

Key Findings:

- **Population size and density are associated with higher levels of COVID19 Cases**
- **Long commuting practices and use of public transportation associated with many hotspot counties**
- **Early implementation of mitigation strategies likely assisted with potentially high risk counties like Centre and Allegheny**

Over the past two months we have seen geographic variation in the spread of COVID19 throughout the commonwealth. The same disparities in nationwide spread have led researchers to question the factors which may encourage or inhibit the spread of this novel coronavirus. Some of these factors may include population size and population density (CDC 2020). Population size and density are also important components of Governor Wolf's reopening plan: "A target goal for reopening has been set at having fewer than 50 new confirmed cases per 100,000 population reported to the department in the previous 14 days" (Wolf 2020). Beyond population size and density in overall counties or jurisdictions, group quarters such as nursing and personal care homes and correctional facilities are also vulnerable to COVID19 across Pennsylvania (PaDOC 2020; PaDOH 2020). The congregate nature of group quarters likely increases risk of infection among residents. Using data from the American Community Survey (2014-2018) we explore the aspects of population size, density, and living and working conditions that are associated with differences in COVID19 rates across counties in Pennsylvania.

Number of Confirmed Cases

As of April 26, 2020, the PaDOH reported a total of 41,165 confirmed cases throughout all counties in the state. This is an increase of 26,606 cases since our last brief on April 7, 2020. At this time, cases range from 1 confirmed (Cameron, Sullivan, and Warren) to 11,152 confirmed in Philadelphia County. Over 50% of confirmed cases (2,1847) are still located in the Philadelphia-Camden-Wilmington Metropolitan Statistical Area, which includes Bucks, Chester, Delaware, Montgomery, and Philadelphia Counties.

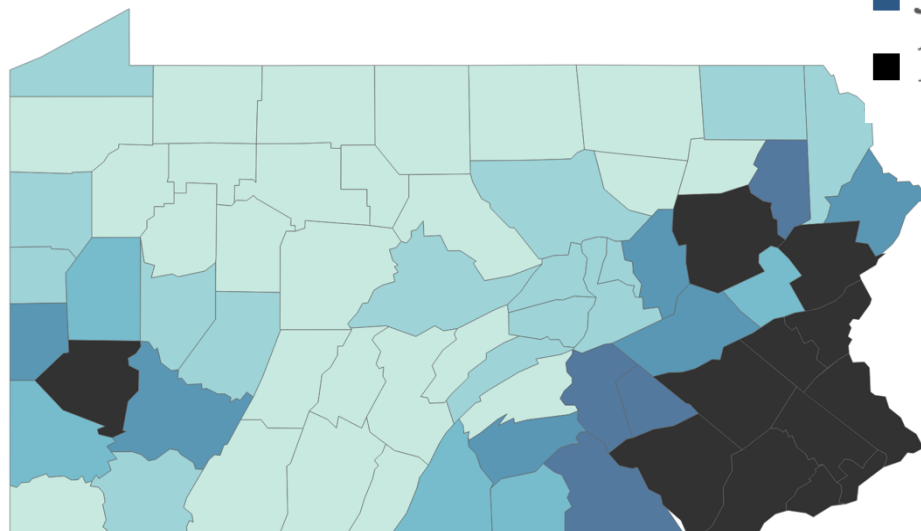
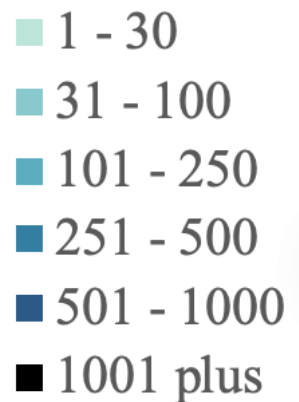


Figure 1 Confirmed Cases by County 4/26/2020

Prevalence Rate & Population Density

Figure 1 displays the number of cases by county and clearly demonstrates that counties with larger populations also have larger numbers of COVID19 cases. However, we can examine the difference in prevalence rates across the same geographies to understand which areas are truly facing the greatest impact. Figure 2 highlights these differences. The prevalence rates range from 2.5 cases per 100,000 in Warren County to 717.3 in Lehigh County.

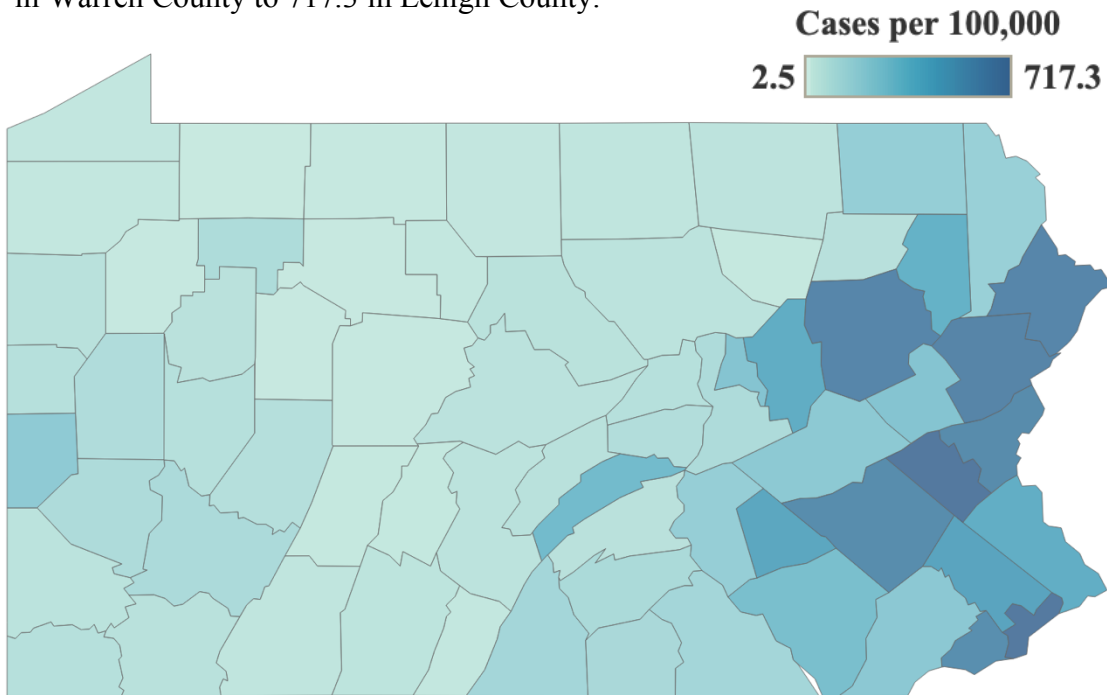


Figure 2 COVID19 Positive Cases per 100,000 by County, PA, 2020

Table 1 displays the counties with the largest and most densely clustered populations. In looking at these figures we see that Lehigh county is not one of the counties with the largest populations but is the 5th most densely populated county at 1,066.3 people per square mile. Conversely, Allegheny County has the second largest population in Pennsylvania and is the 4th most densely populated county. Although it has considerable number of cases, it only ranks 10th in number of positive COVID19 cases (1,211) and 29th in cases per 100,000 (98.8) when compared to other counties. Thus, population size and population density are associated with the spread of COVID19 but are clearly not the only components explaining variation in prevalence across the commonwealth

Table 1 Population Size and Density by County, PA, 2020

Population Size	Population Density per Square Mile
Philadelphia (1,584,138)	Philadelphia (11801.4)
Allegheny (1,218,452)	Delaware (3072.3)
Montgomery (828,604)	Montgomery (1715.7)
Bucks (628,195)	Allegheny (1668.8)
Delaware (564,751)	Lehigh (1066.3)

Living & Riding in Close Proximity

Some areas may face larger numbers of COVID19 positive residents due to other factors associated with population distribution and movement. Types of living quarters (correctional facilities, dorms, nursing homes, etc.) and use of public transportation, both of which are associated with the immediate proximity of people to one another, are also likely to play a role. For instance, Beaver County has a population of 164,742 and 379 people per square mile, but has the largest number of cases per capita (219.3), due to an outbreak in a nursing home there (Kurutz 2020).

Table 2 displays the proportion of residents living in group quarters and proportion using public transit to commute for work. These data are from 5-year ACS estimates (2015-2019) and thus, previous to the onset of COVID19. All counties with the largest proportion of residents in group quarters are in rural counties according to the Centre for Rural Pennsylvania (CRP 2020) and according to a recent report by the Pennsylvania State Data Center, Forest County has one of the largest proportions of individuals 60 or older residing in nursing homes (PaSDC 2020). However, the cases per capita for these counties are not amongst the highest, ranging from 48.4 per 100,000 in Huntingdon to 95.2 in Forest County. Relatedly, Centre County, home to the largest residential campus of the Pennsylvania State University, may have escaped a higher prevalence of COVID 19 despite its relatively high proportion of residents in group quarters because the university discouraged students from returning after Spring Break in March 2020.

Table 2 Proportion in Group Quarters and Public Transit Use by County, PA, 2020

Highest Proportion in Group Quarters	Highest Proportion Using Public Transit
Forest (56.3%)	Philadelphia (25%)
Union (20.9%)	Delaware (10.5%)
Huntingdon (12.0%)	Allegheny (9.5%)
Centre (11.15%)	Montgomery (5.4%)
Greene (9.6%)	Centre (5.4%)

Unsurprisingly, workers in more urbanized locations utilize public transit options for their commute to work more frequently. 3/5^{ths} of these counties are also in the top 10 counties with the greatest number of COVID19 cases per capita. Philadelphia, Delaware, and Montgomery Counties all have 450 or more cases per 100,000 residents. However, the cases per capita in Allegheny and Centre Counties are much lower (98.8 and 50.2 respectively). Again, timing may be a large function of the limited number of cases in Centre County given the high proportion of group quarter residents and reliance on public transportation.

Distance & Time to Work

Looking at Figure 2 again, we can see that there are a number of “hotspot” counties in the northeast of the state, outside of the Philadelphia-Camden-Wilmington Metropolitan Statistical Area. These include Northampton, Pike, Luzerne, and Monroe Counties. They have prevalence rates of 600.7, 628.9, 631.7, and 635.5 per capita, respectively. None of these counties make the top county lists for population size, population density, proportion residing in group living quarters, or use of public transportation. However, a number of the counties most afflicted by COVID19 border New York and New Jersey, states with very high numbers of COVID19 cases. One way to demonstrate connection between these counties and other impacted areas in neighboring states is to look at commuting flows between these counties in Pennsylvania and places outside of the state.

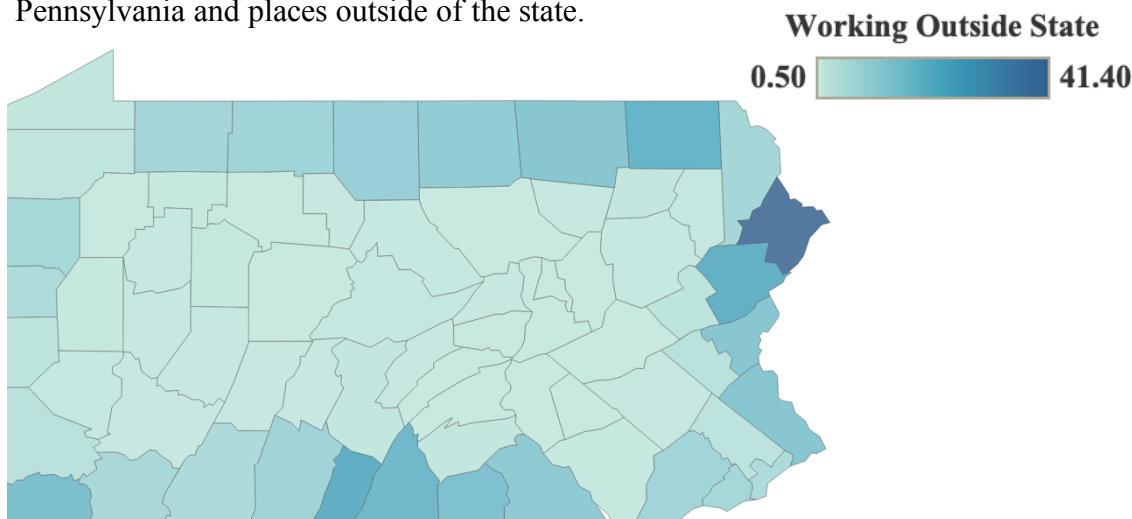


Figure 3 Percent of Workers Working Outside of State by County, PA, 2020

Table 3 Commuting Minutes by County PA, 2020

Figure 3 displays the percent of workers who work outside the state of Pennsylvania. This proportion ranges from 0.5% in Elk County to 41.4% in Pike County. The proximity of Pike County to both New York and New Jersey and the number of residents working out of state likely contribute to the prevalence rate of 628.9 cases per 100,000 for the county. Monroe County, which also borders New Jersey has 22.2% of workers employed out of state and a COVID19 prevalence rate of 635.5 per 100,000.

Average Minutes Commuting
Pike (45)
Monroe (39.1)
Philadelphia (33.4)
Carbon (33.3)
Perry (33.1)

Table 4 Top Proportion Working Out of County PA, 2020

Works Out of County
Perry (65.2)
Carbon (57.1)
Armstrong (53.6)
Juniata (47.7)
Northumberland (46.6)

Tables 3 and 4 displays the average number of minutes a worker commutes and proportion of workers that work outside of their county of residence. All of the counties with large commute times, except for Perry County, have a prevalence rate of 250 cases or more with a range of 56.6 in Perry to 707.8 in Philadelphia. Similarly, the prevalence rates among counties with large cross county commuters range from 56.6 in Perry to 317.6 in Juniata. Interestingly, all these counties are rural.

Policy Implications

As the state looks to meet the benchmarks provided in Governor Wolf’s plan to reopen Pennsylvania, it is important that we understand the difference in case prevalence across the commonwealth and how communities are connected to one another. There is overlap between county COVID19 prevalence and county population distribution and movement. Although cases are higher in larger and more urbanized locations, these are not the only population factors at work. Allegheny County, for instance, is both large in population size and density, and a significant proportion of the county uses public transit, but the case prevalence rate is much smaller than many counties in the eastern part of the state. Notably, Allegheny County has a smaller proportion of its population in group quarters, fewer commuters crossing state borders and much less proximity to other areas with high prevalence of cases.

One aspect that is not directly measured here but that is also important to consider when looking at the distribution of COVID19 cases across the commonwealth is the “timing and extent of community mitigation measures” (CDC 2020). When the first mitigation efforts were implemented on a county by county basis there were few cases confirmed in the state, but already geographic differences were evident. Initial closures began in Montgomery County on March 12 when the Philadelphia area had 17 confirmed cases. On March 14 the state’s total case county had almost doubled and closures were extended to Delaware County. Two days later bar and restaurant closure directives were made for Allegheny, Bucks, and Chester Counties. Allegheny County at this time had 5 confirmed cases. Philadelphia County had 8 confirmed cases, but the surrounding counties in the metropolitan area were already reporting 44 cases. Stay at home orders were issued for Allegheny, Bucks, Chester, Delaware, Monroe, Montgomery, and Philadelphia counties on March 23, at which time Allegheny county had 48 cases, whereas there were almost 400 cases in the Philadelphia MSA. Given the greater reliance on public transit and proportion of residents commuting outside their counties in the areas surrounding Philadelphia, spread of COVID19 had likely begun accelerating and spreading prior to implementation of mitigation measures.

Acknowledgements

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About the Network:

The Pennsylvania Population Network (PPN) is a visible program of demographic and health research, application, and outreach focusing on population characteristics and change in Pennsylvania, the United States and the world.

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