ABSTRACT

EXAMINING PAYER-MIX AS A SOURCE OF DECLINES IN NUMBER OF
RESIDENTS IN NURSING HOMES DURING THE COVID-19 PANDEMIC

by Elliott Crummer

COVID-19 has caused an extreme decline in the number of residents of nursing homes. I investigate the causes of this decline and estimate the effect of different sources that may be associated with this decline in the state of Ohio. Specifically, I analyze how payer-mix is associated with a decline in occupancy due to healthcare policy changes during the pandemic and the suspension of surgeries in March of 2020. I use linear regression to estimate the impacts that the presence of a COVID-19 case and Medicare dependency had on the decline in number of residents. I show that the presence of a COVID-19 case is the primary driver of a decline in occupancy, but a high Medicare dependency also contributes to the decline. These results have implications in the analysis of the impact the pandemic has had on occupancy in nursing homes in Ohio and the U.S., and implications for future questions on financial impacts of the pandemic and the future of the nursing home industry after the COVID-19 pandemic.

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RESIDENTS IN NURSING HOMES DURING THE COVID-19 PANDEMIC

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# I. Introduction

COVID-19 arrived in the United States in January 2020, and the first reported death occurred in Kirkland, Washington in early March (NYT 2020). One of the first highly publicized outbreaks of cases that overwhelmed medical resources was at the Life Care nursing facility in Kirkland (NYT 2020). This gave rise to early discussion of the vulnerability of nursing facilities to COVID-19 due to the age of residents and congregate living arrangements, given that COVID-19 can cause severe symptoms in older adults, and it is a respiratory disease that spreads through close contact (NYT 2020; CDC 2020). The U.S. government responded by shifting resources and policy to support nursing facilities, including supporting infection control protocols and acquiring personal protective equipment (NYT 2020). Despite preventative action, the disproportionate effect on nursing homes became more clear as time went on; as of February 12th, 2021, nursing homes made up just 5% of COVID-19 cases, but accounted for 34% of deaths (NYT 2021).

As the pandemic impacted nursing homes, the number of residents in nursing homes declined drastically. This drew attention to the shift in this industry, with popular media reporting on how COVID-19 was impacting nursing homes and affecting how individuals think of nursing homes during a pandemic. Early reporting showed that average occupancy in nursing homes declined as much as 10 percentage points (PP), an amount that experts say has not been seen in recent history (National Investment Center for Seniors Housing & Care, 2020). The causes of this decline can be summarized as three main sources: residents and their family deciding to not admit or to remove themselves or a loved one from a facility, residents no longer being admitted for post-acute care due to healthcare policy changes in response to COVID-19, and deaths due to the COVID-19 virus. Currently, there is no conclusive research into estimating how much each of these sources impacted the decline in number of residents.

In this paper, I investigate these sources of the decline in number of residents due to the COVID-19 pandemic and estimate the impact that each source had. Specifically, I examine the association between payer-mix and the change in number of residents because of the link between Medicare dependency and changing healthcare policy during the pandemic. As surgeries were cancelled and became less common when reintroduced, I expect nursing facilities

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dependent on these residents to have more extreme declines in occupancy. I use regression analysis to isolate the payer-mix effect from the decline due to the public reporting of a COVID-19 case in individual facilities.

I combine state and national-level data from 2019 and 2020 to identify the key variables, payer-mix, COVID-19 cases, and number of residents. I include additional 2017-2019 datasets to account for other controls that could impact the decline in number of residents. This analysis uses 674 nursing facilities in the state of Ohio that reported daily census information throughout the first three quarters of 2020. I use linear regression analysis to isolate and estimate the effect of Medicare dependency and COVID-19 cases on declines in number of residents. I find a statistically significant relationship in both cases and conclude that the impact of having at least one COVID-19 case to be more significant in explaining declines in number of residents than payer-mix. These results contribute to the general analysis of the impact of COVID-19 on the U.S. healthcare system and nursing homes, as well as to discussion on the future of nursing homes after the COVID-19 pandemic.

## II. Background

The first case of COVID-19 in Ohio was reported on March 9th, 2020. A state of emergency was declared on the same day (State of Ohio 2020). This began a series of orders from the Ohio state government and Ohio Department of Health (ODH) attempting to limit the spread of the virus. On March 11th, all nursing homes were closed to non-essential personnel, and on March 13th to all visitors. On March 17th, all elective surgeries were cancelled in the state. On March 22nd, a stay-at-home order was enacted (State of Ohio 2020). As these orders were put in place, the lives of residents of Ohio nursing facilities changed dramatically to protect them from COVID-19, but the disease continued to infect those in nursing homes; many of the cases and deaths early in the pandemic occurred among nursing home residents.

These changes, and the public reporting of them, changed the decision-making process for older adults and their family on whether to admit themselves or a loved one to a nursing home. Nursing homes across the country saw significant declines in the number of residents in March and April of 2020, the beginning of the pandemic. A July 2020 news release from the National Investment Center for Seniors Housing & Care (NIC) reported that on average,

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occupancy in U.S. nursing homes fell from 84.7% in February to 78.9% in April of 2020, a drastic change for this industry (NIC, 2020). Figure 1 shows this trend for the state of Ohio according to the Payroll Based Journal (PBJ) for late 2019 and early 2020. The average number of residents fell approximately 8% in Ohio nursing homes over the months of March, April, and May and stayed at this level through September 2020.

This decline in number of residents comes from three main sources. First, individuals and family members choosing not to admit themselves or a loved one to a facility during the pandemic or choosing to remove themselves or a family member from a facility. Both these decisions likely stem from fear of infection of COVID-19 in a nursing facility, as it was widely reported early in the pandemic that older adults are more at risk and nursing homes were the sites of outbreaks. This change in decision making could also come from a change in the quality of life in nursing homes, as visitations and group activities were suspended in favor of social distancing and increased isolation of residents (CMS, 2020). Second, deaths of residents due to the virus. Older adults are more likely to die from the COVID-19 virus, and nursing homes in Ohio saw many deaths in facilities throughout the pandemic (ODH, 2020). Third, fewer residents being admitted to facilities due to the suspension of elective surgeries. When older adults get surgery, they sometimes need skilled nursing care during their recovery and will be admitted to a nursing home for a short-term stay. As fewer surgeries were being performed, fewer residents were admitted to nursing homes and this contributed to the decline in number of residents. Per CMS guidelines through the early months of the pandemic, the presence of COVID-19 case did not impact facility decision making on admitting residents. No restrictions were put in place to limit the intake of residents, and CMS advised that facilities continue to admit residents as they usually would (CMS, 2020).

In this analysis, I investigate these causes of the decline in number of residents and the role that payer-mix played in the decline. Payer-mix is a facility characteristic defined as the percent of residents paying for services with different payer sources, typically under three broad categories: Medicare, Medicaid, and private insurance or other payment. Medicare is a government insurance program that typically covers adults over 65, regardless of income; Medicaid is a government assistance program that covers medical expenses for low-income individuals, regardless of age (U.S. Department of Health and Human Services). The

private/other payment category includes all other payer sources, including private insurance, private savings, and veteran benefits. In the U.S. in 2019, 62% of nursing home residents paid with Medicaid, 12% with Medicare, and 26% with private insurance or another form of payment (KFF). Medicare does not cover long-term stays in nursing homes due to just a 20-day full benefit period, followed by an 80-day partial benefit period. Instead, it covers short-term skilled care under certain conditions, typically for post-acute care after an injury, illness, surgery, or another major medical event that includes hospitalization (CMS). Medicaid and private insurance cover long-term stays, so payer-mix gives an indication of the length of stay of residents and reason for admittance.

For the purposes of this analysis, payer-mix is used as a proxy for the reason for admittance and Medicare residents are assumed to be more likely to be admitted for post-acute care after a surgery. This relationship is important during the COVID-19 pandemic because of the suspension of elective surgeries. I expect that facilities dependent on Medicare-paying residents would experience more extreme declines in number of residents due to the suspension of surgeries from March 17th to April 22nd in Ohio. Figure 2 graphs the decline in number of residents and differentiates between nursing homes of different Medicare dependency levels. This confirms the intuition that facilities more dependent on Medicare experienced, on average, higher percentage declines in number of residents, and gives preliminary evidence of the relationship explored in this analysis.

The presence of a COVID-19 case on the ODH dashboard is used as a proxy for impact of the pandemic on the decision-making process for admittance to a nursing facility. Cases are reported on an individual facility level on this public website, meaning that anyone could access the report on if a facility they are considering has had a COVID-19 case. I expect that due to fear of the virus, having a COVID-19 case will cause more extreme declines in the number of residents. Figure 3 graphs percent change in residents, differentiated by facilities that experienced a COVID-19 case early or later in the pandemic, and facilities that had no cases at all. This again confirms the intuition that facilities that had a COVID-19 case experienced more extreme, and earlier, declines in number of residents.

## III. Data & Methods

The outcome of interest in this analysis is the change in number of residents at a facility level. To calculate this, I obtained data on the number of residents from the Payroll Based Journal (PBJ), a national, auditable survey reported to the Center for Medicare & Medicaid Services (CMS) each quarter. I use daily reporting of number of residents in each facility from January 2020 to September 2020 in this analysis. The percent change in number of residents is calculated as the percent change on a given day from the baseline of an average number of residents from January 1$^{st}$, 2020 to February 29$^{th}$, 2020. Mathematically, the percent change of residents for period $t$ relative to the average over January and February 2020 is defined as:

$$\% \, \Delta \, Res_{t,i} \; = \; \frac{\# \, of \, Res_{t,i} \, - \, Jan/Feb \, Avg \, \# \, of \, Res_{\,i}}{\# \, of \, Res_{t,i}}$$

I use a percent change in the number of residents to create a uniform measure across facilities or geographic units of different sizes. For some analyses, I examine the change in the number of residents for a geographic area, and in other cases the unit of observation is an individual nursing home.

In regression models, one of the independent variables of interest is payer-mix. Data on this variable comes from Medicaid Cost Report from 2019. It is reported as 2019-month averages in the three main categories of Medicare, Medicaid, and private/other. I calculate a 2019-year average as a time-invariant facility characteristic for this 2020 analysis. It should be noted that payer-mix changes as residents change, and the change of payer-mix in 2020 during, and potentially due to, the COVID-19 pandemic is not accounted for in this analysis because data is not available. Thus, for the purposes of this analysis, dependency on different payer sources is assumed to be relatively constant, and a facility's 2019-year average payer-mix is representative of facility payer-mix at the beginning of and during the COVID-19 pandemic.

The other independent variable of interest is the presence of COVID-19 in the facility. Data on the presence of and number of COVID-19 cases and deaths comes from the Ohio Department of Health (ODH) Long Term Care Facility COVID-19 Dashboard, which began reporting on April 15$^{th}$, 2020. Cases are reported on an individual facility level as both current week and cumulative number of cases and is differentiated between residents and staff cases. Deaths are reported on a county level and represent only resident deaths by county of residence.

Reporting occurred on Wednesdays, with some irregularities of weeks of reporting missed or reporting on Thursday rather than Wednesday. There are questions of the accuracy of the reporting of COVID-19 cases and deaths in the early weeks of reporting due to this being a new reporting requirement and the extreme stress the facilities and staff were under. For the purposes of this analysis the accuracy of the number of cases is not important, as the importance of the variable is if individuals making admittance decisions believed there was a COVID-19 case and whether that impacted their decision making.

Other facility characteristics that are included as control variables in the regression analysis include number of beds, urban status, Black, Indigenous, and other People of Color (BIPOC) population, percent of residents with certain illnesses, ownership status, and special care units. These control variables are listed and summarized in Table 1. All these come from a combination of the Certification and Survey Provider Enhanced Reporting (CASPER) dataset from 2018/2019 and the Minimum Data Set (MDS) from 2017. Additional controls include staffing levels and location. Staffing controls are calculated as hours per resident per day and percent contract. This analysis uses a weekly average from October 2019 to January 2020 in these two categories as a time-invariant characteristic, so any changes in hours per resident per day and percent contract employment during to the pandemic are not accounted for. These two categories are further differentiated by employee type, of which three are included, listed in descending order of necessary training: registered nurse (RN), licensed practitioner nurse (LPN), and certified nurse's aide (CNA). All staffing data comes from the Payroll Based Journal (PBJ). Differentiating between hours per resident per day and percent contract and between types of employees allows for a more nuanced analysis of if and how these variables impacted the decline in number of residents. The final control variable included is location, for which I include a binary variable for each of the 12 Ohio Area Agency on Aging (AAA) districts. Nursing homes in the same AAA district share a local AAA office that advocate for the needs of older adults and assist older adults with long term care (Ohio AAA). Figure 4, courtesy of the Ohio AAA, shows the location of each district and their numerical labels.

I merged the datasets described on a unique facility provider number to obtain the sample for this analysis, and the resulting sample size is 907. In the regression analysis I use only facilities that fully report the number of residents for the first three quarters of 2020. This is an

important distinction in the Payroll-Based Journal (PBJ) reporting, as only 74% of these facilities have PBJ census reporting for the first three quarters of 2020. Of the 233 facilities that did not have full reporting, 87% of them are missing reporting for quarter 1 of 2020, which includes March 2020 when COVID-19 was first present in Ohio nursing homes. This resulted in an analytical sample of 674 facilities.

Table 1 lists the summary statistics for the differences in these two subsets of facilities: those reporting and not reporting the number of residents for all necessary quarters. Table 1 also contains a two-sample t-test for the difference in means for all variables. There is some difference in the binary characteristics of the facilities in these two subsets that should be noted. Facilities that did not report PBJ for all quarters of 2020 are more likely to be associated with a chain, have non-profit ownership, and be in an urban area. As these are not key variables in their relationship with changes in number of residents, I continue with the subset of 674 facilities that have full reporting for the number of residents.

I use a linear regression to observe the associations between of payer-mix and the presence of a COVID-19 case decline in number of residents. Here, the unit of observation is the individual nursing home, and the main specification is:

$$\% \Delta\, Res_{t,i} \;=\; COVID_{t-1,i} + Medicare_i + Medicaid_i + X_i$$

Where $COVID_{t-1,i}$ is a binary indicator for the presence of at least one cumulative COVID-19 case on the reporting date just before the date defined in the outcome, meaning that facility $i$ is listed on the public ODH dashboard as having at least one COVID-19 case among residents or staff. Using the previous reporting date allows for the time it takes for the reporting of a case to impact resident admittance decisions. $Medicare_i$ and $Medicaid_i$ are continuous measurements for 2019 average percent of residents using each payer source. Private/other payer-mix is used as the reference group. $X_i$ are all other facility characteristics used as control variables, which are all those listed in Table 4 and binary location control variables using Ohio Area Agency on Aging (AAA) district.

## IV. Results

A summary of the number of deaths of nursing home residents in comparison to the total decline of residents is listed in Table 2. Since data on deaths is not given at a facility level, it is not feasible to include it in the facility-level regression. As can be seen, the cumulative number of deaths in each Ohio Area Agency on Aging (AAA) district is lower than the total decline in number of residents in the district up until the three dates listed. This is true for all reporting dates; results are only shown for the three selected dates to illustrate this difference. A maximum estimate for the impact of deaths on declines in occupancy can be estimated by assuming that there were no residents admitted to any facilities from the time deaths started to be recorded, April 15th, to the select date. If this is true, the percent of decline in residents that can be attributed to COVID-19 deaths is 12.45% on May 6th, 23.08% on June 3rd, and 36.28% on July 1st. This is an unreasonable assumption, evidenced by the fact that total decline in residents on July 1st is lower than that of June 3rd and therefore there must have been residents admitted. It becomes less feasible as time goes on and residents being admitted became more likely. Thus, these maximum estimates are higher than the true impact that deaths had on decline in number of residents. This is to show that the decline in residents due to the COVID-19 pandemic can mostly be explained by sources outside of deaths due to the virus, as explored in the regression analysis.

Table 3 lists regression results for the key variables in the primary specification. There is not a significant relationship between payer-mix and percent decline in residents on March 4th and March 18th, which is to be expected as the policy suspending elective surgery was not enacted until March 17th. There is a significant relationship between payer-mix and percent change in number of residents for the entire month of April, with a 10 percentage point (PP) increase in Medicare payer-mix being associated with a 1.29 PP to 3.39 PP decline in number of residents during April. The significant relationship does not persist, and the relationship becomes insignificant starting in July. This matches expectations since elective surgeries were allowed under stricter guidelines beginning April 22nd. These results suggest that the pandemic continued to affect admission for post-acute care after elective surgeries were reinstated.

Table 3 also gives evidence of Medicaid payer-mix being a significant predictor of decline in number of residents but has an opposite relationship of Medicare. The relationship between Medicaid payer-mix and change in residents is significant almost exclusively in the month of

April, with a 10 PP increase in Medicaid payer-mix being associated with a 1.3 PP increase in number of residents. Since many facilities experienced a decline in residents, this can be realistically interpreted as facilities with higher Medicaid dependency experiencing a less extreme decline in number of residents in the month of April. Since private/other payer-mix is the reference group, this gives evidence that residents using private insurance, savings or other forms of payment were more likely to be removed or not admitted to facilities during the month of April than Medicaid residents.

There is also a significant relationship between being reported to have at least one cumulative COVID-19 case one week before the given date and the decline in number of residents on the given date. This relationship is significant from the first date COVID-19 reporting through September, when this analysis ends. On April 29th, having at least one reported case was associated with a 6.6 PP decline in number of residents. This increased to 8.1 PP decline in mid-May, and the association declined from then to 4.6 PP in early September. This indicates that there was a range in the relationship, and it was strongest at the beginning of the pandemic. Despite the range, having at least one COVID-19 case in a facility is a major factor that explains the decline in occupancy.

To compare the effects of Medicare dependency and the presence of COVID-19 on the decline in number of residents, I calculate the difference in Medicare dependency that is estimated to have the same effect as a COVID-19 case. This can be calculated by dividing the coefficient on having any case by the coefficient on Medicare payer-mix. As an example, this amounts to 19.35 for April 29th, 2020. This effectively means that on April 29th, for an otherwise average facility, having a 19.35 PP higher Medicare payer-mix would have the same estimated impact on decline in residents that experiencing a COVID-19 case would have. Given that the standard deviation of Medicare payer-mix is 9.89 PP, this is a large difference in this facility characteristic. Using these facts, I conclude that having a COVID-19 case is a more important factor in explaining the decline in number of residents, but that Medicare dependency is still a significant predictor that had an effect independent of the presence of COVID-19.

The relationship between the control variables and decline in number of residents are listed in Table 4 for the first Wednesday of the month, March through July. There are only a few

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variables I find to be significantly associated with the decline in number of residents. First, being an urban facility is associated with a 2.3 PP positive change in number of residents on May 6th, indicated urban facilities did not have as extreme of declines as facilities in large towns. Similarly, rural facilities have a weakly significant positive relationship with percent change in residents in early April and May. These results both point to large town/suburban facilities experiencing a higher decline in number of residents. Second, non-profit facilities have a weakly significant associated with 2.4 PP and 3.2 PP higher decline in residents than for profit facilities in June and July. Finally, there is evidence of a positive association between number of residents and staffing levels. Pre-pandemic average hours per resident per day are significantly associated with less extreme declines in number of residents for at least two dates of those being considered in Table 4. While all these relationships with control variables are indicative of associations, they should not necessarily be taken as casual as there is not a clear relationship across time.

## V. Discussion

The results of this analysis give some insight into the decision-making process of admitting oneself or a loved one to a nursing facility during a pandemic. It is reasonable to assume that the pandemic impacted these decisions, and the estimates given show that being reported to having a COVID-19 case can explain the majority of the decline in number of residents in nursing homes. While the specific decision-making process of residents and families is not the subject of this analysis, it is reasonable to assume that the presence of a COVID-19 case would be a factor in this decision. The transparency and public reporting on behalf of the Ohio state government allowed residents and families to access weekly-updated information on facilities that had a COVID-19 case, and they could therefore use that information in their decision. This conclusion calls the future of the industry into question, as this analysis cannot address whether this was a one-time change to the decision making, or if this change in preferences will be more permanent. As experts continue to analyze the impact COVID-19 will have on the nursing home industry, a major question will be whether preferences and policies to admit residents will be permanently changed.

Regarding payer-mix, this analysis gives evidence that there is a relationship between elective surgeries and nursing home admissions through the connection of Medicare payer-mix. Facilities more dependent on Medicare-paying residents experienced more declines in

occupancy, even after the impact of having a COVID-19 case is accounted for. This confirms the intuition that facilities are dependent on residents needing post-acute care, and a disruption to hospital healthcare can disrupt their admissions. These results can inform the industry on the future of nursing home after the pandemic. There is speculation on whether the nursing home industry will be able to recover from this extreme decline in number of residents, and if nursing homes will continue to be seen as a viable option when the pandemic is over. Since some of the decline has been shown in this analysis to be due to Medicare dependency and therefore post-acute care, it can be concluded that at least a portion of the decline is due to policy changes and not public decision-making changes. Thus, after the pandemic and if or when the healthcare industry returns to normal care, it can be expected that this portion of the decline in number of residents will be recouped and return to normal levels.

Another application of these results can be in analysis of the financial impact of the COVID-19 pandemic on nursing homes. Number of residents and payer-mix for nursing facilities are important indicator of financial viability. Nursing home's main revenue comes from direct patient care from in-house residents, thus a decline in number of residents reduces revenue, and an extreme drop like the one experienced during the pandemic will likely have a large impact on financial outcomes. Payer-mix also contributes to financial viability because the forms of payment have difference reimbursement rates. Medicaid provides the lowest reimbursement rate, covering on 70-80% of cost of care, and Medicare provides higher reimbursement rates that help cover these losses (ACHA). If the decline in residents due to the pandemic is more likely to come from Medicare residents, as these results suggest, it will have a larger impact on financial outcomes. These results lead to further questions on the financial impact the pandemic has had on nursing homes and what facilities are more likely to be at financial risk.

## VI. Conclusion

As the COVID-19 pandemic spread through communities in the U.S., life changed for everyone and most notably for the residents and staff of nursing homes. They experienced a disproportionate number of COVID-19 cases and deaths, and a significant change in the way the facility was run. This resulted in a large, unprecedented decline in the number of residents of

these nursing facilities. In this analysis, I estimated the sources of the decline and found that having a COVID-19 case is a major predictor of a decline in number of residents, but another important factor is dependency on Medicare-paying residents. This link comes from the benefits of Medicare being tied to post-acute care, which was in less demand due to the suspension of elective surgeries in Ohio. This analysis suggests that there was a structural, policy reason behind some of the declines in residents, despite nursing homes admitting residents as usual, even when they experienced a COVID-19 case.

It is important to understand the sources of the decline in occupancy to understand the impact of COVID-19 and make informed predictions on the future of the nursing home industry. These results give insight to the sources of decline, indicating that it was not only fear of infection resulting in fewer admissions and more withdrawals from the facility, but the characteristic makeup of the facility in terms of payer-mix and Medicare dependency that contributed to the decline in the number of residents. As the impact of the COVID-19 pandemic continues to be analyzed for years to come, this informs some further questions to be asked about the nursing home industry. Future research can determine the financial impact that this has on these facilities, as a decline in Medicare-paying residents will have a more extreme negative financial impact on nursing homes than declines in Medicaid-paying residents. This also contributes to initial analyses of how the pandemic changed decision making process to admit oneself or a loved one to a nursing home and can inform further research on whether impacts on these decisions will be temporary or have some permanence. Permanence in the decisions not to use skilled nursing care could have large impacts on the structure of the industry.

# VII. Tables

**Table 1: Summary Statistics and Difference-in-Means Tests by Reporting Census Information in Payroll Based Journal (PBJ) Data**

| | Full Sample Mean (SD) | Census Data Reported Mean (SD) | Census Data Not Reported Mean (SD) | Difference in Means T or Z Statistic (P-Value) |
|---|---|---|---|---|
| Number of Observations | 907 | 674 (74.3%) | 233 (25.7%) | |
| Medicare Payer-Mix | 14.1 | 13.95 | 14.51 | 0.7141 |
| *% of Residents* | (10.17) | (9.892) | (10.94) | (0.4753) |
| Medicaid Payer-Mix | 64.55 | 64.73 | 64.04 | -0.5648 |
| *% of Residents* | (16.23) | (15.73) | (17.62) | (0.5723) |
| Private/Other Payer-Mix | 21.35 | 21.31 | 21.46 | 0.1627 |
| *% of Residents* | (11.71) | (11.66) | (11.87) | (0.8708) |
| Number of Beds | 93.89 | 94.19 | 93.03 | -0.3976 |
| *Continuous* | (38.56) | (39.11) | (37.00) | (0.691) |
| BIPOC Population Percent | 13.05 | 12.45 | 14.81 | 1.5993 |
| *% of Residents* | (19.28) | (19.01) | (19.99) | (0.1101) |
| Acuity Index | 10.38 | 10.35 | 10.47 | 1.4589 |
| *Continuous* | (1.057) | (1.044) | (1.091) | (0.1449) |
| Dementia Case-Mix | 43.99 | 44.04 | 43.84 | -0.1702 |
| *% of Residents* | (14.88) | (14.57) | (15.77) | (0.8649) |
| Psychiatric Illness Case-Mix | 42.08 | 42.74 | 40.18 | -1.895 |
| *% of Residents* | (17.81) | (18.12) | (16.77) | (0.0584) |
| Depression Case-Mix | 52.72 | 53.19 | 51.37 | -1.0982 |
| *% of Residents* | (21.74) | (21.75) | (21.7) | (0.2724) |
| Developmental Disability Case-Mix | 2.022 | 2.129 | 1.714 | -1.5024 |
| *% of Residents* | (3.631) | (3.932) | (2.547) | (0.1333) |
| Chain | 0.627 | 0.602 | 0.7 | 2.6451 |
| *Indicator* | | | | (0.0082***) |
| CCRC | 0.16 | 0.156 | 0.172 | 0.5704 |
| *Indicator* | | | | (0.5684) |
| Ownership: For Profit | 0.781 | 0.806 | 0.708 | -3.0996 |
| *Indicator* | | | | (0.0019***) |
| Ownership: Nonprofit | 0.202 | 0.174 | 0.283 | 3.5959 |
| *Indicator* | | | | (0.0003***) |
| Ownership: Government | 0.0165 | 0.0193 | 0.00858 | -1.1044 |
| *Indicator* | | | | (0.2694) |
| Urban Status: Urban | 0.718 | 0.694 | 0.785 | 2.6617 |
| *Indicator* | | | | (0.0078***) |
| Urban Status: Large Town | 0.183 | 0.197 | 0.142 | -1.8954 |
| *Indicator* | | | | (0.0580) |
| Urban Status: Small Town/Isolated | 0.0992 | 0.108 | 0.073 | -1.5557 |
| *Indicator* | | | | (0.1198) |
| Special Care Unit: Dementia | 0.279 | 0.28 | 0.275 | -0.1683 |
| *Indicator* | | | | (0.8663) |
| Special Care Unit: Ventilator | 0.0628 | 0.0668 | 0.0515 | -0.8276 |
| *Indicator* | | | | (0.4079) |

**Table 2: Summary of Total Change in Number of Residents by Ohio Area Agency on Aging (AAA) District for Select Dates**

| AAA District | Jan/Feb Average Total # of Residents | May 6th | | June 3rd | | July 1st | |
|---|---|---|---|---|---|---|---|
| | | Cumulative Deaths | Total Decline in # of Residents from Jan/Feb Average | Cumulative Deaths | Total Decline in # of Residents from Jan/Feb Average | Cumulative Deaths | Total Decline in # of Residents from Jan/Feb Average |
| 1 | 7818 | 40 | 480 | 86 | 530 | 148 | 567 |
| | | 0.51% | 6.14% | 1.10% | 6.78% | 1.89% | 7.25% |
| 2 | 5166 | 8 | 398 | 17 | 433 | 31 | 437 |
| | | 0.15% | 7.70% | 0.33% | 8.38% | 0.60% | 8.46% |
| 3 | 2098 | 32 | 122 | 39 | 139 | 58 | 194 |
| | | 1.53% | 5.82% | 1.86% | 6.63% | 2.76% | 9.25% |
| 4 | 4487 | 92 | 324 | 190 | 418 | 275 | 354 |
| | | 2.05% | 7.22% | 4.23% | 9.32% | 6.13% | 7.89% |
| 5 | 2558 | 1 | 178 | 10 | 210 | 20 | 221 |
| | | 0.04% | 6.96% | 0.39% | 8.21% | 0.78% | 8.64% |
| 6 | 5742 | 48 | 623 | 165 | 722 | 299 | 739 |
| | | 0.84% | 10.85% | 2.87% | 12.57% | 5.21% | 12.87% |
| 7 | 2145 | 0 | 133 | 0 | 188 | 0 | 151 |
| | | 0.00% | 6.20% | 0.00% | 8.76% | 0.00% | 7.04% |
| 8 | 1326 | 11 | 83 | 27 | 88 | 35 | 82 |
| | | 0.83% | 6.26% | 2.04% | 6.64% | 2.64% | 6.18% |
| 9 | 3232 | 3 | 202 | 5 | 209 | 11 | 177 |
| | | 0.09% | 6.25% | 0.15% | 6.47% | 0.34% | 5.48% |
| 10a | 8673 | 84 | 594 | 143 | 705 | 253 | 672 |
| | | 0.97% | 6.85% | 1.65% | 8.13% | 2.92% | 7.75% |
| 10b | 5473 | 101 | 590 | 226 | 695 | 284 | 612 |
| | | 1.85% | 10.78% | 4.13% | 12.70% | 5.19% | 11.18% |
| 11 | 3390 | 79 | 280 | 165 | 312 | 238 | 348 |
| | | 2.33% | 8.26% | 4.87% | 9.20% | 7.02% | 10.27% |
| Total | 52108 | 499 | 4007 | 1073 | 4649 | 1652 | 4554 |
| | | 0.96% | 7.69% | 2.06% | 8.92% | 3.17% | 8.74% |

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**Table 3: Regression Results for Percentage Decline in Number of Residents: Key Variables**

| | (1) 4-Mar | (2) 18-Mar | (3) 1-Apr | (4) 15-Apr | (5) 29-Apr |
|---|---|---|---|---|---|
| Medicaid Payer-Mix | -0.00037 | 0.0447* | 0.120*** | 0.130*** | 0.138*** |
| | (0.0230) | (0.0252) | (0.0313) | (0.0379) | (0.0451) |
| Medicare Payer-Mix | 0.0335 | -0.0734 | -0.129*** | -0.263*** | -0.339*** |
| | (0.0491) | (0.0529) | (0.0469) | (0.0537) | (0.0870) |
| Any COVID-19 Case Reported Week Prior | - | - | - | - | -6.561*** |
| | - | - | - | - | (2.301) |

| | (6) 13-May | (7) 3-Jun | (8) 1-Jul | (9) 5-Aug | (10) 2-Sep |
|---|---|---|---|---|---|
| Medicaid Payer-Mix | 0.0797* | 0.0515 | 0.0403 | 0.0579 | 0.0558 |
| | (0.0444) | (0.0488) | (0.0538) | (0.0531) | (0.0532) |
| Medicare Payer-Mix | -0.310*** | -0.214** | -0.135 | -0.145* | -0.0514 |
| | (0.0719) | (0.0928) | (0.0996) | (0.0807) | (0.105) |
| Any COVID-19 Case Reported Week Prior | -8.133*** | -7.512*** | -6.030*** | -4.370*** | -4.602*** |
| | (1.274) | (1.066) | (1.008) | (0.964) | (0.966) |

Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.
Other control variables included in regression not reported, see Table 4. Private/Other payer-mix used as reference for Medicaid and Medicare. Any COVID-19 Case Reported Week Prior is a binary variable for at least one cumulative case reported on ODH dashboard one week before given date, reporting began on April 15th.

**Table 4: Regression Results for Percentage Decline in Number of Residents: Control Variables**

| | (1) 4-Mar | (2) 1-Apr | (3) 6-May | (4) 3-Jun | (5) 1-Jul |
|---|---|---|---|---|---|
| BIPOC Population | 0.0102 | -0.00567 | 0.00530 | 0.0280 | -1.88e-05 |
| | (0.0117) | (0.0152) | (0.0214) | (0.0255) | (0.0291) |
| Urban | -0.393 | 1.030 | 2.252** | 1.541 | 0.607 |
| Ref: Large Town | (0.610) | (0.761) | (1.086) | (1.257) | (1.363) |
| Rural/Isolated | -0.753 | 1.834* | 2.189* | -0.774 | 0.100 |
| Ref: Large Town | (0.726) | (1.074) | (1.276) | (1.339) | (1.399) |
| Number of Beds | -0.00267 | -0.00423 | 0.0114 | 0.0133 | 0.00928 |
| | (0.00484) | (0.00709) | (0.0105) | (0.0120) | (0.0139) |
| CCRC | -0.415 | 0.0922 | 1.457 | -0.173 | -1.584 |
| | (0.717) | (0.742) | (1.190) | (1.475) | (1.529) |
| Chain | 0.419 | 0.410 | -1.084 | -0.481 | -0.389 |
| | (0.404) | (0.541) | (0.746) | (0.884) | (0.978) |
| Government | 0.747 | 4.150 | 3.988* | -0.0773 | -1.810 |
| Ref: For Profit | (1.322) | (2.843) | (2.379) | (2.506) | (2.361) |
| Nonprofit | -0.122 | -1.328 | -1.774 | -2.373* | -3.175* |
| Ref: For Profit | (0.714) | (0.834) | (1.207) | (1.434) | (1.618) |
| Acuity Index | -0.155 | -0.111 | -0.324 | -0.193 | -0.262 |
| | (0.206) | (0.288) | (0.391) | (0.423) | (0.478) |
| Dementia Case-Mix | 0.0224 | 0.0146 | -0.0255 | -0.00264 | -0.0118 |
| | (0.0158) | (0.0193) | (0.0284) | (0.0327) | (0.0352) |
| Psychiatric Illness Case-Mix | 0.0252** | 0.00571 | 0.0181 | 0.0414 | 0.0263 |
| | (0.0126) | (0.0168) | (0.0226) | (0.0252) | (0.0274) |
| Depression Case-Mix | 0.00577 | 0.0126 | 0.00395 | 0.00722 | 0.00490 |
| | (0.00960) | (0.0125) | (0.0164) | (0.0195) | (0.0210) |
| Developmental Disability Case-Mix | -0.107*** | -0.0678 | 0.00628 | -0.00132 | 0.00292 |
| | (0.0397) | (0.0538) | (0.0679) | (0.0946) | (0.0794) |
| Special Care Unit: Dementia | -0.404 | -0.695 | -1.341 | -0.679 | -0.156 |
| | (0.430) | (0.606) | (0.821) | (0.899) | (1.033) |
| Special Care Unit: Ventilator | -0.153 | -0.847 | 1.154 | 0.748 | 0.0688 |
| | (0.769) | (1.252) | (1.530) | (1.651) | (1.814) |
| CNA HPRD | 0.334 | 0.803 | 0.732 | 2.935** | 3.382** |
| | (0.550) | (0.811) | (1.158) | (1.304) | (1.480) |
| RN HPRD | 1.097 | 3.476* | 5.024** | 1.770 | 1.144 |
| | (0.990) | (1.958) | (2.160) | (2.457) | (3.143) |
| LPN HPRD | 0.935 | 3.370** | 3.395* | 0.853 | -0.0773 |
| | (0.891) | (1.625) | (1.743) | (1.867) | (1.885) |
| CNA % Contract | 0.0568 | 0.0327 | -0.143* | -0.144 | -0.122 |
| | (0.0443) | (0.0489) | (0.0735) | (0.0892) | (0.0907) |
| RN % Contract | -0.0137 | -0.0937 | -0.0452 | -0.0500 | -0.0428 |
| | (0.0322) | (0.0612) | (0.0694) | (0.0654) | (0.0848) |
| LPN % Contract | -0.0532 | -0.0416 | 0.150** | 0.140** | 0.127 |
| | (0.0367) | (0.0480) | (0.0705) | (0.0687) | (0.0816) |

Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.
Abbreviations: BIPOC, Black, Indigenous, and Other People of Color; HPRD, hours per resident per day; CNA, certified nurse's aide; RN, registered nurse; LPN, licensed practitioner nurse. Key variables included in regression not reported, see Table 3. Location controls included in regression, not reported.
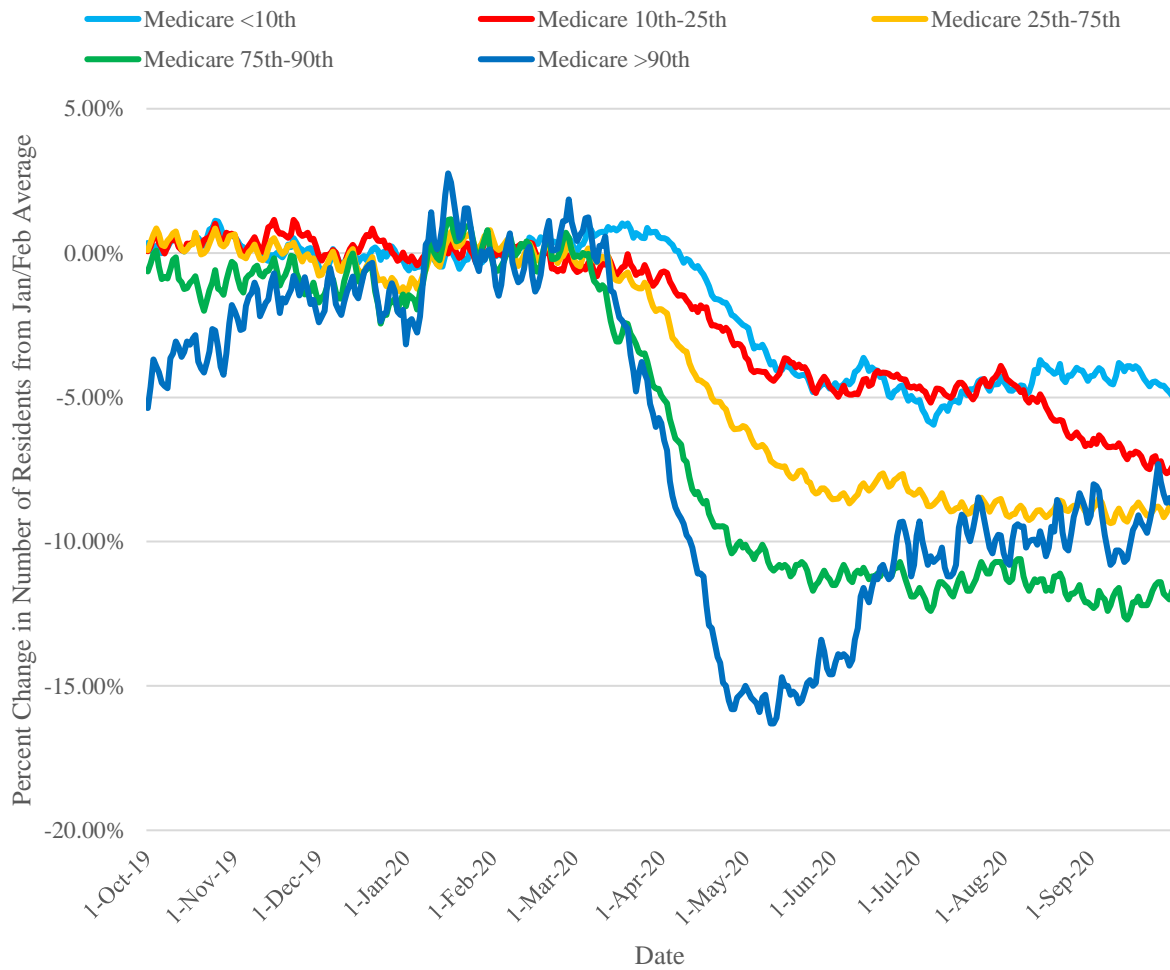
# VIII. Figures

**Figure 1: Percent Change in Number of Residents All Facilities**
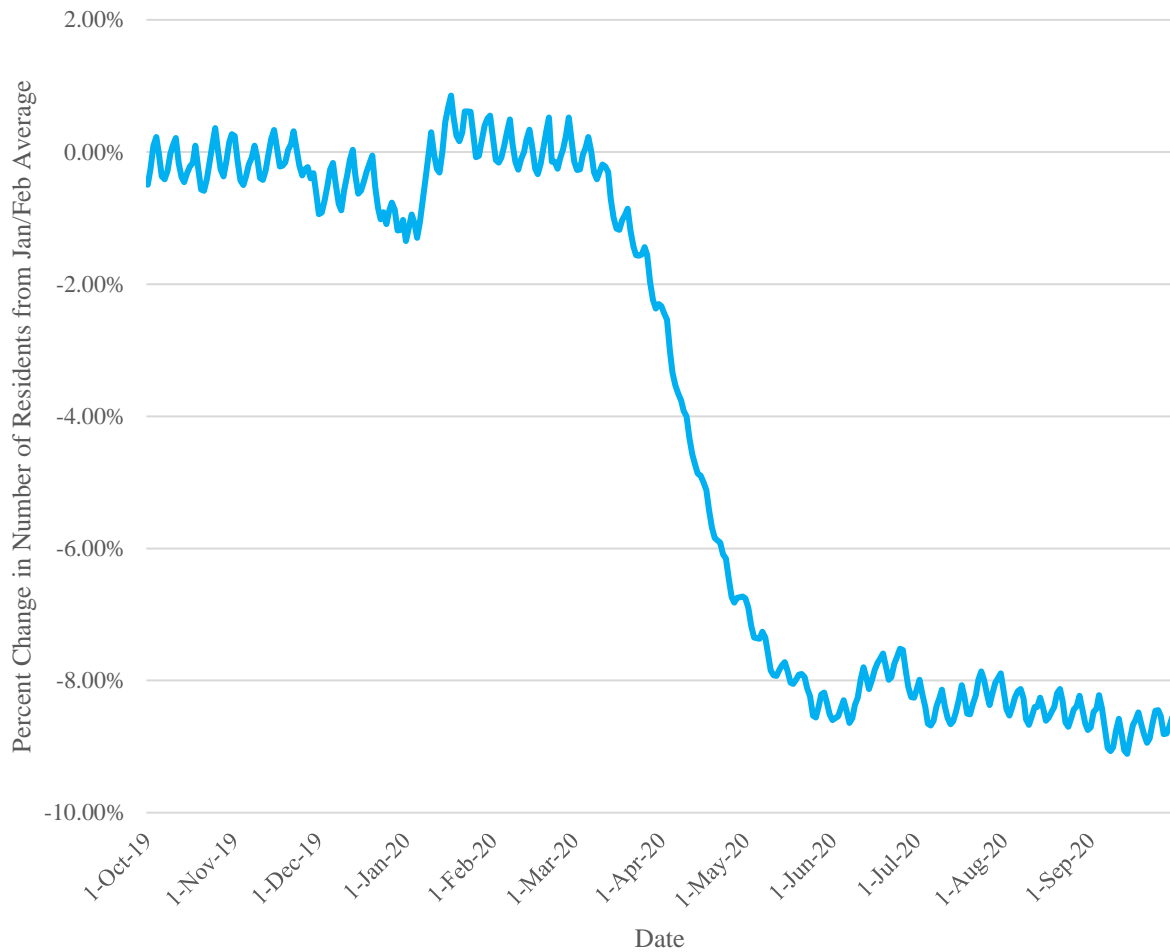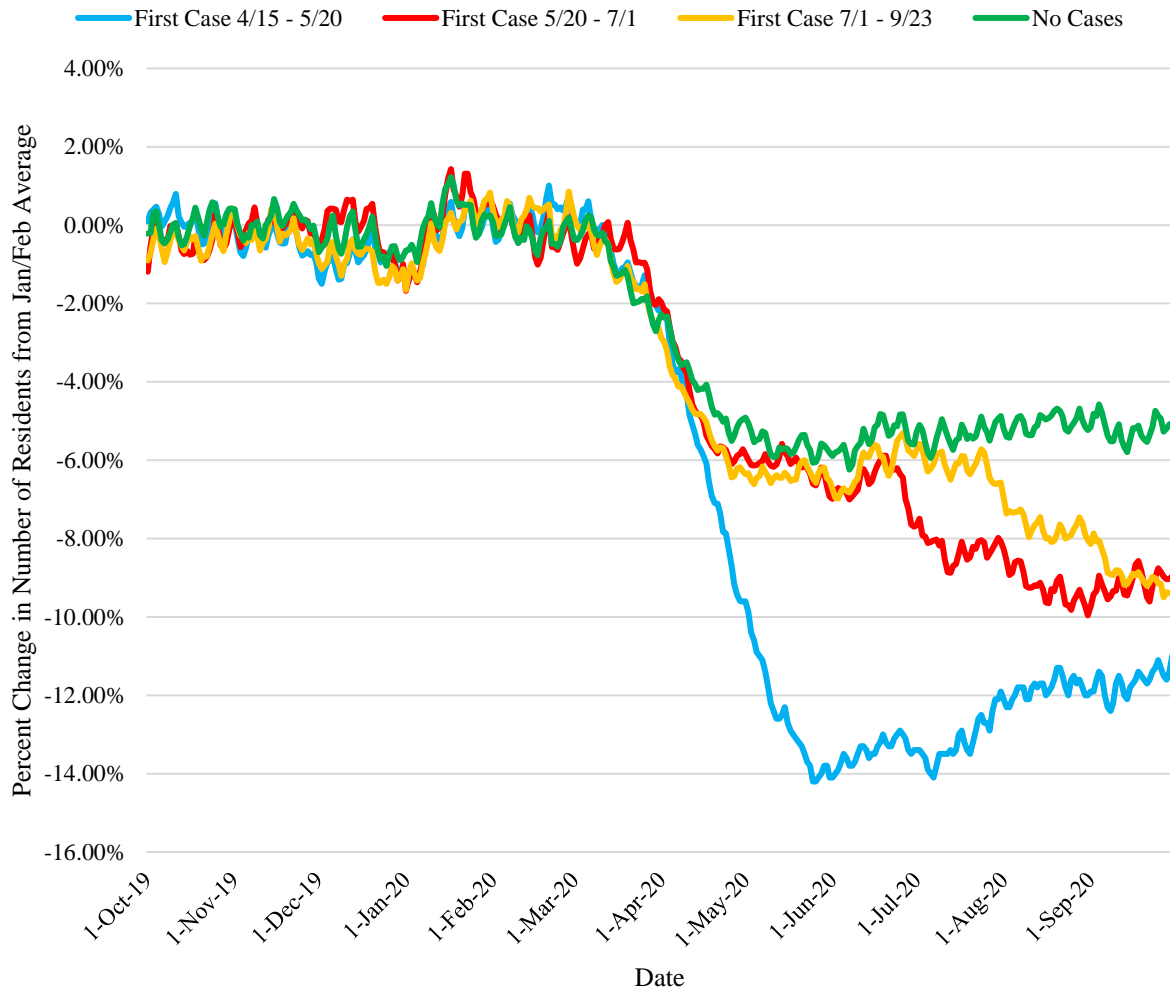


Data on number of residents comes from the Payroll Based Journal.

**Figure 2: Percent Change in Number of Residents by Medicare Percentile**



Data on number of residents comes from the Payroll Based Journal. Data on Medicare percentile comes from the Medicaid Cost Report.

**Figure 3: Percent Change in Number of Residents by Time of First COVID-19 Case**



Data on number of residents comes from the Payroll Based Journal. Data on date of first COVID-19 case comes from Ohio Department of Health COVID-19 Dashboard.

**Figure 4: Map of Ohio Area Agency on Aging (AAA) Districts**
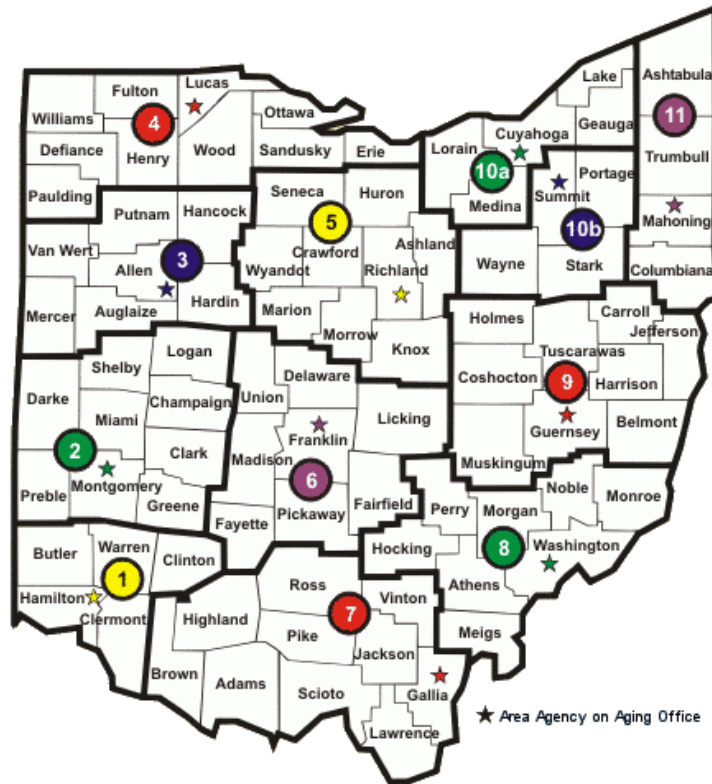


All districts included as binary controls in all regressions run in this analysis. District 11 (Ashtabula, Trumbull, Mahoning, and Columbiana counties) is used as a reference group. These districts share an Area Agency on Aging office that "respond to the needs of older adults as advocates, planners and funders" (Ohio AAA).
Image retrieved from http://ohioaging.org/area-agencies/ on February 21st, 2020.

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