# The Effect of Medicare Advantage Enrollment on Post-Acute Care Utilization and Associated Patient Outcomes

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# INTRODUCTION

Between 2011 and 2021, enrollment in privately administered Medicare Advantage (MA) plans expanded from 26% (11.9M) to 46% (27M) of all Medicare beneficiaries (1). The Centers for Medicare and Medicaid Services (CMS) provides MA plans with prospective risk-adjusted capitation payments to provide Medicare benefits to its enrollees, and offers bonus payments to plans with high performance across a set of quality measures. MA insurance carriers are thereby incentivized to innovate cost-efficient solutions for providing high value care to their populations. This program is associated with reduced cost and healthcare utilization relative to the traditional Medicare (TM.) program, and appears to have positive spillover effects on the TM population (2-4).

In an effort to reduce wasteful spending, many MA carriers have targeted the post-acute care (PAC) service-line, which constitutes approximately 10% of total Medicare expenditures, and is a significant source of geographic variation (5). PAC settings provide rehabilitative care for persons following hospitalization, and include skilled nursing facilities (SNF), home health (HH), inpatient rehabilitation facilities (IRF), and long-term care hospitals (LTCH), which vary by the intensity of services offered and cost. MA carriers employ various strategies attempting to improve the value of PAC (minimizing costs, and maximizing patient outcomes), including provider network optimization, cost-sharing mechanisms, transitional care management interventions, and more (6). Prior research has indicated that MA enrollment is associated with reduced PAC utilization (across all settings) and marginal improvements in associated patient outcomes following hospital discharge (7-9).

Among the tools MA plans have available to them for modifying the utilization and quality of PAC for their enrollees are provider network optimization, enrollee cost-sharing, and care management interventions. Since the passage of the Medicare Prescription Drug, Improvement, and Modernization Act 2003, MA plans have been permitted to form selective provider networks to improve cost-efficiency (10, 11). Little is known about how MA plans have influenced IRF provider networks, but prior research has demonstrated that MA enrollees are more likely to receive care in lower-quality nursing homes and from lower-quality home health agencies (12, 13).

MA plans have the ability to tailor their benefit packages to suit the needs of their enrolled populations and to limit use of services including SNF, HH, and IRF care. Cost-sharing mechanisms such as copayments, service-line specific out-of-pocket limits, and co-insurance vary across MA plans and can be applied for any of the three aforementioned PAC settings (14). Though it is unclear whether cost-sharing influences MA enrollees utilization of HH services, prior research has indicated that MA enrollees in plans with "first-dollar" cost sharing (in TM, SNF users do not face cost-sharing during the first twenty days of a qualifying stay) utilize fewer days of SNF care (15, 16).

In addition to provider network optimization and plan benefit design (cost-sharing), MA plans may influence the provision and quality of PAC via referral requirements, requiring prior authorization for PAC services, and by employing care management teams to assist medical providers in coordinating enrollee's PAC episode(s). A study of the 2022 Medicare Advantage Enrollment and Plan Benefit files revealed that 98% of MA enrollees were enrolled in plans requiring prior authorization for SNF admission, and 92% of MA enrollees were in plans requiring

prior authorization for HH admission, increasing from 71% and 62% in 2018, respectively. (17, 18) Some evidence suggests that MA plans have reduced hospital readmission rates by either incentivizing or requiring post-hospital follow-up visits within thirty days of hospital discharge. (19, 20) Taken together, the confluence of factors influencing MA enrollee's utilization of PAC are complex. Prior research has consistently found that relative to TM beneficiaries, MA enrollees are discharged from the hospital to less intense PAC settings, and utilize fewer days of PAC, while patient outcomes are relatively comparable (8, 21-26).

As enrollment in MA plans continues to expand, understanding the effects of MA enrollment on PAC utilization and outcomes following hospital discharge grows increasingly important. Currently the effects of MA on PAC utilization and outcomes subsequent to hospitalization are unclear due to concerns about non-random selection of beneficiaries into MA plans (22). The objective of this dissertation is to provide evidence of the relationship between MA and the delivery and quality of PAC for Medicare beneficiaries residing in the United States.

**Research Objectives**

This dissertation has two primary chapters. In chapter one, we investigate the relationship between MA market penetration and PAC markets and the utilization of PAC services. In chapter two, I estimate the causal effect of MA enrollment on both PAC utilization (settings utilized, and volume) and patient outcomes following hospitalization.

In Chapter One, I leverage variation in county-level MA enrollment growth rates to isolate the within-market relationship between MA *penetration* (the share of the Medicare population enrolled in MA plans) and both PAC market characteristics and PAC utilization. By pooling

together all Medicare beneficiaries in this approach, our estimates capture the direct effects of enrollment into MA and any possible spillover effects of MA market presence on the TM population. I found that as an increasing share of Medicare Beneficiaries enrolled into MA plans, utilization of nursing homes, home health agencies, and inpatient rehabilitation facilities was reduced. Further, MA expansion was associated with a shifting of patients into lower quality nursing homes, and HH users being concentrated into fewer HH agencies.

In Chapter Two, I exploit changes in MA enrollee characteristics as MA expanded to estimate the unbiased effect of MA enrollment on both PAC utilization and associated patient outcomes. We employed a novel difference-in-differences approach with cross-temporal matching to identify causal estimates, unbiased by non-random selection into MA plans. I found that among Medicare beneficiaries experiencing hip fracture or stroke, MA enrollment was associated with sharp reductions in discharge to inpatient rehabilitation as patients were diverted to less expensive alternatives. Lower intensity rehabilitation did not appear to worsen patient mortality.

As MA insurance carriers gain market power, we observed a reduction in the consumption of PAC and a decline in market competitiveness and overall quality among PAC providers. We found that enrollment into an MA plan led to increased mortality following either hip fracture or stroke hospitalization. Our evidence suggests that MA plans may worsen patient survival probability by restricting access to PAC in inpatient rehabilitation facilities.

## CHAPTER 1 : MEDICARE ADVANTAGE AND POST ACUTE CARE MARKETS


### Abstract

**Background:** Medicare Advantage enrollment is associated with reduced utilization of post-acute care relative to traditional Medicare enrollment. However, little is known about the relationship between market level MA enrollment penetration and the delivery of PAC to all Medicare beneficiaries.

**Objectives:** To measure the aggregate effect of increased Medicare Advantage enrollment on post-acute care provider markets

**Design:** A retrospective cohort study of US counties. In this study we exploit geographic variation in Medicare Advantage enrollment expansion to study the relationship between increased MA enrollment on PAC provider market characteristics and PAC setting utilization among all Medicare beneficiaries.

**Participants:** Non-territory U.S. counties between 2011 and 2017 with a minimum average annual Medicare enrollment of one-thousand persons.

**Main Measures:** PAC market characteristics including nursing home and inpatient rehabilitation bed capacity, nursing home and home health market concentration, and nursing home star ratings. PAC setting utilization measures including nursing home occupancy rates, home health users, and inpatient rehabilitation admissions and days.

**Key Results:** Between 2011 and 2017, the share of Medicare beneficiaries enrolled in MA plans (MA penetration) increased from 25.2% to 33.7%, with substantial geographic variation. A ten percentage-point increase in MA penetration was associated with decreased NH bed capacity (-0.459, $p<0.01$), NH occupancy rates (-0.779, $p<0.01$), NH star ratings (-0.081, $p<0.01$), the rate of

home health users (-10.042, $p<0.01$), and the rate of admission to inpatient rehabilitation facilities (-0.418, $p<0.01$).

**Conclusions:** MA expansion was associated with high magnitude reductions in IRF and HH utilization, and to a lesser extent a reduction in nursing home utilization. Researchers and policymakers should carefully evaluate whether the cost-efficiency of the MA program has detrimental effects on quality of post-acute care for elderly Americans.

## Introduction

The expansion of Medicare Advantage (MA) enrollment (from 23% of all enrollees in 2010 to 38% in 2020) presents a fundamental shift in how health care is paid for and managed among elderly Americans (1). MA plans are incentivized to provide high quality and low-cost care to Medicare beneficiaries by a payment model administered by the Centers for Medicare and Medicaid Services (CMS). The MA payment model provides MA plans with prospective risk-adjusted capitation payments based on the underlying disease burden of each plan's enrolled population and awards bonus incentive payments to plans achieving a sufficient level of quality. As discussed in the introduction to this dissertation, MA payers employ a wide variety of strategies in an effort to reduce wasteful spending and improve care quality for their enrolled populations, ranging from cost-sharing mechanisms to employing care management teams to manage their populations (As depicted in Figure 1-1). With respect to the role of MA on the utilization and quality of PAC, the relevant existing research literature can be allocated into two major groups: comparisons of healthcare utilization, quality, and associated patient outcomes between TM and MA populations; and measuring spillover effects of increasing MA market penetration on the TM population.

Existing research provides evidence that when compared to traditional Medicare fee-for-service (FFS) beneficiaries, MA plan enrollees are discharged less frequently to PAC facilities including skilled nursing facilities (SNF) and inpatient rehabilitation facilities (IRF) following hospitalization, and when they are discharged to PAC facilities they receive fewer days of care (26, 27). MA enrollees appear to utilize fewer days of home health care relative to FFS beneficiaries for both PAC and non-PAC (i.e. home health episodes initiated from the

community setting) services (8, 22-24). Further, MA enrollees appear to receive PAC services from a narrower network of PAC providers with lower CMS star-quality ratings compared to TM beneficiaries (11-13). Although the authors of these prior studies have carefully designed their studies and applied statistical techniques to correct for observable differences between TM and MA populations, these findings are likely biased by spillover effects of MA market penetration on the TM population, and differences in unobserved characteristics between the two complimentary populations.

As MA carriers expand their coverage within a market, their increased scale may enhance their ability to affect behavioral change among physicians, and modify the availability, concentration and quality of post-acute care (PAC) facilities for all Medicare beneficiaries residing within the market (28). A large volume of prior research suggests that increasing MA penetration within a geographic market is associated with strong spillover effects on medical utilization and total medical expenditures for TM beneficiaries. In an instrumental variable analysis, Chernew, et. al. found that a 10% increase in market MA penetration was associated with a 9% reduction in medical expenditures among TM beneficiaries (29). In two separate studies, a 10% increase in MA market penetration was found to be associated with a 4.5% reduction in inpatient hospital expenditures among TM beneficiaries (4, 30). Further, increasing MA market penetration appears to be associated with reduced inpatient utilization and increased outpatient utilization (a substitution of expensive acute care for less expensive care) among TM beneficiaries (31). In a recent study by Park, et. al., the association between MA and reduced medical spending among TM population appears to be concentrated among persons with high disease burden (six or more chronic conditions) (32). Spillover effects appear to be non-linear, with greater effect sizes

identified at higher the level of baseline MA penetration (e.g. an increase from 10-20% MA market penetration is expected to yield smaller spillover effects relative to an increase from 30-40%) (33). Presumably this non-linear relationship exists because MA payers gain market advantage at a certain level of market control, granting them greater control of provider networks and their practice patterns.

In this study, I leverage variation in county-level MA enrollment growth rates to isolate the within-market relationship between MA *penetration* (the share of the Medicare population enrolled in MA plans) and both PAC market characteristics and PAC utilization of the total Medicare population. By pooling together all Medicare beneficiaries in this study, our estimates capture the aggregate of direct effects of new enrollment into MA and any possible spillover effects of increasing MA market penetration on the TM population. Further, by measuring changes in PAC utilization among the total Medicare population we eliminate concerns about non-random selection of Medicare beneficiaries into MA plans.

## Study Data and Methods

### Data Sources

We constructed measures of Medicare enrollment characteristics, PAC market characteristics, and PAC service utilization at the county level for each year between 2011 and 2017. The Medicare Beneficiary Summary File (MBSF) was used to summarize enrollment characteristics and demographics of Medicare beneficiaries. To identify measures of PAC market characteristics and PAC setting utilization, we used the Home Health Outcome and Assessment Information Set (OASIS), the Inpatient Rehabilitation Facility Patient Assessment Instrument (IRF-PAI), data from Long-Term Care Focus (LTCF), and the Medicare Provider of Service (POS) file. We obtained nursing home star ratings from the Nursing Home Compare (NHC) website.

To construct county level measures of median income and poverty (as described in the **Variables** section below) we used zip-code level data from the American Community Survey (ACS) and the IRS Individual Income Tax Zip Code Data (34, 35).

Study Population

We included all non-territory U.S. counties between 2011 and 2017 with an average Medicare enrollment of greater than or equal to one-thousand person-years. We excluded counties which did not have at least one nursing home.

### Study Design

As MA enrollment expanded across time, the timing and intensity of expansion varied substantially by county. We exploit this variation to examine the relationship between MA penetration and measures of PAC market characteristics and utilization in a retrospective

cohort study of U.S. county level data between 2011 and 2017. Our independent variable was MA penetration (the percentage of Medicare beneficiaries enrolled in MA plans) which varied by county and year. Outcomes were aggregated at the county-year level, and pooled across the Medicare population (including both TM beneficiaries and MA enrollees in a single unit of analysis).

**Variables**

Dependent Variables

Our set of outcomes consists of both PAC utilization measures and PAC provider market characteristics among nursing homes (NH), inpatient rehabilitation facilities (IRF) and home health agencies (HHA). Nursing Home measures were calculated at the county level by pooling utilization, capacity, and quality data across all facilities located within each county. Inpatient rehabilitation facility (IRF) and home health (HH) measures were calculated at the county level based on the residential county of IRF and HH users.

We created four nursing home specific dependent variables, measuring NH capacity, utilization, market concentration, and quality. The count of NH beds available at NHs located within in each county were measured using data from LTCFocus and the Medicare POS file. NH beds per 1,000 Medicare beneficiaries was included as a direct measure of the aggregate capacity of nursing homes within a county. For each county, we measured the average daily NH census by pooling the census of each NH located within the county. NH occupancy was then calculated by dividing the average daily census of NHs located within a county by the count of

beds available in those NHs. To measure NH market concentration, we calculated the Herfindahl Hirschman Index (HHI) based on the market share (based on avg. daily residence) of NH's located within each county (36). Lastly, we construct a measure of county level NH star ratings (data from NHCompare), using the relative volume (residence days) of each NH within a county as a weight for computing average star ratings. For example, in a county with two nursing homes, one having an avg. of 100 residents/day and a 4-star rating, and another with an avg. of 50 residents/day and a 3-star rating, the weighted avg. of the counties NH star rating would be 3.67.

Inpatient rehabilitation facilities (IRF) are geographically dispersed, and are classified as either free-standing facilities or as hospital-based IRF units. For each IRF-specific dependent variable, we include both stratified measures (IRF units and free-standing facilities) and the combined total. First, using the Medicare POS file we calculate the number of IRF beds available at facilities located within each county. Next, we identify IRF stays using MEDPAR records and calculate both the rate of IRF admissions (/1,000 Medicare beneficiaries) and the rate of IRF utilization days (/1,000 Medicare beneficiaries). For both the IRF admissions /1,000 measure and the IRF days / 1,000 measure we attribute IRF stays to counties based on the county residence of the Medicare beneficiary.

Home health agencies are not constrained by the local geography of their office address, and many home health aides deliver home care in locations distant from their office location. For this reason, we assign computed measures of home health utilization and market characteristics to counties based on the residential counties of persons utilizing home health services. Using OASIS assessments, we calculate the share of Medicare beneficiaries using any

home health services per 1,000 beneficiaries. We then compute the HHI (based on the share of HH users by HH agency) to measure the concentration of home health agencies operating within each county. Finally, we measure the distinct count of home health agencies operating in within each county per one-thousand Medicare beneficiaries, which is later used to aide in the interpretation of our home health HHI.

Primary Independent Variable

County level MA penetration was measured by dividing the count of enrollment months in any MA plan by the total number of enrollment months enrolled in *either* an MA plan *or* traditional FFS Medicare (conditional on covered months). We express county level MA penetration as the number of MA enrollment years per 100 total (MA + FFS) enrollment years (Table 1-1), thereby allowing us to interpret this variable's ordinary-least squares (OLS) coefficient as the association between a percentage point (pp) change in MA enrollment and the outcome.

To examine the lagged effect of changes in MA penetration on our outcomes, we captured both one-year and two-year lagged measures of MA penetration for each county. Applying a lag to the exposure allows us to ensure that changes in the MA penetration rate preceded changes in the outcome(s) and that changes in the MA penetration rate had sufficient time to influence the outcome(s) (37).

Other Covariates

To account for temporal trends in the case-mix of county Medicare populations and other sources of confounding we constructed county-year aggregated measures of demographics (age, sex, and race), dual-enrollment in Medicaid (partial or full benefits), and reasons for Medicare entitlement (OASI, disability, ESRD) using data from the MBSF. We calculated population weighted county averages of the proportion of the population living under the federal poverty rate using zip-code level data from the U.S. Census Bureau's American Community Survey (ACS). Lastly, zip-code level data from the IRS's Individual Income Tax Zip Code Data was used to construct a county population weighted median household income measure. (34)

**Statistical Analysis**

All analyses were performed at the county level with repeated observations for years between 2011 and 2017. We use weighted ordinary least squares regression to test the association between changes in MA penetration and each outcome, after adjusting for demographic and enrollment characteristics. Indicators for counties and years were included as fixed effect terms to control for time-invariant county specific differences and national trends in our levels of our outcome measures. The regression coefficient of our primary independent variable can be interpreted as the change in the level of the outcome for each ten-percentage point increase in county-level MA penetration. In addition to our primary estimates, we fit models with one and two-year lagged exposures.

All regressions were adjusted for age (and its squared term), sex, race, dual-enrollment in Medicaid, Medicare entitlement reason (OASI, disability and/or ESRD), and measures of median county level household income and poverty. We weighted observations by the count of enrollment years contributed by Medicare beneficiaries residing in each county, allowing larger counties to contribute more weight and thereby producing nationally representative estimates. Unweighted estimates would over-state the relationship of MA penetration and our outcomes in smaller counties. Standard errors were clustered at the county level to adjust for within-county correlation(38).

Our primary regression specification takes the following form:

$$Y_{ct} = \beta_1 M_{ct} + \beta_2 X_{ct} + \delta_c + \gamma_t + \varepsilon_{ct}$$

*Where $Y_{ct}$ represents our dependent variable measure(s), in county c and year t; $M_{ct}$ represents the county level MA Penetration rate, our primary independent variable; $X_{ct}$ is a vector of county-year specific covariates; and $\delta_c$ and $\gamma_t$ represent county and year fixed effects, respectively.*

Sensitivity Analysis

It is unclear whether we should expect the relationship between MA penetration and our set of PAC utilization and PAC market measures to be linear, though prior evidence suggests that MA penetration has a non-linear relationship with inpatient medical expenditures among TM beneficiaries. To assess non-linearities, we refit our models using a categorical independent variable which was discretized across levels of MA penetration (0-5%; 6-10%;…65-100%}.

IRF care is delivered in either free-standing IRFs (IRF-F) or in hospital-based units (IRF-U). Between 2012 and 2017, admissions (/1,000 beneficiaries) to IRF-U declined sharply (4.8 in 2011; 3.94 in 2017) while admissions (/1,000 beneficiaries) to IRF-F increased moderately (3.7 in 2011;

4.2 in 2017) (Table 1-2). Accordingly, we separately estimate the relationship between MA penetration and IRF admission rates for IRF-F and IRF-U sub-groups.

Access to both IRF and Home Health care varies substantially across geographic markets. Nearly all Medicare beneficiaries in the US reside in counties with *some* access to home health care, though the capacity of HH agencies and the volume of services delivered varies greatly. IRFs are far less numerous than either HH agencies or SNFs. The county distribution of IRF utilization is right-skewed, with a large share of Medicare beneficiaries residing in markets with relatively low IRF utilization (Figure 1-6). Meanwhile, the county distributions of HH utilization and NH occupancy rates are normally distributed with lesser dispersion relative to IRF utilization (Figure 1-5, Figure 1-7).

We classify counties into three groups (low, middle, and high) based on their relative volume of 2011 IRF and HH utilization. Our main analysis for the IRF and HH utilization outcomes measures is then stratified by county terciles of baseline utilization to test for effect heterogeneity.

**Limitations**

Our study has several limitations. First, we are unable to measure aggregate SNF utilization among MA enrollees, so we do not evaluate SNF provider market or utilization outcomes. Instead, we included measures of nursing home provider markets and utilization (including both post-acute SNF stays paid for by Medicare, and custodial care stays paid for by Medicaid/other payers) among nursing homes certified as Medicare SNFs. Second, we pooled PAC setting utilization across the MA and TM populations for the construction of our outcome

measures. While this approach allows us to examine the relationship between MA penetration and our set of outcomes among the Medicare population, it is unclear whether PAC markets respond to lesser Medicare utilization by increasing PAC delivery among non-Medicare populations. Further, we evaluate the aggregate relationship between MA penetration and outcomes across the total Medicare population, without examining the direct (MA population) and spillover effects (TM population) individually.

In this observational study, we observe the relationship between changes in MA penetration and PAC market and utilization outcomes. Although we take measures to control for sources of confounding, and apply a lagged exposure approach, we cannot draw causal conclusions from our findings. It is possible that MA carriers strategically enter markets with excess PAC utilization, leading to a potentially spurious association between changes in MA penetration and PAC utilization. Further, during the study period there were various CMS interventions (e.g. Bundled Payments for Care Improvement, Hospital Readmissions Reduction Program) which aimed to improve the value of PAC for TM beneficiaries; if participants in these programs were located in markets where MA enrollment expanded, we might observe a spurious relationship between MA penetration and our set of outcomes. However, given the strength of the associations we observe in this study, it seems unlikely that our findings are driven entirely by external factors.

## Study Results

### Sample Characteristics and MA Expansion

Our sample included 2,822 counties with an average of 18,585 Medicare beneficiaries (MA & FFS pooled) per year between 2011 and 2017. Across the seven-year period, the total Medicare population increased from 47.5 to 57.0 million beneficiaries (a 19.9% increase) (Table 1-1). The mean age of all Medicare beneficiaries remained stable between 71.2 and 71.4, the percentage of non-white persons increased from 23.3% to 25.8%, and the percentage of persons qualifying for Medicare with disability (17.7 to 14.2%) and ESRD (.5% to .2%) declined.

During the seven-year study period, Medicare Advantage enrollment increased from 12.0 million in 2011 to 19.2 million in 2017, as MA accounted for a growing share of total Medicare enrollment (MA penetration: 2011, 25.2%; 2017, 33.7%). MA expansion was concentrated among counties located in the US South, Mid-West, and North-East (Appendix Figure 1-3). Growth in Medicare enrollment was not associated with increased MA penetration (Appendix Figure 1-4). Variation in MA expansion across counties was high, as counties ranked in the *lowest* quartile of MA expansion experienced an increase of 0.9 percentage points (from 27.0% in 2011 to 27.9% in 2017) and counties ranked in the *highest* quartile experienced an increase of 15.6 pp (from 21.3% in 2011 to 36.9% in 2017). Baseline (2011) county MA penetration was not associated with MA expansion between 2011 and 2017 (Appendix Figure 1-2, Appendix Table 1-8).

As MA enrollment expanded, differences in the demographic composition of MA enrollees and TM beneficiaries intensified, while differences in Medicare entitlement and Medicaid dual-enrollment status attenuated. Relative to TM beneficiaries in 2011, MA enrollees

were 1.9 years younger, 2.5% more likely to be female, 3.9% less likely to White, and 3.1% more likely to be Hispanic (Appendix Table 1-9). By 2017, differences in age decreased to 1.5 years, while differences in the percent of beneficiaries' females (MA, -3.24), percent of White (MA, -7.2), percent of Hispanic (MA, -4.7%) increased. Differences in the reason for Medicare entitlement shrunk between 2011 and 2017; notably the difference in percent of persons qualifying by disability (6.21 to 3.16) and the percent of percent of persons qualifying through OASI (-6.74 to -3.42). The share of MA enrollees enrolled in Medicaid increased from 15.0% to 19.2% while the share of TM beneficiaries enrolled as duals decreased from 19.2% to 17.8%.

**MA Expansion and PAC Markets and Utilization**

Nursing Homes

Prior to adjustment, the mean number of nursing home beds per one-thousand Medicare beneficiaries in 2011 was 34.57, mean NH occupancy was 81.59%, mean HHI was 1,745, and the average county had a weighted NH star rating of 2.96 (Table 1-2). Between 2011 and 2017, the mean number of NH beds per one-thousand Medicare beneficiaries fell 18.7% to 28.1, NH occupancy remained stable, NH market concentration increased marginally, and average NH star ratings increased to 3.17.

A ten-percentage point increase in county MA penetration was associated with a 0.459 ($p<0.01$) decrease in the rate of NH beds per one-thousand Medicare beneficiaries (/1,000), a 0.779 ($p<0.01$) decrease in NH occupancy rates, a 0.081 ($p<0.01$) decrease in NH star ratings, and no change in NH market competitiveness (estimate, 1.929; std. error, 1.929) (Table 1-3).

After applying a one-year lag to our exposure variable, we find that the association for NH beds /1,000 increased in magnitude to -0.569 ($p<0.01$), attenuated marginally for occupancy rates to -0.708 ($p<0.01$), did not change for NH market competitiveness, and increased marginally in magnitude for NH star ratings to -0.088 ($p<0.01$) (Table 1-3). Our estimates were stable across both specifications using either a one and two year lagged exposure.

Home Health

Prior to adjustment, the baseline (2011) rate of home health (HH) users per one-thousand Medicare beneficiaries (/1,000) was 106.41, and the Herfindahl Hirschman Index was 2,031 (moderately concentrated) (Table 1-2). By 2017, the rate of HH users / 1,000 declined to 102.82, while HH market competition increased (HHI, 1,932).

Our main estimates suggest that MA expansion of ten-percentage points was associated with a nearly 10% reduction in the rate of Medicare beneficiaries using any home health (estimate, -10.042; $p<0.01$), but was not associated with HH market concentration (estimate 41.418; $p>0.05$) (Table 1-3). One-year lagged exposure estimates of HH users/1,000 are marginally lesser in magnitude (estimate, -9.160; $p<0.01$), while our two-year lagged exposure estimates reduced in magnitude to -6.334 ($p<0.01$). In both one (estimate, 63.777; $p<0.01$) and two-year (estimate, 61.241; $p<0.01$) lagged exposure estimates, we find that increased MA penetration was associated with increased HH market concentration (Table 1-6). Further, we find a strong negative association between increased MA penetration and the count of HH agencies per thousand Medicare beneficiaries in both unlagged (estimate, -0.166; $p<0.01$) and lagged estimates (estimate, -0.195; $p<0.01$).

Inpatient Rehabilitation

During the seven-year study period, the unadjusted rate of IRF admissions per one-thousand Medicare beneficiaries (/1,000) declined from 8.51 to 8.12, and the rate of IRF days / 1,000 declined from 118.59 to 112.93 (Table 1-2). A ten-percentage point increase in MA penetration was associated with a 0.418 ($p<0.01$) reduction in IRF admissions / 1,000 and a 5.828 reduction in IRF days / 1,000 (Table 1-3). One-year lagged exposure estimates for IRF admissions / 1,000 (-0.255, $p<.05$) and IRF days / 1,000 (-3.169, $p<0.05$) were smaller in magnitude, while estimates for the two-year lagged exposure were not different from zero (Table 1-3).

**Sensitivity Analysis**

Stratified Estimates Across Baseline Volume of Utilization

County (n=2,822) terciles of 2011 IRF utilization were strongly correlated with county Medicare population size; the 941 counties in the lowest tercile had an average of 13,988 beneficiaries while the 940 counties in the highest tercile had an average of 19,616 beneficiaries in 2011 (Appendix Table 1-5). Similarly, counties grouped into the lowest tercile of baseline HH utilization had fewer Medicare beneficiaries in 2011 (Lowest tercile, 9,717; Highest tercile, 20,500) (Appendix Table 1-6). Across terciles of NH occupancy, counties in the middle tercile had greater Medicare enrollments relative to the lower and upper terciles (Appendix Table 1-4).

County nursing home occupancy rates varied from 69.04% (lower tercile) to 90.63% (upper tercile) in 2011 (Appendix Table 1-4**,** Appendix Figure 1-5). Beneficiaries residing in counties in the upper tercile of 2011 IRF utilization (14.4 admits / 1,000) were admitted to IRFs more than five times more frequently than those residing in lower tercile counties (2.7 admits / 1,000) (Appendix Table 1-5**,** Appendix Figure 1-6). The difference in the rate of HH utilization between persons residing in the lower (57.8 users / 1,000) and upper (143.0 users / 1,000) tercile counties of 2011 HH utilization was less extreme, though still substantial (Appendix Table 1-6**,** Appendix Figure 1-7).

Our main estimates (pooled across all counties) showed that a ten-percentage point increase in MA penetration was associated with a 0.42 decrease in the rate of IRF admissions (mean, 8.51, p<.01). Stratified estimates display a concave relationship between MA penetration and IRF utilization across terciles of baseline (2011) IRF utilization. Among counties in the lowest tercile the association was 0.71 (p<0.01), a 26% relative increase compared to the mean baseline rate of IRF utilization (Table 1-11, Figure 1-9). The association was not significant among counties in the middle tercile, and among counties grouped in the highest tercile the association was -1.07 (p<0.01), representing a 7.4% relative decrease compared to the mean baseline rate of IRF utilization. This concave relationship was consistent for both classifications of IRF (hospital-based units, and free-standing facilities).

Our main estimates showed that a ten-percentage point increase in MA penetration was associated with a 1.105 (p<0.01) percentage point reduction (1.3% relative reduction) in Nursing home occupancy. Among counties grouped in the lowest tercile of baseline (2011) NH occupancy this association was not statistically significant, while in counties in the middle

tercile the association was -0.088 ($p<0.05$) and among counties in the highest tercile the association was -2.39 ($p<0.01$) (Table 1-10, Figure 1-8).

Our main estimates showed that a ten-percentage point increase in MA penetration was associated with a reduction of home health users per one thousand Medicare beneficiaries (estimate, -10.04; $p <0.01$). This association was weakest among counties in the lowest tercile of baseline HH utilization (estimate, -1.62; $p >=0.05$) and strongest among counties in the highest tercile (estimate, -16.797; $p <0.01$) (Table 1-12, Figure 1-10). Relative to the mean baseline rate of HH utilization, our estimate for counties in the lowest tercile represents a 2.8% reduction in utilization, and our estimate for counties in the highest tercile represents a 11.7% relative reduction in utilization.

Baseline (2011) county MA penetration was classified into four quartiles (0-13%; 14-23%; 24%-36%; >36%), with approximately equivalent Medicare population sizes (total person years observed during 2011). In the lowest quartile (Q1) of baseline MA penetration, a ten-percentage point expansion in MA penetration was associated with a 0.795 ($p<0.05$) reduction in nursing home beds/1,000, a 1.070 reduction in NH occupancy rates ($p<0.01$), a 0.117 ($p<0.05$) reduction in NH star ratings, and no statistically significant change in NH market concentration (est. 3.05, $p>0.10$) (Table 1-7). The association between MA enrollment and home health users/1,000 was relatively stable across quartiles (Q1: -9.830, $p<0.01$; Q2: 9.426, $p<0.01$; Q3: 11.678, $p<0.01$; Q4: -9.418, $p>0.10$). Among IRF utilization outcomes, baseline MA penetration was associated with mean levels of admissions/1,000 beneficiaries (Q1: 9.563; Q2: 9.132; Q3: 9.101; Q4: 6.265) and utilization days/1,000 beneficiaries (Q1: 132.594; Q2: 127.587; Q3: 126.705; Q4: 89.039). Estimates of the association between MA penetration and our IRF

utilization outcomes were only statistically significant in the lower two quartiles for both IRF admissions/1,000 beneficiaries (Q1: est. -0.574, $p<0.05$; Q2: est. -0.587, $p<0.05$) and IRF utilization days/1,000 beneficiaries (Q1: est. -7.616, $p<0.05$; Q2: est. -8.158, $p<0.01$). In markets classified in the highest quartile of baseline MA market penetration (Q4), MA penetration was not associated with any of the nursing home, home health, or IRF associated outcome measures.

## Discussion

We find that increased MA market penetration is associated with high magnitude reductions in home health and IRF utilization, moderate reductions in nursing home utilization, less competitive home health agency markets, and a shift of nursing home patients into facilities with lower CMS star ratings.

MA carriers seeking to improve the efficiency of PAC for their enrolled populations have various levers through which to effect change, including: formation of PAC provider networks; cost-sharing; influencing discharge setting triage; active case management of enrollees during PAC episodes. By forming PAC provider networks, MA plans restrict access to certain SNFs, IRFs, HH agencies for a segment of the market's population (the plan's enrollees). In doing so, they favor certain providers and disadvantage others. Given sufficient market power, we would expect MA plan's provider networking activities to cause result in increased concentration of PAC provider markets. Our findings corroborate this hypothesis, as increasing MA penetration was associated with increased concertation of home health users among fewer HH agencies.

Other strategies available to MA plans, such as direct involvement in post-acute discharge triage, and cost-sharing mechanisms, directly alter the utilization (discharge rates, and length of

stay) of PAC. We find that increasing MA penetration is associated with reductions in NH occupancy, the rate of Medicare beneficiaries using home health during a one-year period, and both the rate of admission to IRFs and the volume of days of IRF utilized.

Overall, we find evidence that increased county MA penetration is associated with lesser utilization across all PAC settings, and less competitive PAC markets. In Chapter Two, we will investigate the causal effect of MA enrollment (relative to TM) on PAC utilization.

**Tables and Figures**

Table 1-1: County MA Enrollment Expansion, by Quartile and Year

| | MA Expansion Quartile & Year | | | | | |
|---|---|---|---|---|---|---|
| | Low (0-24th) | | High (75-99th) | | Total | |
| | 2011 | 2017 | 2011 | 2017 | 2011 | 2017 |
| **Counties (N)** | 706 | 706 | 705 | 705 | 2,822 | 2,822 |
| **Person Years (1,000's)** | 8,485 | 10,105 | 11,252 | 13,472 | 47,537 | 56,997 |
| **MA Penetration** | 27.0 | 27.9 | 21.3 | 36.9 | 25.2 | 33.7 |
| **MA Enrollment Characteristics** | | | | | | |
| **Plan Type** | | | | | | |
| *HMO* | 66.8 | 70.0 | 57.5 | 50.0 | 62.7 | 60.2 |
| *Local PPO* | 17.2 | 21.5 | 19.8 | 33.3 | 18.2 | 26.0 |
| *Reg PPO* | 7.0 | 3.7 | 11.2 | 8.8 | 9.5 | 7.1 |
| *Other* | 9.0 | 4.7 | 11.5 | 7.9 | 9.6 | 6.7 |
| **Special Needs Plan** | 9.3 | 10.0 | 12.2 | 14.0 | 9.4 | 11.1 |
| **Zero Premium Plan** | 35.1 | 38.1 | 59.3 | 51.3 | 51.1 | 47.7 |
| **US Census Region (2011)*** | | | | | | |
| Midwest | 29.3 | | 20.4 | | 100.0 | |
| Northeast | 19.4 | | 11.5 | | 100.0 | |
| South | 12.2 | | 36.4 | | 100.0 | |
| West | 65.4 | | 1.7 | | 100.0 | |

* Percent of counties in Quartile by Census Region

Table 1-2: Outcomes Measures by Year

| | | Year | | |
|---|---|---|---|---|
| | | **2011** | **2017** | **Difference** |
| **Counties (N)** | | 2,822 | 2,822 | |
| **Bene.'s (1,000's)** | | 47,537 | 56,997 | |
| **County Avg. Bene.'s (N)** | | 16,845 | 20,197 | |
| **Measures** | | | | |
| **Nursing Homes** | | | | |
| | Beds/1,000 Benes | 24.69 | 20.34 | -4.34 |
| | Occupancy Rate | 82.19 | 82.38 | 0.19 |
| | HHI | 1,795.00 | 1776.58 | -18.42 |
| | Star Rating | 2.93 | 3.15 | 0.22 |
| **Home Health** | | | | |
| | Users / 1,000 Benes | 106.41 | 102.82 | -3.59 |
| | HHA / 1,000 Benes | 1.31 | 1.07 | -0.24 |
| | HHI | 2,030.53 | 1,932.21 | -98.32 |
| **Inpatient Rehabilitation** | | | | |
| | Beds/1,000 Benes | | | |
| | Total | 8.10 | 6.82 | -1.27 |
| | IRF Unit | 4.62 | 3.68 | -0.94 |
| | Free-Standing | 3.48 | 3.14 | -0.34 |
| | Admits/1,000 Benes | | | |
| | Total | 8.51 | 8.12 | -0.39 |
| | IRF Unit | 4.80 | 3.94 | -0.86 |
| | Free-Standing | 3.71 | 4.17 | 0.46 |
| | Days/1,000 Benes | | | |
| | Total | 118.59 | 112.93 | -5.66 |
| | IRF Unit | 65.59 | 54.86 | -10.73 |
| | Free-Standing | 53.00 | 58.07 | 5.07 |

Table 1-3: Main Estimates and Lagged Effects

| | | | No Lag | | 1Y Lag | | 2Y Lag | |
|---|---|---|---|---|---|---|---|---|
| | | **Mean** | **Estimate** | **SE** | **Estimate** | **SE** | **Estimate** | **SE** |
| **Nursing Homes** | | | | | | | | |
| | Beds/1,000 Bene.'s | 34.574 | -0.459*** | (0.169) | -0.569*** | (0.165) | -0.640*** | (0.131) |
| | Occupancy Rate | 82.295 | -1.105*** | (0.275) | -1.107*** | (0.288) | -0.884** | (0.275) |
| | HHI | 1786.09 | 10.932 | (12.714) | 15.300 | (13.567) | 23.688* | (14.142) |
| | Star Rating | 3.064 | -0.088*** | (0.032) | -0.098*** | (0.031) | -0.104*** | (0.030) |
| **Home Health** | | | | | | | | |
| | Users/1,000 Bene.'s | 104.451 | -10.042*** | (1.833) | -9.160*** | (1.677) | -6.334*** | (1.478) |
| | HHA / 1,000 Bene.'s | 1.176 | -0.166*** | (0.027) | -0.195*** | (0.026) | -0.161*** | (0.024) |
| | HHI | 1976.919 | 41.418 | (27.186) | 63.777** | (25.257) | 61.241*** | (22.633) |
| **Inpatient Rehabilitation** | | | | | | | | |
| | Beds/1,000 Bene.'s | | | | | | | |
| | Total | 0.740 | -0.075*** | (0.024) | -0.040* | (0.021) | -0.038 | (0.030) |
| | Hospital Unit | 0.411 | -0.021 | (0.014) | -0.018 | (0.015) | -0.022 | (0.014) |
| | Free-Standing | 0.330 | -0.054* | (0.028) | -0.021 | (0.024) | -0.015 | (0.031) |
| | Admits/1,000 Bene.'s | | | | | | | |
| | Total | 8.294 | -0.418*** | (0.148) | -0.255* | (0.133) | -0.102 | (0.120) |
| | Hospital Unit | 4.330 | -0.294** | (0.116) | -0.279*** | (0.104) | -0.326*** | (0.092) |
| | Free-Standing | 3.964 | -0.124 | (0.115) | 0.024 | (0.116) | 0.224* | (0.121) |
| | Days/1,000 Bene.'s | | | | | | | |
| | Total | 115.505 | -5.828*** | (1.853) | -3.169* | (1.741) | -1.011 | (1.582) |
| | Hospital Unit | 59.739 | -3.913*** | (1.495) | -3.687*** | (1.387) | -4.410*** | (1.242) |
| | Free-Standing | 55.766 | -1.915 | (1.564) | 0.518 | (1.626) | 3.399** | (1.668) |
| **N** | | | **19,754** | | **19,754** | | **19,754** | |

Table 1-4: NH Occupancy, by Initial (2011) Terciles of County NH Occupancy

| | Baseline (2011) NH Occupancy Tercile | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Lowest | | | Middle | | | Highest | | |
| | Mean | Estimate | SE | Mean | Estimate | SE | Mean | Estimate | SE |
| **NH Occupancy Rate** | | | | | | | | | |
| *Total* | 69.911 | 0.427 | 0.526 | 82.191 | -0.880* | 0.363 | 88.798 | -2.389*** | 0.361 |
| **Counties (N)** | **941** | | | **941** | | | **940** | | |

Table 1-5: IRF Utilization, by Initial (2011) Terciles of County IRF Utilization

| | Baseline (2011) IRF Utilization Tercile | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Lowest | | | Middle | | | Highest | | |
| | Mean | Estimate | SE | Mean | Estimate | SE | Mean | Estimate | SE |
| **Admits/1,000 Bene.'s** | | | | | | | | | |
| *Total* | 3.141 | 0.709*** | (0.180) | 6.480 | -0.180 | (0.143) | 14.151 | -1.072*** | (0.186) |
| *Hospital-Based IRF Units* | 2.256 | 0.384** | (0.121) | 4.187 | -0.222 | (0.120) | 6.372 | -0.639*** | (0.168) |
| *Free-Standing IRFs* | 0.885 | 0.325* | (0.163) | 2.293 | 0.042 | (0.146) | 7.779 | -0.433** | (0.162) |
| **Days/1,000 Bene.'s** | | | | | | | | | |
| *Total* | 45.411 | 10.807*** | (2.419) | 92.492 | -2.941 | (1.857) | 194.953 | -15.040*** | (2.364) |
| *Hospital-Based IRF Units* | 32.565 | 5.051** | (1.647) | 59.280 | -3.489* | (1.621) | 86.508 | -8.097*** | (2.238) |
| *Free-Standing IRFs* | 12.846 | 5.757* | (2.247) | 33.212 | 0.548 | (1.962) | 108.445 | -6.942** | (2.241) |
| **Counties (N)** | **941** | | | **941** | | | **940** | | |

Table 1-6: HH Utilization, by Initial (2011) Terciles of County HH Utilization

| | Baseline (2011) HH Utilization Tercile | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Lowest | | | Middle | | | Highest | | |
| | Mean | Estimate | SE | Mean | Estimate | SE | Mean | Estimate | SE |
| **HH Users/1,000 Bene.'s** | | | | | | | | | |
| *Total* | 60.708 | -1.620 | (1.037) | 93.607 | -3.787*** | (0.947) | 135.637 | -16.797*** | (2.315) |
| **Counties (N)** | **941** | | | **941** | | | **940** | | |

Table 1-7: Estimates Stratified by Initial (2011) Quartiles of MA Penetration

| | | Q1 (<14%) | | | Q2 (14-24%) | | | Q3 (24-36%) | | | Q4 (>36%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Mean** | **Est.** | **SE** | **Mean** | **Est.** | **SE** | **Mean** | **Est.** | **SE** | **Mean** | **Est.** | **SE** |
| Nursing Homes | | | | | | | | | | | | | |
| | Beds/1,000 Bene.'s | 36.593 | -0.795*** | (0.224) | 32.021 | -0.229 | (0.188) | 29.027 | -0.108 | (0.268) | 26.610 | -0.741 | (0.478) |
| | Occupancy Rate | 79.865 | -1.070** | (0.336) | 82.279 | -1.728*** | (0.326) | 81.660 | -1.055* | (0.462) | 82.698 | 0.786 | (0.576) |
| | HHI | 2709.793 | 3.050 | (19.996) | 2192.314 | 21.483 | (15.331) | 1345.138 | 4.652 | (15.686) | 878.995 | 17.801 | (19.332) |
| | Star Rating | 3.062 | -0.117** | (0.037) | 3.044 | -0.086* | (0.043) | 3.105 | -0.059 | (0.065) | 3.260 | -0.045 | (0.089) |
| Home Health | | | | | | | | | | | | | |
| | Users/1,000 Bene.'s | 102.860 | -9.830*** | (2.746) | 106.920 | -9.426*** | (2.589) | 104.157 | -11.678*** | (2.037) | 102.788 | -9.418 | (5.960) |
| | HHA / 1,000 Bene.'s | 1.643 | -0.167*** | (0.039) | 1.364 | -0.205*** | (0.048) | 1.002 | -0.134*** | (0.040) | 0.798 | -0.098 | (0.085) |
| | HHI | 2784.950 | 38.199 | (33.434) | 2229.163 | 40.177 | (34.285) | 1589.987 | 53.284 | (43.503) | 1327.329 | 32.153 | (63.457) |
| Inpatient Rehab. | | | | | | | | | | | | | |
| | Beds/1,000 Bene.'s | | | | | | | | | | | | |
| | Total | 0.688 | -0.086 | (0.048) | 0.753 | -0.065* | (0.028) | 0.902 | -0.070 | (0.047) | 0.652 | -0.077 | (0.062) |
| | Hospital Unit | 0.392 | -0.009 | (0.021) | 0.387 | -0.036 | (0.020) | 0.471 | -0.034 | (0.025) | 0.409 | 0.012 | (0.018) |
| | Free-Standing | 0.297 | -0.077 | (0.061) | 0.367 | -0.029 | (0.029) | 0.431 | -0.036 | (0.046) | 0.243 | -0.089 | (0.063) |
| | Admits/1,000 Bene.'s | | | | | | | | | | | | |
| | Total | 9.563 | -0.574** | (0.222) | 9.132 | -0.587** | (0.196) | 9.101 | 0.072 | (0.255) | 6.265 | -0.314 | (0.213) |
| | Hospital Unit | 5.213 | -0.333* | (0.167) | 4.241 | -0.337* | (0.166) | 4.774 | -0.292 | (0.186) | 3.746 | -0.007 | (0.179) |
| | Free-Standing | 4.350 | -0.241 | (0.164) | 4.891 | -0.250 | (0.191) | 4.326 | 0.364 | (0.218) | 2.519 | -0.306 | (0.196) |
| | Days/1,000 Bene.'s | | | | | | | | | | | | |
| | Total | 132.594 | -7.616** | (2.805) | 127.587 | -8.158*** | (2.467) | 126.705 | 0.666 | (3.461) | 89.039 | -5.122 | (3.124) |
| | Hospital Unit | 61.307 | -3.199 | (2.167) | 69.111 | -3.954 | (2.740) | 60.146 | 4.967 | (2.939) | 35.927 | -4.939 | (2.936) |
| | Free-Standing | 71.287 | -4.417* | (2.192) | 58.476 | -4.204 | (2.155) | 66.559 | -4.301 | (2.661) | 53.112 | -0.182 | (2.589) |

**Supplemental Appendix**

Figure 1-1: Diagram of Potential Mechanisms Used by MA Plans to Influence the Delivery & Quality of Post-Acute Care

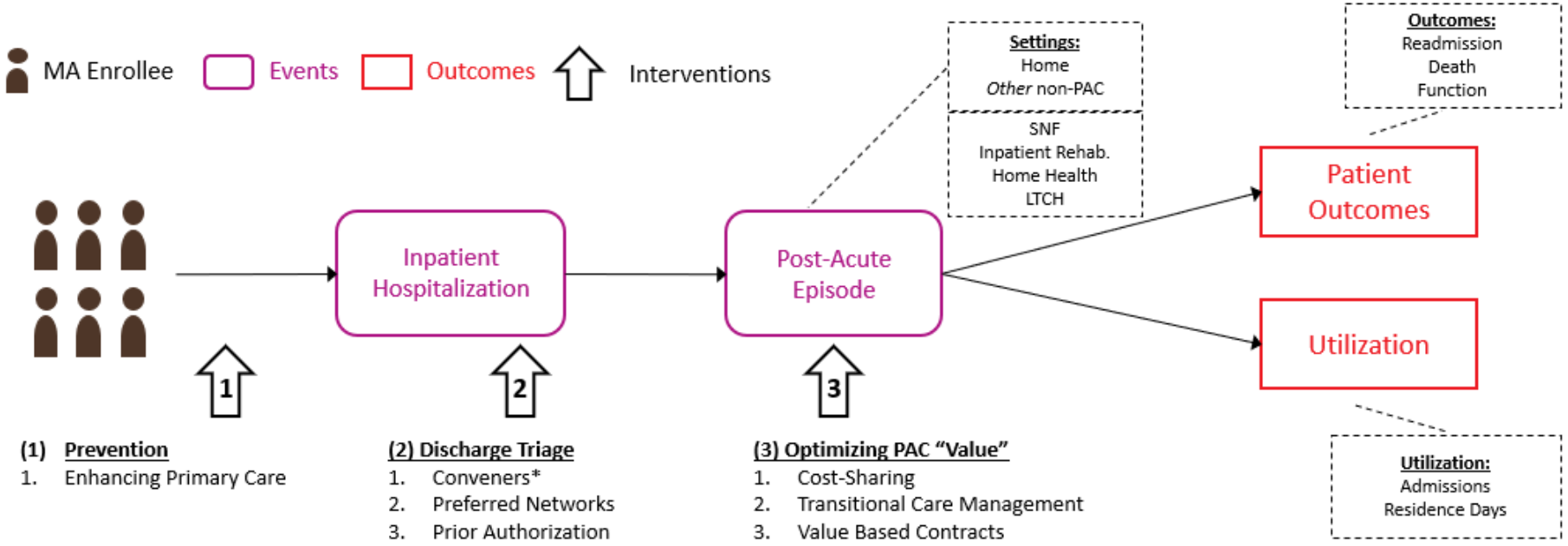


Figure 1-2: County MA Expansion by Initial MA Penetration

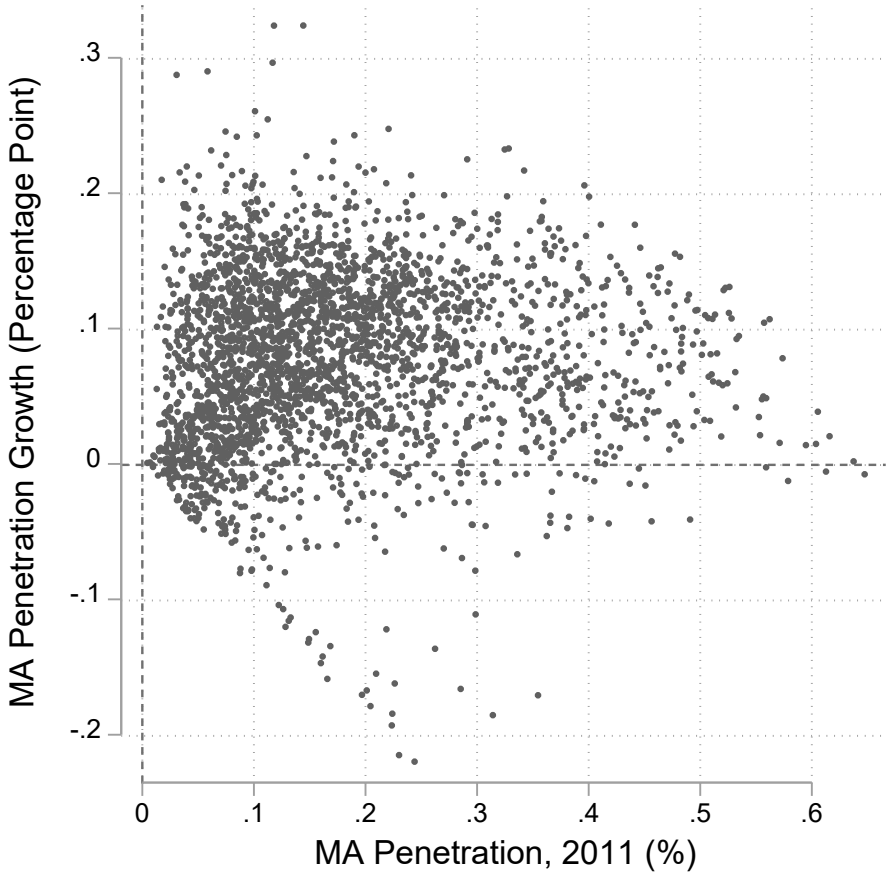


Figure 1-3: County MA Expansion by Initial MA Penetration, Census Divisions

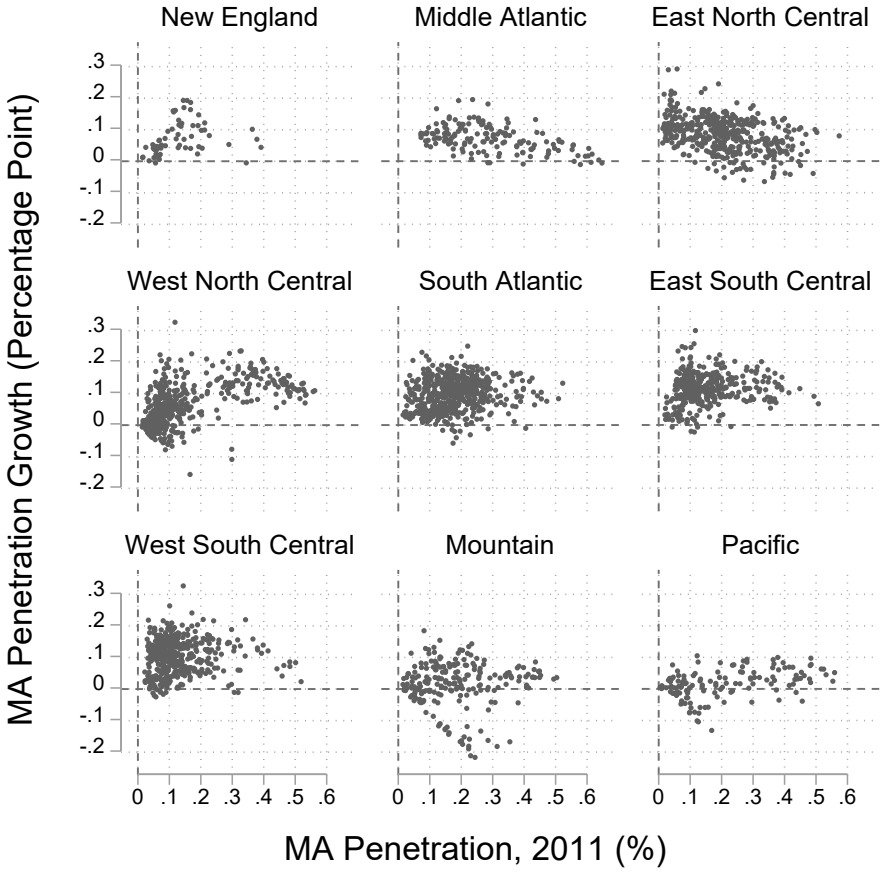



Table 1-8: MA Expansion by Baseline (2011) MA Penetration

| | | Baseline (2011) MA Penetration, Quintiles | | | | |
|---|---|---|---|---|---|---|
| | | **One** | **Two** | **Three** | **Four** | **Five** |
| Counties | | 565 | 564 | 565 | 564 | 564 |
| Medicare Enrollment, 2011 (thousands) | | 3,922.5 | 5,484.6 | 7,485.6 | 9,660.5 | 20,983.3 |
| MA Penetration (%) | | | | | | |
| | *2011* | 5.1 | 9.8 | 14.8 | 21.6 | 38.3 |
| | *2017* | 12.5 | 19.2 | 23.9 | 31.3 | 45.7 |
| MA Expansion | | 7.3 | 9.5 | 9.1 | 9.6 | 7.4 |

Figure 1-4: County Medicare Growth and Medicare Advantage Expansion

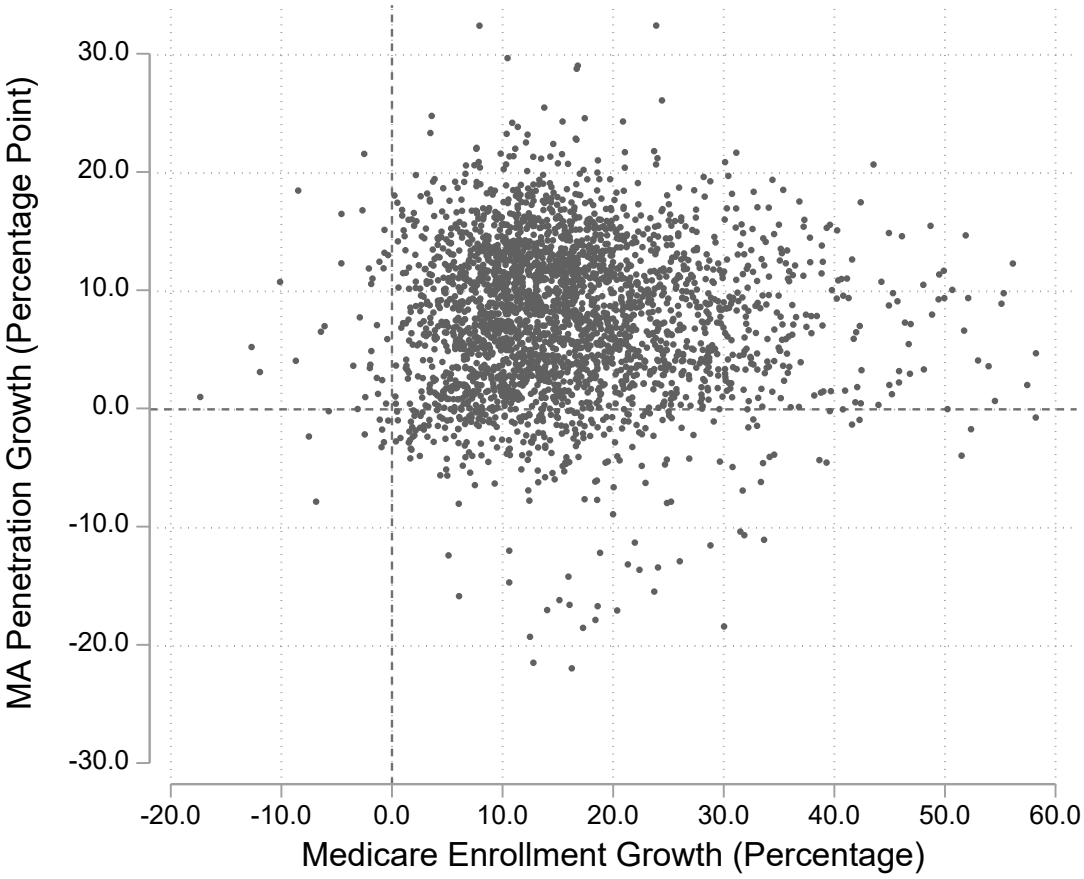


Table 1-9: Demographic & Enrollment Trends of MA Enrollees and TM Beneficiaries

| | 2011 | | | 2017 | | |
|---|---|---|---|---|---|---|
| | **MA** | **TM** | **Difference** | **MA** | **TM** | **Difference** |
| **Age** | 72.83 | 70.97 | -1.87 | 72.41 | 70.94 | -1.48 |
| **Female (%)** | 56.89 | 54.43 | -2.46 | 56.57 | 53.33 | -3.24 |
| **Race (%)** | | | | | | |
| *White* | 75.51 | 79.43 | 3.92 | 70.55 | 77.78 | 7.23 |
| *Black* | 10.71 | 10.07 | -0.64 | 12.29 | 9.69 | -2.60 |
| *Hispanic* | 9.36 | 6.20 | -3.17 | 11.11 | 6.41 | -4.70 |
| *Other* | 4.41 | 4.30 | -0.11 | 6.06 | 6.13 | 0.07 |
| **Reason for Enrollment (%)** | | | | | | |
| *Aged* | 86.78 | 80.04 | -6.74 | 87.19 | 83.77 | -3.42 |
| *Disability* | 13.09 | 19.30 | 6.21 | 12.75 | 15.91 | 3.16 |
| *ESRD* | 0.06 | 0.34 | 0.28 | 0.03 | 0.24 | 0.21 |
| *Disability & ESRD* | 0.07 | 0.32 | 0.25 | 0.03 | 0.08 | 0.05 |
| **Medicaid Dual-Enrollment (%)** | | | | | | |
| *Full Benefits* | 8.95 | 14.89 | 5.94 | 12.18 | 13.47 | 1.28 |
| *Partial Benefits* | 6.05 | 4.45 | -1.60 | 6.99 | 4.29 | -2.70 |
| *Any* | 15.00 | 19.34 | 4.34 | 19.18 | 17.76 | -1.42 |
| **Person Years, N (%)** | 11,963,952 (25.17) | 35,572,605 (74.83) | | 19,179,622 (33.65) | 37,817,620 (66.35) | |

Figure 1-5: County Distribution of NH Occupancy Rates

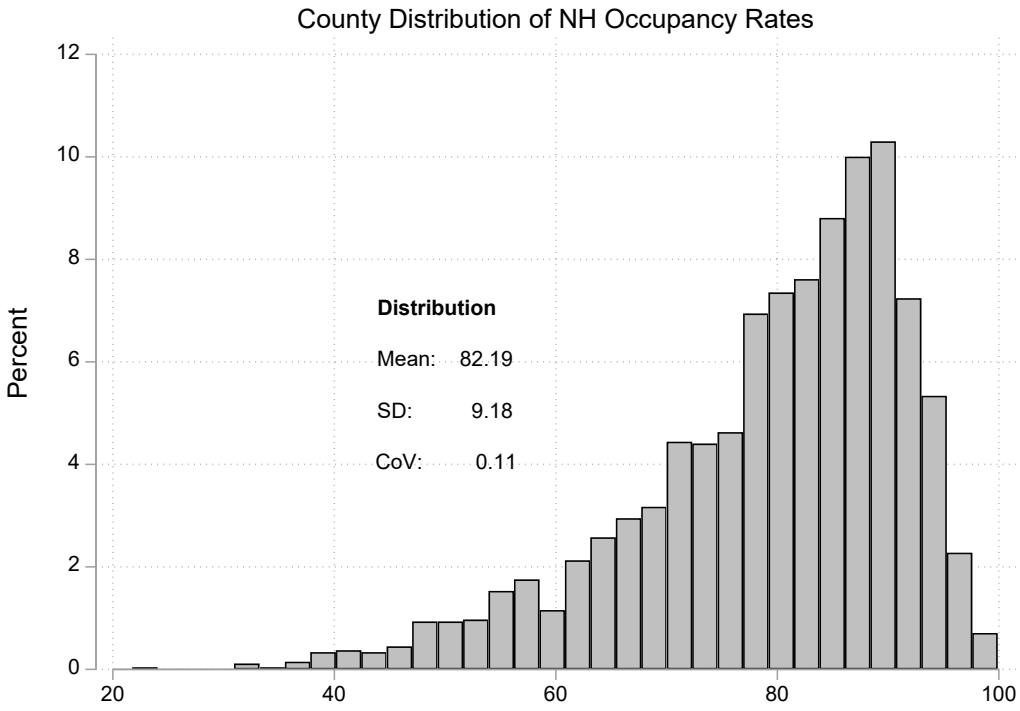



Figure 1-6: County Distribution of IRF Admissions / 1,000

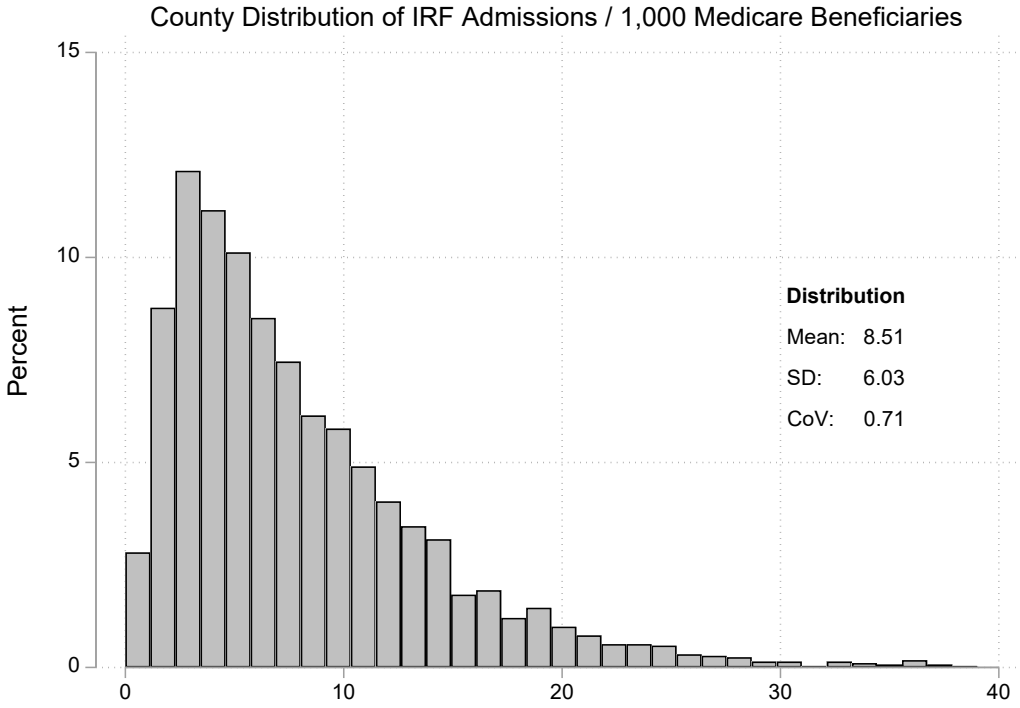


Figure 1-7: County Distribution of HH Users / 1,000

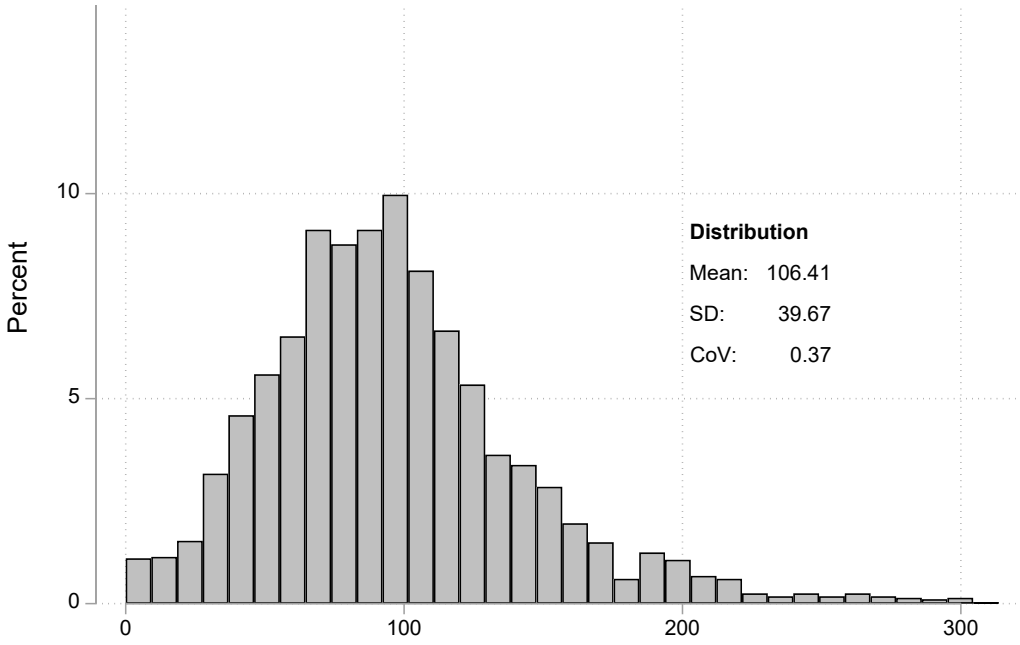


Table 1-10: 2011 NH Occupancy, Counties Stratified by Terciles of 2011 NH Occupancy

| | Low | | Middle | | High | |
|---|---|---|---|---|---|---|
| | **2011** | **2017** | **2011** | **2017** | **2011** | **2017** |
| Counties | 941 | 941 | 941 | 941 | 940 | 940 |
| Medicare Beneficiaries (mean) | 11,482 | 13,951 | 23,708 | 28,353 | 17,005 | 20,272 |
| NH Occupancy Rate | 69.038 | 71.414 | 82.514 | 83.126 | 90.632 | 88.821 |

Table 1-11: 2011 IRF Utilization, Counties Stratified by Terciles of 2011 IRF Utilization

| | Low | | Middle | | High | |
|---|---|---|---|---|---|---|
| | **2011** | **2017** | **2011** | **2017** | **2011** | **2017** |
| Counties | 941 | 941 | 941 | 941 | 940 | 940 |
| Medicare Beneficiaries (mean) | 13,988 | 17,033 | 16,934 | 20,226 | 19,616 | 23,337 |
| IRF Admissions/1,000 Bene.'s | | | | | | |
| Total | 2.70 | 3.34 | 6.46 | 6.29 | 14.43 | 13.18 |
| Free-Standing IRF | 0.55 | 1.22 | 1.92 | 2.63 | 7.51 | 7.67 |
| Hospital-Based IRF Unit | 2.15 | 2.13 | 4.54 | 3.66 | 6.92 | 5.51 |
| IRF Days/1,000 Bene.'s | | | | | | |
| Total | 38.83 | 48.26 | 92.33 | 88.98 | 198.22 | 180.97 |
| Free-Standing IRF | 8.20 | 17.38 | 28.86 | 37.21 | 105.84 | 105.91 |
| Hospital-Based IRF Unit | 30.62 | 30.89 | 63.47 | 51.77 | 92.38 | 75.06 |

Table 1-12: 2011 HH Utilization, Counties Stratified by Terciles of 2011 HH Utilization

| | Low | | Middle | | High | |
|---|---|---|---|---|---|---|
| | **2011** | **2017** | **2011** | **2017** | **2011** | **2017** |
| Counties | 941 | 941 | 941 | 941 | 940 | 940 |
| Medicare Beneficiaries (mean) | 9,717 | 11,757 | 20,322 | 24,554 | 20,500 | 24,285 |
| HH Users/1,000 Bene.'s | 57.83 | 63.37 | 92.82 | 94.88 | 142.95 | 129.97 |

Figure 1-8: Association of MA Penetration and NH Occupancy, by Initial Level of NH Occupancy

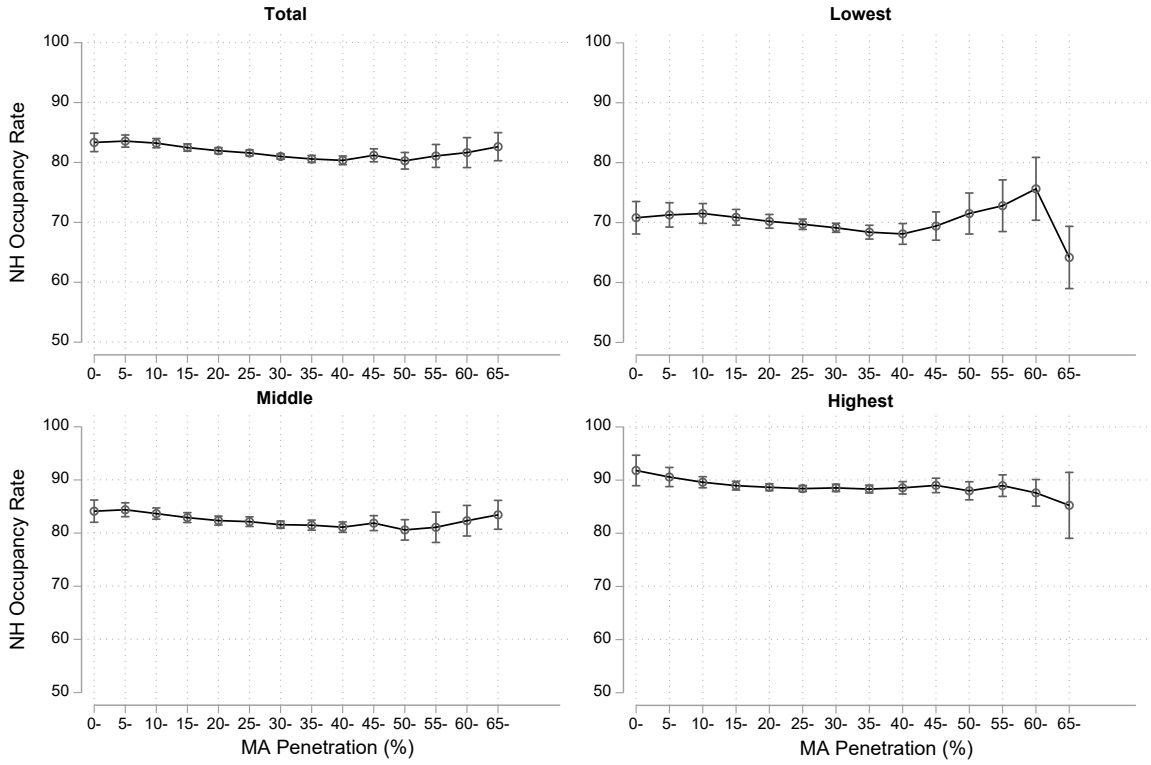


Figure 1-9: Association of MA Penetration and IRF Utilization, by Initial Level of IRF Utilization

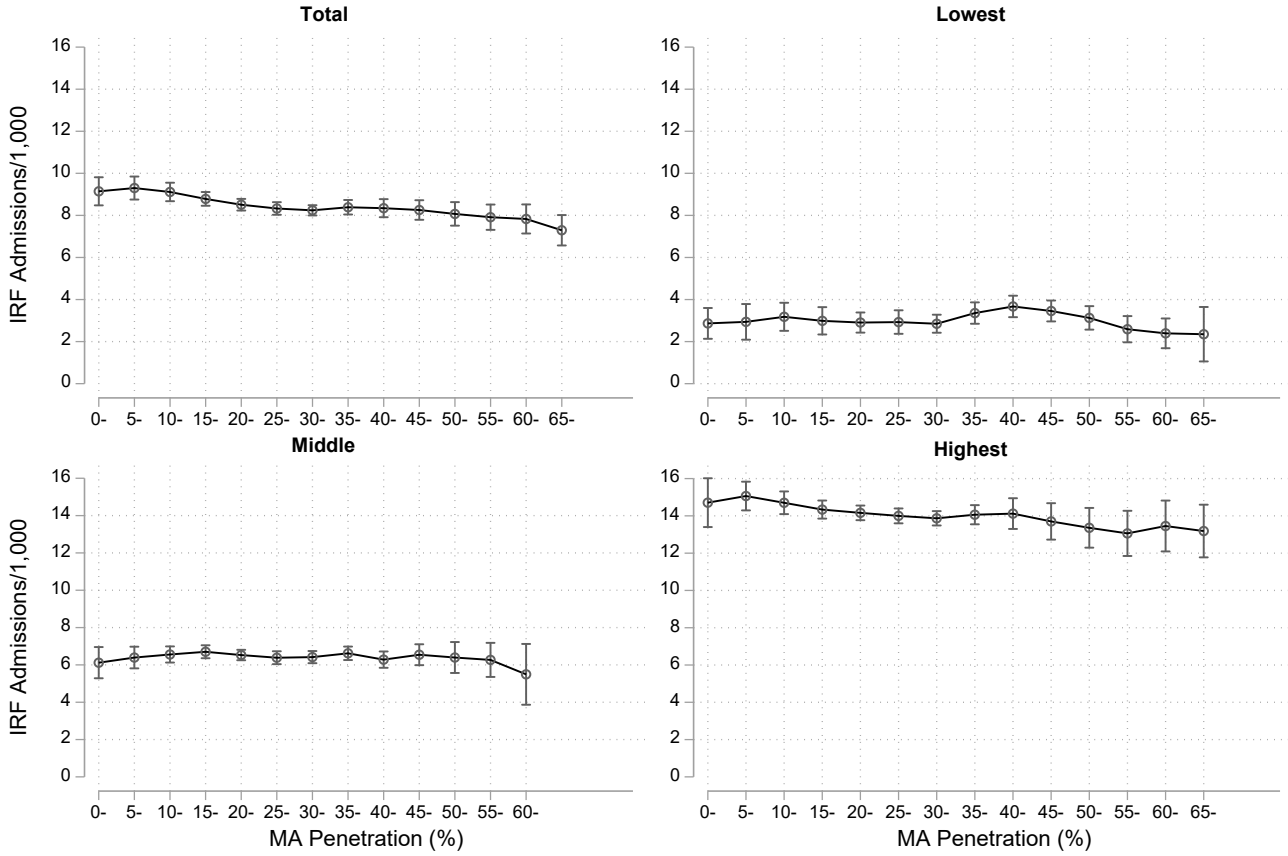
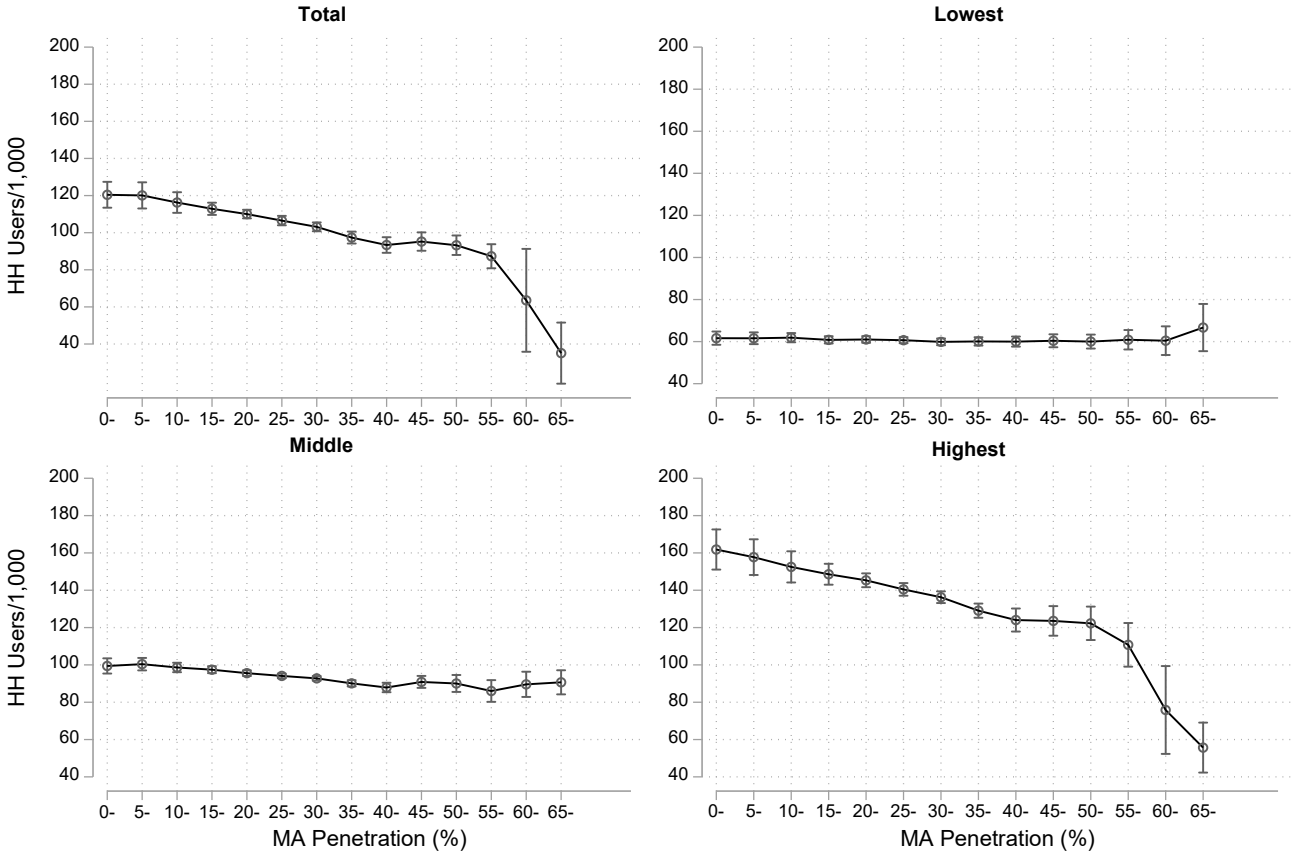


Figure 1-10: Association of MA Penetration and HH Utilization, by Initial Level of HH Utilization



## CHAPTER 2 : THE EFFECT OF MEDICARE ADVANTAGE ENROLLMENT ON POST-ACUTE CARE UTILIZATION AND ASSOCIATED PATIENT OUTCOMES


### Abstract

**Background:** Prior research indicates that compared to Traditional Medicare (TM.) beneficiaries, Medicare Advantage (MA) enrollees utilize less intense and fewer days of post-acute care (PAC) following hospitalization, without experiencing worse patient outcomes. However, existing comparisons of PAC utilization and patient outcomes between the MA and TM populations are likely biased by non-random selection of Medicare beneficiaries into MA plans.

**Objectives:** Our objective was to identify unbiased estimates of the effect of MA enrollment relative to TM enrollment on PAC utilization and associated patient outcomes following hospital discharge.

**Design, Setting, and Participants:** We exploited the expansion of MA enrollment between 2012 and 2017 as a natural experiment in a difference-in-differences analysis using cross-temporal matching to examine changes in PAC utilization and patient outcomes following hospital discharge associated with MA enrollment. Our study population included Medicare beneficiaries hospitalized for stroke (N=177,322) or hip fracture (N=144,119) who resided in counties experiencing significant expansion in MA enrollment (>= 8 percentage point growth) during the study period.

**Main Outcome Measures:** We included measures of PAC utilization including the first discharge setting following hospitalization, and the count of PAC episode days by setting. As patient

outcomes, we included hospital readmission and mortality at 30, 90, and 180 days, and the count of days residing in the community during the 180-days following hospital discharge.

**Key Results:** Among 177,322 stroke and 144,119 hip fracture hospitalizations, 24.7% in 2012 and 36.5% in 2017 were MA enrollees. MA enrollment was associated with a reduced probability of discharge to IRF for both stroke (-8.5 pp) and hip fracture (-13.4pp) cases, and increased probability of discharge to SNF among hip fracture cases (+9.0 pp) and to home without PAC among stroke cases (+8.2 pp). MA enrollment was associated with a greater number of SNF days (stroke: 1.4 days; fracture: 3.2 days), and fewer days of IRF (stroke: -1.3 days; fracture: -1.9 days) and home health (stroke: -3.1 days; fracture: -4.6 days) during PAC episodes. For patient outcomes, MA enrollment was associated with decreased all-cause 180-day hospital readmission (stroke: -2.8 pp; fracture -2.1 pp), increased days residing at home (stroke: 6.1 days; fracture: 6.1 days), and Increased mortality at 30 (stroke: 0.6pp; fracture: 0.7pp), 90 (fracture: 1.3pp), and 180 days (fracture: 0.9pp) following hospital discharge.

**Conclusions:** Our findings indicate that Medicare beneficiaries enrolling in MA plans utilize fewer days of PAC services in less expensive settings of care, while experiencing increased mortality during the 180 days post-hospitalization relative to comparable Traditional Medicare beneficiaries.

## Introduction

Between 2011 and 2021, enrollment in privately administered Medicare Advantage (MA) plans expanded from 26% (11.9M) to 46% (27M) of all Medicare beneficiaries (7). The Centers for Medicare and Medicaid Services (CMS) provides MA plans with prospective risk-adjusted capitation payments to provide Medicare benefits to its enrollees, and offers bonus payments to plans with high performance across a set of quality measures. In an effort to reduce wasteful spending, many MA carriers have targeted the post-acute care (PAC) service-line, which constitutes approximately 10% of total Medicare expenditures, and is a significant source of geographic variation (8). PAC settings include skilled nursing facilities (SNF), home health (HH), inpatient rehabilitation facilities (IRF), and long-term care hospitals (LTCH), which vary by the intensity of PAC services offered and cost. MA carriers have employed various strategies attempting to improve the value of PAC (minimizing cost, and maximizing patient outcomes), including provider network optimization, cost-sharing, transitional care management interventions, and more (9). Prior research has indicated that MA enrollment is associated with reduced PAC utilization (across all settings) and marginal improvements in associated patient outcomes following hospital discharge (5, 10). In particular, MA enrollees utilize a substantially lower volume of PAC in the IRF setting, which is likely driven by MA plan's prior authorization requirements. Despite accounting for 40% of the Medicare population in 2019, MA enrollees accounted for only 18% of total Medicare IRF case volume (MA, 92,400; TM, 34,000). (39)

As enrollment in MA plans continues to expand, understanding the effects of MA enrollment on PAC utilization and outcomes following hospital discharge grows increasingly important. Currently the effects of MA on PAC utilization and outcomes subsequent to

hospitalization are unclear due to concerns about non-random selection of beneficiaries into MA plans (11). Both observed and unobserved characteristics of Medicare Advantage enrollees and Traditional Medicare beneficiaries vary across markets and time. Unobserved differences in person-level characteristics (such as patient preferences, and healthcare needs) between the two populations may result in biased effect estimates.

To address this concern, we propose a novel approach for recovering the person-level treatment effect of MA enrollment on PAC utilization and associated patient outcomes, exploiting variation in the characteristics of MA enrollees as MA enrollment expanded across time. By leveraging time-variant characteristics of MA enrollees, we employ a cross-temporal matching difference-in-differences approach to correct for non-random patient selection into MA. In this study, we estimate the effect of MA enrollment on PAC utilization (discharge settings, and days of PAC setting utilization) and patient outcomes (mortality, hospital readmission, and days residing at home during the 180 days post-discharge). We expect that MA enrollment is associated with reductions in PAC utilization across all settings while maintaining similar performance across patient outcomes following hospital discharge. By conducting this research, we seek to produce unbiased estimates of the effect of MA enrollment on PAC utilization and associated patient outcomes.

## Study Data and Methods

### Data Sources

To identify MA enrollees and TM beneficiaries, we used the Medicare Beneficiary Summary File (MBSF) between (2011-2013 and 2016-2018). The MBSF provides annual person level information including Medicare enrollment information, demographics, residential zip code, and more. In combination with the MBSF, we leveraged the Healthcare Effectiveness Data and Information Set (HEDIS) to identify Medicare Advantage contract & plan ID's, and identified relevant MA plan characteristics (plan type, special needs plan designation, plan premium amounts, etc.) using the publicly available Medicare Plan Benefit Files.

Geographic (zip-code & county level) market characteristics were captured using data from various sources, and associated with Medicare beneficiaries using their residential zip-code. Geographic market characteristics were identified using the Internal Revenue Service Income Tax Zip Code Data (annual zip code level median household income), the Area-Health Resource File (poverty) and US Dept. of Agriculture (Rurality) (34, 40, 41).

Medical utilization and residential history for Medicare beneficiaries was identified using a combination of the Residential History File (RHF), and both claim encounter data and assessments from PAC settings. Hospitalizations and corresponding data (including diagnoses, procedures, etc.) were identified using the Medicare Provider Analysis and Review (MEDPAR) file, and SNF stays, IRF stays, and home health episodes were identified using assessments data from the Minimum Data Set 3.0 (MDS), the Inpatient Rehabilitation Facility Patient Assessment Instrument (IRF-PAI), and the Outcomes and Assessment Information set (OASIS), respectively.

Hospital's not required to submit Medicare encounter claims (those not receiving disproportionate share hospital payments or graduate medical education payments) were identified using Hospital cost reports (42).

**Study Population**

Among non-territory US counties with a minimum of one thousand Medicare beneficiaries during 2012 and 2017, we measured and ranked (high to low) county-level MA enrollment expansion between 2012 and 2017 (See the section: *County Level Medicare Advantage Expansion*), and retained counties in the top 40% (mean +11.7 pp; min. +8.0 pp; max. +29.8 pp). Within these counties, we identified Medicare beneficiaries (TM/MA) who were hospitalized with a primary diagnosis of stroke or hip fracture during 2012 and 2017. Stroke hospitalizations were identified using *International Classification of Diseases, Ninth Revision* (ICD-9) codes 434.X, 436, and 433.X (excluding 433.10) and ICD-10 codes I60, I61, I63, I64, I65 (excluding I65.2), I66, and I67.89. (43, 44) Hip Fracture hospitalizations were identified using ICD-9 codes 820, 808.1, 733.14, 733.15, 733.81, 733.82, and 733.96. and ICD-10 codes S720-S722, S790, S324, M80, or M84. (45)

Stroke and hip fracture were selected due to their emergent nature, as hospitalization is less likely to be influenced by enrollment into MA relative to other conditions (e.g. heart failure, or COPD). Further, patients recovering from either stroke or hip fracture often require intensive rehabilitation. Among inpatient rehabilitation facilities (IRF), stroke and fractures of the lower extremity (including hip fracture) account for nearly 30% (2019) of IRF's case volume (39). For

beneficiaries with multiple hip fracture or stroke hospitalizations during the same year, we retained only the first occurrence. Hospitalizations at hospitals not required to submit Medicare encounter claims (those not receiving DSH or GME payments) were excluded from the denominator of index hospitalizations (27). To avoid misclassification of custodial nursing home care and SNF care (for purposes of PAC utilization measurement), we exclude beneficiaries with any nursing home residence days or any SNF utilization during the 180 days prior to hospital admission (26). Lastly, we excluded any counties with less than five hospitalizations (stroke and hip fracture, separately) of either MA enrollees and TM beneficiaries during each year. Our study population consisted of 177,322 stroke hospitalizations (2012: 78,121; 2017: 99,201) and 144,119 hip fracture hospitalizations (2012: 64,370; 2017: 79,749).

**County Level Medicare Advantage Expansion**

We measure Medicare Advantage penetration (the proportion of total Medicare population enrolled in MA plans) at the county level during each year. MA penetration is then stratified by plan type (e.g. HMO, local PPO, regional PPO, etc.) and meaningful plan characteristics (e.g. *Special Needs Plans*, and plans with zero-premium) to characterize the composition of MA products in a market. Counties were chosen as the geographic unit of aggregation because insurance carriers establish contracts with CMS to offer MA plans at the county-level, and CMS sets MA payment rate benchmarks at the county level (46). Between 2012 and 2017 MA penetration expanded from 26.6% to 33.6% (Table 2-1), primarily driven by counties in the Southern region of the United States (Table 2-1, Figure 2-2). Among the top 40%

of counties (N=1,128) by MA expansion, MA penetration increased from 24.5% to 36.2% (11.7 pp), with enrollment into HMO (6.0 pp) and PPO (6.4 pp) plan types increasing at a similar rate.

**Study Design**

Overview & Identification Strategy

The decision whether to enroll in a MA plan is complex, as Medicare beneficiary preferences are diverse and MA plan offerings vary substantially across markets and time. A primary concern in cross-sectional comparisons of MA and TM beneficiaries is that those who elect to enroll in MA have a different set of preferences and health care needs from those who choose not enroll. Since these preferences are not directly measurable, selection bias threatens the validity of studies which leverage matching to identify comparable populations of TM & MA populations – even if observable characteristics are well-balanced.

We exploit the expansion of Medicare Advantage penetration between 2012 and 2017 as a natural experiment using a difference in differences design with cross-temporal matching to compare PAC utilization and patient outcomes among matched groups of MA enrollees and TM beneficiaries (16). Our approach takes advantage of changes in the characteristics of persons who chose to enroll in MA across time. In counties with substantial (top 40%) MA enrollment expansion, we applied cross-temporal matching to establish three groups of beneficiaries: MA enrollees in 2012 and 2017 who were likely to enroll regardless of MA expansion (Group 1); second, we matched MA enrollees during 2017 whose enrollment can be attributed to MA expansion, to TM beneficiaries in 2012 who likely would have enrolled in MA

during 2017 (Group 2); and third, we matched TM beneficiaries in 2012 and 2017 who were unlikely to enroll in MA during either year (Group 3). Using a difference in differences framework, we compare changes in outcomes across time among Group 2 with changes in outcomes across time among Group 3 to estimate the effect of MA enrollment on PAC utilization and patient outcomes.

Propensity to Enroll in MA

To construct our three comparison groups, we first estimated propensity score models for the probability of enrolling in MA during 2012 and 2017 (P2012 and P2017, respectively) using all Medicare beneficiaries residing in the 1,128 selected counties. The majority of Medicare beneficiaries elect whether to enroll in MA during the year prior to the coverage period (Medicare open enrollment: October 15th to December 7th), so we measured predictors of enrollment (described in the Appendix) using 2011 and 2016 data for the enrollment years 2012 and 2017, respectively (17). To account for heterogeneity in the characteristics which predict MA enrollment across geographies and time, each of the two year-specific propensity score models were fit separately by county. Our models include zip code level fixed effect terms to capture variation of unmeasured market-level variables (e.g. income, poverty, access to health care services, etc.) within county. Propensity scores from each model (2012 and 2017) were generated for all Medicare beneficiaries, before limiting our analysis sample to beneficiaries with a stroke or hip fracture hospitalization.

## Variables

### Predictors of MA Enrollment

For each Medicare beneficiary residing in selected counties during 2012 and 2017, we constructed a set of variables predictive of enrollment into MA. Because enrollment decisions are made during the Fall prior to an enrollment period (year), each measure was constructed using the periods 11/1/2010-10/31/2011 and 11/1/2015-10/31/2016 for the enrollment periods 1/1/2012-12/31/2012 and 1/1/2017-12/31/2017, respectively. We identified demographic measures including age, sex, and race (White, Black, Hispanic, and other) and both Medicare (reason for entitlement: aged, disability, and/or end-stage renal-disease) and Medicaid (dual-enrollment in Medicaid with either partial or full coverage) enrollment characteristics using the Medicare Beneficiary Summary File (MBSF). Next, we summarized person-level utilization volume (use of any, and days of residence) of inpatient hospital stays, nursing home stays, and home health episodes using the MEDPAR file, the MDS 3.0 file, and the OASIS file. Since socio-economic status and other local factors vary substantially within counties, we identified the zip-code of residence for each person during the enrollment period and generated county specific zip-code fixed effect variables.

## Outcomes

### *First Discharge Setting*

We identify the first discharge setting following hospitalization using a residential history file which captures Medicare beneficiaries' residential settings longitudinally (47). For each case we determine the discharge setting, including the following alternatives: home without services, home with home health (HH), skilled nursing facilities (SNF), inpatient rehabilitation facilities (IRF), and long-term care hospitals (LTCH).

To determine the first discharge setting for each hospitalization case, we follow a two-step algorithm: We select the first non-home (excluding home with HH services) setting within seven days following discharge as the first discharge setting. Persons discharged immediately home (without HH services) who either died or remained in the home setting during the first seven days post-discharge were considered to be discharged to home.

### *PAC Episode Days & 180d Post-Discharge Residence by Setting*

We constructed PAC episodes as the period following hospitalization during which a beneficiary received continuously delivered PAC across various settings (SNF, IRF, HH, LTCH) and providers, uninterrupted by death, reentry to the community (more than seven days at home without care), or admission to a non-PAC inpatient facility (48). We aggregate both the count of total PAC episode days, and the count of days contributed by each setting.

For each hospitalization case we identify the beneficiaries' daily residence across settings for 180 days post-discharge, and summarize the count of days by setting. We measure the count of days in PAC settings (SNF, IRF, home with HH, and LTCH), hospitals (all provider

types, excluding LTCH), home without home health services, post-death, and other settings. We cannot be certain whether nursing home entries subsequent to an initial PAC episode are for custodial care or SNF care, so we group both together when reporting this measure.

*Mortality*

We measure mortality within thirty, ninety, and one-hundred and eighty days of hospital discharge using the death date captured in the MBSF.

*All-Cause Hospital Readmission*

We measure all-cause hospital readmission within thirty, ninety, and one-hundred and eighty days of hospital discharge using MedPAR records. We excluded hospitalizations at hospitals not required to submit Medicare encounter claims from the measure numerator (see the **Study Population** section).

*Days Alive in the Community*

During the first one hundred- and eighty days following hospital discharge, we count the number of days each beneficiary was alive and residing in the community (outside of healthcare facilities such as hospitals, nursing facilities, IRFs, etc.).

## Statistical Analysis

### Matching

To identify the matched groups described in the ***Overview & Identification Strategy*** section, we applied a three step within-county propensity score matching approach (as depicted by Figure 2-1). Our first step (**Step 1**) matched MA enrollees in 2012 to MA enrollees in 2017 (G1) using the propensity to enroll in MA during 2012 as a distance metric. Next, in **Step 2** we first matched all MA enrollees in 2017 who were not matched during **Step 1** with TM beneficiaries in 2012 using the propensity to enroll in MA during 2017 as a distance metric. Lastly, we matched TM beneficiaries in 2017 with TM beneficiaries in 2012 using the propensity to enroll in MA during 2017 as a distance metric. Unmatched beneficiaries were retained for comparison purposes. Additional details describing our matching approach are provided in the appendix.

### Statistical Analysis

We estimated difference-in-differences models using multinomial logistic regression for the first discharge setting outcome, and ordinary least squares for the remaining outcomes (49). We adjusted these models for the predictors used in propensity score estimation, and a set of covariates derived from the stroke hospitalization including: hospital length of stay, ICU & CCU utilization (any use, and days of use), stroke type (Ischemic, Intracranial Hemorrhage, or Subarachnoid Hemorrhage), the Elixhauser mortality index (calculated using diagnoses included on the index hospitalization claim), and a selection of cohort-specific diagnosis and procedure

classifications (Grouped by the HCUP clinical classification software. See details in the **Appendix**)(50). We estimated cluster (county level) robust standard errors to account for the within-cluster matching approach taken (51). To generate estimates for the first discharge setting outcome (a five-level discrete variable), we computed marginal predicted probabilities for each first discharge setting (SNF, IRF, HHA, Home, LTCH) within matching group and period and then calculated difference-in-differences estimates (additional details are available in the **Appendix**) (52). For each of the remaining outcomes, our difference-in-differences estimates were estimated using ordinary least squares (OLS) regression.

Sensitivity Analysis

We conducted various sensitivity analyses to assess whether variation in the product mix of MA plans driving a market's MA growth modified our main effect estimates. First, we identify important market characteristics which we expect to modify the relationship between MA enrollment and our set of outcomes, including: the mix of MA plan types beneficiaries enrolled in within counties; the level of market concentration among MA insurers within counties; and the baseline (2012) utilization rate of IRF following hospitalization for all Medicare beneficiaries with a primary diagnosis of hip fracture or stroke within each county. We stratify our main estimates across levels of each of these three market (county) level measures to test for effect heterogeneity. Second, we evaluate the receipt of any PAC services (by setting within the 180 days following hospitalization. Third, we apply a hierarchical within-cluster matching approach which considers both the county of beneficiary residence and the hospital at which they were hospitalized to address concerns about within county variation

across hospitals. Lastly, we replicate our main analysis after excluding counties located in Minnesota due to the unique (and no longer relevant) mix of Medicare plan offerings available in that state during the time of our study period.

*Classification of Market-Level MA Plan Characteristics*

We classified county-markets with high growth in PPO plans, HMO plans, zero-dollar premium plans, and Special Needs Plans (SNPs) (Figures 2-3, 2-4, 2-5). In high-growth PPO plan counties, PPO enrollment increased by 13 pp, and in high-growth HMO plan counties (n=169), HMO enrollment increased by 11 pp (Table 2-2). We identified 169 counties with high-growth of Zero-dollar premium plan enrollment (11 pp) and 169 counties with high-growth of SNP enrollment (6 pp). For each sub-group, we repeat our main analysis for the PAC discharge setting outcome.

*Initial (2012) Level of MA Market Concentration*

A recent study of the competitiveness of health insurance markets conducted by the American Medical Association found that among 380 metropolitan statistical areas (MSAs) examined, 300 (79%) had *highly concentrated* (non-competitive, with a small number of firms controlling a majority of the market share) Medicare Advantage markets. (53) As health insurance markets continue to become increasingly concentrated (driven largely by health insurer consolidation), dominant insurers gain market power, allowing them to charge higher premiums (along with increased cost-sharing such as higher co-pays and deductibles) and

restrict coverage to the market's insured population (i.e. narrower provider networks, lower quality benefits, stricter prior authorization policies, etc.). (54) (55)

The Medicare Advantage market for health insurance is particularly sensitive to policy decisions impacting market concentration, as the federal government both acts as a subsidizer and regulator. (56) Given the variety of levers MA insurers have available to them to manipulate access to PAC providers, and the quality of care delivered by PAC providers (prior authorization, cost-sharing, provider network management, etc.), it is reasonable to assert that PAC markets are particularly exposed to increasing levels of MA market concentration relative to other healthcare market service lines.

To determine whether MA market concentration acts as a modifier of the effect of MA enrollment on the delivery of PAC and subsequent patient outcomes, we stratify our main analysis across levels of county level MA market concentration. We calculated quartile cutoffs for baseline (2012) levels of county MA market concentration using the Herfindahl Hirschman Index (HHI), weighting counties (all US counties) by the number of Medicare enrollment years to create approximately equivalent sample sizes per group. The HHI is a commonly accepted measure of market concentration which is calculated by summing the squares of competitor's market shares, and ranges from 10,000 (pure monopoly) to a number approaching zero (perfectly competitive, atomized). Markets with an HHI lesser than 1,500 are considered competitive, while markets with an HHI between 1,500 and 2,500 are considered moderately concentrated, and markets with an HHI above 2,500 are considered highly concentrated. (57) To calculate insurer's county-level market share, we divide the number of covered MA enrolled beneficiary years by the total number of beneficiary years for all MA enrollees residing within

the county. Due to the distinctly concentrated nature of MA markets, classifying counties into quartiles of HHI allows us to exploit the variation in market concentration.

*Baseline (2012) Level of IRF Utilization*

Post-acute discharge setting patterns vary substantially across the United States, driven both by access to PAC providers and penetration of Medicare Advantage enrollment. (58) Prior research has documented that relative to TM at the same hospital, MA enrollees are discharged to IRF substantially less frequently. However, differences are understated due to the concentration of IRFs in certain geographic regions of the US. In a descriptive analysis of the 2,024 hospitals included in our analytic sample, only 1,191 had at least one discharge (hip fracture) to IRF in 2012, while 50% of all IRF discharges were concentrated among 140 hospitals (99 in the US South, and 51 in Texas). To evaluate effect heterogeneity of MA enrollment of PAC utilization and associated patient outcomes across varying levels of (geographic) access to IRF, we separately estimated DID models within sets of hospitals characterized by their baseline (2012) rates of discharge to IRF.

*Enrollment in Cost-plans: Excluding Minnesota*

Counties located in Minnesota were unique during the study period, as the preponderance of MA enrollment (2012: 46.2%; 2017: 56.9%) was in cost plans (2012: 25.0%; 2017: 36.2%), which share features of both MA (privately administered, bundled Part D drug coverage, etc.) and TM (open provider networks, fee-for-service reimbursement rather than

risk-based capitation). Since 2017, cost plans have largely been replaced by HMO and PPO MA plans in Minnesota. We excluded Minnesota counties from our sample and then re-estimated our main effects.

*Utilization of any PAC Setting During PAC Episodes & 180d Post-Discharge*

In our main analysis of the effect of MA enrollment on PAC utilization for Medicare beneficiaries with a primary diagnosis of stroke and hip fracture, we included the following outcomes: first discharge setting following hospitalization, PAC episode days by setting of care, and days of residence during the 180 days following hospital discharge by setting. The first discharge setting following hospitalization is the only setting in which the majority of cases in our analytic sample receive PAC prior to terminating their PAC episode (as patients are discharged from this first PAC setting to the community, the hospital, other non-PAC settings, or death). Next, we measured the count of PAC days utilized during PAC episodes (following the initial index hospitalization) and the count of PAC days during the first one hundred- and eighty-days following hospital discharge. However, there is some concern about 1.) the accuracy of measuring home health days using OASIS assessments (particularly for home health episodes initiating from the community), and 2.) bias induced by geographic variation in the duration of care delivered in PAC settings. To address this, we examine a set of binary indicators identifying the use of any SNF, home health, IRF, or LTCH utilization during the 180 days following hospital discharge.

*Within Cluster Matching: County and Hospital*

In our main analysis, our approach leverages a within-county cross-temporal matching to identify comparable MA enrollees and Traditional Medicare beneficiaries. For Medicare beneficiaries residing in a given county, enrollment in an MA plan might be associated with the facility they are admitted to when hospitalized with hip fracture or stroke. Additionally, the hospital a person is admitted to is likely associated with post-acute discharge setting selection. To account for this threat to the validity of our matching approach we conduct a sensitivity analysis in which Medicare beneficiaries are matched within both county and hospital (e.g. TM beneficiary in 2012 matched with an MA enrollee in 2017, both hospitalized at UCSD Medical Center and residents of San Diego county, CA). To account for changes to our matching approach, we replace the hospital fixed effect term in the empirical specification defined by **Appendix, Equation 4** with a county-hospital fixed effect term, and we calculate robust standard errors using county-hospital clusters. Finally, we stratify our DID models across levels of baseline (2012) IRF utilization to test effect heterogeneity.

**Limitations**

This study has several important limitations. First, we were limited to studying index hospitalizations between the years 2012 and 2017 because we only had access to sufficient claims data for Medicare Advantage beneficiaries between 2011 and 2017 (one pre-year was required for 2012 index hospitalizations to generate measures of healthcare utilization during the pre-enrollment period). Second, the set of predictors we used in our propensity score

models was limited to available data. In an effort to improve the accuracy of our propensity score models, we exploited the hierarchal structure of geographic markets (zip codes nested within counties) to capture unobserved market characteristics associated with beneficiary's propensity to enroll in a MA plan. Third, this study only considers two cohorts (hip fracture and stroke), so our interpretations are not generalizable across all hospitalizations. We selected these cohorts as strong candidates for the study because it is unlikely that MA plan enrollment is associated with the probability of hospitalization for stroke or hip fracture (whereas MA plans might reduce the probability of hospitalization for other conditions, invalidating our research design).

## Study Results

### Balance of Observables

#### *Pre-Matching Balance*

Among stroke cases in 2012, MA beneficiaries were similar in terms of age (MA 75.3 years vs TM 75.7 years) and sex (MA 55.2% vs TM 56.0%), but were significantly less likely to be white (MA 60.6%, TM 69.9%) (Table 2-3). Rates of enrollment for dual-Medicaid coverage were comparable, though MA enrollees were more likely to receive partial benefits (MA 9.8%, TM 6.2%) and less likely to have full benefits (MA 11.7%, TM 16.3%). MA enrollees were also less likely to have been hospitalized (MA 24.1%, TM 27.8%), spent time residing in a nursing home (MA 4.4%, TM 5.2%), or received any home health care services (MA 13.0%, TM 21.2%) during

the prior year. Among hip fracture cases, differences between the MA and TM cases in 2012 were comparable (Table 2-4).

*Post-Matching Balance*

Among stroke cases, matching group G1 (Always Takers) of 2012 and 2017 MA enrollees was initially well balanced (ASMD=3.08) prior to matching, with dual-Medicaid full-benefits as the only variable with an ASMD exceeding the 10% threshold (Table 2-8 and Figure 2-6). Post-matching, ASMD was less than 10% across all variables. Matching improved balance substantially among G2 (Compliers) from an ASMD of 10.03 to 4.27, reducing the number of variables exceeding 10% from six (age, race: white, race: black, ESRD, dual-Medicaid Partial, and home health utilization) to one (ESRD, ASMD=). G3 (Never Takers) was well balanced before and after matching. Among hip fracture cases, ASMD improved across all three matching groups (G1: 3.26 to 2.98; G2: 9.56 to 4.56; G3: 2.77 to 2.85) (Table 2-9 and Figure 2-7). Further, bias from unobserved variables clustered at the zip code level was minimized implicitly by including zip code level effects in the propensity score modeling approach.

Difference-in-Differences Estimates

*First Discharge Setting*

Prior to matching, baseline differences in first discharge setting choices between MA & TM beneficiaries during 2012 were substantial: Among stroke cases, MA enrollees were discharged 2.9 pp more often to SNF (TM 21.4, MA 24.3), 8.6 pp less frequently to IRF (TM

25.1%, MA 16.5%), 2.7 pp less often to home with home health (TM 16.0%, MA 13.3%), and 9.3 pp more often to home without services (TM 35.9%, MA 45.2%) relative to TM beneficiaries (Table 2-5). Among hip fracture cases, MA enrollees were discharged 8.8 pp more often to SNF (TM 60.0%, MA 68.8%), 14.5 pp less frequently to IRF (TM 25.0%, MA 10.5%), and 6.8 pp more often to home without services (TM 5.7%, MA 12.5%) during the baseline period (Table 2-5).

Comparing changes in discharge settings among stroke cases in G2 and G3 between 2012 and 2017, we compute adjusted difference in differences estimates for SNF, HHA, IRF, LTCH, and home of 1.7 pp (p<.001), -0.7 pp (p<.1), -8.5 pp (p<.001), -0.8 pp (p<.001), and 8.2 pp (p<.001), respectively (Table 2-10, Figure 2-8, Figure 2-16). Temporal trends among the Never Takers group (TM during both years) show marginal increases in discharge to home (with and without HH) and SNF, and a decreasing rate of discharge to IRF, though these changes were small relative to changes among the Compliers group (Table 2-10). Among hip fracture cases, DID estimates for SNF, HHA, IRF, LTCH, and home were 9.0 pp (p<.001), -0.7 pp (p<.1), -13.4 pp (p<.001), -0.4 pp (p<.001), and 5.6 pp (p<.001), respectively (Table 2-10, Figure 2-9, Figure 2-17).

*PAC Episode Days & 180d Post-Discharge Residence by Setting*

Among stroke cases, MA enrollment was associated with 3.14 (p<.001) fewer PAC episode days, driven by 3.08 (p<.001) fewer days at home with HH, 1.25 (p<.001) fewer days in IRF, .25 fewer days in LTCH, and 1.44 (p<.001) greater SNF days (Table 2-11, Figure 2-10, Figure 2-12). During the first 180 days following hospital discharge, MA enrollment was associated with 4.16 (p<.001) fewer days of residence in the nursing home (custodial or SNF) setting, 1.42

(p<.001) fewer days in the IRF setting, and 5.87 (p<.001) fewer days at home with home health (Table 2-11, Figure 2-10, Figure 2-12). Results for the hip fracture cohort were directionally the same, though MA enrollment was associated with a higher magnitude increase in SNF days and reduction in days at home with home health (Table 2-11, Figure 2-11, Figure 2-13).

*Patient Outcomes*

Among stroke cases during the baseline period, MA enrollees experienced lower rates of all-cause hospital readmission (180d readmission: MA 31.04%, TM 34.36%), lower rates of mortality (180d mortality: MA 16.6%, TM 17.81%), and resided in the community for a greater number of days (MA 134.31, TM 125.69) (Table 2-5). MA enrollment was associated with lower probability of all-cause hospital readmission during the 30 (1.05 pp: P Value <.001), 90 (2.0 pp: P Value<.001), and 180 days (2.8 pp: P Value<.001) following initial hospital discharge. However, we did not find a statistically significant relationship between MA enrollment and mortality at 30, 90, or 180 days post-discharge. MA enrollment was associated with a substantial increase in the number of days that patients resided in the community during the first 180d post-discharge (6.14 pp: P Value<.001) (Table 2-12, Figure 2-14). Results for the hip fracture cohort were comparable; MA was associated with reduced all-cause hospital readmission (30d, -.8 pp; 90d, -1.5 pp; 180d, -2.1 pp), and increased days spent alive in the community (6.1 pp), but was not associated with changes in mortality (Table 2-5, Table 2-12, Figure 2-15).

Sensitivity Analysis

*Stratified Estimates by Classification of Market-Level MA Plan Characteristics*

Among stroke cases in markets with high PPO growth, MA enrollment was associated with reduced discharges to IRF (-8.7 pp) and increased discharges to home without HH (7.4 pp). Effect sizes were greater in markets with high growth of HMO plan enrollment, with decreased discharges to IRF (10.6 pp), and increased discharges to SNF (2.6 pp) and home without HH (9.5 pp). In markets with either high growth of zero-premium plans or SNPs, decreases in IRF discharges (-10.8 pp, and -11.2 pp) were exceeded in magnitude by increased discharge home without HH (11.9 pp, and 12.8 pp) (Table 2-13). Among hip fracture cases, reductions in discharge to IRF were smallest in markets with high PPO growth (-12.5 pp) and greatest in markets with high growth of both zero-dollar premium plans and SNPs (-16.4 pp, and -16.6 pp) (Table 2-14).

*Stratified Estimates by Initial (2012) Level of MA Market Concentration*

Among 2,821 US counties, 2,506 (88.8%) had highly concentrated MA markets, 307 (10.9%) were moderately concentrated, and only 8 (0.2%) were not concentrated. We calculated quartiles of MA concentration across counties, and assigned them to observations included in our analytic sample based on beneficiary's county of residence. The bounds of MA market HHI quartiles we assigned were <=2,282 (Q1), 2,283-2,866 (Q2), 2,867-3,591 (Q3), and >=3,591 (Q4).

Among stroke hospitalizations, MA enrollment was associated with a greater probability of discharge to home with no-PAC in counties classified as the least concentrated (Q1) MA markets (10.9 pp: P Value<0.01) relative to counties classified as the most concentrated (Q4) MA markets (7.6 pp; P Value<0.01) (Table 2-18). In counties with the least (Q1) concentrated markets, MA enrollment was associated with a lower probability of discharge to home with HH (-3.2 pp; p<0.01) and increased discharges to SNF (2.6pp; p<0.01), while MA enrollment was not associated with changes in discharge rate to home with HH (0.2 pp; p>0.1) or SNF (1.2 pp; p>0.1) in counties with the most concentrated (Q4) markets.

Among hip fracture hospitalizations, in counties with the least (Q1) concentrated MA markets the association between MA enrollment and discharge to IRF (-17.8 pp; p<0.01) and SNF (12.7 pp; p<0.01) were greater in magnitude relative to the association of MA enrollment and discharge rates to IRF (-12.5 pp; p<0.01) and SNF (8.4 pp; p<0.01) in counties with the most (Q4) concentrated MA markets (Table 2-19).

*Stratified Estimates by Initial (2012) Level of IRF Utilization*

For both the hip fracture and stroke cohorts, we measured the baseline (2012) mean discharge rate to IRF, and classified counties into quintiles accordingly. Among the hip fracture cohort, county variation in the rate of discharge to IRF was high with quintile cut-points of 7.2%, 13.0%, 19.3%, and 28.8%, while county variation in the rate of discharge to IRF among the stroke cohort was moderate with quintile cut-points of 16.8%, 20.6%, 26.2%, and 29.8%. The distribution of baseline IRF utilization across counties was left skewed among hip fracture hospitalizations, but approximately normal among stroke hospitalizations, suggesting that IRF

as a PAC discharge setting is more discretionary for hip fracture patients (Figure 2-18, Figure 2-19). Due to the method applied for calculating quartiles of baseline (2012) county level IRF discharge rates, the percentage of matched cases (Never Takers [NT], and Compliers [CO]) discharged to IRF in 2012 was lowest in Q1 (stroke: NT 14.3%, CO 15.1%; hip fracture: NT 5.7%, CO 6.3%) and greatest in Q5 (stroke: NT 34.7%, CO 34.9%; hip fracture: NT 46.1%, CO 46.6%).

Among the hip fracture cohort MA enrollment was associated with lower probability of discharge to IRF across all five quintiles (baseline county level IRF utilization) with substantial differences in effect magnitude but comparatively similar relative effect sizes (DID estimate divided by baseline IRF discharge rate among *compliers*). MA was associated with a 3.5 percentage point lower probability of discharge to IRF in counties with the lowest (Q1) level of baseline IRF utilization (est. -3.5 pp, $p<0.01$, relative effect: 55.6%) and a 30.6 percentage point lower probability of discharge to IRF in counties with the greatest (Q5) level of baseline IRF utilization (est. 30.6 pp, $p<0.01$, relative effect: 65.7%) (Table 2-21). Among counties in the lower quintiles (Q1, Q2) of baseline IRF utilization, the lower probability of discharge to IRF associated with MA enrollment appears to be offset primarily by discharge to home with no PAC (Q1: 5.1 pp, $p<0.01$; Q2: 6.5 pp, $p<0.01$), while in counties in the upper quintiles (Q4, Q5) of baseline IRF utilization, an increased probability of discharge to SNF (Q4: 12.1 pp, $p<0.01$; Q5: 25.9 pp, $p<0.01$) offset the lower probability of discharge to IRF.

Among the stroke cohort MA enrollment was associated with a 5.6 pp lower probability of discharge to IRF in Q1 counties (est. -5.6 pp, $p<0.01$, relative effect: -37.1%) and a 11.4 pp lower probability of discharge to IRF in Q5 counties (est. -11.4 pp, $p<0.01$, relative effect: 32.7%) (Table 2-20). MA enrollment was associated with relatively similar magnitude increases

in the probability of discharge to home without PAC across quintiles (Q1: 8.5 pp, p<0.01; Q5: 7.5 pp, p<0.01). Changes in the probability of discharge to SNF were only statistically significant in counties with a baseline IRF utilization exceeding 20.6% (Q3: est. 2.0 pp, p<0.05; Q4: est. 4.3 pp, p<0.01; Q5: est. 3.3 pp, p<0.01).

*Enrollment in Cost-plans: Excluding Minnesota*

We excluded all 5,898 stroke hospitalizations and 5,437 hip fracture hospitalizations occurring among beneficiaries residing in Minnesota (32 counties), and re-estimated our main findings for the *first discharge setting* outcome and all patient outcomes (hospital readmission, mortality, and days residing at home during the 180-day period post-discharge). Our main effect estimates remained stable, suggesting that either the number of observations contributed by Minnesota counties was not substantial enough to induce meaningful bias, or that the magnitude and direction of effect among cost-plans was similar to those presented as the main effects.

*Receipt of PAC services During PAC Episode & 180-day Post-Discharge Period*

In 2012, 16.0% of TM beneficiaries and 13.3% of MA enrollees hospitalized with a primary diagnosis of stroke were discharged to home with home health (**Table 2-5**). More than twice the number of persons received home health services during their PAC episode (TM, 35.0%; MA, 27.5%), and nearly three times as many persons received home health services during the first 180 days following hospital discharge (TM, 46.0%; MA, 38.0%) (**Table 2-15)**.

Between 2012 and 2017, the percentage of both TM beneficiaries and MA enrollees discharged home with home health decreased marginally (TM, -1.9 pp; MA, -0.7 pp).

We present difference-in-differences estimates for the stroke cohort, comparing receipt of each PAC setting during the PAC episode period (Table 2-16) and the 180-day post-discharge period (Table 2-17) between MA and TM beneficiaries. MA enrollment was associated with a 4.0 ($p<0.01$) pp reduction (a 11.8% reduction from the baseline value) in HH utilization during the PAC episode period and a 5.2 ($p<0.01$) pp reduction (an 11.6% relative reduction from the baseline level) in HH utilization during the 180 days post-hospital discharge.

Among hip fracture cases the unadjusted rate of discharge to HH was low for both MA (8.0%) and TM (8.2%) during 2012 (Table 2-5), though roughly half of cases had HH utilization during the PAC episode (MA, 43.0%; TM, 53.2%) (Table 2-15). Difference in Differences estimates for the hip fracture cohort are presented in Table 2-16 and Table 2-17. MA enrollment was associated with a 4.1 pp reduction (a 7.8% relative reduction) in home health utilization during the PAC episode, and a 5.1 pp reduction (a 7.8% relative reduction) in HH utilization during the 180 days post hospital-discharge.

*Within Cluster Matching: County and Hospital*

We employed a within-county and hospital cross-temporal matching approach for the stroke and hip fracture cohorts and evaluate the stability of our main effect estimates. Following matching of the stroke cohort, the pooled absolute standardized mean differences of covariates were sufficiently balanced for G1 (pre-matching, 3.06; post-matching, 4.01), G2 (pre-matching, 10.03; post-matching, 4.27), and G3 (pre-matching, 3.45; post-matching, 3.04)

(Figure 2-20). Similarly, following matching of the hip fracture cohort we observe sufficient balance of covariates in G1 (pre-matching, 3.26; post-matching, 2.96), G2 (pre-matching, 9.56; post-matching, 4.56), and G3 (pre-matching, 2.77; post-matching, 2.85) (Figure 2-21).

We present adjusted difference-in-differences estimates of the association between MA enrollment and PAC utilization (Table 2-22, Table 2-23) and our set of patient outcomes (Table 2-24, Table 2-25). Compared to our main effect estimates, DID estimates for the first discharge setting suggest a marginally greater effect of MA enrollment among stroke cases (SNF, 2.4 pp, $p<0.01$; HH, -1.3 pp, $p<0.05$; IRF, -8.9, $p<0.01$; home, 8.8 pp, $p<0.01$) and hip fracture cases (SNF, 9.9 pp, $p<0.01$; HH, -1.1 pp, $p>0.10$; IRF, -14.4, $p<0.01$; home, 6.0 pp, $p<0.01$). Our within-county and hospital matching approach produced attenuated DID estimates of all-cause hospital readmission (30 day, -0.9 pp, $p<0.1$; 90 day, -1.7 pp, $p<0.05$; 180 day, -2.3 pp, $p<0.01$) among stroke cases and higher magnitude DID estimates (30 day, -0.8 pp, $p<0.1$; 90 day, -0.2 pp, $p>0.1$; 180 day, -0.4 pp, $p>0.1$) among hip fracture cases. Among stroke cases, MA enrollment was associated with increased mortality at 30 days post-discharge (0.6pp, $p<0.05$), while among hip fracture cases MA enrollment was mortality with increased mortality at 30 days (0.7pp, $p<0.05$), 90 days (1.3pp, $p<0.01$), and 180 days (0.9pp, $p<0.05$).

We classified hospitals (N=1,312) by the percentage of stroke and hip fracture cases discharged to IRF during 2012 using three strata: low (<4.8%), middle (4.8-33.3%), and high (>33.3%). The effect of MA enrollment on discharge setting choice was greatest within the *high IRF* group for both the stroke (baseline IRF discharge rate 43.5%; DID est. -19.9pp, $p<0.01$) and hip fracture (baseline IRF discharge rate 53.1%; DID est. -34.5, $p<0.01$) cohort, while no meaningful effects were detected in the *low IRF* group (Table 2-26, Table 2-27). Among hip

fracture cases, MA enrollment was associated with increased mortality only within the *high IRF* group across 30d (1.2pp, $p<0.05$), 90d (2.3pp, $p<0.001$), and 180d (2.6pp, $p<0.001$) representing relative increases in mortality risk between 17.0 - 26.1% (Table 2-29). Among stroke cases, MA enrollment was associated with increased mortality only within the *high IRF* group across 30d (1.5pp, $p<0.01$), 90d (2.0pp, $p<0.01$), and 180d (1.5pp, $p<0.05$), representing changes from the baseline of 20.3%, 18.0%, and 9.6% respectively (Table 2-28).

## Discussion

Between 2012 and 2017 MA enrollment expanded from 26.6% to 33.6% of the total Medicare population, driven predominantly by growth in counties located in the Southern region of the United States. MA enrollment was associated with a substantial reduction in the rate of discharge to IRFs, primarily offset by an increased rate of discharge home (without services) for stroke cases and to SNFs for hip fracture cases. In markets with high growth of PPO plans, we found a slightly weaker effect of MA enrollment on PAC discharge patterns relative to markets with high growth of HMO plans, zero-premium plans, and Special Needs Plans. Across both cohorts MA enrollment was associated with a greater number of SNF days, and fewer days at home with home health and in IRFs during the initial post-acute episode. Applying a matching approach which minimizes the threat of selection bias from unobserved differences between TM and MA enrollees and accounts for hospital-specific differences in patient outcomes, we find that MA enrollment is associated with increased mortality for both hip fracture and stroke patients. Increased mortality among MA enrollees appears to be

concentrated in geographic markets where MA insurers reduced the rate of discharge to IRFs substantially relative to TM beneficiaries. As MA continues to expand nationally, policymakers should focus on aligning payment policy in accordance with the value of PAC to ensure that quality of care does not suffer in for Medicare beneficiaries enrolling in MA plans.

## Tables and Figures

Figure 2-1: Diagram of Cross Temporal Matching Approach

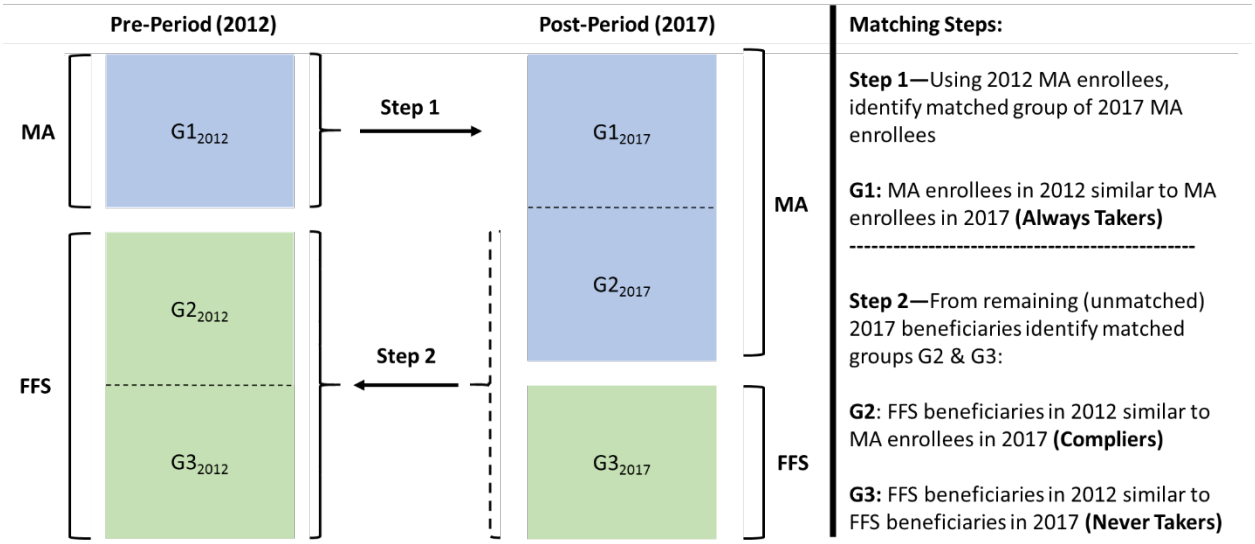



Table 2-1: County Level Medicare Advantage Expansion (2012-2017) by Quintile of Expansion

| | County MA Growth Rank (Quintiles) | | | | | |
|---|---|---|---|---|---|---|
| | 0-19th | 20-39th | 40-59th | 60-79th | 80-99th | Total |
| **Counties (N)** | 564 | 564 | 565 | 564 | 564 | 2,821 |
| **County Avg. Enrollment (thousands)** | | | | | | |
| 2012 | 11.0 | 19.6 | 22.8 | 17.7 | 16.4 | 17.5 |
| 2017 | 12.6 | 22.7 | 26.4 | 20.5 | 18.9 | 20.2 |
| 2012, MA (%) | 28.0 | 27.0 | 28.8 | 27.8 | 21.0 | 26.6 |
| 2017, MA (%) | 27.5 | 30.4 | 35.4 | 37.2 | 35.2 | 33.6 |
| **MA Expansion (pp)** | | | | | | |
| County Min. | -22.4 | 1.6 | 5.0 | 8.0 | 11.1 | -22.4 |
| County Max. | 1.6 | 5.0 | 8.0 | 11.1 | 29.8 | 29.8 |
| Population Weighted Avg. | -0.4 | 3.4 | 6.6 | 9.4 | 14.1 | 7.0 |
| *by Plan Type (pp)* | | | | | | |
| HMO | 1.8 | 4.2 | 5.0 | 5.4 | 6.6 | 4.8 |
| Local PPO | -0.2 | 1.3 | 2.0 | 3.6 | 7.8 | 3.0 |
| Regional PPO | -0.2 | 0.1 | 0.6 | 0.8 | 0.8 | 0.5 |
| Other | -1.9 | -2.1 | -1.0 | -0.5 | -1.0 | -1.3 |
| *by Plan Characteristics (pp)* | | | | | | |
| Special Needs Plans | 0.2 | 0.6 | 1.4 | 1.8 | 1.8 | 1.2 |
| Zero-Dollar Premium Plans | 0.1 | 0.0 | 1.1 | 2.6 | 3.9 | 1.6 |
| **Counties Rural (%)** | 76.0 | 51.4 | 54.5 | 55.5 | 59.2 | 59.3 |
| **Census Region (% Row)** | | | | | | |
| South | 8.0 | 15.8 | 20.9 | 25.1 | 30.3 | 100.0 |
| West | 51.5 | 29.8 | 14.2 | 3.3 | 1.1 | 100.0 |
| Midwest | 13.8 | 33.6 | 27.2 | 17.1 | 8.3 | 100.0 |
| Northeast | 26.7 | 19.1 | 19.4 | 19.7 | 15.1 | 100.0 |

Figure 2-2: Counties by Percentile of MA Expansion (2012-2017)

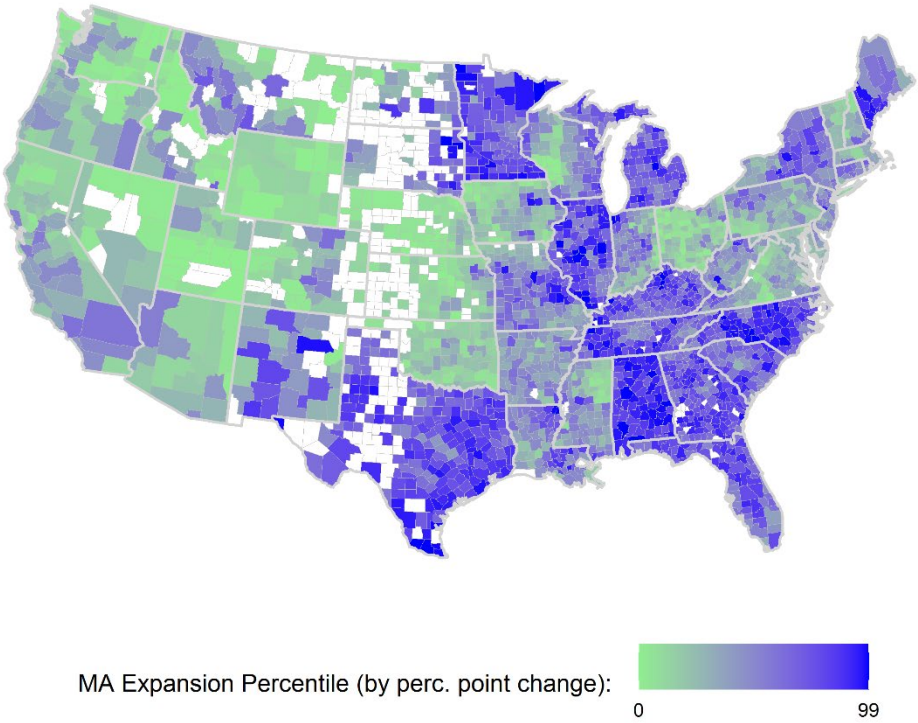



Table 2-2: Classification of County Markets by MA Plan Characteristics

| | | Market Classification (High Growth) | | | |
|---|---|---|---|---|---|
| | **Total** | **PPO** | **HMO** | **$0 Premium** | **SNP** |
| Inclusion Criteria | *All* | *Top 50%* | *Top 15%* | *Top 15%* | *Top 15%* |
| Counties | 1128 | 564 | 169 | 169 | 169 |
| Avg. Medicare Pop. (2012) | 17,061 | 9,814 | 20,699 | 18,726 | 15,074 |
| MA Growth (2012-2017) * | | | | | |
| *Total* | 12% | 12% | 12% | 13% | 12% |
| *PPO plans* | 8% | **13%** | 3% | 6% | 11% |
| *HMO plans* | 3% | 2% | **11%** | 8% | 4% |
| *$0 premium plans* | 2% | 1% | 6% | **11%** | 4% |
| *SNPs* | 2% | 2% | 2% | 3% | **6%** |

Figure 2-3: Counties in the top 40 Percentiles of MA Expansion (2012-2017), by Plan Type Driving Growth

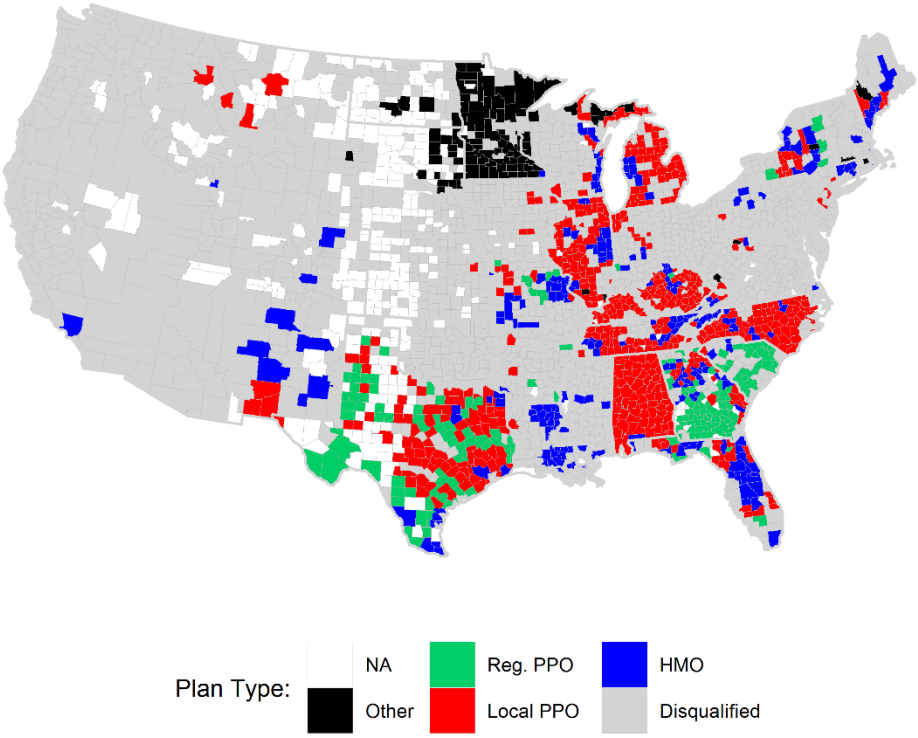



Figure 2-4: Counties in the top 40 Percentiles of MA Expansion (2012-2017), by $0 Premium Plan Expansion Dominance (>=50% growth)

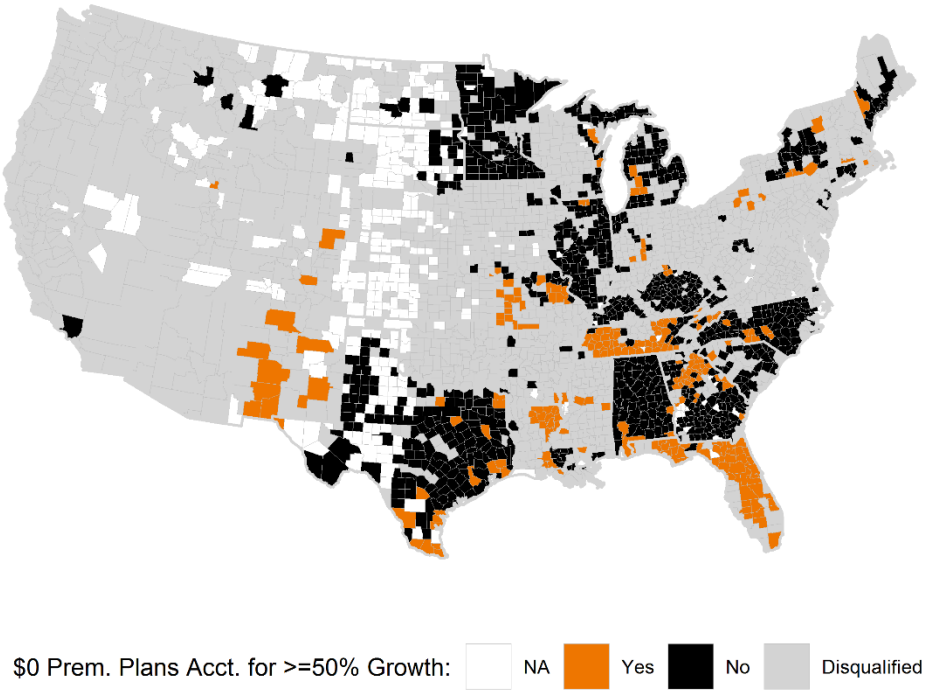


Figure 2-5: Counties in the top 40 Percentiles of MA Expansion (2012-2017), by SNP Expansion Dominance (>=25% growth)

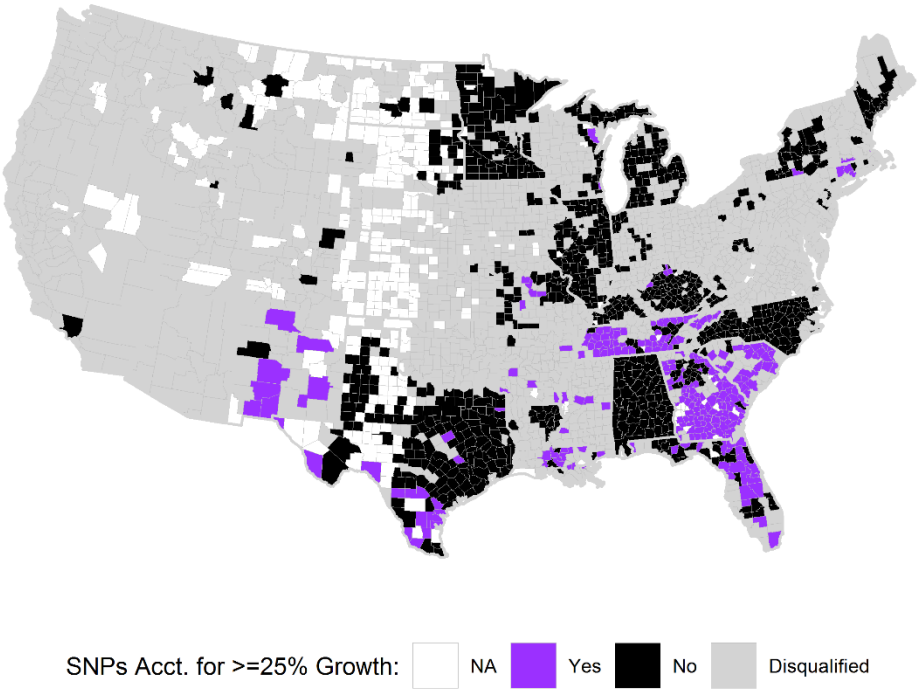


Table 2-3: Traditional Medicare and Medicare Advantage Enrollee Characteristics (2012 - 2017), Stroke

| | Pre Period (2012) | | Post Period (2017) | | Difference Between TM & MA | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | 2012 | | 2017 | |
| | TM | MA | TM | MA | Difference | P Value | Difference | P Value |
| **N** | **57,803** | **20,318** | **61,500** | **37,701** | | | | |
| | **74.0%** | **26.0%** | **62.0%** | **38.0%** | | | | |
| **Demographics (At Time of Enrollment)** | | | | | | | | |
| Age | 75.7 | 75.3 | 75.1 | 74.8 | -0.4 | 0.0000 | -0.3 | 0.0000 |
| Female | 56.0 | 55.2 | 52.9 | 53.2 | -0.8 | 0.0419 | 0.2 | 0.5320 |
| Race: White | 69.9 | 60.6 | 69.4 | 57.9 | -9.4 | 0.0000 | -11.5 | 0.0000 |
| Race: Black | 18.9 | 23.1 | 19.0 | 24.2 | 4.2 | 0.0000 | 5.3 | 0.0000 |
| Race: Hispanic | 8.2 | 13.6 | 7.8 | 14.2 | 5.5 | 0.0000 | 6.3 | 0.0000 |
| Race: Other | 3.0 | 2.7 | 3.8 | 3.7 | -0.3 | 0.0201 | -0.1 | 0.4493 |
| **Enrollment (Prior to Annual Enrollment)** | | | | | | | | |
| ORE: OASI | 86.8 | 88.5 | 87.8 | 88.3 | 1.6 | 0.0000 | 0.5 | 0.0251 |
| ORE: Disability | 11.8 | 11.3 | 11.5 | 11.5 | -0.6 | 0.0230 | 0.1 | 0.6647 |
| ORE: ESRD | 1.3 | 0.3 | 0.7 | 0.2 | -1.0 | 0.0000 | -0.6 | 0.0000 |
| Full Dual | 16.3 | 11.7 | 15.2 | 15.1 | -4.6 | 0.0000 | -0.1 | 0.6734 |
| Partial Dual | 6.2 | 9.8 | 5.8 | 10.3 | 3.6 | 0.0000 | 4.5 | 0.0000 |
| **MA <-> TM Switching** | | | | | | | | |
| w/in 3 mo. Post-Disch. | 0.9 | 3.1 | 1.5 | 2.8 | 2.2 | 0.0000 | 1.3 | 0.0000 |
| w/in 6 mo. Post-Disch. | 2.2 | 5.5 | 3.5 | 4.8 | 3.3 | 0.0000 | 1.4 | 0.0000 |
| w/in 12 mo. Post-Disch. | 4.4 | 8.6 | 7.1 | 7.2 | 4.2 | 0.0000 | 0.2 | 0.2730 |
| **Medical Care Utilization (Prior to Annual Enrollment)** | | | | | | | | |
| Days in Hospital | 1.6 | 1.3 | 1.4 | 1.2 | -0.4 | 0.0000 | -0.1 | 0.0000 |
| Days in Nursing Home | 2.0 | 1.3 | 1.9 | 1.4 | -0.7 | 0.0000 | -0.6 | 0.0000 |
| Days at Home w HH | 23.8 | 10.3 | 19.2 | 10.2 | -13.4 | 0.0000 | -9.0 | 0.0000 |
| Any Days in Hospital | 27.8 | 24.1 | 25.0 | 22.7 | -3.6 | 0.0000 | -2.3 | 0.0000 |
| Any Days in Nursing Home | 5.2 | 4.4 | 5.2 | 4.9 | -0.7 | 0.0000 | -0.3 | 0.0878 |
| Any Days at Home w HH | 21.2 | 13.0 | 19.2 | 13.3 | -8.2 | 0.0000 | -5.8 | 0.0000 |
| **Zip-Code Level Market Characteristics** | | | | | | | | |
| Market: Poverty | 16.5 | 16.6 | 16.3 | 16.5 | 0.1 | 0.0000 | 0.2 | 0.0000 |
| Market: HH Income | 63,544.9 | 64,129.2 | 64,216.5 | 64,228.8 | 584.3 | 0.0000 | 12.3 | 0.9110 |
| Market: Rurality | 4.9 | 4.2 | 4.7 | 3.7 | -0.7 | 0.0000 | -1.0 | 0.0000 |
| **Distance b/t Bene. Residence & Hospital** | | | | | | | | |
| Miles to Hospital | 37.7 | 32.5 | 42.5 | 37.9 | -5.2 | 0.0000 | -4.6 | 0.0000 |
| Miles to Hospital (Truncated) | 19.1 | 16.9 | 21.3 | 19.0 | -2.1 | 0.0000 | -2.2 | 0.0000 |
| Distance to Hospital: 0-5mi | 42.3 | 41.5 | 39.3 | 40.0 | -0.8 | 0.0474 | 0.7 | 0.0288 |
| Distance to Hospital: 5-10mi | 23.9 | 25.1 | 23.6 | 24.8 | 1.2 | 0.0006 | 1.2 | 0.0000 |
| Distance to Hospital: 11-25mi | 20.6 | 21.6 | 21.5 | 21.4 | 1.0 | 0.0033 | -0.1 | 0.7459 |
| Distance to Hospital: > 25mi | 13.1 | 11.8 | 15.5 | 13.7 | -1.4 | 0.0000 | -1.8 | 0.0000 |
| **PAC Market: IRF Availability** | 95.2 | 94.7 | 97.3 | 97.1 | -0.5 | 0.0056 | -0.2 | 0.0545 |
| **Hospitalization Detail** | | | | | | | | |
| Hospital LOS | 5.2 | 5.3 | 4.9 | 5.4 | 0.1 | 0.0370 | 0.5 | 0.0000 |
| ICU | 46.3 | 44.2 | 48.2 | 47.4 | -2.1 | 0.0000 | -0.8 | 0.0115 |
| CCU | 15.6 | 15.5 | 14.2 | 14.1 | -0.2 | 0.5421 | -0.1 | 0.7830 |
| ICU Days | 2.1 | 2.0 | 2.0 | 2.1 | -0.1 | 0.0060 | 0.1 | 0.0010 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Stroke Type: Hemorrhagic | 12.1 | 12.0 | 12.8 | 12.8 | 0.0 | 0.9256 | 0.0 | 0.9783 |
| Urinary tract infections | 14.2 | 13.4 | 12.4 | 12.0 | -0.7 | 0.0098 | -0.4 | 0.0912 |
| COPD and bronchiectasis | 12.2 | 11.5 | 13.3 | 13.1 | -0.7 | 0.0070 | -0.2 | 0.4153 |
| CHF; Non-hypertensive | 15.4 | 14.1 | 16.8 | 16.4 | -1.3 | 0.0000 | -0.4 | 0.1166 |
| Diabetes with complications | 10.4 | 12.8 | 22.0 | 24.9 | 2.4 | 0.0000 | 2.9 | 0.0000 |
| Gastrostomy; temp. & perm. | 5.6 | 4.9 | 4.3 | 4.0 | -0.7 | 0.0003 | -0.3 | 0.0129 |
| Respiratory intubation and MV | 4.5 | 4.6 | 5.0 | 5.0 | 0.1 | 0.5877 | -0.1 | 0.6362 |
| Diagnostic ultrasound of heart (echo.) | 11.4 | 11.8 | 8.7 | 8.7 | 0.4 | 0.1839 | 0.0 | 0.8097 |
| Other vascular cath.; not heart | 5.3 | 4.9 | 4.0 | 3.9 | -0.4 | 0.0360 | -0.1 | 0.3282 |

Table 2-4: Traditional Medicare and Medicare Advantage Enrollee Characteristics (2012 - 2017), Hip Fracture

| | Pre Period (2012) | | Post Period (2017) | | Difference Between TM & MA | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | 2012 | | 2017 | |
| | TM | MA | TM | MA | Difference | P Value | Difference | P Value |
| **N** | **49,457** | **14,913** | **52,168** | **27,581** | | | | |
| | **76.8%** | **23.2%** | **65.4%** | **34.6%** | | | | |
| **Demographics (At Time of Enrollment)** | | | | | | | | |
| Age | 80.9 | 80.4 | 80.2 | 79.6 | -0.5 | 0.0000 | -0.6 | 0.0000 |
| Female | 74.2 | 73.4 | 71.3 | 70.9 | -0.8 | 0.0433 | -0.4 | 0.2485 |
| Race: White | 85.7 | 78.2 | 85.3 | 76.7 | -7.5 | 0.0000 | -8.6 | 0.0000 |
| Race: Black | 5.7 | 7.4 | 5.8 | 7.8 | 1.7 | 0.0000 | 2.1 | 0.0000 |
| Race: Hispanic | 6.4 | 12.3 | 6.3 | 12.8 | 5.9 | 0.0000 | 6.6 | 0.0000 |
| Race: Other | 2.2 | 2.1 | 2.7 | 2.7 | -0.1 | 0.5090 | 0.0 | 0.9815 |
| **Enrollment (Prior to Annual Enrollment)** | | | | | | | | |
| ORE: OASI | 93.7 | 94.8 | 93.9 | 94.5 | 1.1 | 0.0000 | 0.6 | 0.0005 |
| ORE: Disability | 5.5 | 5.0 | 5.8 | 5.5 | -0.6 | 0.0059 | -0.3 | 0.0904 |
| ORE: ESRD | 0.8 | 0.2 | 0.4 | 0.1 | -0.5 | 0.0000 | -0.3 | 0.0000 |
| Full Dual | 13.9 | 10.7 | 13.1 | 12.6 | -3.2 | 0.0000 | -0.5 | 0.0622 |
| Partial Dual | 4.4 | 8.1 | 4.4 | 7.5 | 3.7 | 0.0000 | 3.2 | 0.0000 |
| **MA <-> TM Switching** | | | | | | | | |
| w/in 3 mo. Post-Disch. | 0.5 | 3.3 | 0.9 | 2.7 | 2.7 | 0.0000 | 1.8 | 0.0000 |
| w/in 6 mo. Post-Disch. | 1.3 | 5.4 | 2.2 | 4.4 | 4.1 | 0.0000 | 2.2 | 0.0000 |
| w/in 12 mo. Post-Disch. | 2.8 | 8.0 | 4.6 | 6.1 | 8.0 | 0.0000 | 1.5 | 0.0000 |
| **Medical Care Utilization (Prior to Annual Enrollment)** | | | | | | | | |
| Days in Hospital | 189.2 | 147.1 | 157.4 | 140.0 | -42.1 | 0.0000 | -17.4 | 0.0000 |
| Days in Nursing Home | 344.5 | 220.1 | 328.6 | 241.9 | -124.4 | 0.0000 | -86.7 | 0.0000 |
| Days at Home w Home Health | 29.3 | 13.6 | 26.9 | 14.8 | -15.8 | 0.0000 | -12.1 | 0.0000 |
| Any Days in Hospital | 29.7 | 25.1 | 27.0 | 24.3 | -4.6 | 0.0000 | -2.7 | 0.0000 |
| Any Days in Nursing Home | 8.6 | 7.2 | 8.8 | 8.1 | -1.4 | 0.0000 | -0.7 | 0.0006 |
| Any Days at Home w Home Health | | | | | | | | |
| **Zip-Code Level Market Characteristics** | | | | | | | | |
| Market: Poverty | 16.0 | 16.2 | 15.8 | 16.0 | 0.1 | 0.0050 | 0.1 | 0.0000 |
| Market: HH Income | 64,845.4 | 65,254.9 | 65,817.1 | 65,461.2 | 409.5 | 0.0090 | -355.9 | 0.0050 |
| Market: Rurality | 3.8 | 4.1 | 3.5 | 3.4 | 0.3 | 0.0560 | -0.2 | 0.2710 |
| **Distance b/t Bene. Residence & Hospital** | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Miles to Hospital | 39.7 | 32.5 | 45.2 | 37.6 | -7.2 | 0.0000 | -7.6 | 0.0000 |
| Miles to Hospital (Truncated) | 18.8 | 15.8 | 20.5 | 18.2 | -3.0 | 0.0000 | -2.3 | 0.0000 |
| Distance to Hospital: 0-5mi | 0.5 | 0.4 | 0.4 | 0.4 | 0.0 | 0.0923 | 0.0 | 0.0033 |
| Distance to Hospital: 5-10mi | 24.7 | 26.3 | 24.8 | 25.8 | 1.6 | 0.0001 | 1.0 | 0.0013 |
| Distance to Hospital: 11-25mi | 19.1 | 20.2 | 20.2 | 21.2 | 1.0 | 0.0054 | 1.0 | 0.0011 |
| Distance to Hospital: > 25mi | 11.0 | 9.2 | 12.1 | 11.1 | -1.9 | 0.0000 | -0.9 | 0.0001 |
| **PAC Market: IRF Availability** | 93.7 | 92.9 | 96.4 | 95.8 | -0.8 | 0.0012 | -0.6 | 0.0000 |
| **Hospitalization Detail** | | | | | | | | |
| Hospital LOS | 5.8 | 5.8 | 5.3 | 5.8 | 0.1 | 0.1060 | 0.5 | 0.0000 |
| ICU | 18.3 | 16.3 | 17.7 | 17.4 | -2.0 | 0.0000 | -0.3 | 0.2863 |
| CCU | 6.6 | 7.1 | 6.7 | 6.2 | 0.5 | 0.0454 | -0.6 | 0.0026 |
| ICU Days | 0.9 | 0.8 | 0.8 | 0.9 | -0.1 | 0.0110 | 0.0 | 0.0900 |
| Other fractures | 19.1 | 17.7 | 19.9 | 17.3 | -1.4 | 0.0001 | -2.6 | 0.0000 |
| Acute post hemorrhagic anemia | 32.8 | 31.4 | 32.2 | 33.6 | -1.4 | 0.0014 | 1.4 | 0.0001 |
| Chronic kidney disease | 17.4 | 18.1 | 20.2 | 20.7 | 0.7 | 0.0653 | 0.4 | 0.1562 |
| Pulmonary heart disease | 5.8 | 5.1 | 6.8 | 6.5 | -0.7 | 0.0018 | -0.4 | 0.0499 |
| Urinary tract infections | 19.0 | 17.6 | 15.7 | 15.1 | -1.4 | 0.0001 | -0.6 | 0.0238 |
| Fx tx incl. reposition w/ or w/o fix | 48.5 | 49.6 | 48.2 | 50.6 | 1.1 | 0.0166 | 2.4 | 0.0000 |
| Hip replacement; total and partial | 29.8 | 30.1 | 28.8 | 29.9 | 0.3 | 0.4617 | 1.1 | 0.0012 |
| Blood transfusion | 31.6 | 31.6 | 15.1 | 15.2 | 0.0 | 0.9926 | 0.1 | 0.7144 |
| Other vascular cath.; not heart | 3.7 | 3.2 | 2.5 | 2.5 | -0.6 | 0.0008 | -0.1 | 0.6712 |
| Respiratory intubation and MV | 2.4 | 2.2 | 2.1 | 2.3 | -0.1 | 0.3553 | 0.2 | 0.137 |
| Indwelling catheterization | 2.6 | 2.2 | 1.8 | 1.5 | -0.4 | 0.0133 | -0.2 | 0.0113 |

Table 2-5: Unadjusted Differences in PAC Utilization & Patient Outcomes Measures, by Enrollment Type (2012 & 2017)

| | Stroke | | | | | | Hip Fracture | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2012 | | | 2017 | | | 2012 | | | 2017 | | |
| **Measure** | **TM** | **MA** | **Diff** | **TM** | **MA** | **Diff** | **TM** | **MA** | **Diff** | **TM** | **MA** | **Diff** |
| **Discharge Setting (%)** | | | | | | | | | | | | |
| *SNF* | 21.4 | 24.3 | 2.89*** | 19.9 | 23.6 | 3.73*** | 60.0 | 68.8 | 8.78*** | 62.4 | 72.1 | 9.71*** |
| *IRF* | 25.1 | 16.5 | -8.57*** | 27.3 | 18.2 | -9.07*** | 25.0 | 10.5 | -14.50*** | 20.9 | 5.7 | -15.25*** |
| *HH* | 16.0 | 13.3 | -2.66*** | 14.1 | 12.6 | -1.55*** | 8.2 | 8.0 | -0.21 | 9.0 | 8.7 | -0.36* |
| *Home* | 35.9 | 45.2 | 9.33*** | 37.1 | 44.8 | 7.73*** | 5.7 | 12.5 | 6.77*** | 7.0 | 13.3 | 6.38*** |
| *LTCH* | 1.7 | 0.8 | -0.99*** | 1.6 | 0.7 | -0.83*** | 1.2 | 0.3 | -0.85*** | 0.7 | 0.2 | -0.49*** |
| **PAC Episode Days** | | | | | | | | | | | | |
| *Total* | 33.7 | 26.1 | -7.59*** | 31.4 | 26.9 | -4.56*** | 55.2 | 44.6 | -10.63*** | 51.3 | 44.4 | -6.92*** |
| *SNF* | 10.9 | 11.7 | 0.81*** | 9.5 | 10.9 | 1.42*** | 24.6 | 26.1 | 1.57*** | 21.7 | 23.6 | 1.88*** |
| *HHA* | 18.4 | 11.5 | -6.82*** | 17.3 | 12.8 | -4.44*** | 26.9 | 16.9 | -9.94*** | 26.6 | 20.0 | -6.59*** |
| *IRF* | 4.0 | 2.6 | -1.31*** | 4.2 | 2.9 | -1.29*** | 3.4 | 1.4 | -2.03*** | 2.8 | 0.8 | -2.07*** |
| *LTCH* | 0.5 | 0.3 | -0.27*** | 0.5 | 0.3 | -0.24*** | 0.3 | 0.1 | -0.24*** | 0.2 | 0.1 | -0.14*** |
| **180d Residence Days** | | | | | | | | | | | | |
| *SNF/NH* | 23.0 | 18.1 | -4.95*** | 20.2 | 16.5 | -3.70*** | 39.9 | 33.4 | -6.50*** | 34.9 | 29.4 | -5.42*** |
| *IRF* | 4.4 | 2.9 | -1.47*** | 4.6 | 3.1 | -1.54*** | 3.6 | 1.5 | -2.15*** | 3.1 | 0.8 | -2.22*** |
| *HHA* | 30.1 | 19.0 | -11.17*** | 28.8 | 20.9 | -7.87*** | 39.8 | 24.8 | -15.03*** | 39.4 | 29.0 | -10.44*** |
| **Hospital Readmission (%)** | | | | | | | | | | | | |
| *30d* | 12.0 | 10.9 | -1.15*** | 11.2 | 10.2 | -0.92*** | 11.8 | 10.6 | -1.20*** | 11.0 | 9.9 | -1.12*** |
| *90d* | 24.8 | 22.6 | -2.21*** | 23.2 | 21.4 | -1.75*** | 23.9 | 21.8 | -2.11*** | 22.6 | 20.4 | -2.17*** |
| *180d* | 34.4 | 31.0 | -3.33*** | 32.3 | 29.7 | -2.63*** | 32.8 | 30.0 | -2.80*** | 31.2 | 28.0 | -3.14*** |
| **Mortality (%)** | | | | | | | | | | | | |
| *30d* | 8.8 | 8.3 | -0.48** | 8.3 | 7.6 | -0.66*** | 5.7 | 5.5 | -0.17 | 5.8 | 5.3 | -0.43** |
| *90d* | 13.4 | 12.9 | -0.52* | 12.5 | 11.9 | -0.66*** | 11.8 | 11.3 | -0.41 | 11.4 | 11.0 | -0.49** |
| *180d* | 17.8 | 16.6 | -1.21*** | 16.6 | 15.7 | -0.85*** | 16.9 | 16.3 | -0.62* | 16.5 | 15.5 | -1.00*** |
| **Community Days** | 125.7 | 134.3 | 8.62*** | 130.0 | 137.2 | 7.12*** | 113.1 | 123.4 | 10.35*** | 119.6 | 129.0 | 9.37*** |
| **N (%)** | **57,803** | **20,318** | | **61,500** | **37,701** | | **49,457** | **14,913** | | **52,168** | **27,581** | |
| | 74% | 26% | | 62% | 38% | | 77% | 23% | | 65% | 35% | |

Table 2-6: (Stroke) Adjusted Differences in Patient Outcomes Measures, by Enrollment Type (2012 & 2017)

| | Unadjusted | | | Adjusted | | | Adjusted w/ Hospital FE | | |
|---|---|---|---|---|---|---|---|---|---|
| **Year & Measure** | **TM** | **MA** | **Diff** | **TM** | **MA** | **Diff** | **TM** | **MA** | **Diff** |
| **2012** | | | | | | | | | |
| Hospital Readmission | | | | | | | | | |
| 30 days | 12.02 | 10.86 | -1.15*** | 11.95 | 11.06 | -0.89*** | 11.95 | 11.05 | -0.90 |
| 90 days | 24.77 | 22.55 | -2.21*** | 24.61 | 22.98 | -1.63*** | 24.62 | 22.97 | -1.64*** |
| 180 days | 34.36 | 31.04 | -3.33*** | 34.17 | 31.58 | -2.59*** | 34.15 | 31.65 | -2.50 |
| Mortality | | | | | | | | | |
| 30 days | 8.78 | 8.30 | -0.48** | 8.43 | 9.31 | 0.88*** | 8.45 | 9.24 | 0.79** |
| 90 days | 13.41 | 12.89 | -0.52* | 12.94 | 14.24 | 1.31*** | 12.97 | 14.15 | 1.18*** |
| 180 days | 17.81 | 16.6 | -1.21*** | 17.23 | 18.23 | 1.00*** | 17.28 | 18.10 | 0.82** |
| Days Alive in Comm. | 125.69 | 134.31 | 8.62*** | 126.87 | 130.95 | 4.09*** | 126.75 | 131.27 | 4.52 |
| **2017** | | | | | | | | | |
| Hospital Readmission | | | | | | | | | |
| 30 days | 11.15 | 10.23 | -0.92*** | 11.16 | 10.21 | -0.95*** | 11.17 | 10.20 | -0.97*** |
| 90 days | 23.16 | 21.41 | -1.75*** | 23.22 | 21.31 | -1.91*** | 23.22 | 21.31 | -1.91 |
| 180 days | 32.31 | 29.68 | -2.63*** | 32.37 | 29.57 | -2.80*** | 32.37 | 29.58 | -2.79 |
| Mortality | | | | | | | | | |
| 30 days | 8.26 | 7.60 | -0.66*** | 7.88 | 8.23 | 0.35* | 7.87 | 8.24 | 0.38* |
| 90 days | 12.54 | 11.88 | -0.66*** | 12.09 | 12.63 | 0.54** | 12.09 | 12.62 | 0.52* |
| 180 days | 16.58 | 15.73 | -0.85*** | 16.05 | 16.59 | 0.54* | 16.06 | 16.58 | 0.53 |
| Days Alive in Comm. | 130.02 | 137.15 | 7.12*** | 130.55 | 136.30 | 5.75*** | 130.55 | 136.29 | 5.74 |

Table 2-7: (Hip Fracture) Adjusted Differences in Patient Outcomes Measures, by Enrollment Type (2012 & 2017)

| | Unadjusted | | | Adjusted | | | Adjusted w/ Hospital FE | | |
|---|---|---|---|---|---|---|---|---|---|
| **Year & Measure** | **TM** | **MA** | **Diff** | **TM** | **MA** | **Diff** | **TM** | **MA** | **Diff** |
| **2012** | | | | | | | | | |
| Hospital Readmission | | | | | | | | | |
| 30 days | 11.77 | 10.57 | -1.20*** | 11.70 | 10.83 | -0.87** | 11.69 | 10.86 | -0.83** |
| 90 days | 23.89 | 21.78 | -2.11*** | 23.72 | 22.35 | -1.37*** | 23.67 | 22.51 | -1.17 |
| 180 days | 32.77 | 29.97 | -2.80*** | 32.53 | 30.78 | -1.75*** | 32.43 | 31.11 | -1.31 |
| Mortality | | | | | | | | | |
| 30 days | 5.65 | 5.47 | -0.17 | 5.51 | 5.91 | 0.39 | 5.55 | 5.79 | 0.24 |
| 90 days | 11.75 | 11.34 | -0.41 | 11.51 | 12.15 | 0.64* | 11.56 | 11.99 | 0.43 |
| 180 days | 16.93 | 16.30 | -0.62* | 16.59 | 17.41 | 0.81* | 16.61 | 17.36 | 0.75* |
| Days Alive in Comm. | 113.10 | 123.447 | 10.35*** | 113.97 | 120.54 | 6.57*** | 114.06 | 120.24 | 6.18*** |
| **2017** | | | | | | | | | |
| Hospital Readmission | | | | | | | | | |
| 30 days | 10.98 | 9.87 | -1.12*** | 10.95 | 9.94 | -1.01*** | 10.97 | 9.898 | -1.07 |
| 90 days | 22.55 | 20.38 | -2.17*** | 22.46 | 20.57 | -1.90*** | 22.39 | 20.70 | -1.69 |
| 180 days | 31.17 | 28.03 | -3.14*** | 31.03 | 28.29 | -2.73*** | 30.92 | 28.50 | -2.41*** |
| Mortality | | | | | | | | | |
| 30 days | 5.77 | 5.34 | -0.43** | 5.56 | 5.74 | 0.18 | 5.63 | 5.61 | -0.02 |
| 90 days | 11.44 | 10.96 | -0.49** | 11.12 | 11.57 | 0.44 | 11.20 | 11.41 | 0.21 |
| 180 days | 16.50 | 15.50 | -1.00*** | 16.09 | 16.28 | 0.19 | 16.19 | 16.10 | -0.10 |
| Days Alive in Comm. | 119.62 | 128.99 | 9.37*** | 120.40 | 127.52 | 7.12*** | 120.38 | 127.56 | 7.18*** |

Table 2-8: (Stroke) Post-Matching Balance

| | 2012 | | | | 2017 | | | | Standardized Mean Differences (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Group** | **$G1_{2012}$** | **$G2_{2012}$** | **$G3_{2012}$** | **$UNM_{2012}$** | **$G1_{2017}$** | **$G2_{2017}$** | **$G3_{2017}$** | **$UNM_{2017}$** | **$G1_{2012}$ vs $G1_{2017}$** | **$G2_{2012}$ vs $G2_{2017}$** | **$G3_{2012}$ vs $G3_{2017}$** |
| **Medicare Advantage Enrollee** | **Yes** | **No** | **No** | **Both** | **Yes** | **Yes** | **No** | **Both** | | | |
| **N (Unique persons)** | 19,632 | 19,950 | 41,032 | 13,482 | 19,140 | 17,684 | 59,499 | 2,928 | | | |
| **N (Weighted for Matching)** | 19,632 | 17,684 | 59,499 | 13,482 | 19,632 | 17,684 | 59,499 | 2,928 | | | |
| **Demographics (At Time of Enrollment)** | | | | | | | | | | | |
| Age | 75.4 | 75.4 | 75.8 | | 75.0 | 74.5 | 75.3 | | 3.70 | -9.32 | -4.76 |
| Female (%) | 55.0 | 57.4 | 55.6 | | 53.1 | 52.9 | 52.9 | | 3.96 | -8.97 | -5.26 |
| Race: White (%) | 60.4 | 66.1 | 70.9 | | 56.7 | 63.3 | 69.5 | | 7.51 | -5.66 | -2.98 |
| Race: Black (%) | 23.0 | 22.2 | 18.4 | | 23.9 | 23.5 | 18.8 | | -2.22 | 2.99 | 0.98 |
| Race: Hispanic (%) | 13.9 | 9.4 | 7.7 | | 15.3 | 10.2 | 7.9 | | -3.92 | 2.61 | 0.72 |
| Race: Other (%) | 2.7 | 2.3 | 3.0 | | 4.1 | 3.0 | 3.8 | | -8.48 | 3.94 | 4.15 |
| **Enrollment (Prior to Annual Enrollment)** | | | | | | | | | | | |
| Aged (%) | 88.9 | 87.7 | 87.8 | | 89.8 | 86.9 | 88.6 | | -2.77 | -2.16 | 2.51 |
| Disability (%) | 10.9 | 11.7 | 11.2 | | 10.1 | 12.9 | 10.9 | | 2.31 | 3.42 | -1.02 |
| ESRD (%) | 0.2 | 0.6 | 1.0 | | 0.1 | 0.2 | 0.5 | | 3.04 | -10.31 | -6.79 |
| Dual Medicaid, Full (%) | 11.4 | 14.7 | 15.5 | | 13.6 | 14.7 | 14.7 | | -6.95 | -0.11 | -2.19 |
| Dual Medicaid, Partial (%) | 9.0 | 10.5 | 5.4 | | 10.2 | 9.9 | 5.3 | | -4.26 | -2.13 | -0.39 |
| **Medical Care Utilization (Prior to Annual Enrollment)** | | | | | | | | | | | |
| Days in Hospital | 1.2 | 1.4 | 1.5 | | 1.1 | 1.4 | 1.3 | | 3.12 | -0.49 | -4.90 |
| Days in Nursing Home | 1.3 | 1.5 | 1.9 | | 1.1 | 1.6 | 1.8 | | 1.34 | 0.47 | -0.48 |
| Days at Home w Home Health | 10.0 | 15.4 | 21.8 | | 8.9 | 12.3 | 18.6 | | 2.58 | -7.19 | -5.43 |
| **Zip-Code Level Market Characteristics** | | | | | | | | | | | |
| Poverty (%) | 16.6 | 16.2 | 16.3 | | 16.6 | 16.2 | 16.3 | | 0.00 | 0.00 | 0.00 |
| Median Household Income (%) | 64,487.3 | 62,494.6 | 64,465.2 | | 64,487.3 | 62,494.6 | 64,465.2 | | 0.00 | 0.00 | 0.00 |
| Rural (%) | 3.5 | 4.1 | 4.2 | | 3.5 | 4.1 | 4.2 | | 0.00 | 0.00 | 0.00 |
| **Unmatched ASMD** | | | | | | | | | 3.0837 | 10.0285 | 3.4455 |
| **Matched ASMD** | | | | | | | | | 4.0106 | 4.2696 | 3.0418 |
| **Rubin's B-Statistic** | | | | | | | | | -0.0229 | 0.0494 | -0.0182 |
| **Rubin's R Statistic** | | | | | | | | | 1.0010 | 1.0007 | 1.0007 |

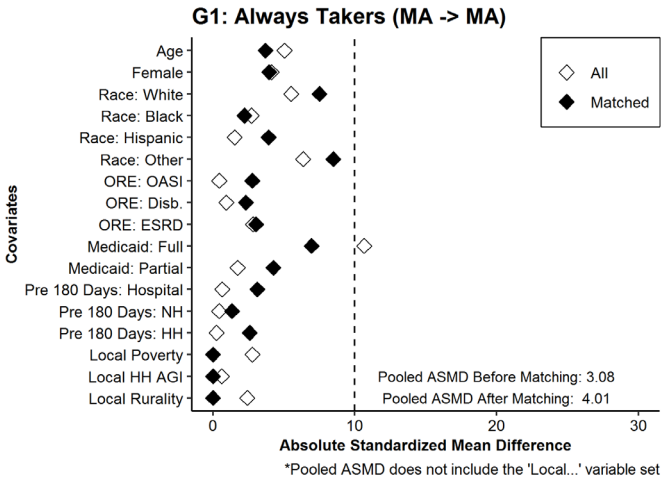
*In an effort to reduce downwards bias (towards 0% Differences), when calculating the pooled "unmatched mean differences" and "matched mean differences" we exclude the three "Zip-code level Market Characteristics"

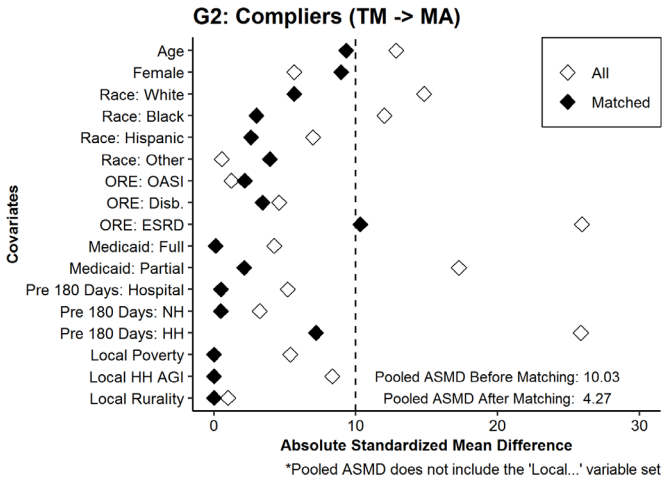
Table 2-9: (Hip Fracture) Post-Matching Balance

| | 2012 | | | | 2017 | | | | Standardized Mean Differences (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Group** | **$G1_{2012}$** | **$G2_{2012}$** | **$G3_{2012}$** | **$UNM_{2012}$** | **$G1_{2017}$** | **$G2_{2017}$** | **$G3_{2017}$** | **$UNM_{2017}$** | **$G1_{2012}$ vs $G1_{2017}$** | **$G2_{2012}$ vs $G2_{2017}$** | **$G3_{2012}$ vs $G3_{2017}$** |
| **Medicare Advantage Enrollee** | **Yes** | **No** | **No** | **Both** | **Yes** | **Yes** | **No** | **Both** | | | |
| **N (Unique persons)** | 14,362 | 15,488 | 34,897 | 11,965 | 13,500 | 13,396 | 50,431 | 2,422 | | | |
| **N (Weighted for Matching)** | 14,362 | 13,396 | 50,431 | 11,965 | 14,362 | 13,396 | 50,431 | 2,422 | | | |
| **Demographics (At Time of Enrollment)** | | | | | | | | | | | |
| Age | 80.5 | 80.6 | 81.0 | | 79.8 | 79.4 | 80.4 | | 6.87 | -11.80 | -5.91 |
| Female (%) | 0.7 | 0.8 | 0.7 | | 0.7 | 0.7 | 0.7 | | 5.29 | -10.25 | -5.87 |
| Race: White (%) | 0.8 | 0.8 | 0.9 | | 0.8 | 0.8 | 0.9 | | 4.95 | -4.42 | -3.16 |
| Race: Black (%) | 0.1 | 0.1 | 0.1 | | 0.1 | 0.1 | 0.1 | | 0.04 | 2.71 | 1.27 |
| Race: Hispanic (%) | 0.1 | 0.1 | 0.1 | | 0.1 | 0.1 | 0.1 | | -4.45 | 2.40 | 1.37 |
| Race: Other (%) | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | | -4.04 | 2.20 | 3.04 |
| **Enrollment (Prior to Annual Enrollment)** | | | | | | | | | | | |
| Aged (%) | 1.0 | 0.9 | 0.9 | | 0.9 | 0.9 | 0.9 | | 1.61 | -1.57 | 1.05 |
| Disability (%) | 0.0 | 0.1 | 0.1 | | 0.1 | 0.1 | 0.1 | | -2.27 | 2.71 | 0.20 |
| ESRD (%) | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | | 3.38 | -8.81 | -5.26 |
| Dual Medicaid, Full (%) | 0.1 | 0.1 | 0.1 | | 0.1 | 0.1 | 0.1 | | -4.14 | -1.21 | -2.01 |
| Dual Medicaid, Partial (%) | 0.1 | 0.1 | 0.0 | | 0.1 | 0.1 | 0.0 | | -1.05 | -1.44 | 0.16 |
| **Medical Care Utilization (Prior to Annual Enrollment)** | | | | | | | | | | | |
| Days in Hospital | 1.4 | 1.6 | 1.8 | | 1.4 | 1.4 | 1.5 | | 0.92 | -4.52 | -5.05 |
| Days in Nursing Home | 2.1 | 2.8 | 3.3 | | 2.4 | 2.5 | 3.1 | | -2.23 | -2.26 | -1.34 |
| Days at Home w Home Health | 12.7 | 21.3 | 29.0 | | 12.4 | 17.5 | 26.2 | | 0.52 | -7.49 | -4.18 |
| **Zip-Code Level Market Characteristics** | | | | | | | | | | | |
| Poverty (%) | 0.2 | 0.2 | 0.2 | | 0.2 | 0.2 | 0.2 | | 0.00 | 0.00 | 0.00 |
| Median Household Income (%) | 65,668.1 | 63,748.7 | 66,086.6 | | 65,668.1 | 63,748.7 | 66,086.6 | | 0.00 | 0.00 | 0.00 |
| Rural (%) | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | | 0.00 | 0.00 | 0.00 |
| **Unmatched Mean Differences** | | | | | | | | | 3.2600 | 9.7400 | 2.7700 |
| **Matched Mean Differences** | | | | | | | | | 2.9800 | 4.5600 | 2.8500 |
| **Rubin's B-Statistic** | | | | | | | | | 0.0058 | 0.0173 | -0.0030 |
| **Rubin's R Statistic** | | | | | | | | | 1.0004 | 1.0005 | 1.0008 |

*In an effort to reduce downwards bias (towards 0% Differences), when calculating the pooled "unmatched mean differences" and "matched mean differences" we exclude the three "Zip-code level Market Characteristics"

Figure 2-6: (Stroke) Post-Matching Balance



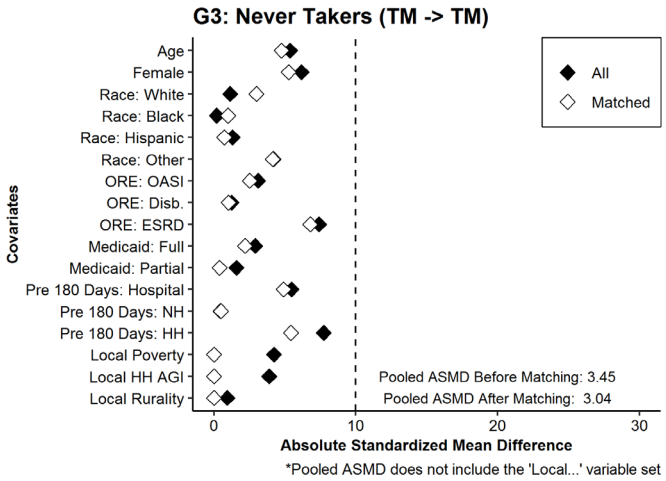
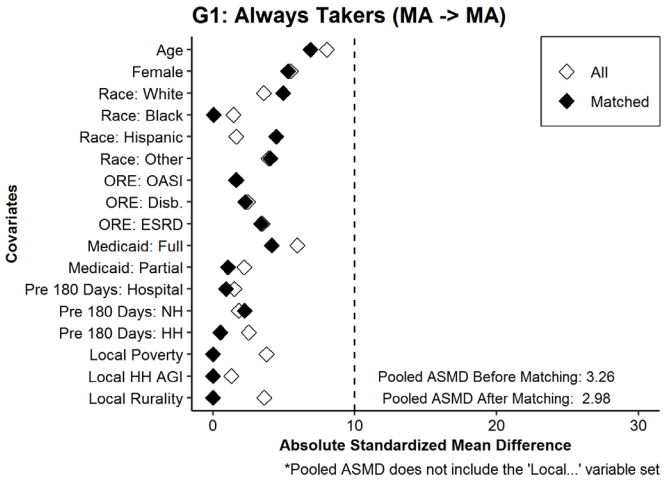
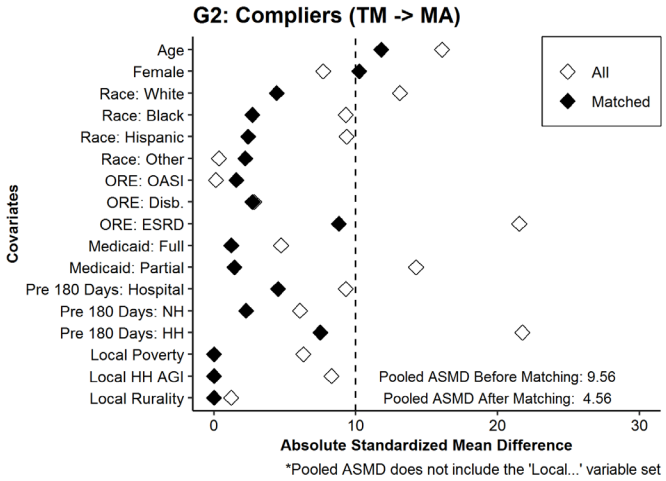




Figure 2-7: (Hip Fracture) Post-Matching Balance



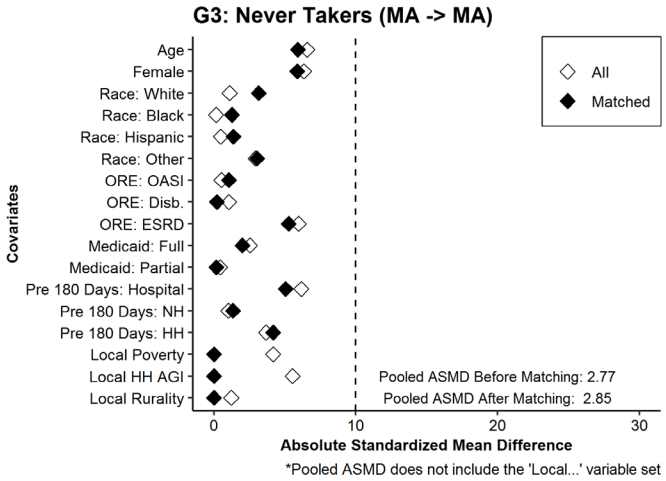



Table 2-10: Difference-in-Differences, First Discharge Setting

| | | Stroke | | | | Hip Fracture | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Setting** | **Group** | **2012** | **2017** | **First Difference** | **Second Difference** | **2012** | **2017** | **First Difference** | **Second Difference** |
| SNF | Never Takers | 20.5 | 20.7 | 0.2 | | 59.3 | 63.3 | 4.0*** | |
| | | (.1) | (.1) | (.2) | | (.2) | (.2) | (.2) | |
| | Compliers | 21.5 | 23.4 | 1.9*** | 1.7*** | 60.1 | 73 | 13.0*** | 9.0*** |
| | | (.2) | (.2) | (.3) | (.3) | (.3) | (.3) | (.4) | (.4) |
| HHA | Never Takers | 15.3 | 14.5 | -0.8*** | | 8.3 | 8.7 | 0.4** | |
| | | (.1) | (.1) | (.1) | | (.1) | (.1) | (.1) | |
| | Compliers | 15 | 13.6 | -1.5*** | -0.7* | 8.9 | 8.6 | -0.3 | -0.7* |
| | | (.2) | (.2) | (.3) | (.3) | (.2) | (.2) | (.2) | (.3) |
| IRF | Never Takers | 26.3 | 26.3 | -0.1 | | 25.3 | 20.8 | -4.5*** | |
| | | (.1) | (.1) | (.2) | | (.1) | (.1) | (.2) | |
| | Compliers | 26 | 17.4 | -8.6*** | -8.5*** | 23.7 | 5.7 | -17.9*** | -13.4*** |
| | | (.2) | (.2) | (.3) | (.3) | (.3) | (.1) | (.3) | (.4) |
| LTCH | Never Takers | 1.7 | 1.6 | -0.1** | | 1.1 | 0.7 | -0.4*** | |
| | | (0) | (0) | (0) | | (0) | (0) | (0) | |
| | Compliers | 1.7 | 0.7 | -1.0*** | -0.8*** | 1 | 0.2 | -0.8*** | -0.4*** |
| | | (.1) | (0) | (.1) | (.1) | (.1) | (0) | (.1) | (.1) |
| Home | Never Takers | 36.1 | 37 | 0.8*** | | 6 | 6.6 | 0.6*** | |
| | | (.1) | (.1) | (.2) | | (.1) | (.1) | (.1) | |
| | Compliers | 35.8 | 44.9 | 9.1*** | 8.2*** | 6.3 | 12.5 | 6.1*** | 5.6*** |
| | | (.2) | (.2) | (.3) | (.4) | (.2) | (.2) | (.2) | (.3) |

Table 2-11: Difference-in-Differences, PAC Episode Days and Residence Days During 180 Days Post-Discharge

| | | Stroke | | | | Hip Fracture | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Variable** | **Group** | **2012** | **2017** | **First Difference** | **Second Difference** | **2012** | **2017** | **First Difference** | **Second Difference** |
| **PAC Episode** | | | | | | | | | |
| Total | Never Takers | 33.60 | 31.32 | -2.28*** | | 54.58 | 51.69 | -2.89*** | |
| | | (0.13) | (0.13) | (0.18) | | (0.15) | (0.15) | (0.21) | |
| | Compliers | 33.44 | 28.02 | -5.42*** | -3.14*** | 53.92 | 47.57 | -6.35*** | -3.46*** |
| | | (0.23) | (0.23) | (0.33) | (0.37) | (0.28) | (0.28) | (0.40) | (0.45) |
| SNF | Never Takers | 11.02 | 9.58 | -1.44*** | | 24.16 | 22.10 | -2.06*** | |
| | | (0.07) | (0.07) | (0.10) | | (0.09) | (0.09) | (0.13) | |
| | Compliers | 11.34 | 11.34 | -0.00 | 1.44*** | 23.99 | 25.10 | 1.11*** | 3.17*** |
| | | (0.13) | (0.13) | (0.18) | (0.20) | (0.17) | (0.17) | (0.24) | (0.27) |
| HH | Never Takers | 17.84 | 17.29 | -0.55*** | | 26.65 | 26.54 | -0.12 | |
| | | (0.10) | (0.10) | (0.14) | | (0.12) | (0.12) | (0.17) | |
| | Compliers | 17.46 | 13.83 | -3.63*** | -3.08*** | 26.42 | 21.72 | -4.70*** | -4.58*** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | (0.18) | (0.18) | (0.26) | (0.29) | (0.23) | (0.23) | (0.33) | (0.37) |
| IRF | Never Takers | 4.23 | 3.93 | -0.30*** | | 3.46 | 2.83 | -0.63*** | |
| | | (0.02) | (0.02) | (0.03) | | (0.02) | (0.02) | (0.03) | |
| | Compliers | 4.17 | 2.62 | -1.54*** | -1.25*** | 3.26 | 0.74 | -2.52*** | -1.89*** |
| | | (0.04) | (0.04) | (0.06) | (0.06) | (0.04) | (0.04) | (0.05) | (0.06) |
| LTCH | Never Takers | 0.50 | 0.51 | 0.01 | | 0.31 | 0.22 | -0.09*** | |
| | | (0.01) | (0.01) | (0.02) | | (0.01) | (0.01) | (0.01) | |
| | Compliers | 0.47 | 0.23 | -0.24*** | -0.25*** | 0.25 | 0.01 | -0.24*** | -0.16*** |
| | | (0.02) | (0.02) | (0.03) | (0.04) | (0.02) | (0.02) | (0.03) | (0.03) |
| **180d Residence** | | | | | | | | | |
| SNF/NH | Never Takers | 23.02 | 20.41 | -2.61*** | | 38.83 | 35.47 | -3.35*** | |
| | | (0.12) | (0.12) | (0.17) | | (0.15) | (0.15) | (0.21) | |
| | Compliers | 23.54 | 16.77 | -6.77*** | -4.16*** | 38.70 | 31.63 | -7.07*** | -3.72*** |
| | | (0.22) | (0.22) | (0.31) | (0.35) | (0.28) | (0.28) | (0.40) | (0.44) |
| IRF | Never Takers | 4.71 | 4.40 | -0.31*** | | 3.65 | 3.05 | -0.60*** | |
| | | (0.02) | (0.02) | (0.03) | | (0.02) | (0.02) | (0.03) | |
| | Compliers | 4.56 | 2.84 | -1.72*** | -1.42*** | 3.42 | 0.83 | -2.59*** | -1.99*** |
| | | (0.04) | (0.04) | (0.06) | (0.07) | (0.04) | (0.04) | (0.06) | (0.06) |
| HH | Never Takers | 29.42 | 28.76 | -0.66*** | | 39.36 | 39.46 | 0.10 | |
| | | (0.12) | (0.12) | (0.18) | | (0.14) | (0.14) | (0.20) | |
| | Compliers | 28.76 | 22.23 | -6.53*** | -5.87*** | 39.24 | 31.60 | -7.65*** | -7.75*** |
| | | (0.23) | (0.23) | (0.32) | (0.37) | (0.27) | (0.27) | (0.38) | (0.42) |

Table 2-12: Difference-in-Differences, Patient Outcomes

| | | Stroke | | | | Hip Fracture | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Variable** | **Group** | **2012** | **2017** | **First** | **Second** | **2012** | **2017** | **First** | **Second** |
| 30d Readmit | | 11.8 | 11.2 | -0.6*** | | 11.2 | 11.1 | -0.1 | |
| | | (0.1) | (0.1) | (0.1) | | (0.1) | (0.1) | (0.1) | |
| | Compliers | 11.8 | 10.2 | -1.7*** | -1.1*** | 10.8 | 9.9 | -1.0*** | -0.8** |
| | | (0.2) | (0.2) | (0.2) | (0.3) | (0.2) | (0.2) | (0.3) | (0.3) |
| 90d Readmit | Never Takers | 24.3 | 23.2 | -1.1*** | | 23.0 | 22.6 | -0.4 | |
| | | (0.1) | (0.1) | (0.2) | | (0.1) | (0.1) | (0.2) | |
| | Compliers | 24.4 | 21.3 | -3.1*** | -2.0*** | 22.6 | 20.7 | -1.9*** | -1.5*** |
| | | (0.2) | (0.2) | (0.3) | (0.4) | (0.3) | (0.3) | (0.4) | (0.4) |
| 180d Readmit | Never Takers | 33.6 | 32.5 | -1.2*** | | 31.9 | 31.2 | -0.7** | |
| | | (0.1) | (0.1) | (0.2) | | (0.1) | (0.1) | (0.2) | |
| | Compliers | 33.6 | 29.7 | -4.0*** | -2.8*** | 31.4 | 28.6 | -2.8*** | -2.1*** |
| | | (0.2) | (0.2) | (0.3) | (0.4) | (0.3) | (0.3) | (0.4) | (0.5) |
| 30d Death | Never Takers | 8.9 | 7.7 | -1.3*** | | 5.3 | 5.8 | 0.4*** | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | (0.1) | (0.1) | (0.1) | | (0.1) | (0.1) | (0.1) | |
| | Compliers | 9.2 | 8.0 | -1.2*** | 0.1 | 5.6 | 6.0 | 0.3 | -0.1 |
| | | (0.1) | (0.1) | (0.2) | (0.2) | (0.1) | (0.1) | (0.2) | (0.2) |
| 90d Death | Never Takers | 13.4 | 12.0 | -1.4*** | | 11.1 | 11.5 | 0.3* | |
| | | (0.1) | (0.1) | (0.1) | | (0.1) | (0.1) | (0.1) | |
| | Compliers | 13.7 | 12.4 | -1.3*** | 0.1 | 11.3 | 11.9 | 0.6* | 0.3 |
| | | (0.2) | (0.2) | (0.2) | (0.3) | (0.2) | (0.2) | (0.3) | (0.3) |
| 180d Death | Never Takers | 17.7 | 16.1 | -1.6*** | | 16.3 | 16.5 | 0.2 | |
| | | (0.1) | (0.1) | (0.1) | | (0.1) | (0.1) | (0.2) | |
| | Compliers | 18.1 | 16.5 | -1.6*** | 0.0 | 16.5 | 16.6 | 0.1 | -0.2 |
| | | (0.2) | (0.2) | (0.3) | (0.3) | (0.2) | (0.2) | (0.3) | (0.4) |
| Community Days | Never Takers | 125.3 | 131.0 | 5.7*** | | 115.1 | 119.0 | 3.9*** | |
| | | (0.2) | (0.2) | (0.2) | | (0.2) | (0.2) | (0.2) | |
| | Compliers | 124.4 | 136.3 | 11.8*** | 6.1*** | 115.3 | 125.3 | 10.0*** | 6.1*** |
| | | (0.3) | (0.3) | (0.4) | (0.5) | (0.3) | (0.4) | (0.5) | (0.6) |

Figure 2-8: (Stroke) Difference-in-Differences, First Discharge Setting

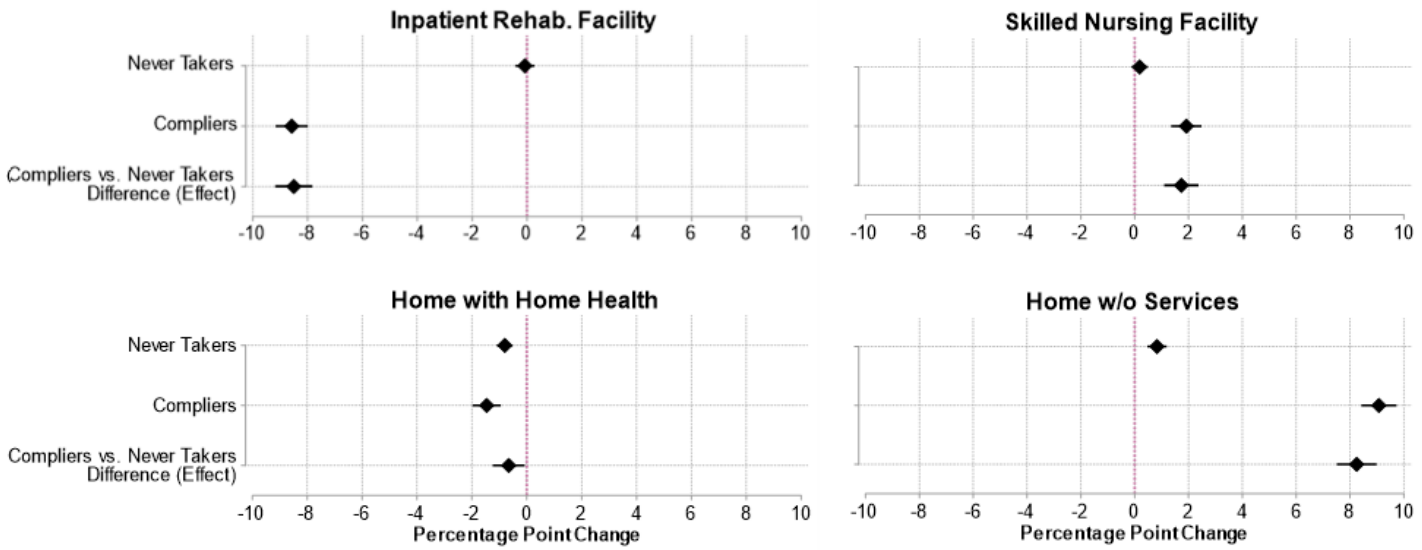



Figure 2-9: (Hip Fracture) Difference-in-Differences, First Discharge Setting

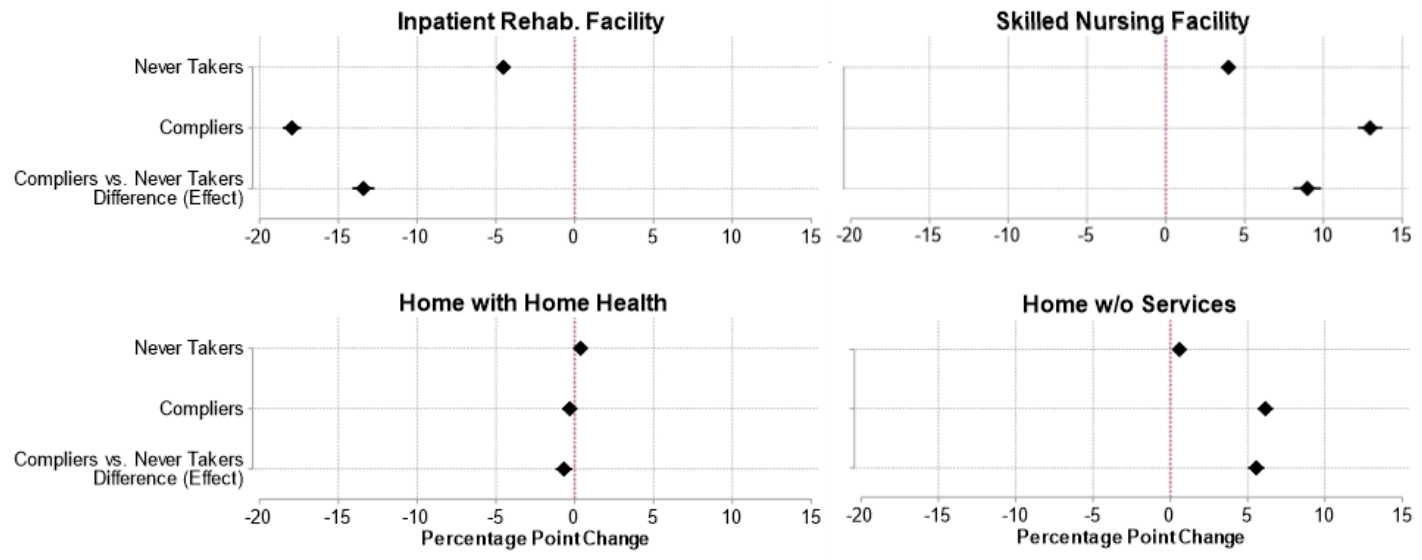


Figure 2-10: (Stroke) Difference-in-Differences, PAC Episode Days

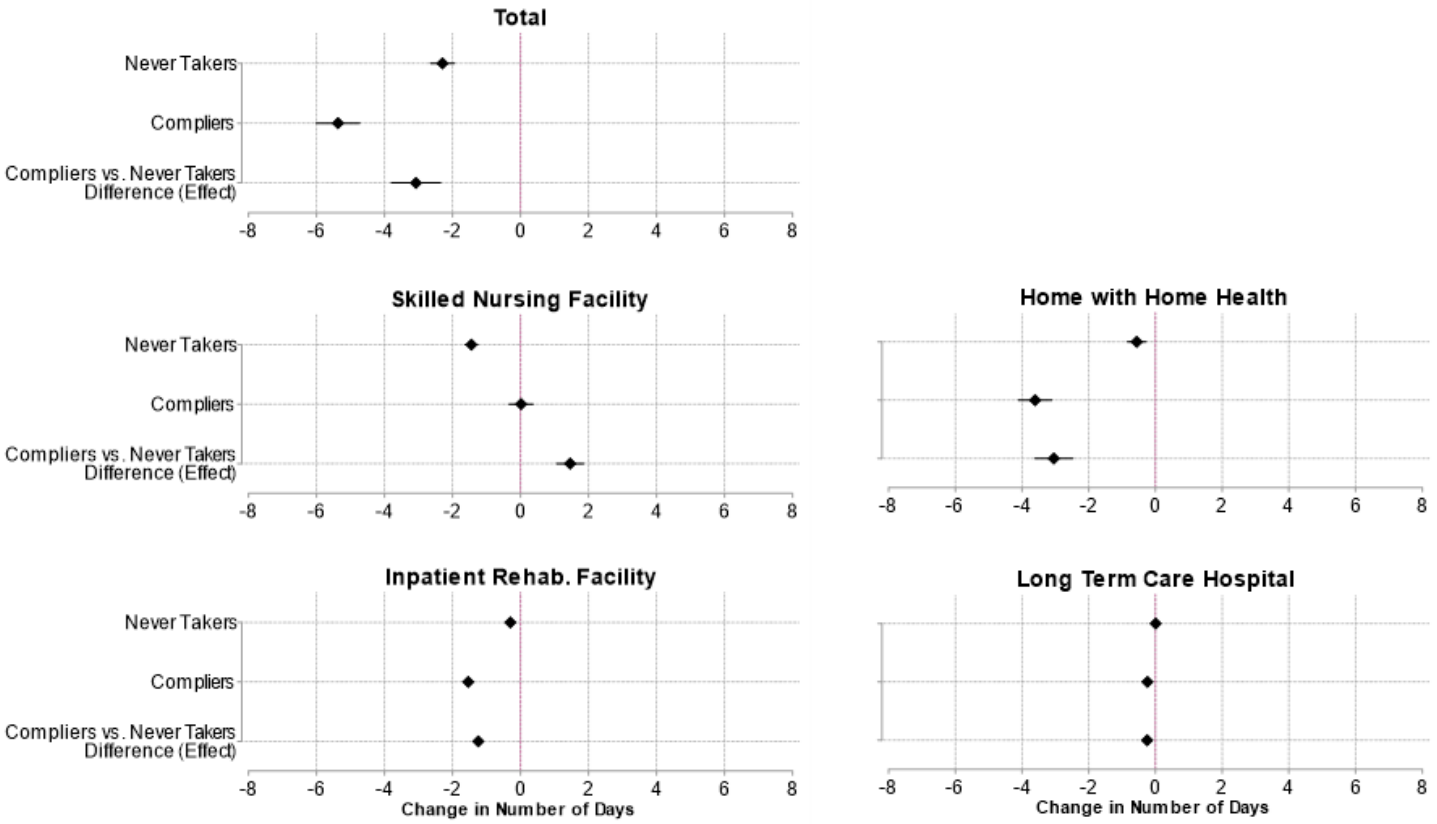



Figure 2-11: (Hip Fracture) Difference-in-Differences, PAC Episode Days

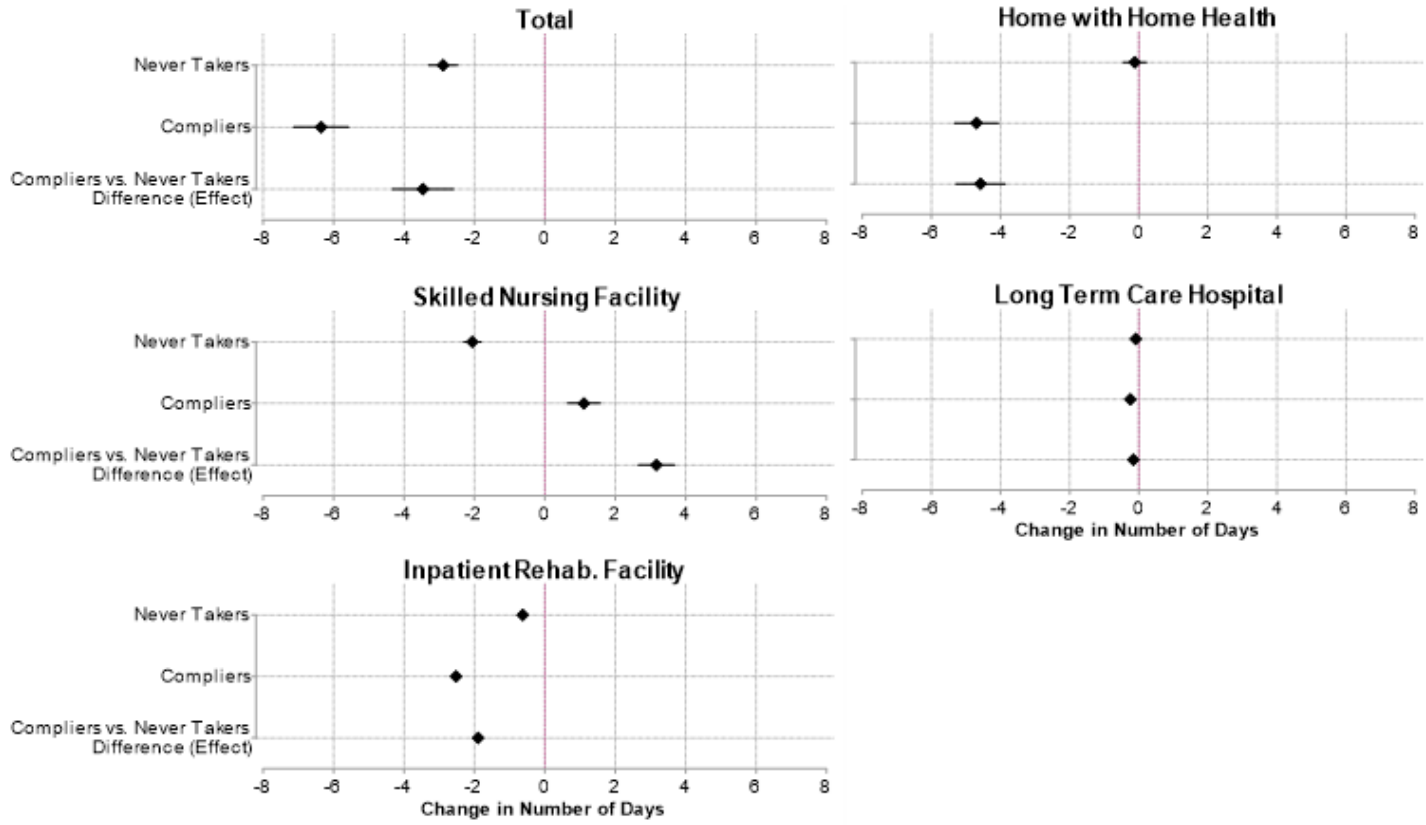


Figure 2-12: (Stroke) Difference-in-Differences, Residence Days During 180 Days Post-Discharge

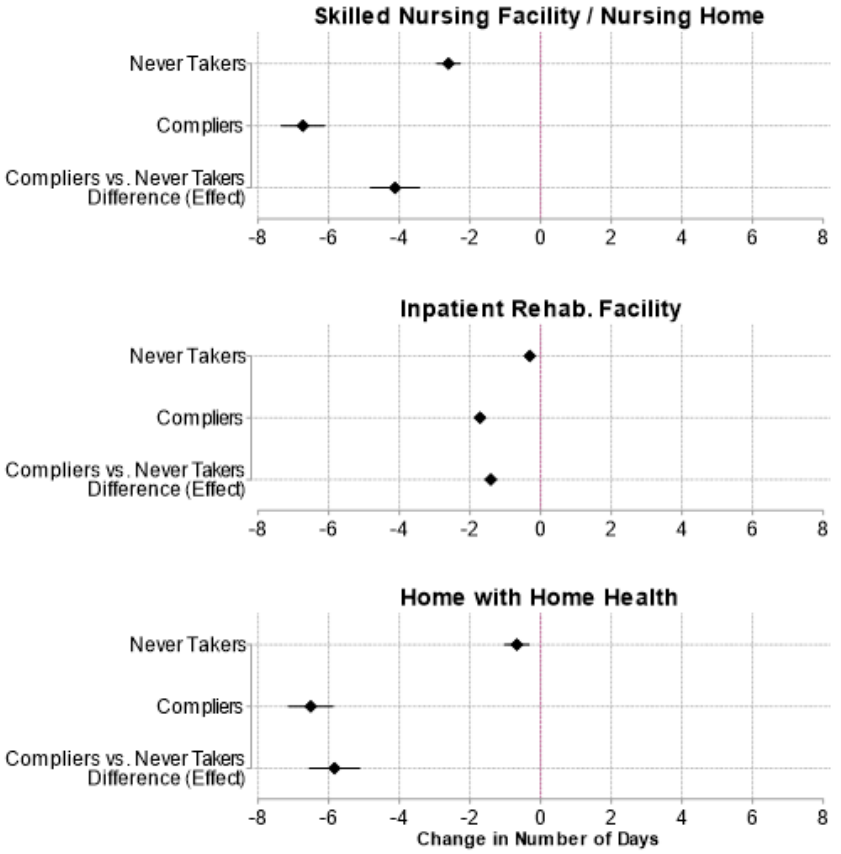



Figure 2-13: (Hip Fracture) Difference-in-Differences, Residence Days During 180 Days Post-Discharge

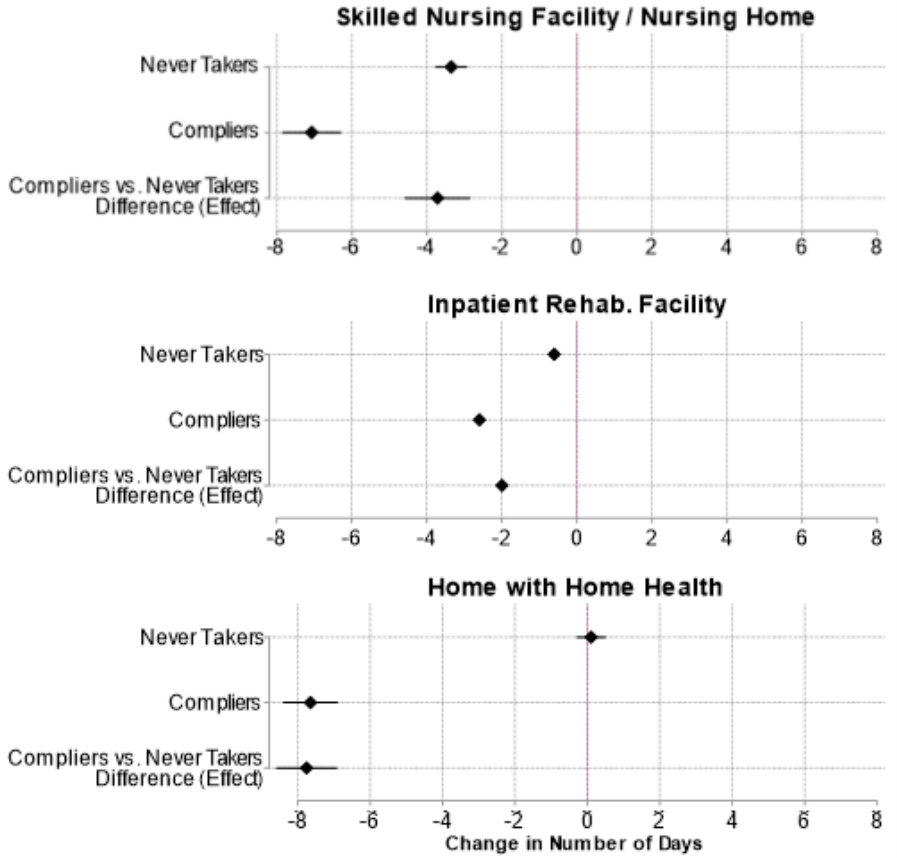


Figure 2-14: (Stroke) Difference-in-Differences, Patient Outcomes

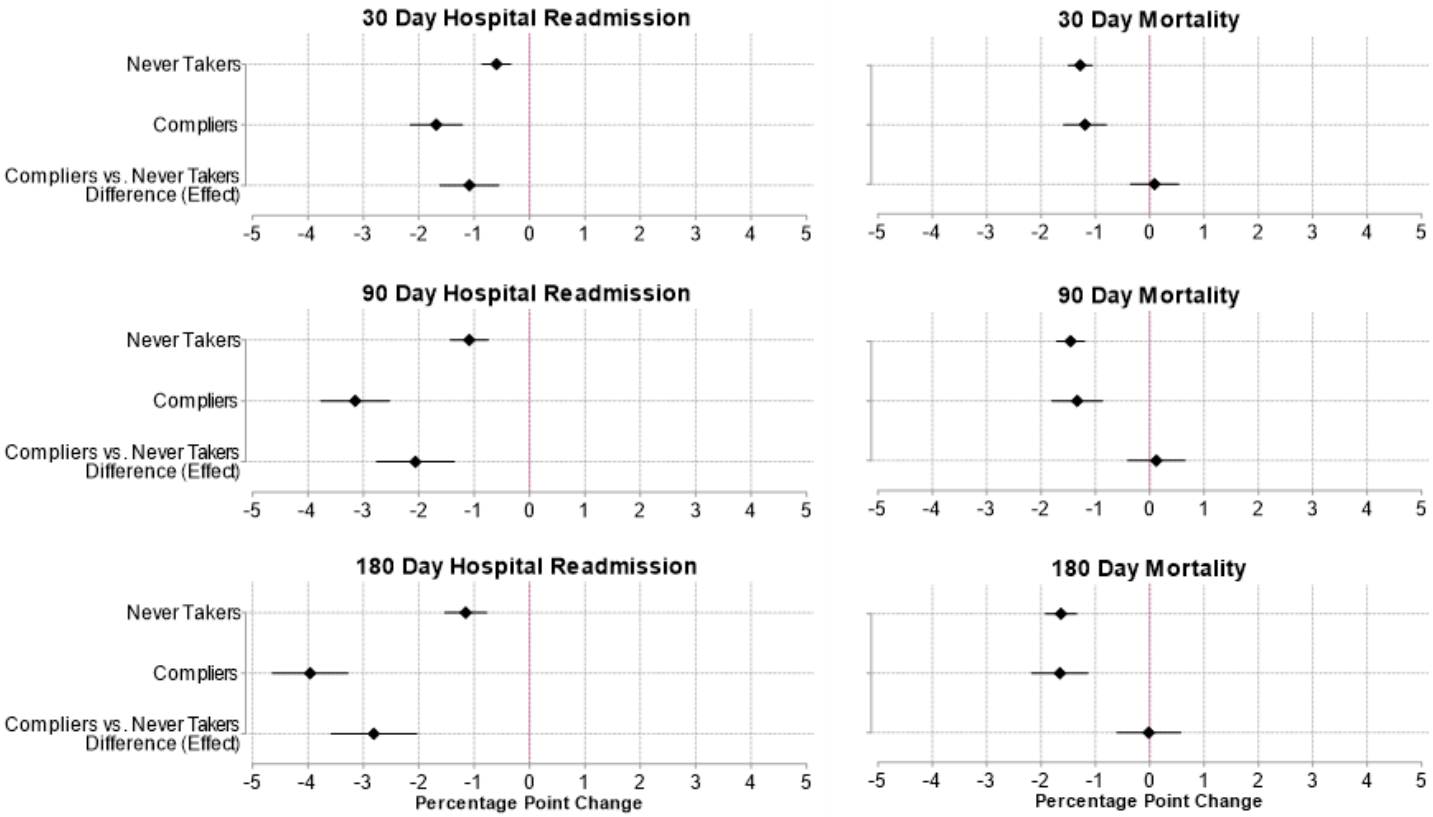



Figure 2-15: (Hip Fracture) Difference-in-Differences, Patient Outcomes

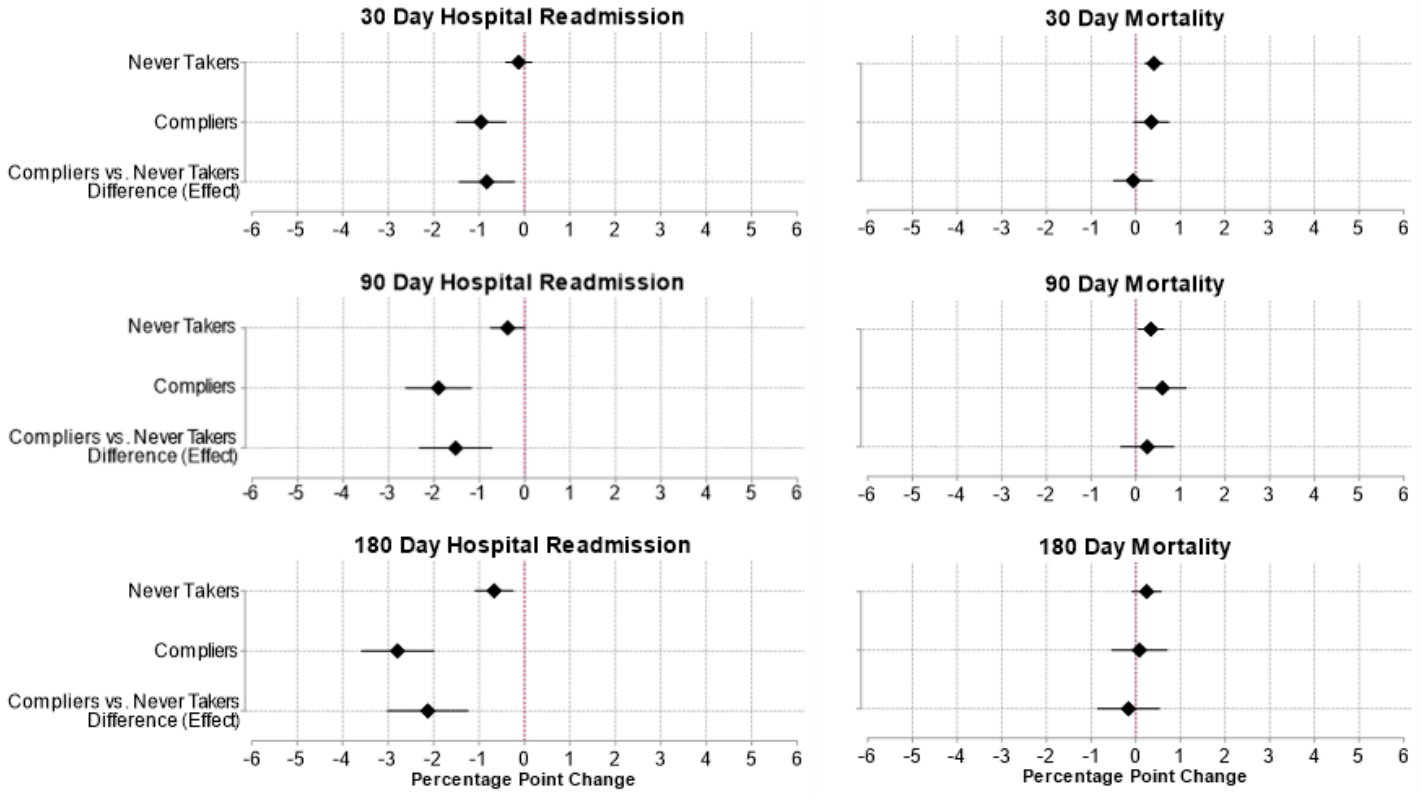


Figure 2-16: (Stroke) Changes in First Discharge Setting, by Matching Group

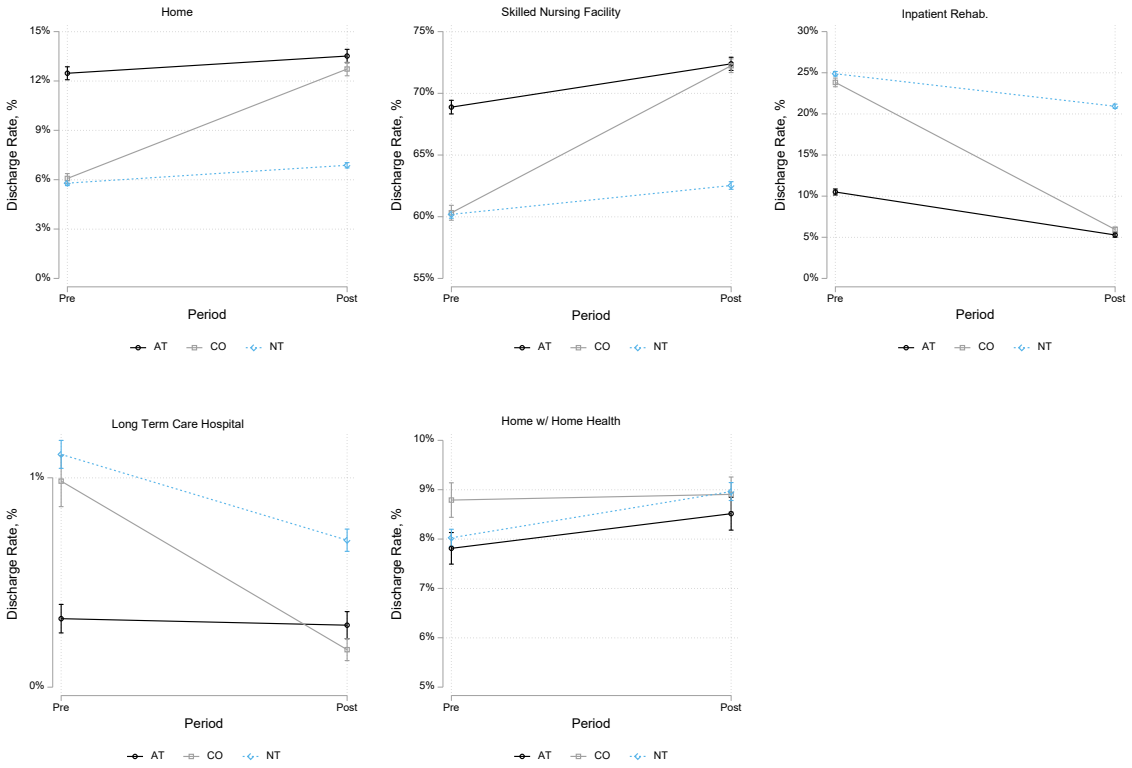



Figure 2-17: (Hip Fracture) Changes in First Discharge Setting, by Matching Group

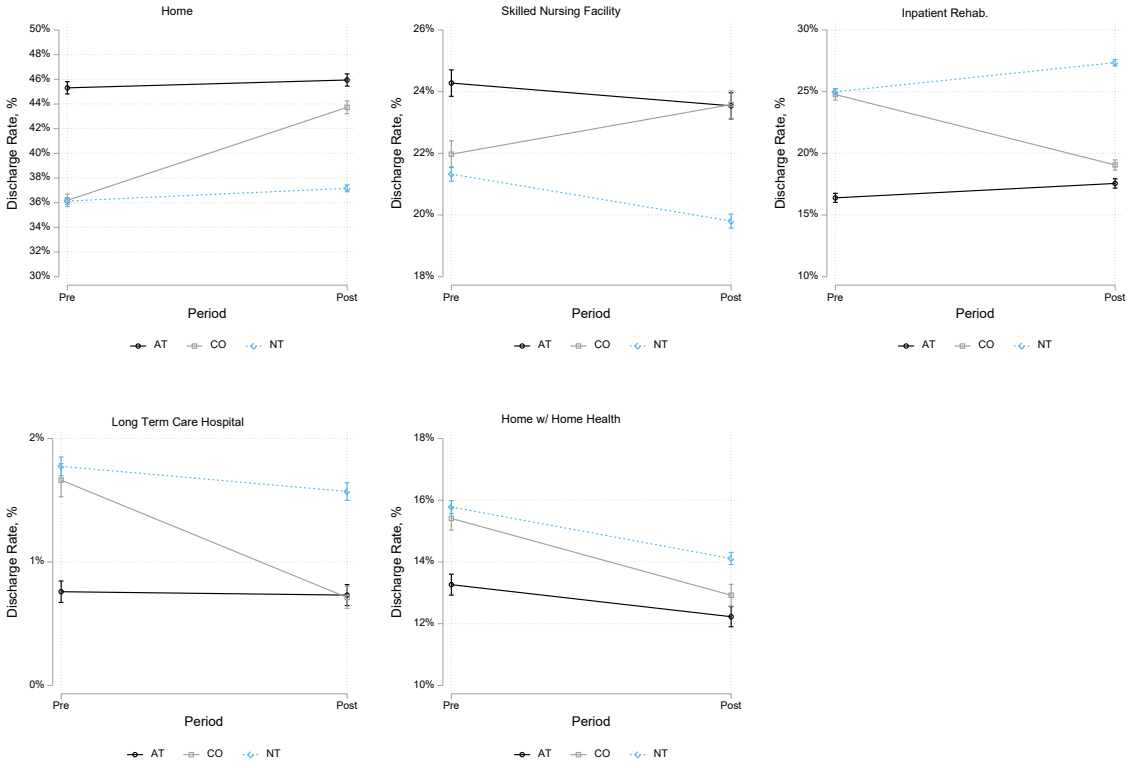


Table 2-13: (Stroke) Difference-in-Differences, First Discharge Setting, by Market Classification

| | | PPO | | HMO | | $0 Premium | | SNPs | |
|---|---|---|---|---|---|---|---|---|---|
| **Setting** | **Group** | **2012** | **DID** | **2012** | **DID** | **2012** | **DID** | **2012** | **DID** |
| SNF | Never Takers | 20.8 | | 22.0 | | 23.1 | | 21.9 | |
| | | (0.3) | | (0.3) | | (0.3) | | (0.4) | |
| | Compliers | 21.3 | 0.7 | 21.6 | 2.6** | 23.5 | 1.3 | 23.4 | 1.3 |
| | | (0.5) | (0.8) | (0.5) | (0.9) | (0.6) | (0.9) | (0.6) | (1.0) |
| HH | Never Takers | 15.2 | | 16.1 | | 18.0 | | 19.5 | |
| | | (0.3) | | (0.3) | | (0.3) | | (0.4) | |
| | Compliers | 15.4 | 1.4 | 15.7 | -0.9 | 17.7 | -1.4 | 19.2 | -2.0* |
| | | (0.5) | (0.7) | (0.5) | (0.8) | (0.5) | (0.9) | (0.6) | (1.0) |
| IRF | Never Takers | 25.2 | | 24.7 | | 21.6 | | 22.7 | |
| | | (0.3) | | (0.4) | | (0.4) | | (0.4) | |
| | Compliers | 25.5 | -8.7*** | 26.4 | -10.6*** | 22.0 | -10.8*** | 22.4 | -11.2*** |
| | | (0.5) | (0.8) | (0.6) | (0.9) | (0.6) | (0.9) | (0.7) | (1.0) |
| LTCH | Never Takers | 1.3 | | 1.7 | | 1.8 | | 2.1 | |
| | | (0.1) | | (0.1) | | (0.1) | | (0.1) | |
| | Compliers | 1.1 | -0.8*** | 1.4 | -0.7** | 1.8 | -1.0*** | 2.2 | -0.9** |
| | | (0.1) | (0.2) | (0.2) | (0.3) | (0.2) | (0.2) | (0.2) | (0.3) |
| Home | Never Takers | 37.6 | | 35.4 | | 35.6 | | 33.8 | |
| | | (0.3) | | (0.4) | | (0.4) | | (0.4) | |
| | Compliers | 36.7 | 7.4*** | 34.9 | 9.5*** | 35.0 | 11.9*** | 32.8 | 12.8*** |
| | | (0.6) | (0.9) | (0.6) | (1.0) | (0.6) | (1.1) | (0.7) | (1.2) |
| **N** | | 48,524 | | 38,776 | | 35,160 | | 28,692 | |

Table 2-14: (Hip Fracture) Difference-in-Differences, First Discharge Setting, by Market Classification

| | | PPO | | HMO | | $0 Premium | | SNPs | |
|---|---|---|---|---|---|---|---|---|---|
| **Setting** | **Group** | **2012** | **DiD** | **2012** | **DiD** | **2012** | **DiD** | **2012** | **DiD** |
| SNF | Never Takers | 58.6 | | 60.7 | | 59.7 | | 55.4 | |
| | | (0.4) | | (0.4) | | (0.4) | | (0.5) | |
| | Compliers | 58.6 | 7.7*** | 59.3 | 12.0*** | 58.7 | 11.9*** | 55.8 | 13.6*** |
| | | (0.7) | (1.1) | (0.8) | (1.2) | (0.8) | (1.2) | (0.9) | (1.4) |
| HH | Never Takers | 9.4 | | 8.2 | | 9.4 | | 9.6 | |
| | | (0.2) | | (0.2) | | (0.3) | | (0.3) | |
| | Compliers | 10.4 | -0.8 | 9.6 | -2.1** | 10.6 | -2.3** | 11.0 | -3.5*** |
| | | (0.4) | (0.7) | (0.5) | (0.7) | (0.5) | (0.8) | (0.6) | (0.8) |
| IRF | Never Takers | 25.8 | | 24.4 | | 24.0 | | 28.3 | |
| | | (0.4) | | (0.4) | | (0.4) | | (0.5) | |
| | Compliers | 24.5 | -12.5*** | 23.7 | -14.7*** | 23.9 | -16.4*** | 25.9 | -16.6*** |
| | | (0.6) | (0.9) | (0.7) | (0.9) | (0.7) | (0.9) | (0.8) | (1.1) |
| LTCH | Never Takers | 0.7 | | 1.1 | | 1.1 | | 1.4 | |
| | | (0.1) | | (.) | | (0.1) | | (0.1) | |
| | Compliers | 0.7 | -0.5** | 1.1 | -0.4* | 1.1 | -0.5 | 1.3 | -0.5* |
| | | (0.1) | (0.2) | (.) | (0.2) | (0.2) | (.) | (0.2) | (0.3) |
| Home | Never Takers | 5.5 | | 5.7 | | 5.8 | | 5.3 | |
| | | (0.2) | | (0.2) | | (0.2) | | (0.2) | |
| | Compliers | 5.9 | 6.0*** | 6.3 | 5.2*** | 5.7 | 7.3*** | 6.0 | 7.0*** |
| | | (0.3) | (0.6) | (0.4) | (0.7) | (0.4) | (0.7) | (0.4) | (0.8) |
| | | 38,904 | | 32,758 | | 31,970 | | 24,478 | |

Table 2-15: Setting Utilization During PAC Episode and 180d Post-Discharge, by Year

| | 2012 | | | 2017 | | |
|---|---|---|---|---|---|---|
| **Year & Measure** | **TM** | **MA** | **Diff** | **TM** | **MA** | **Diff** |
| **Stroke** | | | | | | |
| PAC Episode (%) | | | | | | |
| SNF | 27.30 | 28.82 | -0.02*** | 25.78 | 28.37 | -0.03*** |
| Home Health | 35.04 | 27.50 | 0.08*** | 34.14 | 28.45 | 5.68*** |
| IRF | 25.74 | 16.74 | 0.09*** | 27.99 | 18.45 | 9.54*** |
| LTCH | 1.82 | 0.75 | 0.01*** | 1.61 | 0.77 | 0.85*** |
| 180d Post-Discharge (%) | | | | | | |
| SNF | 34.24 | 34.53 | -0.29 | 32.69 | 33.67 | -0.98*** |
| Home Health | 46.01 | 37.97 | 8.04*** | 45.28 | 38.84 | 6.45*** |
| IRF | 27.39 | 17.92 | 9.47*** | 29.95 | 19.62 | 10.32*** |
| **Hip Fracture** | | | | | | |
| PAC Episode (%) | | | | | | |
| SNF | 65.30 | 70.94 | 5.65*** | 65.87 | 73.44 | -7.57*** |
| Home Health | 53.15 | 43.00 | 10.15*** | 53.85 | 46.76 | 7.09*** |
| IRF | 25.56 | 10.52 | 15.04*** | 21.54 | 5.73 | 15.81*** |
| LTCH | 1.29 | 0.35 | 0.01*** | 0.83 | 0.25 | 0.58*** |
| 180d Post-Discharge (%) | | | | | | |
| SNF | 69.56 | 72.94 | -3.38*** | 69.41 | 74.94 | -5.52*** |
| Home Health | 66.37 | 54.15 | 12.21*** | 66.75 | 58.39 | 8.36*** |
| IRF | 26.50 | 11.04 | 15.46*** | 22.81 | 6.32 | 16.49*** |

Table 2-16: Difference-in-Differences, Setting Utilization During PAC Episode

| Difference in Differences: Any Use of Setting During PAC Episode | | | | | |
|---|---|---|---|---|---|
| Variable | Group | 2012 | 2017 | First Difference | Second Difference |
| **Stroke** | | | | | |
| SNF (%) | Never Takers | 27.3 | 26.6 | -0.7*** | |
| | | (0.1) | (0.1) | (0.2) | |
| | Compliers | 28.3 | 27.7 | -0.6* | 0.0 |
| | | (0.2) | (0.2) | (0.3) | (0.4) |
| Home Health (%) | Never Takers | 34.5 | 34.2 | -0.3 | |
| | | (0.1) | (0.1) | (0.2) | |
| | Compliers | 33.9 | 29.6 | -4.3*** | -4.0*** |
| | | (0.2) | (0.2) | (0.4) | (0.4) |
| IRF (%) | Never Takers | 27.1 | 26.7 | -0.4* | |
| | | (0.1) | (0.1) | (0.2) | |
| | Compliers | 26.7 | 17.3 | -9.4*** | -9.0*** |
| | | (0.2) | (0.2) | (0.3) | (0.4) |
| LTCH (%) | Never Takers | 1.8 | 1.7 | -0.1* | |
| | | (0.0) | (0.0) | (0.0) | |
| | Compliers | 1.6 | 0.8 | -0.9*** | -0.8*** |
| | | (0.1) | (0.1) | (0.1) | (0.1) |
| **Hip Fracture** | | | | | |
| SNF (%) | Never Takers | 64.7 | 66.8 | 2.1*** | |
| | | (0.1) | (0.1) | (0.2) | |
| | Compliers | 64.8 | 74.6 | 9.8*** | 7.7*** |
| | | (0.3) | (0.3) | (0.4) | (0.4) |
| Home Health (%) | Never Takers | 53.6 | 53.7 | 0.1 | |
| | | (0.2) | (0.2) | (0.2) | |
| | Compliers | 52.7 | 48.6 | -4.1*** | -4.1*** |
| | | (0.3) | (0.3) | (0.4) | (0.5) |
| IRF (%) | Never Takers | 25.7 | 21.3 | -4.4*** | |
| | | (0.1) | (0.1) | (0.2) | |
| | Compliers | 24.2 | 5.5 | -18.7*** | -14.3*** |
| | | (0.3) | (0.3) | (0.4) | (0.4) |
| LTCH (%) | Never Takers | 1.2 | 0.9 | -0.3*** | |
| | | (0.0) | (0.0) | (0.0) | |
| | Compliers | 1.0 | 0.1 | -0.9*** | -0.6*** |
| | | (0.1) | (0.1) | (0.1) | (0.1) |

Table 2-17: Difference-in-Differences, Setting Utilization During 180d Post-Discharge

| Difference in Differences: Any Use of Setting During 180d Post-Discharge | | | | | |
|---|---|---|---|---|---|
| **Variable** | **Group** | **2012** | **2017** | **First Difference** | **Second Difference** |
| **Stroke** | | | | | |
| SNF (%) | Never Takers | 34.1 | 33.5 | -0.6** | |
| | | (0.1) | (0.1) | (0.2) | |
| | Compliers | 35.1 | 32.9 | -2.1*** | -1.6*** |
| | | (0.2) | (0.2) | (0.3) | (0.4) |
| Home Health (%) | Never Takers | 45.6 | 45.5 | -0.1 | |
| | | (0.1) | (0.1) | (0.2) | |
| | Compliers | 44.9 | 39.6 | -5.3*** | -5.2*** |
| | | (0.3) | (0.3) | (0.4) | (0.4) |
| IRF (%) | Never Takers | 28.8 | 28.6 | -0.1 | |
| | | (0.1) | (0.1) | (0.2) | |
| | Compliers | 28.3 | 18.5 | -9.8*** | -9.6*** |
| | | (0.2) | (0.2) | (0.3) | (0.4) |
| **Hip Fracture** | | | | | |
| SNF (%) | Never Takers | 69.0 | 70.3 | 1.3*** | |
| | | (0.1) | (0.1) | (0.2) | |
| | Compliers | 68.9 | 76.1 | 7.2*** | 5.9*** |
| | | (0.3) | (0.3) | (0.4) | (0.4) |
| Home Health (%) | Never Takers | 66.7 | 66.7 | -0.0 | |
| | | (0.2) | (0.2) | (0.2) | |
| | Compliers | 65.5 | 60.4 | -5.1*** | -5.1*** |
| | | (0.3) | (0.3) | (0.4) | (0.5) |
| IRF (%) | Never Takers | 26.7 | 22.6 | -4.1*** | |
| | | (0.1) | (0.1) | (0.2) | |
| | Compliers | 25.2 | 6.1 | -19.1*** | -15.0*** |
| | | (0.3) | (0.3) | (0.4) | (0.4) |

Table 2-18: (Stroke) Difference-in-Differences, First Discharge Setting, by Market HHI

| | | Q1 (<2282) | | Q2 (2283-2866) | | Q3 (2867- 3591) | | Q4 (>3591) | |
|---|---|---|---|---|---|---|---|---|---|
| Setting | Group | 2012 | Second Difference | 2012 | Second Difference | 2012 | Second Difference | 2012 | Second Difference |
| SNF | Never Takers | 20.6 | | 22.5 | | 19.9 | | 19.0 | |
| | | (0.2) | | (0.2) | | (0.3) | | (0.3) | |
| | Compliers | 20.9 | 2.6*** | 24.2 | -0.3 | 19.8 | 3.7*** | 20.3 | 1.2 |
| | | (0.3) | (0.5) | (0.4) | (0.7) | (0.5) | (0.8) | (0.5) | (0.8) |
| HHA | Never Takers | 17.2 | | 14.6 | | 14.0 | | 15.1 | |
| | | (0.2) | | (0.2) | | (0.2) | | (0.3) | |
| | Compliers | 17.6 | -3.2*** | 14.3 | -0.5 | 13.7 | 0.2 | 14.9 | 0.2 |
| | | (0.3) | (0.5) | (0.4) | (0.6) | (0.4) | (0.7) | (0.5) | (0.7) |
| IRF | Never Takers | 26.9 | | 25.2 | | 27.6 | | 25.8 | |
| | | (0.2) | | (0.3) | | (0.3) | | (0.3) | |
| | Compliers | 25.9 | -9.2*** | 24.4 | -7.4*** | 28.2 | -9.5*** | 26.0 | -8.4*** |
| | | (0.4) | (0.5) | (0.5) | (0.7) | (0.6) | (0.8) | (0.6) | (0.9) |
| LTCH | Never Takers | 2.4 | | 1.6 | | 1.2 | | 1.7 | |
| | | (0.1) | | (0.1) | | (0.1) | | (0.1) | |
| | Compliers | 2.6 | -1.2*** | 1.3 | -0.5** | 1.6 | -1.2*** | 1.4 | -0.6** |
| | | (0.1) | (0.2) | (0.1) | (0.2) | (0.1) | (0.2) | (0.1) | (0.2) |
| Home | Never Takers | 32.9 | | 36.1 | | 37.3 | | 38.3 | |
| | | (0.2) | | (0.3) | | (0.3) | | (0.3) | |
| | Compliers | 33.0 | 10.9*** | 35.8 | 8.7*** | 36.8 | 6.8*** | 37.4 | 7.6*** |
| | | (0.4) | (0.6) | (0.5) | (0.8) | (0.6) | (0.9) | (0.6) | (0.9) |

Table 2-19: (Hip Fracture) Difference-in-Differences, First Discharge Setting, by Market HHI

| | | Q1 (<2282) | | Q2 (2283-2866) | | Q3 (2867-3591) | | Q4 (>3591) | |
|---|---|---|---|---|---|---|---|---|---|
| **Setting** | **Group** | **2012** | **Second Difference** | **2012** | **Second Difference** | **2012** | **Second Difference** | **2012** | **Second Difference** |
| SNF | Never Takers | 57.9 | | 63.5 | | 58.3 | | 57.6 | |
| | | (0.2) | | (0.4) | | (0.3) | | (0.4) | |
| | Compliers | 55.9 | 12.7*** | 63.8 | 6.1*** | 59.1 | 9.2*** | 60.5 | 8.4*** |
| | | (0.5) | (0.7) | (0.7) | (1.0) | (0.6) | (1.0) | (0.7) | (1.1) |
| HHA | Never Takers | 8.6 | | 8.7 | | 8.0 | | 7.9 | |
| | | (0.1) | | (0.2) | | (0.2) | | (0.2) | |
| | Compliers | 10.0 | -2.0*** | 8.7 | -0.5 | 8.2 | 0.6 | 9.0 | -1.1 |
| | | (0.3) | (0.5) | (0.4) | (0.6) | (0.4) | (0.6) | (0.4) | (0.6) |
| IRF | Never Takers | 26.1 | | 21.0 | | 26.7 | | 27.2 | |
| | | (0.2) | | (0.3) | | (0.3) | | (0.4) | |
| | Compliers | 26.8 | -17.8*** | 19.7 | -9.7*** | 25.5 | -14.3*** | 23.4 | -12.5*** |
| | | (0.5) | (0.6) | (0.6) | (0.8) | (0.6) | (0.8) | (0.6) | (0.8) |
| LTCH | Never Takers | 1.8 | | 0.8 | | 0.8 | | 1.1 | |
| | | (0.1) | | (0.1) | | (0.1) | | (0.1) | |
| | Compliers | 1.7 | -0.6*** | 0.6 | 0.1 | 0.9 | -0.7*** | 1.0 | -0.6** |
| | | (0.1) | (0.1) | (0.1) | (0.2) | (0.1) | (0.2) | (0.1) | (0.2) |
| Home | Never Takers | 5.6 | | 5.9 | | 6.2 | | 6.3 | |
| | | (0.1) | | (0.2) | | (0.2) | | (0.2) | |
| | Compliers | 5.6 | 7.7*** | 7.2 | 4.0*** | 6.4 | 5.2*** | 6.0 | 5.8*** |
| | | (0.2) | (0.4) | (0.4) | (0.6) | (0.3) | (0.6) | (0.3) | (0.6) |

Figure 2-18: (Stroke) County Distribution, % Hospitalizations Discharged to IRF (2012)

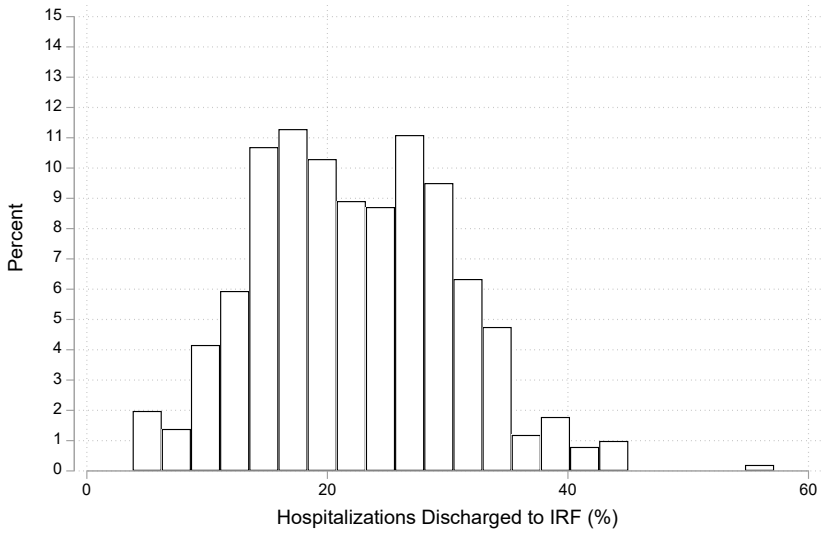



Figure 2-19: (Hip Fracture) County Distribution, % Hospitalizations Discharged to IRF (2012)

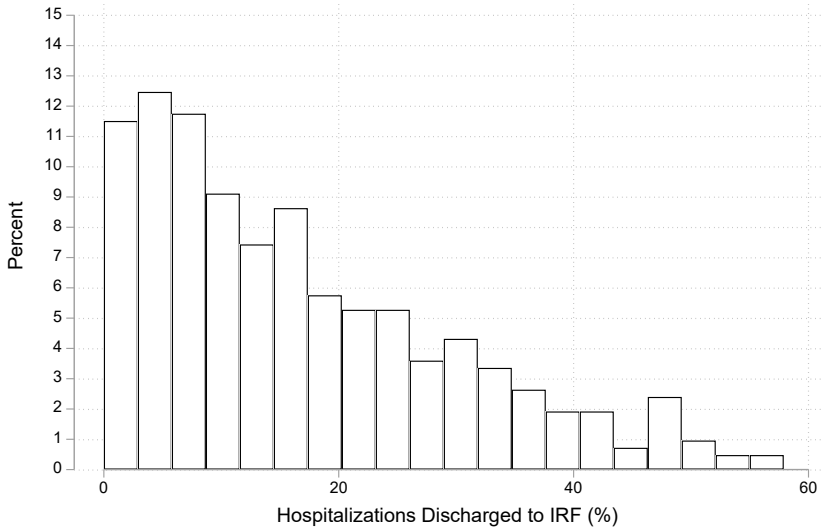


Table 2-20: (Stroke) Difference-in-Differences, First Discharge Setting, by Initial (2012) Level of IRF Utilization

| | | Q1 (<16.8%) | | Q2 (16.9-20.6%) | | Q3 (20.7-26.2%) | | Q4 (26.3-29.8%) | | Q5 (>29.8%) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Setting | Group | 2012 | Second Difference | 2012 | Second Difference | 2012 | Second Difference | 2012 | Second Difference | 2012 | Second Difference |
| SNF | Never Takers | 29.5 | | 23.6 | | 18.4 | | 18.5 | | 13.8 | |
| | | (0.3) | | (0.2) | | (0.2) | | (0.2) | | (0.2) | |
| | Compliers | 30.7 | -0.6 | 25.1 | 0.6 | 18.3 | 2.0** | 18.0 | 4.3*** | 14.3 | 3.3*** |
| | | (0.5) | (0.9) | (0.5) | (0.7) | (0.5) | (0.7) | (0.4) | (0.6) | (0.4) | (0.7) |
| HHA | Never Takers | 16.3 | | 17.7 | | 15.4 | | 13.7 | | 13.8 | |
| | | (0.3) | | (0.2) | | (0.2) | | (0.2) | | (0.2) | |
| | Compliers | 15.4 | -1.7* | 17.3 | -2.8*** | 16.3 | -0.9 | 14.0 | 0.0 | 12.7 | 1.7* |
| | | (0.5) | (0.8) | (0.4) | (0.7) | (0.5) | (0.7) | (0.4) | (0.6) | (0.4) | (0.7) |
| IRF | Never Takers | 14.3 | | 22.5 | | 26.3 | | 31.9 | | 34.7 | |
| | | (0.3) | | (0.2) | | (0.3) | | (0.2) | | (0.3) | |
| | Compliers | 15.1 | -5.6*** | 21.9 | -8.9*** | 27.0 | -8.6*** | 32.3 | -9.6*** | 34.9 | -11.4*** |
| | | (0.5) | (0.7) | (0.5) | (0.7) | (0.6) | (0.8) | (0.5) | (0.7) | (0.6) | (1.0) |
| LTCH | Never Takers | 1.6 | | 1.6 | | 2.2 | | 1.6 | | 1.9 | |
| | | (0.1) | | (0.1) | | (0.1) | | (0.1) | | (0.1) | |
| | Compliers | 1.3 | -0.6** | 1.4 | -0.6** | 2.1 | -0.9*** | 1.7 | -0.9*** | 1.9 | -1.1*** |
| | | (0.1) | (0.2) | (0.1) | (0.2) | (0.2) | (0.2) | (0.1) | (0.2) | (0.2) | (0.2) |
| Home | Never Takers | 38.3 | | 34.7 | | 37.7 | | 34.4 | | 35.8 | |
| | | (0.4) | | (0.2) | | (0.3) | | (0.2) | | (0.3) | |
| | Compliers | 37.6 | 8.5*** | 34.2 | 11.6*** | 36.4 | 8.3*** | 34.0 | 6.1*** | 36.3 | 7.5*** |
| | | (0.6) | (1.0) | (0.5) | (0.8) | (0.6) | (0.9) | (0.5) | (0.7) | (0.6) | (1.0) |

Table 2-21: (Hip Fracture) Difference-in-Differences, First Discharge Setting, by Initial (2012) Level of IRF Utilization

| | | Q1 (<7.2%) | | Q2 (7.2-13.0%) | | Q3 (13.1-19.3%) | | Q4 (19.4-28.8%) | | Q5 (>28.8%) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Setting | Group | 2012 | Second Difference | 2012 | Second Difference | 2012 | Second Difference | 2012 | Second Difference | 2012 | Second Difference |
| SNF | Never Takers | 78.6 | | 68.2 | | 61.2 | | 50.9 | | 38.3 | |
| | | (0.3) | | (0.3) | | (0.3) | | (0.4) | | (0.4) | |
| | Compliers | 77.8 | -0.1 | 70.9 | 3.4*** | 60.4 | 6.0*** | 50.7 | 12.1*** | 36.0 | 25.9*** |
| | | (0.6) | (1.0) | (0.6) | (0.8) | (0.6) | (0.9) | (0.7) | (1.0) | (0.8) | (1.2) |
| HHA | Never Takers | 9.0 | | 8.9 | | 8.1 | | 8.0 | | 7.6 | |
| | | (0.3) | | (0.2) | | (0.2) | | (0.2) | | (0.2) | |
| | Compliers | 8.9 | -1.4* | 9.0 | -2.0*** | 8.8 | -1.5** | 8.5 | 0.9 | 9.2 | 0.8 |
| | | (0.4) | (0.7) | (0.4) | (0.5) | (0.4) | (0.6) | (0.4) | (0.6) | (0.5) | (0.7) |
| IRF | Never Takers | 5.7 | | 16.3 | | 24.3 | | 33.4 | | 46.1 | |
| | | (0.2) | | (0.2) | | (0.3) | | (0.3) | | (0.4) | |
| | Compliers | 6.3 | -3.5*** | 14.1 | -7.7*** | 23.9 | -10.3*** | 32.2 | -17.7*** | 46.6 | -30.6*** |
| | | (0.4) | (0.5) | (0.4) | (0.6) | (0.6) | (0.7) | (0.7) | (0.9) | (0.8) | (1.1) |
| LTCH | Never Takers | 0.5 | | 0.9 | | 0.5 | | 1.8 | | 1.8 | |
| | | (0.1) | | (0.1) | | (.) | | (0.1) | | (0.1) | |
| | Compliers | 0.4 | -0.1 | 0.6 | -0.2 | 0.9 | -0.4** | 2.0 | -1.0*** | 1.3 | -0.5* |
| | | (0.1) | (0.1) | (0.1) | (0.1) | (.) | (0.1) | (0.2) | (0.2) | (0.2) | (0.2) |
| Home | Never Takers | 6.3 | | 5.7 | | 5.8 | | 6.0 | | 6.3 | |
| | | (0.2) | | (0.1) | | (0.2) | | (0.2) | | (0.2) | |
| | Compliers | 6.6 | 5.1*** | 5.4 | 6.5*** | 6.0 | 6.3*** | 6.5 | 5.7*** | 6.8 | 4.5*** |
| | | (0.4) | (0.7) | (0.3) | (0.5) | (0.3) | (0.6) | (0.4) | (0.6) | (0.4) | (0.7) |

Figure 2-20: (Stroke) Post-Matching Balance, Within County & Hospital Matching Approach

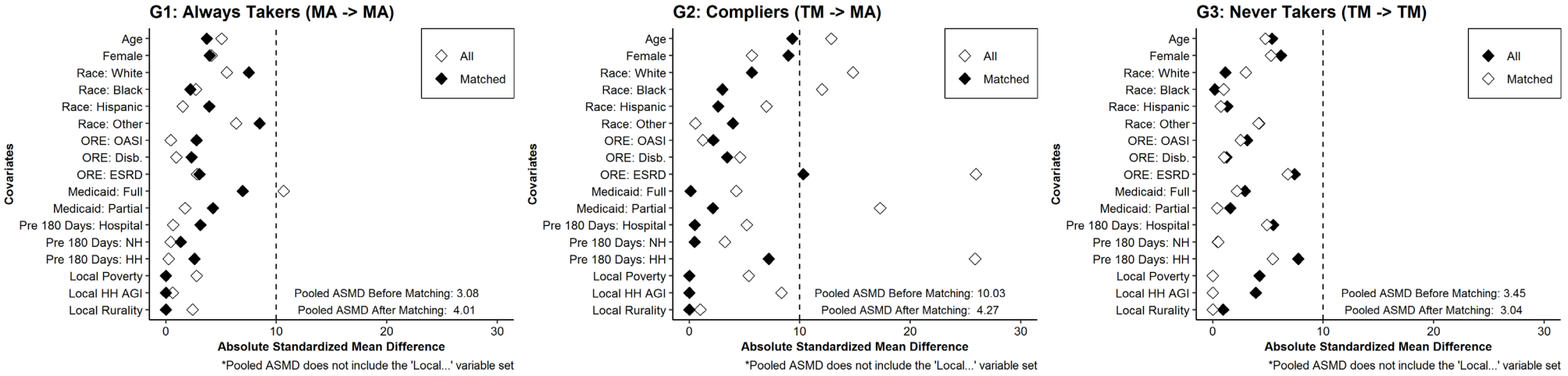



Figure 2-21: (Hip fracture) Post-Matching Balance, Within County & Hospital Matching Approach

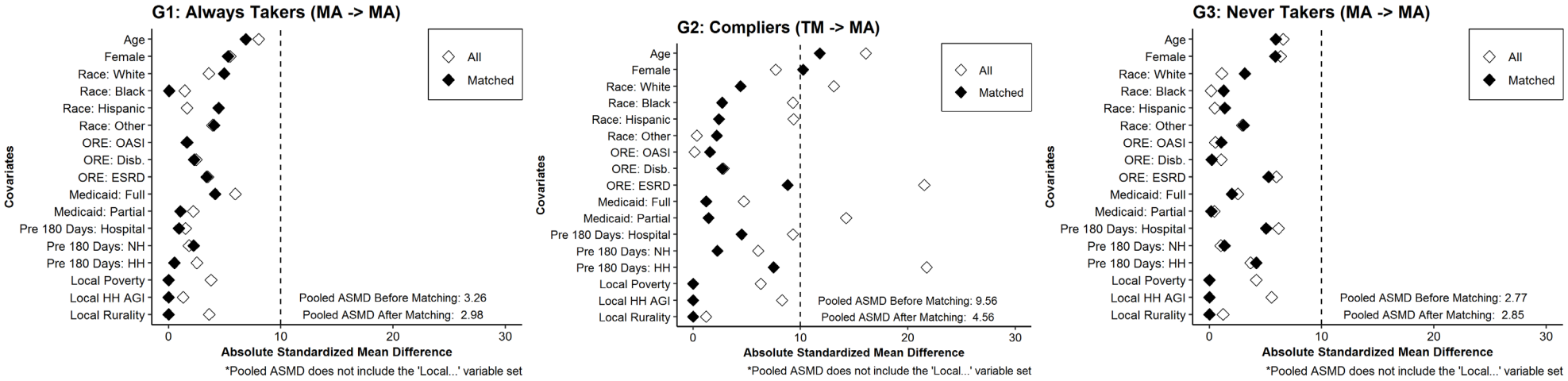


Table 2-22: (Stroke) Difference-in-Differences, PAC Utilization, County-Hospital Matching

| | Group | 2012 | 2017 | First Difference | Second Difference |
|---|---|---|---|---|---|
| **N** | | | | | **148,396** |
| **Discharge Setting** | | | | | |
| SNF | Never Takers | 19.9 | 20.7 | 0.8** | |
| | | -0.2 | -0.2 | -0.3 | |
| | Compliers | 20.8 | 23.9 | 3.1*** | 2.4*** |
| | | -0.3 | -0.3 | -0.4 | -0.5 |
| HHA | Never Takers | 15.4 | 15 | -0.4 | |
| | | -0.2 | -0.2 | -0.3 | |
| | Compliers | 15.3 | 13.6 | -1.7*** | -1.3** |
| | | -0.2 | -0.2 | -0.3 | -0.4 |
| IRF | Never Takers | 26.9 | 26.5 | -0.5 | |
| | | -0.2 | -0.2 | -0.3 | |
| | Compliers | 26.4 | 17 | -9.4*** | -8.9*** |
| | | -0.3 | -0.2 | -0.4 | -0.5 |
| LTCH | Never Takers | 1.7 | 1.6 | -0.1 | |
| | | -0.1 | -0.1 | -0.1 | |
| | Compliers | 1.8 | 0.7 | -1.1*** | -1.0*** |
| | | -0.1 | -0.1 | -0.1 | -0.1 |
| Home | Never Takers | 36.1 | 36.3 | 0.2 | |
| | | -0.2 | -0.2 | -0.3 | |
| | Compliers | 35.8 | 44.8 | 9.0*** | 8.8*** |
| | | -0.3 | -0.3 | -0.4 | -0.5 |
| **PAC Episode Days** | | | | | |
| SNF | Never Takers | 10.7 | 9.6 | -1.2*** | |
| | | -0.1 | -0.1 | -0.2 | |
| | Compliers | 11.2 | 10.8 | -0.4 | 0.8** |
| | | -0.2 | -0.2 | -0.2 | -0.3 |
| IRF | Never Takers | 4.3 | 3.9 | -0.3*** | |
| | | 0 | 0 | -0.1 | |
| | Compliers | 4.3 | 2.6 | -1.7*** | -1.4*** |
| | | -0.1 | -0.1 | -0.1 | -0.1 |
| HHA | Never Takers | 17.9 | 17.4 | -0.5* | |
| | | -0.2 | -0.2 | -0.3 | |
| | Compliers | 18.5 | 13.7 | -4.8*** | -4.3*** |
| | | -0.2 | -0.2 | -0.3 | -0.4 |
| LTCH | Never Takers | 0.5 | 0.5 | 0 | |
| | | 0 | 0 | 0 | |
| | Compliers | 0.5 | 0.2 | -0.3*** | -0.3*** |
| | | 0 | 0 | 0 | 0 |

Table 2-23: (Hip Fracture) Difference-in-Differences, PAC Utilization, County-Hospital Matching

| Setting | Group | 2012 | 2017 | First Difference | Second Difference |
|---|---|---|---|---|---|
| **N** | | | | | **126,046** |
| **Discharge Setting** | | | | | |
| SNF | Never Takers | 59.2 | 63.4 | 4.2*** | |
| | | -0.2 | -0.2 | -0.4 | |
| | Compliers | 59.4 | 73.5 | 14.1*** | 9.9*** |
| | | -0.4 | -0.3 | -0.5 | -0.6 |
| HHA | Never Takers | 8.5 | 8.8 | 0.4 | |
| | | -0.1 | -0.1 | -0.2 | |
| | Compliers | 9.2 | 8.5 | -0.8* | -1.1** |
| | | -0.2 | -0.2 | -0.3 | -0.4 |
| IRF | Never Takers | 25.4 | 21.1 | -4.3*** | |
| | | -0.2 | -0.2 | -0.3 | |
| | Compliers | 24.2 | 5.4 | -18.7*** | -14.4*** |
| | | -0.3 | -0.2 | -0.4 | -0.5 |
| LTCH | Never Takers | 1.2 | 0.7 | -0.5*** | |
| | | -0.1 | 0 | -0.1 | |
| | Compliers | 0.9 | 0.2 | -0.7*** | -0.3* |
| | | -0.1 | 0 | -0.1 | -0.1 |
| Home | Never Takers | 5.8 | 6 | 0.2 | |
| | | -0.1 | -0.1 | -0.2 | |
| | Compliers | 6.3 | 12.4 | 6.2*** | 6.0*** |
| | | -0.2 | -0.2 | -0.3 | -0.3 |
| **PAC Episode Days** | | | | | |
| SNF | Never Takers | 24 | 22.4 | -1.6*** | |
| | | -0.1 | -0.1 | -0.2 | |
| | Compliers | 23.9 | 24.8 | 1.0** | 2.6*** |
| | | -0.2 | -0.2 | -0.3 | -0.4 |
| IRF | Never Takers | 3.4 | 2.8 | -0.6*** | |
| | | 0 | 0 | 0 | |
| | Compliers | 3.5 | 0.8 | -2.7*** | -2.1*** |
| | | 0 | 0 | -0.1 | -0.1 |
| HHA | Never Takers | 27.3 | 26.9 | -0.4 | |
| | | -0.2 | -0.2 | -0.3 | |
| | Compliers | 27.6 | 22 | -5.6*** | -5.2*** |
| | | -0.3 | -0.3 | -0.4 | -0.5 |
| LTCH | Never Takers | 0.3 | 0.2 | -0.1*** | |
| | | 0 | 0 | 0 | |
| | Compliers | 0.3 | 0.1 | -0.2*** | -0.1** |
| | | 0 | 0 | 0 | 0 |

Table 2-24: (Stroke) Difference-in-Differences, Patient Outcomes, County-Hospital Matching

| | Group | 2012 | 2017 | First Diff. | Second Diff. |
|---|---|---|---|---|---|
| N | | | | | **148,396** |
| 30d Readmit | Never Takers | 11.8 | 11.3 | -0.4 | |
| | | -0.2 | -0.2 | -0.2 | |
| | Compliers | 11.6 | 10.3 | -1.3*** | -0.9* |
| | | -0.2 | -0.2 | -0.3 | -0.4 |
| 90d Readmit | Never Takers | 24.2 | 23.5 | -0.7* | |
| | | -0.2 | -0.2 | -0.3 | |
| | Compliers | 24.1 | 21.7 | -2.4*** | -1.7** |
| | | -0.3 | -0.3 | -0.4 | -0.5 |
| 180d Readmit | Never Takers | 33.7 | 32.7 | -1.0** | |
| | | -0.2 | -0.2 | -0.3 | |
| | Compliers | 33.3 | 30.1 | -3.3*** | -2.3*** |
| | | -0.3 | -0.3 | -0.5 | -0.6 |
| 30d Death | Never Takers | 8.9 | 7.6 | -1.3*** | |
| | | -0.1 | -0.1 | -0.2 | |
| | Compliers | 8.5 | 7.8 | -0.7** | 0.6* |
| | | -0.2 | -0.2 | -0.3 | -0.3 |
| 90d Death | Never Takers | 13.2 | 12.1 | -1.2*** | |
| | | -0.2 | -0.2 | -0.2 | |
| | Compliers | 12.8 | 12.1 | -0.7* | 0.5 |
| | | -0.2 | -0.2 | -0.3 | -0.4 |
| 180d Death | Never Takers | 17.3 | 16.1 | -1.2*** | |
| | | -0.2 | -0.2 | -0.3 | |
| | Compliers | 17 | 16.1 | -1.0** | 0.3 |
| | | -0.2 | -0.2 | -0.3 | -0.4 |
| DAIC* | Never Takers | 126.3 | 131 | 4.7*** | |
| | | -0.3 | -0.3 | -0.4 | |
| | Compliers | 126.8 | 137.3 | 10.5*** | 5.8*** |
| | | -41.3 | -0.4 | -0.6 | -0.7 |

*DAIC-Days Alive in the Community

Table 2-25: (Hip Fracture) Difference-in-Differences, Patient Outcomes, County-Hospital Matching

| | Group | 2012 | 2017 | First Diff. | Second Diff. |
|---|---|---|---|---|---|
| N | | | | | **126,046** |
| 30d Readmit | Never Takers | 11.8 | 10.9 | -0.9*** | |
| | | -0.2 | -0.2 | -0.2 | |
| | Compliers | 11.2 | 9.5 | -1.7*** | -0.8* |
| | | -0.3 | -0.3 | -0.3 | -0.4 |
| 90d Readmit | Never Takers | 24 | 22.2 | -1.8*** | |
| | | -0.2 | -0.2 | -0.3 | |
| | Compliers | 22.4 | 20.4 | -2.0*** | -0.2 |
| | | -0.3 | -0.3 | -0.5 | -0.5 |
| 180d Readmit | Never Takers | 33.1 | 30.6 | -2.4*** | |
| | | -0.2 | -0.2 | -0.3 | |
| | Compliers | 30.8 | 28 | -2.8*** | -0.4 |
| | | -0.4 | -0.4 | -0.5 | -0.6 |
| 30d Death | Never Takers | 5.6 | 5.4 | -0.2 | |
| | | -0.1 | -0.1 | -0.2 | |
| | Compliers | 5.2 | 5.6 | 0.5 | 0.7* |
| | | -0.2 | -0.2 | -0.2 | -0.3 |
| 90d Death | Never Takers | 11.6 | 11 | -0.6* | |
| | | -0.2 | -0.2 | -0.2 | |
| | Compliers | 10.9 | 11.7 | 0.8* | 1.3** |
| | | -0.2 | -0.3 | -0.3 | -0.4 |
| 180d Death | Never Takers | 16.8 | 16 | -0.8** | |
| | | -0.2 | -0.2 | -0.3 | |
| | Compliers | 16 | 16.1 | 0.1 | 0.9* |
| | | -0.3 | -0.3 | -0.4 | -0.5 |
| DAIC* | Never Takers | 114.1 | 119.8 | 5.7*** | |
| | | -0.3 | -0.3 | -0.4 | |
| | Compliers | 116.8 | 126 | 9.2*** | 3.5*** |
| | | -0.5 | -0.5 | -0.6 | -0.8 |

Table 2-26: (Stroke) Difference-in-Differences Estimates, Discharge Setting, by Baseline Level of IRF Discharge Rate Among TM Bene.'s

| | | Main | | | Low | | | | Middle | | | | High | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Beneficiaries (N)** | | **148,396** | | | **49,874** | | | | **46,808** | | | | **51,714** | | | |
| **Hospitals (N)** | | **1,320** | | | **750** | | | | **198** | | | | **372** | | | |
| **Setting** | **Group** | **2012** | **2017** | **Second Diff.** | **2012** | **2017** | **First Diff.** | **Second Diff.** | **2012** | **2017** | **First Diff.** | **Second Diff.** | **2012** | **2017** | **First Diff.** | **Second Diff.** |
| SNF | Never Takers | 19.9 | 20.7 | | 25.2 | 25.2 | -0.1 | | 18.9 | 19.9 | 1.1* | | 15.5 | 16.4 | 0.8 | |
| | | (0.2) | (0.2) | | (0.4) | (0.4) | (0.5) | | (0.3) | (0.4) | (0.5) | | (0.3) | (0.3) | (0.4) | |
| | Compliers | 20.8 | 23.9 | 2.4*** | 29.7 | 27.5 | -2.2** | -2.1* | 19.2 | 23.0 | 3.8*** | 2.7*** | 14.4 | 20.9 | 6.4*** | 5.6*** |
| | | (0.3) | (0.3) | (0.5) | (0.5) | (0.5) | (0.7) | (0.9) | (0.4) | (0.5) | (0.6) | (0.8) | (0.4) | (0.4) | (0.6) | (0.7) |
| HHA | Never Takers | 15.4 | 15.0 | | 17.0 | 16.6 | -0.5 | | 15.6 | 14.7 | -1.0* | | 13.8 | 13.4 | -0.4 | |
| | | (0.2) | (0.2) | | (0.3) | (0.3) | (0.5) | | (0.3) | (0.3) | (0.5) | | (0.3) | (0.3) | (0.4) | |
| | Compliers | 15.3 | 13.6 | -1.3** | 19.8 | 14.2 | -5.6*** | -5.2*** | 15.6 | 13.0 | -2.5*** | -1.6* | 11.2 | 13.2 | 2.0*** | 2.4*** |
| | | (0.2) | (0.2) | (0.4) | (0.5) | (0.4) | (0.6) | (0.8) | (0.4) | (0.4) | (0.6) | (0.8) | (0.4) | (0.4) | (0.6) | (0.7) |
| IRF | Never Takers | 26.9 | 26.5 | | 18.2 | 19.7 | 1.5** | | 28.2 | 26.7 | -1.5** | | 34.7 | 33.1 | -1.6** | |
| | | (0.2) | (0.2) | | (0.3) | (0.3) | (0.5) | | (0.4) | (0.4) | (0.6) | | (0.4) | (0.4) | (0.6) | |
| | Compliers | 26.4 | 17.0 | -8.9*** | 9.0 | 11.2 | 2.1*** | 0.6 | 26.0 | 17.8 | -8.2*** | -6.7*** | 43.5 | 22.0 | -21.5*** | -19.9*** |
| | | (0.3) | (0.2) | (0.5) | (0.4) | (0.4) | (0.5) | (0.7) | (0.5) | (0.4) | (0.7) | (0.9) | (0.6) | (0.5) | (0.7) | (0.9) |
| LTCH | Never Takers | 1.7 | 1.6 | | 1.6 | 1.7 | 0.1 | | 1.7 | 1.5 | -0.3 | | 1.8 | 1.6 | -0.2 | |
| | | (0.1) | (0.1) | | (0.1) | (0.1) | (0.1) | | (0.1) | (0.1) | (0.2) | | (0.1) | (0.1) | (0.1) | |
| | Compliers | 1.8 | 0.7 | -1.0*** | 1.7 | 0.7 | -1.0*** | -1.1*** | 2.2 | 0.6 | -1.6*** | -1.3*** | 1.4 | 0.6 | -0.8*** | -0.6** |
| | | (0.1) | (0.1) | (0.1) | (0.1) | (0.1) | (0.2) | (0.2) | (0.2) | (0.1) | (0.2) | (0.2) | (0.1) | (0.1) | (0.2) | (0.2) |
| Home | Never Takers | 36.1 | 36.3 | | 38.0 | 36.8 | -1.2* | | 35.5 | 37.2 | 1.7** | | 34.1 | 35.6 | 1.5** | |
| | | (0.2) | (0.2) | | (0.4) | (0.4) | (0.6) | | (0.4) | (0.4) | (0.6) | | (0.4) | (0.4) | (0.6) | |
| | Compliers | 35.8 | 44.8 | 8.8*** | 39.8 | 46.4 | 6.6*** | 7.8*** | 37.0 | 45.5 | 8.5*** | 6.8*** | 29.5 | 43.4 | 13.9*** | 12.4*** |
| | | (0.3) | (0.3) | (0.5) | (0.5) | (0.5) | (0.8) | (0.9) | (0.5) | (0.5) | (0.8) | (1.0) | (0.5) | (0.5) | (0.7) | (0.9) |

Table 2-27: (Hip Fracture) Difference-in-Differences Estimates, Discharge Setting, by Baseline Level of IRF Discharge Rate Among TM Bene.'s

| | | Main | | | Low [ 0 <= X < 4.7% ] | | | | Middle [ 4.7% <= X < 33.3% ] | | | | High [ 33.3% <= X <=100% ] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Beneficiaries (N)** | | **126,046** | | | **42,620** | | | | **38,798** | | | | **44,628** | | | |
| **Hospitals (N)** | | 1,312 | | | 717 | | | | 230 | | | | 365 | | | |
| **Setting** | **Group** | **2012** | **2017** | **Second Diff.** | **2012** | **2017** | **First Diff.** | **Second Diff.** | **2012** | **2017** | **First Diff.** | **Second Diff.** | **2012** | **2017** | **First Diff.** | **Second Diff.** |
| SNF | Never Takers | 59.2 | 63.4 | | 77.3 | 75.7 | -1.6** | | 62.4 | 66.1 | 3.6*** | | 39.1 | 49.1 | 10.0*** | |
| | | (0.2) | (0.2) | | (0.4) | (0.4) | (0.5) | | (0.4) | (0.4) | (0.6) | | (0.4) | (0.4) | (0.6) | |
| | Compliers | 59.4 | 73.5 | 9.9*** | 81.5 | 77.4 | -4.2*** | -2.6** | 64.2 | 73.5 | 9.3*** | 5.7*** | 33.6 | 69.5 | 35.9*** | 25.9*** |
| | | (0.4) | (0.3) | (0.6) | (0.5) | (0.5) | (0.7) | (0.9) | (0.6) | (0.6) | (0.9) | (1.0) | (0.6) | (0.6) | (0.8) | (1.0) |
| HHA | Never Takers | 8.5 | 8.8 | | 8.5 | 9.1 | 0.6 | | 9.5 | 9.7 | 0.2 | | 7.5 | 7.8 | 0.2 | |
| | | (0.1) | (0.1) | | (0.2) | (0.2) | (0.3) | | (0.3) | (0.3) | (0.4) | | (0.2) | (0.2) | (0.3) | |
| | Compliers | 9.2 | 8.5 | -1.1** | 10.0 | 8.7 | -1.3* | -1.9** | 10.5 | 8.1 | -2.4*** | -2.5*** | 7.3 | 8.6 | 1.2* | 1.0 |
| | | (0.2) | (0.2) | (0.4) | (0.4) | (0.4) | (0.5) | (0.6) | (0.4) | (0.4) | (0.6) | (0.7) | (0.3) | (0.4) | (0.5) | (0.6) |
| IRF | Never Takers | 25.4 | 21.1 | | 7.9 | 8.7 | 0.8* | | 20.7 | 17.1 | -3.7*** | | 45.9 | 36.5 | -9.5*** | |
| | | (0.2) | (0.2) | | (0.2) | (0.2) | (0.4) | | (0.4) | (0.4) | (0.5) | | (0.4) | (0.4) | (0.6) | |
| | Compliers | 24.2 | 5.4 | -14.4*** | 0.6 | 2.1 | 1.4*** | 0.7 | 17.6 | 5.2 | -12.4*** | -8.8*** | 53.1 | 9.1 | -44.0*** | -34.5*** |
| | | (0.3) | (0.2) | (0.5) | (0.1) | (0.2) | (0.2) | (0.4) | (0.5) | (0.3) | (0.6) | (0.8) | (0.7) | (0.4) | (0.8) | (1.0) |
| LTCH | Never Takers | 1.2 | 0.7 | | 0.7 | 0.5 | -0.2* | | 1.3 | 0.6 | -0.7*** | | 1.6 | 1.0 | -0.6*** | |
| | | (0.1) | (0.0) | | (0.1) | (0.1) | (0.1) | | (0.1) | (0.1) | (0.1) | | (0.1) | (0.1) | (0.1) | |
| | Compliers | 0.9 | 0.2 | -0.3* | 0.6 | 0.1 | -0.5*** | -0.3 | 1.4 | 0.1 | -1.3*** | -0.6** | 0.9 | 0.3 | -0.6*** | -0.0 |
| | | (0.1) | (0.0) | (0.1) | (0.1) | (0.0) | (0.1) | (0.1) | (0.2) | (0.0) | (0.2) | (0.2) | (0.1) | (0.1) | (0.1) | (0.2) |
| Home | Never Takers | 5.8 | 6.0 | | 5.5 | 5.9 | 0.4 | | 5.9 | 6.5 | 0.5 | | 5.9 | 5.7 | -0.2 | |
| | | (0.1) | (0.1) | | (0.2) | (0.2) | (0.3) | | (0.2) | (0.2) | (0.3) | | (0.2) | (0.2) | (0.3) | |
| | Compliers | 6.3 | 12.4 | 6.0*** | 7.3 | 11.8 | 4.5*** | 4.1*** | 6.3 | 13.0 | 6.7*** | 6.2*** | 5.1 | 12.6 | 7.4*** | 7.7*** |
| | | (0.2) | (0.2) | (0.3) | (0.3) | (0.4) | (0.5) | (0.6) | (0.3) | (0.4) | (0.6) | (0.6) | (0.3) | (0.4) | (0.5) | (0.6) |

Table 2-28: (Stroke) Difference-in-Differences Estimates, Patient Outcomes, by Baseline Level of IRF Discharge Rate Among TM Bene.'s

| | | Main | | | Low | | | | Middle | | | | High | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Beneficiaries (N)** | | **148,396** | | | **49,874** | | | | **46,808** | | | | **51,714** | | | |
| **Hospitals (N)** | | **1,320** | | | **750** | | | | **198** | | | | **372** | | | |
| **Outcome** | **Group** | **2012** | **First Diff.** | **Second Diff.** | **2012** | **2017** | **First Diff.** | **Second Diff.** | **2012** | **2017** | **First Diff.** | **Second Diff.** | **2012** | **2017** | **First Diff.** | **Second Diff.** |
| 30d Readmit | Never Takers | 11.8 | -0.4 | | 11.6 | 11.5 | -0.1 | | 11.7 | 10.8 | -0.8 | | 12.1 | 11.7 | -0.4 | |
| | | (0.2) | (0.2) | | (0.3) | (0.3) | (0.4) | | (0.3) | (0.3) | (0.4) | | (0.3) | (0.3) | (0.4) | |
| | Compliers | 11.6 | -1.3*** | -0.9* | 11.8 | 10.1 | -1.7** | -1.6* | 11.8 | 10.2 | -1.6** | -0.8 | 11.2 | 10.7 | -0.5 | -0.1 |
| | | (0.2) | (0.3) | (0.4) | (0.4) | (0.4) | (0.5) | (0.7) | (0.4) | (0.4) | (0.5) | (0.7) | (0.4) | (0.4) | (0.5) | (0.7) |
| 90d Readmit | Never Takers | 24.2 | -0.7* | | 23.8 | 23.4 | -0.4 | | 24.7 | 23.2 | -1.5* | | 24.2 | 23.7 | -0.5 | |
| | | (0.2) | (0.3) | | (0.4) | (0.4) | (0.5) | | (0.4) | (0.4) | (0.6) | | (0.4) | (0.4) | (0.5) | |
| | Compliers | 24.1 | -2.4*** | -1.7** | 23.6 | 21.6 | -2.0** | -1.6 | 24.3 | 21.4 | -2.8*** | -1.4 | 24.4 | 22.1 | -2.4*** | -1.9* |
| | | (0.3) | (0.4) | (0.5) | (0.5) | (0.5) | (0.7) | (0.9) | (0.5) | (0.5) | (0.7) | (0.9) | (0.5) | (0.5) | (0.7) | (0.9) |
| 180d Readmit | Never Takers | 33.7 | -1.0** | | 33.2 | 32.7 | -0.6 | | 33.7 | 32.7 | -1.0 | | 34.3 | 32.8 | -1.5* | |
| | | (0.2) | (0.3) | | (0.4) | (0.4) | (0.6) | | (0.5) | (0.4) | (0.6) | | (0.4) | (0.4) | (0.6) | |
| | Compliers | 33.3 | -3.3*** | -2.3*** | 32.9 | 29.8 | -3.0*** | -2.5** | 33.4 | 29.6 | -3.7*** | -2.8** | 33.7 | 30.7 | -3.0*** | -1.5 |
| | | (0.3) | (0.5) | (0.6) | (0.6) | (0.6) | (0.8) | (1.0) | (0.6) | (0.6) | (0.8) | (1.0) | (0.6) | (0.6) | (0.8) | (1.0) |
| 30d Death | Never Takers | 8.8 | -1.2*** | | 9.0 | 7.8 | -1.3*** | | 8.8 | 7.5 | -1.3*** | | 8.6 | 7.5 | -1.1*** | |
| | | (0.1) | (0.2) | | (0.2) | (0.2) | (0.3) | | (0.3) | (0.3) | (0.4) | | (0.2) | (0.2) | (0.3) | |
| | Compliers | 8.4 | -0.6* | 0.6 | 8.6 | 7.7 | -0.9 | 0.4 | 9.2 | 7.7 | -1.5*** | -0.2 | 7.4 | 7.8 | 0.4 | 1.5** |
| | | (0.2) | (0.3) | (0.3) | (0.3) | (0.3) | (0.4) | (0.6) | (0.3) | (0.3) | (0.4) | (0.6) | (0.3) | (0.3) | (0.4) | (0.5) |
| 90d Death | Never Takers | 13.2 | -1.1*** | | 13.2 | 12.0 | -1.2** | | 13.2 | 12.2 | -1.0* | | 13.1 | 11.9 | -1.1** | |
| | | (0.2) | (0.2) | | (0.3) | (0.3) | (0.4) | | (0.3) | (0.3) | (0.4) | | (0.3) | (0.3) | (0.4) | |
| | Compliers | 12.8 | -0.6* | 0.5 | 13.5 | 12.1 | -1.4* | -0.2 | 13.8 | 12.4 | -1.4** | -0.4 | 11.1 | 11.9 | 0.8 | 2.0** |
| | | (0.2) | (0.3) | (0.4) | (0.4) | (0.4) | (0.5) | (0.7) | (0.4) | (0.4) | (0.5) | (0.7) | (0.4) | (0.4) | (0.5) | (0.6) |
| 180d Death | Never Takers | 17.3 | -1.2*** | | 17.2 | 15.9 | -1.4** | | 17.1 | 16.3 | -0.8 | | 17.6 | 16.3 | -1.3** | |
| | | (0.2) | (0.3) | | (0.3) | (0.3) | (0.4) | | (0.3) | (0.3) | (0.5) | | (0.3) | (0.3) | (0.4) | |
| | Compliers | 16.9 | -0.8* | 0.4 | 17.3 | 16.2 | -1.1 | 0.3 | 17.9 | 16.2 | -1.7** | -0.8 | 15.7 | 15.9 | 0.3 | 1.5* |
| | | (0.2) | (0.3) | (0.4) | (0.4) | (0.4) | (0.6) | (0.7) | (0.4) | (0.4) | (0.6) | (0.8) | (0.4) | (0.4) | (0.6) | (0.7) |
| DAIC* | Never Takers | 126.4 | 4.7*** | | 127.6 | 131.2 | 3.5*** | | 126.6 | 131.3 | 4.7*** | | 125 | 130.7 | 5.8*** | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (0.3) | (0.4) | | (0.5) | (0.5) | (0.7) | | (0.5) | (0.5) | (0.8) | | (0.5) | (0.5) | (0.7) | |
| Compliers | 126.8 | 10.5*** | 5.8*** | 128.1 | 138.0 | 9.9*** | 6.3*** | 125.2 | 137.5 | 1.2*** | 7.7*** | 127.1 | 136.5 | 9.3*** | 3.6** |
| | (0.4) | (56.6) | (0.7) | (0.7) | (0.7) | (0.9 | (1.2) | (0.7) | (0.7) | (1.0) | (1.3) | (0.7) | (0.7) | (0.9) | (1.2) |

Table 2-29: (Hip Fracture) Difference-in-Differences Estimates, Patient Outcomes, by Baseline Level of IRF Discharge Rate Among TM Bene.'s

| | | Main | | | Low [ 0 <= X < 4.7% ] | | | | Middle [ 4.7% <= X < 33.3% ] | | | | High [ 33.3% <= X <=100% ] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Beneficiaries (N)** | | 126,046 | | | 42,620 | | | | 38,798 | | | | 44,628 | | | |
| **Hospitals (N)** | | 1,312 | | | 717 | | | | 230 | | | | 365 | | | |
| **Variable** | **Group** | **2012** | **First Diff.** | **Second Diff.** | **2012** | **2017** | **First Diff.** | **Second Diff.** | **2012** | **2017** | **First Diff.** | **Second Diff.** | **2012** | **2017** | **First Diff.** | **Second Diff.** |
| 30d Readmit | Never Takers | 11.8 | -0.9*** | | 11.7 | 10.5 | -1.2** | | 11.6 | 11.2 | -0.4 | | 11.9 | 11.0 | -0.9* | |
| | | (0.2) | (0.2) | | (0.3) | (0.3) | (0.4) | | (0.3) | (0.3) | (0.4) | | (0.3) | (0.3) | (0.4) | |
| | Compliers | 11.2 | -1.7*** | -0.8* | 12.1 | 9.2 | -2.8*** | 1.1 | 11.2 | 9.9 | -1.3* | -0.9 | 10.5 | 9.5 | -1.0 | -0.2 |
| | | (0.3) | (0.3) | (0.4) | (0.5) | (0.4) | (0.6) | (0.7) | (0.4) | (0.4) | (0.6) | (0.7) | (0.4) | (0.4) | (0.6) | (0.7) |
| 90d Readmit | Never Takers | 24.0 | -1.8*** | | 23.4 | 21.6 | -1.8*** | | 24.0 | 22.4 | -1.7** | | 24.6 | 22.6 | -2.0*** | |
| | | (0.2) | (0.3) | | (0.4) | (0.4) | (0.5) | | (0.4) | (0.4) | (0.6) | | (0.4) | (0.4) | (0.5) | |
| | Compliers | 22.4 | -2.0*** | -0.2 | 22.6 | 20.5 | -2.1** | -1.6* | 22.1 | 20.5 | -1.6* | 0.0 | 22.6 | 20.4 | -2.1** | -0.2 |
| | | (0.3) | (0.5) | (0.5) | (0.6) | (0.6) | (0.8) | (0.7) | (0.6) | (0.6) | (0.8) | (1.0) | (0.6) | (0.5) | (0.8) | (0.9) |
| 180d Readmit | Never Takers | 33.1 | -2.4*** | | 32.5 | 29.9 | -2.6*** | | 33.2 | 30.5 | -2.7*** | | 33.4 | 31.5 | -1.9** | |
| | | (0.2) | (0.3) | | (0.4) | (0.4) | (0.6) | | (0.4) | (0.4) | (0.6) | | (0.4) | (0.4) | (0.6) | |
| | Compliers | 30.8 | -2.8*** | -0.4 | 30.5 | 27.6 | -2.9*** | -0.3 | 30.7 | 28.1 | -2.7** | 0.0 | 31.0 | 28.3 | -2.7** | -0.9 |
| | | (0.4) | (0.5) | (0.6) | (0.6) | (0.6) | (0.9) | (0.9) | (0.6) | (0.6) | (0.9) | (1.1) | (0.6) | (0.6) | (0.8) | (1.0) |
| 30d Death | Never Takers | 5.6 | -0.2 | | 5.9 | 5.6 | -0.3 | | 5.5 | 5.6 | 0.2 | | 5.6 | 5.1 | -0.4 | |
| | | (0.1) | (0.2) | | (0.2) | (0.2) | (0.3) | | (0.2) | (0.2) | (0.3) | | (0.2) | (0.2) | (0.3) | |
| | Compliers | 5.2 | 0.5 | 0.7* | 5.9 | 6.1 | 0.2 | 0.5 | 5.1 | 5.5 | 0.4 | 0.2 | 4.6 | 5.4 | 0.7 | 1.2* |
| | | (0.2) | (0.2) | (0.3) | (0.3) | (0.3) | (0.4) | (0.5) | (0.3) | (0.3) | (0.4) | (0.5) | (0.3) | (0.3) | (0.4) | (0.5) |
| 90d Death | Never Takers | 11.6 | -0.6* | | 11.8 | 11.2 | -0.6 | | 11.2 | 11.4 | 0.2 | | 11.7 | 10.5 | -1.2** | |
| | | (0.2) | (0.2) | | (0.3) | (0.3) | (0.4) | | (0.3) | (0.3) | (0.4) | | (0.3) | (0.3) | (0.4) | |
| | Compliers | 10.9 | 0.8* | 1.3** | 11.5 | 12.1 | 0.6 | 1.1 | 11.0 | 11.5 | 0.5 | 0.3 | 10.3 | 11.4 | 1.1 | 2.3*** |
| | | (0.2) | (0.3) | (0.4) | (0.4) | (0.5) | (0.6) | (0.5) | (0.4) | (0.4) | (0.6) | (0.7) | (0.4) | (0.4) | (0.6) | (0.7) |
| 180d Death | Never Takers | 16.8 | -0.8** | | 17.1 | 16.4 | -0.7 | | 16.2 | 16.1 | -0.1 | | 17.1 | 15.6 | -1.5*** | |
| | | (0.2) | (0.3) | | (0.3) | (0.3) | (0.5) | | (0.3) | (0.3) | (0.5) | | (0.3) | (0.3) | (0.4) | |
| | Compliers | 16.0 | 0.1 | 0.9* | 17.3 | 16.3 | -1.0 | -0.3 | 15.8 | 16.0 | 0.1 | 0.2 | 15.0 | 16.1 | 1.1 | 2.6*** |
| | | (0.3) | (0.4) | (0.5) | (0.5) | (0.5) | (0.7) | (0.8) | (0.5) | (0.5) | (0.7) | (0.8) | (0.5) | (0.5) | (0.7) | (0.8) |
| DAIC* | Never Takers | 114.1 | 5.7*** | | 111.3 | 118.5 | 7.2*** | | 115.9 | 120.1 | 4.2*** | | 115.4 | 120.7 | 5.3*** | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (0.3) | (0.4) | | (0.6) | (0.5) | (0.7) | | (0.6) | (0.5) | (0.8) | | (0.5) | (0.5) | (0.7) | |
| Compliers | 116.8 | 9.2*** | 3.5*** | 113.7 | 125.2 | 115.0*** | 4.3*** | 116.2 | 126.2 | 10.1*** | 5.8*** | 120.3 | 126.6 | 6.3*** | 1.0 |
| | (0.5) | (0.6) | (0.8) | (0.8) | (0.8) | (1.1) | (1.3) | (0.8) | (0.8) | (1.1) | (1.4) | (0.8) | (0.8) | (1.1) | (1.3) |

**Supplemental Appendix**

*For exposition purposes, this appendix section refers primarily to the stroke cohort to avoid duplication.*

**Appendix 1:** Propensity Score Estimation

Among the 1,128 selected counties, we estimated models for the probability of enrollment in Medicare Advantage during 2012 and 2017, separately. Models were fit independently for each county and each year in order to account for substantial variation in predictors of MA enrollment across time and geography(59-62). We used logistic regression models with person level, and zip code level predictors to estimate propensity scores (**Equation 1**). Our set of predictors included demographics (age, sex, race), enrollment status (reason for entitlement, full/partial dual-Medicaid status), medical care utilization (hospital, nursing home, home health), and zip code level measures of socioeconomic status (median household income, and all-age poverty rate). For established Medicare beneficiaries, the decision to enroll in an MA plan is typically made during the previous year; accordingly, we developed a set of predictors for enrollment in 2012 & 2017 using data from 2011 & 2016, respectively. The two propensity score models were fit using 19,244,860 Medicare beneficiaries in 2011 ($P_{2012}$) and 22,215,275 Medicare beneficiaries in 2016 ($P_{2017}$), and matching was then conducted within the subset of persons hospitalized for stroke (or hip fracture) in 2012 and 2017.

**Equation 1: Propensity Score Specification**

$$\text{MA} = \alpha 0 + \beta_1 X + \beta_2 \text{Z}$$

$$\pi_{ij} = \text{F}\left(X_{ij}\lambda + \delta_j\right)$$

*Where $\pi$ represents the propensity score, F is the logistic cumulative function, X indexes person level predictors, I indexes persons, j indexes zip codes, and $\delta$ represents zip code level fixed effects.*

**Appendix 2:** Matching Approach

Our cross-temporal matching approach is visualized using the schematic in **Exhibit 1** (63). The first step (S1) of this process identified Group 1 (always takers), by applying within-cluster (county) caliper (.1 SD) matching (with replacement) of $MA_{2012}$ to $MA_{2017}$ using $P_{2012}$ as a distance metric (64, 65). Next, we identify Group 2 (compliers) by matching all $MA_{2017}$ cases except for those matched in S1 with $TM_{2012}$ using within-caliper (.1 SD) matching with replacement and $P_{2017}$ as the distance metric. Lastly, we identified Group 3 (never takers) by matching $TM_{2017}$ with $TM_{2012}$ using within-caliper matching (.1 SD) with replacement and $P_{2017}$ as the distance metric. Matching weights were constructed to account for cases which were selected as matches multiple times. We then assessed covariate balance across the three groups (G1 pre vs post; G2 pre vs post; G3 pre vs post) using variable specific and pooled absolute standardized mean differences (**Equation 2** & **Equation 3**), with an a priori threshold of 10% to ascertain balance(66-68). Lastly, we assess Rubin's B (threshold of <25%) and R (bounds: .5, 2) statistics to complete our balance assessment.

**Equation 2: Absolute Standardized Mean Differences (ASMD), Continuous Variables**

$$\text{ASMD (continuous variables)} = \left| 100 \frac{(\overline{X}_T - \overline{X}_C)}{\sqrt{.5(S_T^2 + S_C^2)}} \right|$$

**Equation 3: Absolute Standardized Mean Differences (ASMD), Binary Variables**

$$\text{ASB (binary variables)} = \left| 100 \frac{\hat{P}_T - \hat{P}_C}{\sqrt{\frac{\hat{P}_T(1-\hat{P}_T) + \hat{P}_C(1-\hat{P}_C)}{2}}} \right|$$

**Appendix 3:** Difference-in-Differences Estimation

We estimated difference-in-differences models using multinomial logistic regression for the first discharge setting measure, and ordinary least squares for the remaining outcomes (which

is a linear probability model for our binary outcomes)(49, 52). We adjusted these models for the predictors used in propensity score estimation, and a set of covariates derived from the stroke hospitalization including: hospital length of stay, ICU & CCU utilization, stroke type, Elixhauser readmission and mortality indices, and a selection of diagnosis and procedure classifications (grouped by HCUP clinical classification software). Matching weights were applied to account for our many to one matching approach. We estimated cluster robust standard errors to account for the within-cluster matching approach taken (51). In sensitivity analyses, we calculate pooled difference-in-differences estimates using a within-cluster estimation strategy and calculated standard errors via bootstrapping. Difference in Differences estimates are presented for each outcome, along with changes within group (G2, compliers; G3, never takers) across time. To identify an effect for our first discharge setting outcome, marginal predicted probabilities were computed for each first discharge setting (SNF, IRF, HHA, Home, LTCH) and differenced between comparison groups across time.

**Equation 4: Difference-in-Differences**

$$Y = a_0 + a_1 G2 + a_2 Post + \gamma G2 * Post + \beta_1 \mathrm{X} + \beta_2 \mathrm{Z} + \varepsilon$$

*Where Y is our outcome, $G2$ is a binary indicator identifying matched compliers (G2) and never takers (G3), $Post$ is a binary indicator for the year 2017 (set to 0 for the baseline year 2012), $\gamma$ captures the difference in differences estimate, $X$ is a set of person level covariates, and $Z$ is a set of zip-code level characteristics.*

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