the distribution of children regardless of insurance type, would

provide a more complete picture of accessible dentists and hours of operation in the county. There is also need for qualitative studies to determine why so many children with Medical Assistance do not see a dentist each year. Without this information it cannot be said definitively that the barriers identified are what is keeping children from the dentist.

Children who utilize Medical Assistance and live in Allegheny County need to see a dentist on a more regular basis. It is about more than the financial burden of the chronic diseases that are associated with poor oral health, it is about building a more equitable society. Children who live below or near the federal poverty line experience caries and dental pain at rates far higher than children in higher socioeconomic classes (Duffy el al. 2018). It has also been established that children that suffer from dental pain perform worse at school (Jackson et al. 2011). What chance do these children have if they are set up for failure from the start? Children who utilize Medical Assistance are not able to advocate for themselves in an effective manner; individuals that work in public health need to advocate for them.

This study highlights a few places that advocates can start. An expansion of bus routes to more parts of the county would provide more equitable access. Also, more dental practices accepting Medical Assistance would make it easier for all children who utilize Medical Assistance to get access to care. Utilization of dental care may be about more than simply having access to care, but a place to start is making access to care more equitable. A rate of 50% of children with Medical Assistance seeing a dentist each year is unacceptable. Changes can be made to ensure that all children have access to the dental care they need, regardless of dental insurance type.

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