Location Matters

Differences in Primary Care Supply by Neighborhood in Philadelphia

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EXECUTIVE SUMMARY

Introduction

Implementation of the Affordable Care Act (ACA) has increased the number of Americans with health insurance, raising concerns about the capacity of the primary care workforce. Despite the importance of ensuring access to health care, most local health departments do not have the data or infrastructure to monitor the availability of primary care.

This report, commissioned by the Philadelphia Department of Public Health (PDPH) and funded by the Independence Foundation, addresses three objectives:

1. Describe a method to measure and monitor geographic access to primary care in Philadelphia.
2. Describe current geographic access to primary care by neighborhood in Philadelphia and identify areas at greatest risk of insufficient access.
3. Validate simplified methods to measure geographic access to primary care.

Objective 1 – Methods for monitoring access

The sources of primary care provider information that have traditionally been used for workforce studies have a variety of limitations, especially lack of accurate practice address. To measure the supply of primary care providers in Philadelphia we started with a dataset from SK&A™, a private vendor, which we compared to private insurer and Medicaid provider directories, and lists of community health centers (CHCs), to determine if providers were missing from the SK&A™ list. We then called all practices to verify how many primary care providers practiced at that location through a brief survey. Ultimately, 71% (n=460) of the practices identified via SK&A™ were primary care practices.
Objective 2 – Neighborhood access

Using data from the phone survey, we estimated the number of full-time equivalent providers (FTEs) offering primary care in Philadelphia as well as the proportion of provider time available to provide primary care to patients with Medicaid. We supplemented that with information about practices that are outside the city limits but potentially accessible to city residents. We mapped the adult primary care supply by creating population-to-provider ratios for the general population (Map 1) and for those patients with Medicaid (Map 2). We identified six clusters of census tracts that fall into the lowest quintile of access for the general population.

![Map 1. Population-to-provider ratio, within 5-minute drive time of census tract centroid, by quintile.](image1)

![Map 2. Publicly-insured population ages 18-64 to Medicaid provider ratio, within 5-minute drive time of census tract centroids, by quintile.](image2)

Similar to the overall population, Medicaid populations have particularly low access in the Lower Northeast and Southwest. Many CHCs fall in parts of the city with a high density of Medicaid coverage. The existing CHCs are likely preventing the populations with Medicaid in these areas from being even more inadequately served.
Objective 3 – Validation

Because the PDPH is interested in monitoring primary care access over time, we compared maps created with our full provider dataset to maps created with the information from SK&A™ alone, as well as the SK&A™ dataset supplemented with CHC data. In the future, at a small cost, PDPH will likely be able to easily access both SK&A™ and CHC data.

Map 3 shows similar results to what we found with the full database (Map 1) suggesting that for future iterations, using SK&A™ data supplemented with CHC locations may be a logical way to decrease the resources required without sacrificing significant accuracy.

Conclusions

We found that the overall population-to-primary care provider ratio in the city is 863:1. Compared to established benchmarks¹, this suggests that the city has sufficient primary care supply overall. However, when comparing relative access across different neighborhoods (Map 1), a different picture emerges. In the lowest access areas of the

city there are approximately 10 times more adults per provider than in the best-served neighborhoods. These lowest access census tracts tend to cluster together. We identified six clusters of lowest access: Southwest, West, Northwest, Lower Northeast, Greater Northeast, and South Philadelphia/Gray’s Ferry.

Based on these findings, we recommend:

1) Health care delivery systems, insurers, public health entities, and organizations that operate community health centers should prioritize these six low-access clusters as they assess their current and future primary care services.

2) The Philadelphia Department of Public Health, with support from public health and health care delivery stakeholders, should use the methods in this report as a guide for reassessing primary care access on a biennial basis to inform neighborhood and city-wide planning efforts.

3) Further research is needed to evaluate other aspects of primary care access, such as wait times, transportation, acceptance of Medicaid and the uninsured, and patient preferences. Particular attention should be focused on the six low-access clusters to verify the areas of highest priority for investments in primary care.

Even in the lower access areas clusters, however, the ratios are better than some of the established national benchmarks for critical shortages\(^2\). The large disparities between neighborhoods coupled with a relatively high number of primary care providers for the city overall suggests that the distribution of providers may be more of a problem than the absolute number. While we have identified areas at risk for insufficient primary care, a broader characterization of primary care supply in these

parts of the city is essential for determining where interventions to expand primary care are most needed and could be most effective.

One of the goals of this project was to develop a method by which the Philadelphia Department of Public Health could monitor primary care access in the future. This is particularly important for evaluating interventions to expand primary care access, as well as monitoring changes in primary care with full implementation of the Affordable Care Act. Replication of this work would require: 1) an updated database of current primary care providers (SK&A™ and CHC lists), 2) updated population information, and 3) sufficient expertise in data management and statistics to re-run the analysis using the already developed statistical code.
Introduction

Primary care is an essential building block of a high functioning health care system and population health. Adequate access to primary care has been shown to improve health outcomes and reduce overall health care costs\(^3\). Concerns about the capacity of the primary care workforce have been heightened by the Affordable Care Act (ACA), which has increased the number of people with health insurance. Primary care access concerns are even greater for those covered by Medicaid and the uninsured. Because of higher reimbursement rates for Medicare and private insurance, some providers limit their practices to only those patients.

Although primary care delivery is largely part of the personal health sector, primary care plays such an essential role in the health of a population that monitoring access to primary care is a basic function of public health. In the reports *The Future of Public Health*, the Institute of Medicine (IOM) outlined the three core public health functions of assessment, policy development, and assurance. It specifies the following function:

> “Assurance that high-quality services, including personal health services, needed for the protection of public health in the community are available and accessible to all persons; that the community receives proper consideration in the allocation of federal and state as well as local resources for public health, and that the community is informed about how to obtain public health, including personal health, services…”\(^4\)

This public health role in ensuring access to primary care was further codified by the Centers for Disease Control and Prevention in 1994\(^5\) as an essential public health function. Despite calls for local health departments to assume a larger role in monitoring the availability of personal health services and primary care in particular, most local health departments have lacked the data and infrastructure to carry out this role.


This report has three objectives. Focusing on adults who live in the City of Philadelphia, we will:

1. **Describe a method to measure and monitor geographic access to primary care in Philadelphia.**
2. **Describe current geographic access to primary care by neighborhood in Philadelphia and identify areas at greatest risk of insufficient access.**
3. **Validate simplified methods to measure geographic access to primary care.**

### A. Finding Ways to Measure Access

Monitoring accessibility of primary care is complex, which creates a challenge for public health departments. In 1981, Penchansky and Thomas defined health care access as having five domains: availability, accessibility, accommodation, affordability and acceptability.\(^6\) The availability domain includes basic questions of where services exist, while the accessibility domain includes the relationship of those services to the locations of populations that need them. These ideas have been further refined into the concept of spatial accessibility of primary care, which involves understanding the location and supply of services and the time or distance required to access them.\(^7\)

The simplest method for relating primary care location and supply to populations has been to define a geographic area and then calculate the population-to-provider ratio in that area. If the unit of interest is a large area, such as the state or county, this can be a reasonable choice. However, as the geographic unit of analysis gets smaller, the amount of error introduced by patients crossing borders to see physicians, imprecise location information (such as having only zip code and not street address of providers), and assumptions about travel time become more troublesome. A variety of methods have been attempted to improve small area primary care access analyses. For example, one method weights providers by distance (i.e. counting providers differently based on how far they are from a geographic area). However, these methods require computational expertise that is hard to replicate outside of research settings. These

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methods are also still subject to flaws in the available data about providers and populations.

One method that has been adopted widely in the public health arena is the Primary Care Service Area (PCSA). This method, created at Dartmouth and now used by the Health Resources and Services Administration (HRSA) as part of their definitions of underserved areas (described below), uses Medicare claims data. From claims data, patient home zip codes are compared to the zip codes where they receive care to assess patient travel patterns. Each population zip code is then assigned to the provider zip code based on where most people receive their care. These zip code aggregates are then adjusted to create contiguous geographic units. For an urban center like Philadelphia, though, these PCSAs are still too large to provide a neighborhood-level view of primary care access.

B. Attempts to Improve Primary Care Access

Many government programs work to combat disparities in health care access. In particular, the Federally Qualified Health Center (FQHC) program established by Section 330 of the United States Public Health Service Act provides funding for health centers in the most severely disadvantaged communities. In order to support health centers’ operations, funding administered through the Health Resources and Services Administration (HRSA) is provided to these FQHCs in the form of competitive grants and enhanced Medicaid reimbursement rates. This funding makes it financially viable to serve a large share of Medicaid-insured individuals and provides additional operating budget funds to make serving the uninsured financially feasible. This allows clinics to accept all patients, as is required by the funding. Philadelphia is home to over 30 FQHC clinic locations making them a key part of the primary care delivery system.

Despite the opportunity provided by this funding, barriers to obtaining FQHC status persist. Funding is limited and many health centers with great need are unable to obtain funding through this channel. In 2004, just 20% of applicants were awarded a

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New Access Point\textsuperscript{10}, the grant that establishes a new FQHC. The ACA provided much needed funding support for the FQHC program; however, demand continues to outstrip available funds. Despite required reapplications to ensure ongoing funding, once initially awarded, the majority of centers continue to receive enhanced reimbursement rates and operating grants. The ongoing nature of this award means that it is difficult to access funds to create a ‘New Access Point.’ Therefore, it is critical for local communities to identify areas in greatest need on which to focus their primary care enhancement efforts.

In order to determine the populations most in need of funding, every application for FQHC status must demonstrate the health care needs of the community that the prospective center will serve. Within the funding appropriated for FQHCs, money is set aside for centers that serve migrant and season farmworkers and their families, those experiencing homelessness, and residents of public housing. A health center can receive all, part, or none of its funding through one of these special populations funding streams, however in certain New Access Point grant years centers serving one or more of these special populations are given funding priority.

Beyond special populations, HRSA attempts to understand the needs of various communities in a standardized manner. In particular, all FQHCs must serve a Medically Underserved Area or Population (MUA/P). MUA/P is a score given to a geographic area or specific population. Prospective centers may choose any reasonable cluster of counties, minor civil divisions, census county divisions, or census tracts as the geography that their FQHC would serve, its PCSA, however the MUA/P calculation is standardized. MUA scores take into account the PCSA’s ratio of primary medical care physicians per 1,000 population, infant mortality rate, percentage of the population living under 100% poverty, and percentage of the population age 65 or over. MUPs use these same variables to request a designation for a population within a geographic area with unique economic, cultural, and/or linguistic barriers to care. Serving a MUA/P is a mandatory and critically important portion of the New Access Point application; because additional points are given for particularly low scores, prospective centers are incentivized to find or construct PCSAs in particular need.

\textsuperscript{10} Kanof, M. 2005. Health Centers: Competition for grants and efforts to measure performance have increased.
A similar designation, the Health Profession Shortage Area (HPSA), provides access to other federal benefits, including National Health Service Corps (NHSC) Recruitment and Retention Assistance loan repayment dollars. Geographies, populations, and facilities can each be designated as HPSAs. Primary Medical Care geographic HPSAs must demonstrate that medical professionals are over-utilized, far away, or inaccessible to the target population, and must meet one of the following conditions: have a population to full-time-equivalent primary care physician ratio of at least 3,500:1, or have a ratio of greater than 3,000:1 and insufficient capacity or high needs. HPSA designations fluctuate as conditions in the geography or population change, however all centers that receive FQHC funding are automatically designated as facility HPSAs for the duration of their FQHC funding.

New Access Point applications also require community support, including the support of nearby health centers. While on its face a worthy requirement, this often leads to political challenges for potential applicants. As funding for FQHCs is both competitive and limited, competition for grants can be fierce. Neighboring centers may be hesitant to provide written support for a New Access Point for fear that a new health center will threaten their viability. Furthermore, many FQHCs open multiple sites, often in close geographic proximity. By allowing a new FQHC into the market, existing centers may limit opportunities for expansion. In health care markets with many existing FQHCs but still in need of additional sites, such as Philadelphia, establishing a New Access Point can prove quite challenging because of competition between FQHCs.

C. Measuring Primary Care Provider Supply

Those assessing health care provider supply in the United States rely on many different data sources to identify providers. Two of the most frequently used sources are the National Provider Identifier File and the American Medical Association Physician Masterfile. While both contain important information regarding providers in the United States, each has major limitations. Below, both of these sources and their limitations are described in detail.
**National Provider Identifier File (NPI)**

The NPI file is a database that includes demographic and professional information regarding the majority of health care providers and health care-providing organizations in the United States. These data, which are maintained by the Centers for Medicare and Medicaid Services (CMS) and the Department of Health and Human Services (HHS), are updated monthly. While this database is widely used, including to assess provider supply, it frequently requires significant processing before analysis can begin. A report from the Office of the Inspector General found that provider data in the NPI was inaccurate 48% of the time\(^\text{11}\).

**American Medical Association Physician Masterfile (AMA Masterfile)**

The AMA Physician Masterfile is a database of physicians, which includes all those enrolled in medical school or a residency training program, as well as all physicians who hold a medical license. The database, which is maintained by the American Medical Association, is updated continuously and includes demographic and professional information for each physician.

The AMA Masterfile has a long history of use as a sampling frame for counts of physicians. However, some physicians report only a mailing address (often a home address) and not an office address, which can introduce inaccuracies in mapping physician practice location\(^\text{12}\). Additionally, because the AMA does not routinely remove physicians from its database, it counts inactive older physicians who are no longer in practice\(^\text{13}\). When other databases are linked to the AMA Masterfile, sociodemographic and training information is frequently accurate\(^\text{14}\). Though the AMA Masterfile does not collect information directly about physicians’ primary care services and previous studies

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suggest that it overestimates primary care providers\textsuperscript{15}, the use of primary and secondary specialties listed in the Masterfile has been suggested as a tool for assessing the primary care content of a physician’s practice\textsuperscript{16}.

**Other Sources**

The NPI File and AMA Masterfile are not the only potential sources for provider information. Other sources include private insurance companies’ provider directories, proprietary databases (e.g. the SK&A\textsuperscript{TM} file used in this report), state licensure boards, and outpatient claims data. Similar to the NPI File and AMA Masterfile, none of the sources is comprehensive and many require extensive cleaning and merging to use for analysis.

**SK&A\textsuperscript{TM} Provider Database**

SK&A\textsuperscript{TM} is a private company that maintains databases of healthcare organizations, primarily for marketing purposes. Their physician database includes office-based physicians as well as some NPs and PAs. One of the reported advantages of the SK&A\textsuperscript{TM} database is that the data are telephone-verified (i.e. offices are called) and updated at least twice per year, as well as having additional information about practice setting and characteristics. Although not initially designed as a research tool, it has been increasingly used for research purposes over the past few years\textsuperscript{17,18,19}.

In this report, we start with the SK&A\textsuperscript{TM} database for the following reasons. First, it is updated every 6 months through a telephone survey of practices. Second, it includes information about practices including precise geographic information. Third, although


it is proprietary, the cost to purchase data for a small geographic area is modest. Fourth, the database requires much less manipulation than methods requiring the merging of multiple databases (AMA and NPI files).

Methods

In order to address our three objectives, we first built a robust database of primary care providers in Philadelphia from multiple sources described below. Through a phone survey we then validated the number of equivalent full-time providers (FTEs). Using these FTE numbers, we calculated population-to-provider ratios and mapped the supply of providers, highlighting areas with particularly low provider supply (i.e. high population-to-provider ratios). Finally, we validated simplified approaches to measuring primary care provider supply for future use.

A. Identifying Primary Care Providers in Philadelphia

We measured the supply of primary care providers in Philadelphia using a multi-step process. First, we created an initial database of primary care providers using a proprietary list from SK&A™. Second, we obtained additional provider databases from multiple sources to determine if certain providers were missing from the SK&A™ list. This included provider network directories from a major commercial health insurance plan and the largest Medicaid Managed Care plan in Philadelphia. Third, we attempted to telephone all practices to verify if they provide primary care and how many providers practice at that location. Each of these steps is described in detail below.

Step 1: Create Practice-Level Database Using SK&A™ Physician Database

We identified potential primary care providers in Philadelphia County in the SK&A™ database by selecting physicians who were identified with any of the following specialties: osteopathic medicine (DOP), family practice (FMP), geriatrics (GER), general practice (GNP), internal medicine-pediatrics (IMP), and internal medicine (INT). The abbreviations represent the name of the variable in the SK&A™ database. We then
grouped individual providers into practices by matching on zip code and phone number to create a database of practices.

**Step 2: Supplement SK&A™ Database with Other Sources of Local Provider Data**

We obtained a database of primary care providers in Philadelphia that participate in the Keystone Health Plan East insurance product from Independence Blue Cross, one of the largest insurers in the Philadelphia region. We also obtained a database of all registered providers with AmeriHealth Caritas Keystone First, the largest Medicaid Managed Care plan in southeastern Pennsylvania. This list was filtered to include only providers in Philadelphia County with the following specialties: certified registered nurse practitioner (CRNP); family practice (FP); general practice (GP); internal medicine (IM); nurse practitioner (NP); osteopathy (OST); and geriatrics (GER). Similar to the methods we used with the SK&A™ file, we also grouped providers in these two files into practices using zip codes and phone numbers. We also compiled a list of community health centers (CHCs), which includes FQHCs, FQHC look-alikes such as the city health centers, and nurse-managed health centers. The Philadelphia Department of Public Health provided the list of city health centers, which included the number of practitioners at each location. The Health Federation, a non-profit organization representing many of the FQHCs in the city, provided a list of their members. The Public Health Management Corporation, a non-profit organization which runs additional health centers across the city, provided a list of their locations.

**Step 3: Call All Primary Care Practices – Verify Active Practice & Number of Providers**

Using the multiple sources identified above, we created a single “call-through” database. We eliminated duplicates by matching on zip code and phone number. We manually excluded practices that were obviously specialty practices based on their practice name (e.g. “Gastroenterology Associates”). Trained research assistants called all practices in the call-through database during business hours (Monday through Friday, 9am to 5pm) between July 8th and August 11th, 2014. The research assistants
administered a brief survey (average length = 3 minutes), which assessed whether or not the practice offered primary care for adults and if so, its physical location, contact information, whether or not Medicaid was accepted and the number of full- and part-time physicians, nurse practitioners, and physician assistants. Any practice employee could respond to the survey, including receptionists, practice managers, and care providers.

Research assistants attempted to contact each practice up to three times or until the survey was completed. When a call was answered by a voicemail system, research assistants noted any information about practice hours to ensure subsequent calls occurred when the practice was open. If a voicemail system answered all three calls, the research assistant noted any information relevant to the survey provided in the message on the third attempt. When a number was incorrect or disconnected, internet searches were conducted to identify alternate phone numbers or if the practice has been closed. If alternate telephone numbers were identified, they were called up to three times.

**B. Assessing the Supply of Primary Care in Philadelphia**

Using the information obtained from the practice survey, we assessed the supply of primary care providers in Philadelphia. First, we created a final database of all practices identified as offering primary care. Second, using the data these practices provided, we estimated the number of FTE providers offering primary care in Philadelphia. Third, we used additional data provided during the practice survey to estimate the proportion of provider time available in each practice to provide primary care to patients with Medicaid.

**Step 1: Finalize Provider Database**

Based on the results of the practice survey, we created a final database of practices providing primary care to adults in Philadelphia. To create this database, we eliminated practices that reported not offering primary care. We also eliminated duplicate practices identified during the call-through and those with incorrect phone numbers (e.g., number for another business or a personal residence, repeated busy signal, or disconnected line). Only those who offered primary care were included in the final provider database.
Because Philadelphia residents are not restricted to seeking primary care within city limits, we included practices in the surrounding census tracts in Pennsylvania. However, those practices were not included in the practice survey, so the data about them were based only on the information available in SK&A™. Because the Delaware River creates a significant geographic barrier to travel, we assumed that the number of people who cross into New Jersey for primary care is negligible. Therefore we did not include practices in New Jersey in our analysis.

**Step 2: Estimate Primary Care Provider Counts in Each Practice**

We estimated the number of provider FTEs at each practice as follows. For those practices with complete call-through survey (n=388), we considered the number of doctors and/or nurse practitioners and physicians assistants reported during the call-through to be correct. Any provider reported as seeing patients fewer than four full days per week was counted as 0.5 FTE. As HRSA has done in previous workforce calculations, full-time nurse practitioners and physicians assistants were counted as 0.75 FTE to account for smaller patient panels.

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\text{Provider FTEs in a Practice} = \text{full-time doctors} + 0.5 (\text{total doctors reported} - \text{full-time doctors}) + 0.75 (\text{full-time NPs or PAs} + 0.5 (\text{total NPs or PAs} - \text{full-time NPs or PAs}))
\]

For those practices with incomplete data from the survey (i.e. did not respond to survey or did not respond to all questions), we estimated the number of providers. First, for practices that were in the SK&A™ database but did not respond to the survey (n=51), we predicted provider counts based on a linear regression of the estimated FTEs as a function of the provider counts in SK&A™ from practices that responded to the survey. For practices that were not in the SK&A™ database and did not respond to the survey (n=21) (i.e. were found through an insurer database), we used the average

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provider count reported in the survey for other practices not in the SK&A™ database (2.86).

**Step 3: Estimate Medicaid Primary Care Provider Counts in Each Practice**

Given differences in access for patients covered by private insurance versus Medicaid\(^{21}\), we conducted a secondary analysis to estimate the percent of primary care “available” in each practice to patients covered by Medicaid. In this report, we refer to this as “Medicaid provider counts.” The goal was to develop separate population-to-provider estimates for the Medicaid population. There are several challenges to constructing these estimates. First, practice-level data on the percent of their overall patients covered by Medicaid (i.e. % Medicaid) is difficult to obtain. It could only be reliably obtained through more intensive practice surveys and even then many practices may not know this information or may be reluctant to share. Second, there are likely substantial differences among practices that accept Medicaid in the percent of their overall panel that is covered by Medicaid.

For private practices, we calculated Medicaid provider counts using estimates from a study from the Center for Studying Health System Changes\(^{22}\). In states with high primary care supply (Pennsylvania is considered high according to national averages), primary care practices on average receive 16.6% of their revenue from Medicaid/CHIP. Although percent revenue and percent patients are not exactly equivalent due to differential payment rates, we considered it to be a reasonable approximation. Because some practices in our survey reported not accepting Medicaid, we applied an estimate of 0% to these practices. We then adjusted the estimates for other practices so that the overall average across all practices was equal to 16.6% and assuming that non-responding private practices have the same probability of answering yes as responding private practices. For practices that responded “yes” in the survey to accepting Medicaid, we applied an average of 17.2%. For practices that responded “don’t know” in

\(^{21}\) Rhodes, K. V. et al. (2014). Primary care access for new patients on the eve of health care reform. *JAMA Internal Medicine, 174*(6), 861-869.

the survey to accepting Medicaid or did not reach this point in the survey, we applied an average of 12.5%. For private practices outside of Philadelphia we applied the 16.6% estimate to all practices since we did not conduct the survey outside of Philadelphia but these practices are nonetheless within a reasonable travel time of census tracts on the border of Philadelphia.

For CHCs, we applied an estimate of 43% to obtain a Medicaid provider count. This estimate is derived from the Uniform Data System (UDS)\textsuperscript{23} from the U.S. Department of Health and Human Services’ Health Resources and Services Administration.

C. Mapping Primary Care Supply in Philadelphia

After identifying primary care practices in Philadelphia and estimating the number of providers (FTEs) in each practice, we assessed the geographic availability of primary care in Philadelphia. First, we determined the appropriate unit of analysis and geography to approximate neighborhoods. Second, we mapped population demographics for adults over age 18. Third, we mapped provider information and determined the best technique for visualizing these data. Fourth, we created and mapped overall population-to-provider ratios. And finally, we mapped population-to-provider ratios for patients with Medicaid.

Step 1: Identify Geographies for Analysis

Our goal was to map supply at a neighborhood level in Philadelphia. To best approximate neighborhoods using a consistent geography, we chose to use census tracts as the primary unit of analysis\textsuperscript{24}. Census tracts are small geographic units established for each decennial census. Census tracts vary in size, however ideally they are homogeneous areas with a population of 4,000 and remain fixed so that comparisons can be made between different census years. Smaller geographic units (census block groups) make it challenging to merge other data sources and variables

such as the percentage of the population covered by Medicaid, which is available in the American Community Survey no lower than the census tract level. Larger geographic units such as zip codes can obscure variation across the city. As census tracts are designed to be of homogeneous land use, in Philadelphia some census tracts have very low population counts (e.g. the census tract that is home to the Northeast Philadelphia Airport). As low population census tracts could have extreme population-to-provider ratios and be visually distracting on maps, Philadelphia census tracts in the lowest 5\textsuperscript{th} percentile of population density of adults 18 and over were included in analyses, but not represented on the maps (Table 1).

**Table 1. Census tracts below the 5\textsuperscript{th} percentile of population density of adults 18 and over.**

<table>
<thead>
<tr>
<th>Eliminated Census Tracts</th>
</tr>
</thead>
<tbody>
<tr>
<td>54, 9804, 9809       Refineries, Philadelphia International Airport</td>
</tr>
<tr>
<td>50                  Navy Yard</td>
</tr>
<tr>
<td>9806, 9807          Stadiums, commercial</td>
</tr>
<tr>
<td>355                 Penn's Landing</td>
</tr>
<tr>
<td>9800                Fairmount Park</td>
</tr>
<tr>
<td>9808                Morris Park and golf course</td>
</tr>
<tr>
<td>9805                Hunting Park</td>
</tr>
<tr>
<td>383                 Junata Park Feltonville</td>
</tr>
<tr>
<td>9801, 3860          Wissahickon Valley</td>
</tr>
<tr>
<td>220                 Forest</td>
</tr>
<tr>
<td>9802                Pennypack Creek</td>
</tr>
<tr>
<td>9803                North East Philadelphia Airport</td>
</tr>
<tr>
<td>378                 River border</td>
</tr>
<tr>
<td>3640                Pennsylvania National Guard and Benjamin Rush State Park</td>
</tr>
</tbody>
</table>

**Step 2: Map Population Data**

Merging data from the American Community Survey (ACS) 5-year estimates (2008-2013) with census tract boundaries as defined by the 2010 census, we mapped the demographic characteristics of each census tract in Philadelphia, including total population of adults age 18 and over, percentage of non-elderly adults below 100% of the federal poverty level, median income, percentage of adults age 18-64 who have public insurance (which approximates the Medicaid population), and the percentage of adults age 18-64 without insurance.
Step 3: Map Provider Data

We then assessed the number of providers accessible from each census tract. First, we identified geographical coordinates for each practice, using the latitude and longitude in the SK&A™ database, if available, or using Google Maps™ services based on the address. Using these coordinates, we linked each practice to a census tract based on 2010 census tract boundaries. As patients travel to access primary care providers without regard to census tract borders, we wanted to assess the number of providers within a reasonable travel distance of a census tract, rather than just the providers in that census tract. We considered several options for a “reasonable travel distance”: 1) crow-fly distance, or linear distance between two points, 2) driving distance, which reflects the distance required to travel between two points using streets, and 3) drive time, which reflects the distance that one can travel without traffic within a certain amount of time.

In all cases, we considered providers in nearby census tracts as “available” to the population in a census tract if the linear distance, driving distance, or drive time reached the centroid of a nearby census tract. Crow-fly distances were calculated using standard great-circle calculations based on geographical coordinates between census tract centroids. We retrieved distances and drive times programmatically from Google™ Distance Matrix API. As this process is computationally challenging, we limit the retrieval of time and driving distances to census tract pairs less than three miles away based on the crow-fly distances. As driving times and distances can be different based on travel direction (e.g. point A to point B, versus point B to point A), we retrieved both and used the average between the two.

Because drive time takes into account real-world travel limitations, we chose to focus our analyses on drive time. Much of the existing literature on access to primary care considers a 30-minute drive time to be reasonable, but those studies were done primarily in rural areas. In a dense urban area like Philadelphia, a 30-minute drive time would cover the majority of the city. We chose to test short drive times recognizing that the drive time does not reflect the full travel time required (which would include parking, etc.), and that traffic may often make the driving time much longer. Hereafter, we use a 5-minute drive time without traffic when describing the population served per provider. To identify areas that appeared to have significantly improved with a modest
increase in drive time, we also tested an 8-minute drive time. As shown (Figure 1), drive time, and to a lesser extent driving distance, are correlated with crow-fly distance, but with a notable dispersion of the drive times for a given crow-fly distance. For example, a crow-fly distance of 1.8 miles, on average corresponding to an 8-minute drive time, sees drive times ranging from 5.6 to 10.2 minutes (5th and 95th percentiles for crow-fly distances between 1.7 and 1.9 miles). Note that the distribution of the drive times with crow-fly distances justify a posteriori that a very limited number of census tract pairs are excluded by the 3 mile crow-fly distance threshold for the retrieval of drive times of five or eight minutes.

Figure 1. Correspondence between crow-fly distance, driving distance, and drive time.

![Diagram showing correspondence between crow-fly distance, driving distance, and drive time.](image)

Each point corresponds to the distance between two census tract centroids. All pairs of census tracts in Philadelphia and neighboring census tracts less than 3 miles crow-fly distance apart are represented.

**Step 4: Map Provider-to-Population Ratios**

In order to calculate provider-to-population ratios for a census tract, the populations and practices in any neighboring census tracts whose centroids fell within the defined “reasonable distance” were included in the provider and population totals for the census tract under analysis. This accounts for the ability of patients to move across
census tracts to access care. It also accounts for the fact that providers are shared across populations in different census tracts. Here we use the following definitions:

- **Population of a census tract:** $P^0$
- **Population of nearby census tracts:** $P^{RD}_i$
- **Provider supply of a census tract:** $FTE^0$
- **Provider supply of a nearby census tract:** $FTE^{RD}_i$

In summary the population-to-provider ratios ($P:FTE$) were calculated over the $n$ census tracts within reasonable travel distance as follows:

$$P:FTE = (P^0 + P_1^{RD} + P_2^{RD} + \ldots + P_n^{RD})/(FTE^0 + FTE_1^{RD} + FTE_2^{RD} + \ldots + FTE_n^{RD})$$

We created two different types of maps with a color coding regularly distributed on the population-to-provider ratio scale (referred to as “gradient maps”) and one using quintiles on the distribution of the population-to-provider ratios (referred to as “quintile maps”). A regularly distributed color coding can make outliers stand out excessively, the color scale extends from the lowest 5th percentile to the 95th percentile of the displayed census tracts in the lightest and darkest colors, respectively, with the remaining census tracts represented on a continuous color gradient. In other words, in these gradient maps, the darkest census tracts represent a higher number of people per provider (i.e. lower access). These maps help to visualize the differences in population-to-provider ratio between geographical areas with no absolute cutoff delineated by the grayscale colors.

In contrast, the quintile maps assign each census tract to a quintile of population-to-provider ratio, so that census tracts with a population-to-provider ratio above the 80th percentile are represented as the darkest color. Although this creates absolute cutoffs, it allows for easier visual assessment of parts of the city that have similar levels of access. Using the quintile maps, it was possible to identify “clusters” of lower access census tracts.

**Step 5: Map Population-to-Provider Ratios for Patients with Medicaid**

We created population-to-provider ratios for patients with Medicaid in a similar manner. However, population counts were limited to adults age 18-64 with public
insurance and provider counts were adjusted according to the methods described above. We used the same calculations and mapping techniques as described for the overall population-to-provider ratios.

**Step 6: Map Population-to-Provider Ratios for Uninsured Patients**

We created population-to-provider ratios for patients without insurance in a similar manner. However, population counts were limited to adults age 18-64 without insurance and provider counts were limited to providers in CHCs. We used the same calculations and mapping techniques as described for the overall population-to-provider ratios. As previously described, data for providers outside of Philadelphia was limited to what was available in the SK&A™ database.

**D. Validation of a Simplified Method**

Because the PDPH is interested in monitoring primary care access over time, one of the goals of this project was to determine whether our method could be simplified and still produce an accurate estimate. This hinged primarily on whether any of the stand-alone datasets of providers are comprehensive enough to be used as the only source of provider information. To do this, we compared maps created with our full provider dataset to maps created with the information in SK&A™ alone, as well as the SK&A™ dataset supplemented with CHC data, which is likely to be readily available to the PDPH.

**E. Data Sources**

We relied on five-year estimates (2008-2013) from the American Community Survey (ACS)²⁵ to map population density and demographic factors. Many ACS datapoints are available at the census tract level. Additional community attributes were identified using the 2010 Community Health Database (CHDB)²⁶. This database includes the results of a phone survey administered in Southeastern Pennsylvania by the Public Health Management Corporation. To map provider density and create population-to-

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provider ratios, we used proprietary data from SK&A™, insurer databases, and lists of Federally Qualified Health Centers (FQHC) and FQHC Look-Alikes from the Philadelphia Department of Public Health, the Health Federation, and the Public Health Management Corporation. We chose to use SK&A™ for several reasons. First, it is updated every six months through a telephone survey of practices. Second, it includes information about practices including precise geographic information. Third, although it is proprietary, the cost to purchase data for a small geographic area is modest. Fourth, the database requires much less manipulation than methods requiring the merging of multiple databases (i.e. AMA and NPI files).

Findings

Our findings are focused on the following objectives: describing current geographic access to primary care by neighborhood and identifying areas at greatest risk of insufficient access; and validating simplified methods to measure geographic access to primary care.

A. Identifying Primary Care Practices in Philadelphia

Finding Primary Care Practices

To identify primary care practices across the city, we began with a list of primary care providers from SK&A™, a private company that updates their database approximately every six months. To assess whether the SK&A™ data was missing providers, we compared it to information from the largest private health insurer and a large Medicaid insurer in the region. The creation of practice databases from each of these sources is described in the methods.

Figure 2 details the stepwise process by which we eliminated duplicates and specialty practices, and then verified primary care status by calling each practice. Of the primary care practices identified, 14% appeared only in SK&A™. The original SK&A™ database was missing 21% of the primary care practices in our final validated database.

SK&A™ also included a modest number of practices that were not actively delivering primary care. Ultimately, 71% of the practices we identified via SK&A™ were primary care practices. When SK&A™ was supplemented with insurer provider
directories, even after elimination of duplicates and specialists, the database overestimated the number of practices by approximately 20% (569 versus 460). However, once the practices were verified via phone call, the final number of primary care practices was similar to the original SK&A™ number (460 vs. 513). This suggests that SK&A™ may be a good approximation of the true number of practices in Philadelphia but that is a result of a modest mix of under- and over-counting of practices.

Figure 2. Sources of primary care practice information and reasons for inclusion or exclusion.
Counting Providers per Practice

The original workforce databases were at the individual provider level, which allowed us to estimate a number of providers per practice once we collapsed the databases to the practice level. In order to verify the number of providers per practice and to estimate a full-time equivalent (FTE) count, we conducted a brief phone survey that included questions about the number and type of providers, how many work full time, and whether the practice accepts Medicaid insurance.

Characteristics of primary care practices in Philadelphia that responded to the telephone survey are shown in Table 2. Half of all primary care practices are solo practices – meaning they include just one provider. The largest practice reported 78 providers. Large clinics, most of which are academically affiliated, had difficulty quantifying number of providers at their sites. This is likely due to the part time and variable nature of outpatient clinical time for residents and some teaching faculty physicians. Nearly a third of practices had NPs and/or PAs on staff. Sixty-two percent of practices reported accepting Medicaid, which is similar to nationwide rates of acceptance of Medicaid for new patients. However, in our survey we did not ask specifically about accepting new patients but rather whether they accept Medicaid at all. In addition, 16.5% of practices answered, “do not know” or did not respond to that question.

Table 2. Characteristics of Philadelphia primary care practices.

<table>
<thead>
<tr>
<th>Practice Characteristics (n = 460)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Solo doctor practice</td>
<td>237</td>
</tr>
<tr>
<td>Any NP/PA</td>
<td>150</td>
</tr>
<tr>
<td>Accept Medicaid</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>287</td>
</tr>
<tr>
<td>No</td>
<td>97</td>
</tr>
<tr>
<td>Don’t know or Unknown/Missing</td>
<td>76</td>
</tr>
</tbody>
</table>

27 Decker, S. L. (2012). In 2011 nearly one-third of physicians said they would not accept new Medicaid patients, but rising fees may help. *Health Affairs*, 31(8), 1673-1679.
From the results of our calls, we estimated a FTE provider count per practice. This was based on the number of providers working full time vs. part time, as well as NPs and PAs having somewhat smaller patient panel sizes on average.

**B. Mapping Primary Care Supply in Philadelphia**

*Population Distribution (Density)*

The first step in assessing adequacy of the primary care supply required identifying the location of the population, as well as the location of the primary care providers. To examine neighborhood population, we used data from the American Community Survey (2008-13) to calculate a population density by census tract. The population density map (Map 1) shows that the highest density areas of the city are in West Philadelphia, Center City, and South Philadelphia. Upper Northeast and the Northwest portions of the city tend to have the lowest population density.

![Map 1. Population density, adults age 18 and older per square mile, within 5-minute drive time of census tract centroid, by quintiles.](image)
**Provider Distribution (Density)**

We also mapped the density of providers by census tract (Map 2). Primary care providers are heavily concentrated in Center City, South Philadelphia, and the eastern portion of West Philadelphia, with additional areas of high provider density tracking up Broad Street/Route 611. The Center City and West Philadelphia high-density areas are likely a combination of a large amount of available commercial office space and the presence of multiple academic medical centers, including the University of Pennsylvania in West Philadelphia and Thomas Jefferson University in Center City. The areas of high density along Broad Street farther north likely reflect the locations of Drexel/Hahneman Medical Center, Temple University, and other academic medical institutions.

*Map 2. Provider density per square mile, within 5-minute drive time of census tract centroid, by quintile.*

*Map 3. Population-to-provider ratio, within 5-minute drive time of census tract centroid. Lightest suggests higher access. Darkest suggests lower access.*
University and Einstein Hospital.

**Overall Population-to-Provider Ratios by Census Tract**

To relate the number of providers in a census tract to the need for primary care based on the population, we created population-to-provider ratios. For each of the maps below, the number of providers is calculated based on the FTE count. The population-to-provider ratios across census tracts in Philadelphia vary widely. Map 3 highlights the extremes of highest and lowest ratios. For the city overall, the median ratio is 863:1, well below any established threshold for concerns about access to primary care. However, the lowest access census tracts (below 5\textsuperscript{th} percentile) have a ratio greater than 2609:1, while the ratio in highest access census tracts (above 95\textsuperscript{th} percentile) is more than 10 times lower (252:1). Only nine census tracts have ratios that are greater than 3500:1, the HRSA-designated cutoff for a MUA. This suggests reasonable access when considering the city as a whole, but disparities in access when neighborhoods are compared.

Moreover, census tracts with similar population-to-provider ratios tend to cluster together. This is best seen in a quintile map (Map 4), which shows clusters of higher access and lower access areas across the city. The areas of greatest access are between Broad Street and Front Street from approximately Washington Avenue to Cecil B. Moore Avenue, and in University City just west of the Schuylkill River.

![Map 4. Population-to-provider ratio, within 5-minute drive time of census tract centroid, by quintile. Low access clusters circled in red.](image)
At the other end of the spectrum, several “clusters” of lowest access census tracts emerge. These clusters have five or more contiguous census tracts that fall into the lowest quintile of access. In many cases, census tracts in the second lowest quintile surround these clusters. We display this map several times as a reference point for comparison to the other analyses. We performed a sensitivity analysis with an 8-minute travel time (Map 5), which suggests that the lowest access clusters continue to be relatively undersupplied even if people were willing to travel slightly farther for primary care.

For each cluster, the median population density is less than that of the city overall, which suggests that the lower than average provider density in these census tracts is the determining factor (see Tables 3-5).

Map 5. Population-to-provider ratio, within 8-minute drive time of census tract centroid, by quintile.
<table>
<thead>
<tr>
<th>Location</th>
<th>Census Tracts</th>
<th>Median Density (per sq. mile)</th>
<th>Population: Provider median (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Population</td>
<td>Provider</td>
</tr>
<tr>
<td>Philadelphia</td>
<td></td>
<td>11746</td>
<td>13</td>
</tr>
<tr>
<td>Non-Low Access Areas</td>
<td></td>
<td>12096</td>
<td>15</td>
</tr>
<tr>
<td><strong>Low-Access Clusters</strong></td>
<td></td>
<td>11097</td>
<td>6</td>
</tr>
<tr>
<td>Cluster 1: Southwest</td>
<td>55, 56, 60, 63, 64, 66</td>
<td>10399</td>
<td>6</td>
</tr>
<tr>
<td>Cluster 2: West</td>
<td>81.02, 82, 83.02, 85, 95, 100, 101, 102, 103, 111, 112, 113, 114, 115, 117, 118, 119</td>
<td>13308</td>
<td>6</td>
</tr>
<tr>
<td>Cluster 3: Northwest</td>
<td>253, 254, 255, 262, 263.01, 263.02, 264, 265, 266, 267, 268, 269, 277</td>
<td>10281</td>
<td>6</td>
</tr>
<tr>
<td>Cluster 4: Lower Northeast</td>
<td>292, 293, 294, 298, 299, 300, 301, 302, 309, 311.02, 319, 320, 321, 380, 390</td>
<td>11097</td>
<td>6</td>
</tr>
<tr>
<td>Cluster 5: Greater Northeast</td>
<td>348.01, 348.02, 348.03, 351, 352, 362.03, 363.01</td>
<td>7062</td>
<td>3</td>
</tr>
<tr>
<td>Cluster 6: South Philadelphia</td>
<td>13, 20, 21, 32, 36</td>
<td>17280</td>
<td>6</td>
</tr>
</tbody>
</table>

*Represents 5th-95th percentile
Table 4. Characteristics of lower access clusters as percentage of cluster population

<table>
<thead>
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<tbody>
<tr>
<td>Total population</td>
<td>1,521,076</td>
<td>1227302</td>
<td>293774</td>
<td>25,622</td>
<td>80,977</td>
<td>60,878</td>
<td>74,352</td>
<td>30,587</td>
<td>21,358</td>
</tr>
<tr>
<td>Black or African American</td>
<td>42%</td>
<td>37%</td>
<td>65%</td>
<td>75%</td>
<td>91%</td>
<td>90%</td>
<td>38%</td>
<td>8%</td>
<td>62%</td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>12%</td>
<td>13%</td>
<td>8%</td>
<td>2%</td>
<td>3%</td>
<td>2%</td>
<td>24%</td>
<td>7%</td>
<td>4%</td>
</tr>
<tr>
<td>Median age (among tracts, weighted by tract population)</td>
<td>34</td>
<td>33</td>
<td>35</td>
<td>32</td>
<td>34</td>
<td>41</td>
<td>31</td>
<td>42</td>
<td>33</td>
</tr>
<tr>
<td>Unemployed rate</td>
<td>9%</td>
<td>8%</td>
<td>9%</td>
<td>10%</td>
<td>9%</td>
<td>9%</td>
<td>11%</td>
<td>8%</td>
<td>8%</td>
</tr>
<tr>
<td>Poverty rate (individuals 18-64)</td>
<td>24%</td>
<td>25%</td>
<td>21%</td>
<td>21%</td>
<td>26%</td>
<td>14%</td>
<td>24%</td>
<td>8%</td>
<td>30%</td>
</tr>
<tr>
<td>Insurance (18-64)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Public insurance</td>
<td>23%</td>
<td>23%</td>
<td>26%</td>
<td>27%</td>
<td>27%</td>
<td>24%</td>
<td>29%</td>
<td>10%</td>
<td>33%</td>
</tr>
<tr>
<td>Uninsured</td>
<td>20%</td>
<td>19%</td>
<td>23%</td>
<td>28%</td>
<td>25%</td>
<td>17%</td>
<td>27%</td>
<td>16%</td>
<td>18%</td>
</tr>
</tbody>
</table>
Table 5. Characteristics of lower access clusters as a percentage of City population.

<table>
<thead>
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</tr>
</thead>
<tbody>
<tr>
<td>Total population</td>
<td>100%</td>
<td>81%</td>
<td>19%</td>
<td>2%</td>
<td>5%</td>
<td>4%</td>
<td>5%</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>Black or African American</td>
<td>100%</td>
<td>70%</td>
<td>30%</td>
<td>3%</td>
<td>12%</td>
<td>9%</td>
<td>4%</td>
<td>0%</td>
<td>2%</td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>100%</td>
<td>87%</td>
<td>13%</td>
<td>0%</td>
<td>1%</td>
<td>1%</td>
<td>10%</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Unemployed rate</td>
<td>100%</td>
<td>79%</td>
<td>21%</td>
<td>2%</td>
<td>6%</td>
<td>4%</td>
<td>6%</td>
<td>2%</td>
<td>1%</td>
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<tr>
<td>Poverty rate (individuals 18-64)</td>
<td>100%</td>
<td>84%</td>
<td>16%</td>
<td>1%</td>
<td>5%</td>
<td>2%</td>
<td>5%</td>
<td>1%</td>
<td>2%</td>
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<tr>
<td>Insurance (18-64)</td>
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<td></td>
<td></td>
<td></td>
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<td>Public insurance</td>
<td>100%</td>
<td>79%</td>
<td>21%</td>
<td>2%</td>
<td>6%</td>
<td>4%</td>
<td>6%</td>
<td>1%</td>
<td>2%</td>
</tr>
<tr>
<td>Uninsured</td>
<td>100%</td>
<td>79%</td>
<td>21%</td>
<td>2%</td>
<td>7%</td>
<td>3%</td>
<td>6%</td>
<td>2%</td>
<td>1%</td>
</tr>
</tbody>
</table>
Cluster 1: Southwest Philadelphia

This cluster of six census tracts lies in the southwest corner of the city. Including parts of the Eastwick and Elmwood neighborhoods, it is bordered to the west by Darby and Darby Township, to the south by the Philadelphia Airport, and to the east by a primarily industrial corridor. The majority (75%) of the population in this cluster is Black and younger than the average in the rest of the city (median age 32). Twenty-one percent of non-elderly adults in this cluster live below the poverty line.

Map 6. Southwest cluster population-to-provider ratios, within 5-minute drive time of census tract centroid, by quintile.
Cluster 2: West Philadelphia

With 17 census tracts, this is the largest cluster by both number of tracts and overall population. It is at the western border of the city, between City Line Avenue, West Fairmount Park, and Morris Park. It includes parts of the Morris Park/Overbrook, Haddington/Carroll Park, and Wynnefield neighborhoods. This cluster is also predominantly Black (91%), and 26% of non-elderly adults live below the poverty line.

Map 7. West cluster population-to-provider ratios, within 5-minute drive time of census tract centroid, by quintile.
**Cluster 3: Northwest Philadelphia**

This cluster includes 13 census tracts. It lies between the Wissahickon Valley and Cheltenham Avenue, including parts of four neighborhoods: East Mount Airy, West Oak Lane, Cedar Brook, and East Germantown/ Morton/ Wist. The population in this region is older than the average in the rest of the city (median age 41), and majority Black (90%).

Map 8. Northwestern cluster, population-to-provider ratios, within 5-minute drive time of census tract centroid, by quintile.
Cluster 4: Lower Northeast Philadelphia

This cluster of 15 census tracts lies in the Lower Northeast part of the city on both sides of Oxford Avenue near the northern city borders. It includes parts of the Oxford Circle, Lawncrest/Summerdale, Tacony/Wissanoming, and Mayfair neighborhoods, to the north and west where the Tacony-Palmyra Bridge intersects Interstate 95. This cluster is majority non-white, with 38% identifying as Black, and 24% Hispanic, higher than the city average.

Map 9. Lower Northeast cluster, population-to-provider ratios, within 5-minute drive time of census tract centroid, by quintile.
Cluster 5: Greater Northeast Philadelphia

These seven census tracts lie east of the southernmost border of Pennypack Creek Park, including parts of the Pennypack/Academy Gardens and Holmesbury/Torresdale neighborhoods. Compared to the other clusters, this has the lowest percentage of Blacks and Hispanics (8% and 7%, respectively). It also has the oldest population of all of the clusters, with an average age of 42. It has a relatively low percentage of people insured by Medicaid (10%) and a lower than average rate of uninsurance (16%).

Map 10. Greater Northeast cluster population-to-provider ratio, within 5-minute drive time of census tract centroid, by quintile.
Cluster 6: South Philadelphia/Gray’s Ferry

These five census tracts include areas of southwest Center City and Point Breeze. With a population of 21,358, it is the smallest of all of the clusters. It has the highest rate of poverty with 30% of non-elderly adults falling below the poverty line. African Americans make up 62% of the population.

Map 11. South Philadelphia/Gray’s Ferry cluster population-to-provider ratio, within 5-minute drive time of census tract centroid, by quintile.
Overall Primary Care Supply Compared to Socioeconomic Status

We also explored how income, race, and percent of the population living under the poverty line are associated with the supply of primary care. These analyses are presented as unsmoothed maps, because they are already rates and are not affected by travel. Any areas of overlap seen on these maps do not necessarily suggest any statistical association because of the limitation of small-area analyses and lack of control for other factors.

Reference Map (Map 4). Population-to-provider ratio, within 5-minute drive time of census tract centroid, by quintile.
The relationship between poverty and primary care is complex – poverty is related to poor health status and potential for increased need for primary care, but providers may be less likely to locate their practices in high poverty areas. As expected, in Philadelphia, the areas with the highest poverty rates (Map 12) are also generally the areas of the lowest median income (Map 13). The largest area of poverty is north of Cecil B. Moore Ave., with an additional area of concentrated poverty in the eastern portion of West Philadelphia. The high-poverty area in West Philadelphia overlaps somewhat with the lower primary care access cluster in that part of the city. Interestingly, the clusters in Northwest and Greater Northeast

Map 12. Percent of non-elderly adults living in poverty in each census tract, by quintile.

Map 13. Median household income in each census tract, by quintile.
do not overlap with areas of highest poverty, and the Lower Northeast cluster lies just northeast of a collection of census tracts that have high poverty rates.

Minority status has also been linked with poorer access to primary care. The clusters in West and Northwest Philadelphia heavily overlap with the areas of the city that have the largest Black population (Map 14). Those who identify as Hispanic are concentrated in the Northeast, overlapping with the Lower Northeast cluster (Map 15).

Map 14. Race, percent of people identifying as Black in each census tract, by quintile.

Map 15. Ethnicity, percent of people identifying as Hispanic in each census tract, by quintile.
Some of the Asian population in Philadelphia is also concentrated in the Lower Northeast, but more so in Chinatown and South Philadelphia, where primary care access appears to be less of a concern (Map 16).

Map 16. Race, percent of people identifying as Asian in each census tract, by quintile.
**Medicaid**

**Population-to-Provider Ratios by Census Tract**

For the Medicaid-insured population, geographic access appears to be similar to that of the overall population (Map 17). The median Medicaid-insured population-to-provider ratio is 987:1, and the range from the 5th-95th percentiles is similarly wide (130:1 to 3259:1). The disparity in access to primary care is also in a similar distribution, with the lowest served areas concentrated in West and Southwest Philadelphia, and the lower Northeast.

**Reference Map (Map 3). Population-to-provider ratio, within 5-minute drive time of census tract centroid.** Lightest suggests higher access. Darkest suggests lower access.

**Map 17. Publicly insured population ages 18-64 to Medicaid provider ratios, within 5-minute drive time of census tract centroid.**
As when examining access for the population overall, the quintile map (Map 18) more clearly visualizes the areas of lowest access, particularly in the Lower Northeast and Southwest. Sensitivity analysis with a travel time of eight minutes reinforces those findings. Compared to the distribution of FQHC and FQHC look-alike clinics, which are located primarily in the southern, western, and lower northern sections of the city, the lowest access census tracts have few FQHC and FQHC look-alike clinics.

The location of CHCs outside of the lower access tracts does not indicate that they are poorly located. When the distribution of the Medicaid-insured population is compared to the location of CHCs, the figures show that the CHCs are well distributed to meet the needs of the population.

Reference Map (Map 4). Population-to-provider ratio, within 5-minute drive time of census tract centroid, by quintile.

Map 18. Publicly-insured population ages 18-64 to Medicaid provider ratio, within 5-minute drive time of census tract centroids, by quintile.
(Map 19), many of them do fall in parts of the city with a high density of Medicaid coverage. The existing CHCs are likely preventing the populations with Medicaid in these areas from being even more inadequately served. The CHCs that fall outside of the areas with the highest Medicaid coverage rates tend to be located along public transportation lines. However, in the lower Northeast there does appear to be a paucity of CHCs compared to the number of census tracts with high Medicaid coverage rates.

**Uninsured Population-to-Provider Ratios by Census Tract**

Compared to the population insured by Medicaid, those without

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**Map 19. Rate of publicly-insured adults, within 5-minute drive time of census tract centroid, by quintile.** Flags indicate the location of CHCs.

**Map 20. Uninsured (age 18-64) population-to-provider ratio, within 5-minute drive time of census tract centroid, by quintile.**
insurance have even fewer options for primary care. People without insurance are less likely to have a usual source of care, more likely to seek care in the emergency room, and less likely to be up to date on preventive medicine. Because very few private practices accept many patients without insurance, we limited our analysis to the CHCs within the city. This assumes that people without insurance do not access primary care in any other settings and do not travel across city borders to get primary care. Therefore, the uninsured census tracts along the borders appear to have particularly low access (Map 21).

*Alternative Data Approaches to Mapping*

Because one of the goals of this project is to create a replicable process for monitoring primary care access, we tested options to eliminate the extensive data validation process described in this report, which involves a significant amount of staff time. Because we started with the SK&A™ database, and the overall number of primary care practices in SK&A™ approximates the number of clinics we verified to be primary care, we created population-to-provider ratios that are based on SK&A™ data alone. The results look similar to those obtained from our verified provider data. However, an additional area of lower access census tracts emerged just east of Fairmount Park.
Because the SK&A™ database did not include approximately 50% of the CHCs, we explored whether supplementing SK&A™ data with easily available CHC locations would improve the estimates. Information on CHC locations is readily available to the PDPH. Once the SK&A™ data was supplemented with the CHC information (Map 22), the map appears even more similar to the reference scenario with the validated primary care locations. The lower access cluster east of Fairmount Park disappears. This suggests that for future iterations, using SK&A™ data supplemented with CHC locations may be a logical way to decrease the resources required without sacrificing significant accuracy.


Map 22: Population-to-provider ratio, SK&A™ data plus public CHCs, 5-minute drive time.
Conclusions and Recommendations

Summary

Over the past decade, Philadelphia has experienced significant improvements in some health indicators, including life expectancy and premature death\textsuperscript{28}. Despite that, the city still lags behind other major metropolitan areas on many health goals. Of all of the segments of the health care system, primary care has been shown to have the largest effect on public health, and monitoring primary care access is an essential public health function. In this report, we assess the current state of primary care access and identify areas where there may be a deficiency of primary care.

Conclusion: Primary care access in Philadelphia varies greatly by neighborhood. As measured by adults per primary care provider, the highest access neighborhoods have ten times more access than the lowest access neighborhoods.

We found that the overall population-to-provider ratio in the city for primary care is 863:1. Compared to established benchmarks\textsuperscript{29}, this suggests that Philadelphia has a sufficient supply of primary care when considering the city overall. However, when comparing relative access across different neighborhoods, a different picture emerges. The population-to-provider ratios range from approximately 250:1 to over 2600:1. The lowest access census tracts tend to cluster together.

Based on these findings, we recommend:

1) Health care delivery systems, insurers, public health entities, and organizations that operate community health centers should prioritize these six low-access clusters as they assess their current and future primary care services.


\textsuperscript{29} Health Resources and Services Administration. 2015. \textit{Primary Medical Care HPSA Designation Overview}. Available at: http://bhpr.hrsa.gov/shortage/hpsas/designationcriteria/primarycarehpsaoverview.html. Accessed Feb 17, 2015.
2) The Philadelphia Department of Public Health, with support from public health and health care delivery stakeholders, should use the methods in this report as a guide for reassessing primary care access on a biennial basis to inform neighborhood and city-wide planning efforts.

3) Further research is needed to evaluate other aspects of primary care access, such as wait times, transportation, acceptance of Medicaid and the uninsured, and patient preferences. Particular attention should be focused on the 6 low-access clusters to verify the areas of highest priority for investments in primary care.

Each of these recommendations is explained in further detail below.

Recommendation 1: Health care delivery systems, insurers, public health entities, and organizations that operate community health centers should prioritize these six low-access clusters as they assess their current and future primary care services.

Based on groups of census tracts that fall into the lowest quintile of population-to-provider ratios, we identified six clusters of lowest access: Southwest, West, Northwest, Lower Northeast, Greater Northeast, and South Philadelphia/Gray’s Ferry. Even when the drive time radius is increased to eight minutes, these areas of lowest access persist, reinforcing their relative isolation from primary care services. Even in the lower access areas, however, the ratios are better than some of the established national benchmarks for critical shortages\(^30\). The large disparities between neighborhoods coupled with a relatively high number of primary care providers for the city overall suggests that the distribution of providers may be more of a problem than the absolute number. In that way, Philadelphia may be mirroring what is happening in the rest of the

country: despite years of reports of a primary care shortage, the latest evidence suggests that urban areas are relatively oversupplied, and rural areas undersupplied\textsuperscript{31}.

Further research would be needed to determine the cause of the relative undersupply in these areas, but it is likely the result of multiple factors. One possibility is that economic and demographic factors, such as the higher than average uninsured rates and higher percentages of racial and ethnic minorities, are either overtly or subconsciously affecting where primary care providers choose to locate. Geographic factors that create physical isolation, such as the location of the Southwest Cluster between the Philadelphia International Airport and surrounding industrial area on the Delaware River, may also be contributing to decreased access. Commercial and regulatory factors such as rent prices, available office space, and zoning laws may also play a role. These factors and others are likely to be inter-related and explain both each other and the available primary care supply.

Regardless of the cause of primary care maldistribution, multiple stakeholders should play a role in further defining primary care access problems and ameliorating them. Many of these stakeholders have already considered primary care supply in their work, but information was previously not available at a fine geographic level. This presents both new opportunities and challenges. Health care delivery systems, including hospitals and ambulatory care networks, should consider the distribution of primary care services when planning for expansion of current primary care sites or the development of new offices. In the era of accountable care organizations and integrated delivery networks, even systems that were previously focused primarily on inpatient services will be devoting more effort to ambulatory care, and could direct their investments into areas that are most underserved. Similarly, existing community health center networks, which play an essential role in providing access to primary care for the underserved, may need to consider whether expansion of their existing services or providing support for other organizations in underserved areas would be of value to Philadelphia’s population. Insurers could assist by providing data on primary care practice patterns and utilization in these areas of relatively low supply.

Recommendation 2: The Philadelphia Department of Public Health, with support from public health and health care delivery stakeholders, should use the methods in this report as a guide for reassessing primary care access on a biennial basis to inform neighborhood and city-wide planning efforts.

One of the goals of this project was to develop a method by which the Philadelphia Department of Public Health could monitor primary care access in the future. Full implementation of the Affordable Care Act (ACA) is likely to result in changes in the primary care landscape. Medicaid expansion, with the accompanying increase in demand for primary care by the newly insured, could have major implications for the primary care delivery system. The effects of insurance expansion will likely take several years to become fully apparent. Other ACA-related programs that are designed to encourage innovation in care delivery, like ACOs, are also likely to reshape primary care in the city. It is also essential to evaluate whether any policies designed in response to primary care inequity across the city are having their intended effect.

Replication of this work would require: 1) an updated database of current primary care providers, 2) updated population information, 3) sufficient expertise in data management and statistics to re-run the analysis using the already developed statistical code. Although we have provided a method, we expect that future efforts could improve upon this first attempt, especially through investments in improving data on primary care providers and populations.

Updated Data on Primary Care Providers

Efforts to monitor primary care access on the neighborhood level require a comprehensive, high-quality assessment of number of primary care providers and their locations. As we have shown, the SK&A™ data supplemented with local CHC data are a reasonably accurate approximation of the number and locations of primary care providers in the city. Similar data sets, such as the AMA Masterfile, have been used to study the characteristics of physicians, however have proven less valuable to study practice location and characteristics at a small-area level.
While we found SK&A™ data supplemented with local CHC data sufficient for assessing provider supply at a neighborhood level, additional data could help to paint a clearer picture of primary care supply in Philadelphia. PDPH could encourage government to exercise their regulatory authority and collect information on primary care providers which could supplement what is known from the SK&A™ data. Licensing authority for physicians and physician assistants rests with the State Board of Medicine, and for nurses with the State Board of Nursing. Periodic licensing is one of the only times in which providers are legally required to register with the state.

Recognizing this opportunity, HRSA has recommended a minimum data set (MDS) be collected by the state medical licensing boards. The MDS includes demographic information as well as practice location information that would allow additional insight into the practice habits of individual providers. Current information collected in Pennsylvania is insufficient to conduct neighborhood-level analyses. By modifying the survey to include the full MDS and making responses mandatory for licensure, Pennsylvania would have a comprehensive, frequently updated database. A similar approach could be taken with nursing licensure. Data on payer mix, practice hours, and other provider-specific demographic information could be used to supplement the approach we have described and provide a more detailed picture of primary care supply.

Additionally, the PDPH could encourage the state to develop an all-payer outpatient medical claims database. An all-payer claims database provides claims data for all patients seen in a geographic area, in this case the state of Pennsylvania. This would allow assessment of primary care supply and utilization to include travel patterns of patients in the analyses. By assessing if patients access care close to home or proximal to another location, such as their work, those studying supply could better understand the true underlying population accessing care in that area. Pennsylvania already has a database that includes information on all inpatient services and outpatient procedures, collected from hospitals and ambulatory surgical facilities. The organization that maintains this database, the Pennsylvania Health Care Cost Containment Council.

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Containment Council (PHC4), is currently working toward developing an all-payer claims database\textsuperscript{33}.

\textit{Updated Population Data}

Basic population data is readily available through the American Community Survey. For a more nuanced view of the effect of primary care, PDPH might coordinate with the Public Health Management Corporation to ensure inclusion of questions regarding the availability of primary care services. Over-sampling of low supply areas could be considered to develop better overall measures of access. The access to health care module of the Medical Expenditure Panel Survey (MEPS), a nationwide survey of households on health care expenditures and utilization, could serve as a source for survey questions about access to primary care.

\textit{Data Management Expertise}

We designed our process to result in a statistical software program that could re-run the same analyses on updated data sets, as long as the data was in the same format. Because exact matching of location data was important in this process, PDPH would need to ensure that they have sufficient data management expertise to de-duplicate and standardize any primary care provider database they choose to use going forward.

\textit{Recommendation 3: Further research is needed to evaluate other aspects of primary care access, such as wait times, transportation, acceptance of Medicaid and the uninsured, and patient preferences. Particular attention should be focused on the 6 low-access clusters to verify the areas of highest priority for investments in primary care.}

The scope of this project was limited to the geographic aspects of primary care. However, we recognize that primary care access is multidimensional. As defined by the U.S. Health Resources and Services Administration (HRSA), an adequate primary care provider supply must include the right number of providers, in the right place, at the

\textsuperscript{33} All-Payer Claims Database. nd. Interactive State Map. http://apcdcouncil.org/state/map/Pennsylvania Access Feb 1, 2015.
right time\textsuperscript{34}. The scope of this project addressed some, but not all, of these elements. While we have identified areas at risk for insufficient primary care based on number of providers, a broader characterization of primary care in these parts of the city is essential for determining where interventions to expand primary care are most needed and could be most effective.

\textit{Right Number}

The question of “how many primary care providers are there?” requires more than just counting up the number of clinicians. It requires having accurate information on the type of providers, the scope of care that they provide, and how much they work. We used one of the best available sources of data on primary care providers, and attempted to validate that information with our own independent data collection. Despite that effort, our results are still an approximation because of the constantly changing nature of medical practice, challenges in precisely measuring the number of FTEs within a practice, and a number of assumptions that we needed to make that can lead to small amounts of over- or under-counting (see Table 6).

\begin{table}[h]
\centering
\begin{tabular}{|l|l|}
\hline
\textbf{Over-count} & \textbf{Under-count} \\
\hline
\begin{itemize}
\item Including family physicians, who may spend some time caring for children or pregnant women
\item Counting any patient care done by those identified as primary care, although they may provide some specialty services
\item Counting any providers who provide primary care less than half time as 0.5 FTE
\end{itemize} & \begin{itemize}
\item Excluding specialties that may provide a small amount of primary care (e.g. OB/GYN)
\item Excluding practices that have a sub-specialty in their name because they may provide some primary care
\item Counting any providers who provide primary care less than 4 full days per week as 0.5 FTE, even if they provide primary care more than that
\end{itemize} \\
\hline
\end{tabular}
\caption{Possible sources of over- and under-counts of providers.}
\end{table}

Considering that large portions of the city appear to have an adequate number of providers, collecting more detailed information on provider numbers and practice patterns for the entire city may not be an efficient use of resources. Targeted efforts in

the six geographic clusters we identified may be more practical and informative for decision-making. More detailed data could be collected in a variety of ways, including audit studies (where simulated patients call to request appointments, also known as “secret shopper” studies\textsuperscript{35}), practice surveys, qualitative interviews with community members and providers, and analyses of primary care claims. Audit methodology can explore the number of providers that are available to certain populations, such as those with a particular insurance type or those requiring special services. It could be the best way to explore Medicaid acceptance in a nuanced fashion without sacrificing response rate. Audit could also help to assess the availability of language services, which can be a major barrier to care and effectively reduce primary care choice for those who need or prefer primary care in a language other than English. Primary care claims could provide information on utilization and payer mix.

Even with an accurate count of providers, the “right” number is difficult to determine. Age, chronic disease prevalence, injury rates, and socioeconomic factors affect population demand for primary care. On the other hand, provider efficiency needs to be factored in as well. With new models of primary care delivery rapidly evolving, the target numbers of providers will likely change over time.

\textit{Right Place}

As with the number of providers, provider location is complex. Analyzing the spatial element of primary care requires understanding, for example, the population and their preferences for providers near home or work, transportation networks, geographic barriers to travel such as bodies of water, and neighborhood safety. Future work to examine patient primary care travel patterns to understand both expressed and revealed preferences for primary care locations could also be used to help characterize these areas. Many patients, especially those who are of lower socioeconomic status, rely on public transportation to access primary care. Transportation network analyses were beyond the scope of this study, but should be explored as new tools become available.

\textsuperscript{35} Rhodes, K. V. et al. (2014). Primary care access for new patients on the eve of health care reform. \textit{JAMA Internal Medicine}, 174(6), 861-869.
**Right Time**

There are a variety of ways to measure time in the context of access to primary care. Is the clinic open extended hours, for those who are unable to take time off of work during the day? When is the next available appointment? How long does it take to get through to the clinic on the phone to even schedule an appointment? Some of these can also be answered through audit methodology. The time element that is captured through an audit study reflects what actually happens in the real world, not what gets reported. An audit-type study that oversamples practices in the areas deemed at-risk could provide valuable insight into the temporal elements of access to care in those areas.
Appendix

Appendix 1. Maps

- **Map 1.** Population density, adults age 18 and older per square mile, within 5-minute drive time of census tract centroid, by quintiles.
- **Map 2.** Provider density per square mile, within 5-minute drive time of census tract centroid, by quintile.
- **Map 3.** Population-to-provider ratio, within 5-minute drive time of census tract centroid.
- **Map 4.** Population-to-provider ratio, within 5-minute drive time of census tract centroid, by quintile.
- **Map 5.** Population-to-provider ratio, within 8-minute drive time of census tract centroid, by quintile.
- **Map 6.** Southwest cluster population-to-provider ratios, within 5-minute drive time of census tract centroid, by quintile.
- **Map 7.** West cluster population-to-provider ratios, within 5-minute drive time of census tract centroid, by quintile.
- **Map 8.** Northwest cluster, population-to-provider ratios, within 5-minute drive time of census tract centroid, by quintile.
- **Map 9.** Lower Northeast cluster, population-to-provider ratios, within 5-minute drive time of census tract centroid, by quintile.
- **Map 10.** Greater Northeast cluster population-to-provider ratio, within 5-minute drive time of census tract centroid, by quintile.
- **Map 11.** South Philadelphia/Gray’s Ferry cluster population-to-provider ratio, within 5-minute drive time of census tract centroid, by quintile.
- **Map 12.** Percent of non-elderly adults living in poverty in each census tract, by quintile.
- **Map 13.** Median household income in each census tract, by quintile.
- **Map 14.** Race, percent of people identifying as Black in each census tract, by quintile.
- **Map 15.** Ethnicity, percent of people identifying as Hispanic in each census tract, by quintile.
• **Map 16.** Race, percent of people identifying as Asian in each census tract, by quintile.

• **Map 17.** Publicly insured population ages 18-64 to Medicaid provider ratios, within 5-minute drive time of census tract centroid.

• **Map 18.** Publicly-insured population ages 18-64 to Medicaid provider ratio, within 5-minute drive time of census tract centroids, by quintile.

• **Map 19.** Rate of publicly-insured adults, within 5-minute drive time of census tract centroid, by quintile.

• **Map 20.** Uninsured (age 18-64) population-to-provider ratio, within 5-minute drive time of census tract centroid, by quintile.

• **Map 21.** Population-to-provider ratio, SK&A™ data alone, 5-minute drive time.

• **Map 22.** Population-to-provider ratio, SK&A™ data plus public CHCs, 5-minute drive time.