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MEDICARE PAYMENT TO SKILLED NURSING FACILITIES:
THE CONSEQUENCES OF THE THREE-DAY RULE

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ABSTRACT

Medicare does not pay for a skilled nursing facility (SNF) unless a fee-for-service patient has stayed in the hospital for at least three days. Discharges after the three-day cutoff consistently result in more transfers to SNFs. Using the three-day rule as an instrument, we find that SNF discharges decrease hospital readmission for patients with comorbidities. However, for knee and hip replacement patients, we find significant increases in readmission. This perverse effect is more severe when local SNFs have lower quality. Back-of-the-envelope calculations suggest that the three-day rule may have generated extra Medicare payments to SNFs by \$100-447 million per year.

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1. Introduction

Medicare is the largest single purchaser of personal health care in the US. The total Medicare spending has nearly doubled in the last decade, with 22% devoted to fee-for-service (FFS) inpatient care and 9.5% to FFS post-acute care (MEDPAC 2017). Facing an aging population,¹ Medicare spending is projected (by CBO) to reach \$1 trillion in 2021, and the Medicare Hospital Insurance Trust Fund, which helps to pay for FFS inpatient and post-acute care, is projected to be insolvent by 2028. These alarming predictions call for a better understanding of potential wastes and savings in the Medicare system.

To answer this call, we focus on a specific reimbursement rule that Medicare imposes on the intersection between inpatient and post-acute care: Medicare does not pay for the fee-for-service (FFS) care provided in a skilled nursing facility (SNF) unless the patient has stayed in the hospital for at least three days. This rule applies by number of midnights that a patient stays in a hospital, not the number of hours. For example, a patient admitted at 10 pm on day 1 and discharged 9 am on day 4 satisfies this condition, but a patient admitted at 9 am on day 1 but discharged 10 pm on day 3 is not qualified.

We study the effect of the three-day rule in a framework of difference-in-differences (DID). In particular, we compare regular Medicare patients (65-79) with non-Medicare patients (60-79), and focus on the patients that are initially discharged from a hospital within 24 hours before or after the three-day cutoff. After a long list of controls,² we examine how the three-day rule affects Medicare patients' discharge to SNFs and the subsequent hospital readmission rate within 30 or 60 days.

Using 2.9 million hospital inpatient discharge records from four states (2004-2013), we find that Medicare patients discharged 0-24 hours after the three-day-cutoff are 6.8 percentage points more likely to be discharged to a SNF than those discharged 0-24 hours before the cutoff. This effect is enormous, considering the fact that only 9.4% of Medicare patients (and 8% of all patients) in our sample were discharged to SNFs. When we use the three-day Medicare rule as an instrumental variable (IV) for SNF discharge,

¹ Population Reference Bureau Report (2016). <https://assets.prb.org/pdf16/prb-wpds2016-web-2016.pdf>

² As detailed in Section 5, we control for age, demographics, insurance type, health conditions, hospital fixed effects and time fixed effects.

SNF discharge is found to have a negative effect on 30- or 60-day hospital readmission rate in the whole sample, but this beneficial impact is entirely driven by sicker patients with an above-median Elixhauser Comorbidity Index.³ If we focus on patients with no or fewer comorbidities, the IV results find no significant readmission difference between those discharged to SNFs and those discharged anywhere else.

To better understand these results, we develop a conceptual framework that incorporates both the hospital's discharge decision and the potential differences across SNFs. In addition to the three-day payment rule, Medicare also calculates payment to a SNF based on the patient's need for labor-intensive and non-labor services inside a SNF (CMS 2017a). Though the Medicare payment strives to reflect wage and other costs across geographic areas, it does not differ by SNF quality within the same geographic area (conditional on the same patient). As a result, even if a hospital has decided to discharge the patient to a SNF, every patient prefers higher quality SNFs and the cost-plus structure of Medicare payment may motivate SNFs to prefer patients that need more high-margin services. These settings imply further sorting across SNFs, with less profitable patients – for example, the healthier ones that cannot justify a lot of care or those that require many low-margin services – to be more exposed to the capacity constraint of high quality SNFs. Together, the conceptual framework predicts that (1) the three-day rule is likely to affect the relatively healthy patients that are on the margin of going to SNF or going home, (2) relative to staying home, adverse health outcomes are more likely to occur in low-quality SNFs that have capacity to admit the marginal patients, and (3) the financial burden on Medicare can come from overtreatment, adverse health outcomes, or both.

Consistently, we find the effect of the three-day rule on SNF discharge is the largest (14 percentage points) for knee and hip replacement (KHR), a major health condition that on average has much lower hospital readmission rate and much lower Elixhauser Comorbidity Index than heart disease, stroke and other conditions. Furthermore, among these four categories, KHR is the only one for which we find a significant *increase* in hospital readmission rate as a result of the three-day rule. This

³ We compute Elixhauser Comorbidity Index according to Elixhauser et al. (1998) and the corresponding software developed by AHRQ (<https://www.hcup-us.ahrq.gov/toolssoftware/comorbidity/comorbidity.jsp>).

perverse effect is larger in the health service areas (HSAs) where the average SNFs have a lower-than-state-median occupancy rate or a higher-than-state-median total deficiency count. These findings suggest that many KHR patients go to SNF simply because Medicare will pay for it and there is a bed available in nearby low-quality SNFs.

Back-of-the-envelope calculations suggest that the three-day Medicare rule has the potential to generate significant overuse of SNF services. Pooling all conditions and projecting from our sample to the whole Medicare system, we estimate that the three-day rule may have generated an extra Medicare payment to SNFs of \$100-447 million per year, without a significant reduction in hospital readmissions. The range reflects whether we focus on patients with no comorbidity at all or patients with a below-median Elixhauser Comorbidity Index. They correspond to 0.32-1.43% of Medicare's annual payment to SNFs as of 2016. For KHR only, the three-day rule is estimated to cost Medicare \$83.7 million per year, including payment to SNFs and the subsequent increase in hospital readmission. This number corresponds to 1.2% of Medicare's annual payment for KHR as of 2014.

The rest of the paper is organized as follows. Section 2 describes the Medicare payment rules and reviews the related literature. Section 3 presents a simple analytical framework for the potential effects of the three-day rule on hospital readmission. Section 4 describes our data. Section 5 defines our main econometric specification and presents empirical results. Section 6 concludes with back-of-the-envelope calculations for the potential implication of our analysis for Medicare spending.

2. Background and Literature

The US healthcare expenditure continues to grow rapidly. By 2016, it has exceeded \$3 trillion per year, contributing to 16.9% of the GDP. By 2030, one in every five US residents will be 65 years or older due to the aging of the baby boomer generation. Moreover, the composition of the elderly population will change with increase in the population over 85 years, as people live longer. In the face of an aging population and rising costs, the US healthcare system is in transition from volume-based reimbursement models (e.g., fee-for-service) to value-based reimbursement models (e.g., prospective payment system or bundled payment). How to contain costs and improve

health outcomes via reimbursement reforms is an important and urgent issue for the US healthcare system.

2.1 Medicare's three-day rule for skilled nursing care

Medicare's three-day rule requires a patient to spend at least *three* consecutive days in hospital inpatient care in order to qualify for the Medicare-covered discharge to a SNF for post-acute care. This rule dates back to 1965 when inpatient hospital stays dominated healthcare. The original intention of the rule was to give doctors enough time to evaluate the severity of a patient's health condition, screen out healthier patients, and cover patients who need skilled nursing care. Another intention of the rule is to discourage hospitals from quickly discharging patients without careful observation and admitting new patients just for the sake of providing another billable service.

Since 1998, SNF services are no longer paid on a volume-determined rate, but rather on the basis of a prospective payment system (PPS). The PPS payment rates are case-mix adjusted and cover all costs of furnishing covered SNF services, where the costs are calculated according to labor and non-labor costs by geographic areas. Beginning in the summer of 2009, several states implemented a pay-for-performance reimbursement policy, which intended to reward SNFs that provide good quality services. However, SNF quality changed little after the policy and the results on cost savings are mixed (Werner et al. 2011, Arling et al., 2013 and Grabowski et al. 2017). Because it is hard to measure quality and establish a clear link between effort, performance and rewards, quality-adjusted reimbursement is not widely adopted. Furthermore, rewarding health care providers based on their quality performance may give them perverse incentives to cherry-pick healthier patients and shun sicker ones. This explains why the current Medicare payment to SNFs is adjusted by patient risk and local cost but not by SNF quality.

2.2 SNF Operations

SNFs mainly serve three types of patients based on their insurance type. According to the Nursing Home Compare, 60% of SNF care is paid by Medicaid, 20% by Medicare, and the rest by private insurers or patients themselves. Medicare residents

generate the highest revenue per resident per day (~\$500), while Medicaid residents generate the lowest revenue per resident per day (under \$194).⁴ High revenue does not necessarily imply high profit margin, because the cost of delivering the services that bear a higher CMS reimbursement rate may also be high. However, CMS adjusts the reimbursement rate according to local labor and non-labor cost across regions, and thus we believe revenue and margin are positively correlated. Moreover, SNFs do not independently evaluate patient need for SNF care when they admit patients from hospitals. Rather, they rely on the patient's hospital discharge record, including diagnosis, treatment, inpatient stay, demographics, insurance type, etc. Once a patient is admitted, the SNF determines the category of services the patient needs and the therapy minutes in that category. Bowlblis and Brunt (2014) show that SNFs upcode patients by providing additional therapy minutes to increase revenue, but do not upcode related to patient functionality scores. Above all, SNFs usually prefer Medicare and privately insured patients to Medicaid patients. As shown by Nyman (1993), non-Medicaid patients typically gain admission first when there are not enough beds. According to a New York Times article in 2015, the entire industry is chasing those lucrative consumers while quality of care is said to lag.⁵

To assure quality of care, the Centers for Medicare and Medicaid Services (CMS) launched the Nursing Home Quality Initiative in 2002 and initiated the Five Star Quality Rating System (FSQRS) in 2008. These quality disclosure policies motivated SNFs to improve quality at least along the reported dimensions (Lu, 2012, 2016; Huang and Hirth, 2016; Zhao, 2016; Brickley et al, 2018). It is noteworthy that the FSQRS is constructed mainly using deficiency citations. The CMS weights deficiency citations more than other quality measures in calculating star ratings since they are produced by government inspections, as opposed to self-reports (CMS 2017c). Moreover, the count of deficiency citations is also widely used as a proxy of SNF quality in the literature (e.g. Harrington et al, 2000; Lu and Wedig, 2013).

⁴ The information is obtained from Lu, Rui and Seidmann (2018), footnote 2. "These daily rates are taken from the quarterly report filed by Genesis Healthcare on May 8, 2015. <https://www.sec.gov/Archives/edgar/data/1351051/000110465915036326/0001104659-15-036326-index.htm>."

⁵ <https://www.nytimes.com/2015/04/15/business/as-nursing-homes-chase-lucrative-patients-quality-of-care-is-said-to-lag.html>.

On average, a SNF has 104 beds.⁶ Due to the Certificate of Need Law, SNFs are not allowed to change their bed size without approval from state authority. According to the Medicare Payment Advisory Commission's 2015 report to the Congress, the average length of stay for a Medicare resident in a SNF is 37 days (MedPAC 2015, p. 200). There exist severe excess demand issues from Medicaid patients (Ching et al, 2015). Therefore, the utilization of SNF beds is very high with an overall occupancy rate of 88.8%.

Because most patients do not pay for SNF care themselves, they all prefer high quality SNFs to low quality SNFs. In addition, due to the state certificate of need laws, it is difficult for nursing homes to expand capacity. Naturally, SNFs with high occupancy rates usually provide good quality. A recent study by Hackman and Pohl (2018) shows that SNFs tend to discharge Medicaid patients in order to admit lucrative patients when occupancy rates increase. These lucrative patients tend to demand high quality services, which give SNFs an incentive to promote quality. In the annual OSCAR data of SNF characteristics (to be described in Section 4), we find a negative correlation between occupancy rates and deficiency citations (-0.147).

2.3 Literature Review

Our study contributes to a broad literature on the impact of Medicare reimbursement rules on healthcare spending and outcomes. Finkelstein (2007) shows that the introduction of Medicare in 1965 increased healthcare spending six times more than what was predicted. However, the fee-for-service payment adopted by Medicare at that time had no discernable impact on elderly mortality (Finkelstein and McKnight 2008). Duggan and Morton (2010) find that the introduction of Medicare Part D significantly reduces out-of-pocket prices and results in a substantial increase in utilization of Medicare-intensive drugs. Brown et al. (2014) show that the risk adjustment in the Medicare Advantage (MA) program significantly lowers healthcare costs conditional on patients' health risk. Duggan et al. (2016, 2017) and Curto et al. (2017) investigate the impact of MA and find that health spending is lower for enrollees in MA than in the traditional Medicare, but it has no association with any measurable reduction in hospital quality or patient mortality. In this study, we investigate Medicare's three-day

⁶ https://meps.ahrq.gov/data_files/publications/rf4/rf4.shtml

reimbursement rule on SNF discharge and the subsequent hospital readmission. We find that the three-day rule increases the likelihood of discharging Medicare patients to SNFs, which increases healthcare spending but does not necessarily reduce readmission rates.

Most relevant to our study is a small but growing literature on the impact of reimbursement rules on coordination care. Grebla et al. (2015) study the three-day rule *within* Medicare Advantage (MA) patients. Unlike Medicare FFS patients, MA patients may or may not be subject to the three-day rule depending on their MA plan. By comparing hospital discharges in the MA plans with and without the three-day rule, Grebla et al. (2015) find that eliminating the three-day rule may reduce the hospital length of stay (before discharge to SNF) by 0.7 days. But this reduction is from an average of more than 6 inpatient days, which is way over the key margin of discharging a patient on day 2 or day 3. Our study focuses on this particular margin, and includes all discharge outcomes after an inpatient stay, not just the discharge to SNFs. Unfortunately, only two of the four states in our data distinguish MA from Medicare FFS, and none of them spell out the identity of the MA plan or whether the MA plan adopts the three-day rule or not. For these reasons, we keep all Medicare patients as one group in the empirical analysis. Later on, we show that our results are robust if we exclude MA patients from the sample in Session 5.4.1.

More broadly on coordination care, Gornick and Hall (1988) document the trend in Medicare use of post-hospital care. Grabowski (2007) points out that Medicare and Medicaid provide conflicting incentives for long-term care. Meyers et al. (2018) shows that MA patients are more likely to enter lower-quality nursing homes compared to FFS enrollees. Recent research by Einav et al. (2017) investigates the effect of a payment “jump” on the timing of discharge and mortality in long-term acute-care hospitals (LTCHs). They find that the share of LTCH stays increases significantly at the precise day of the jump. However, the timing of discharge does not have significant effects on patient mortality. By contrast, Eliason et al. (2017) find that the gaming of discharge timing leads to worse outcomes for patients in LTCHs. Doyle et al. (2017) explore a random assignment of patients by ambulance companies to hospitals. They find that lack of productivity in post-acute care could be a possible reason for the waste in healthcare.

We directly test whether SNF care in fact produces substantial waste in healthcare using the three-day rule as an instrument for SNF discharges.

Navathe et al. (2017) examine the impact of Medicare's bundled payments in joint replacement. They find that the implementation of bundled payment significantly reduced Medicare payment and almost half of the savings come from less spending in post-acute care. Our study tackles the impact of the three-day rule on SNF discharge, including patients with knee or hip replacement (KHR). We find a significant increase in hospital readmission rate for KHR patients as a result of the three-day rule. This perverse effect is larger in the HSAs where the average SNFs have a lower-than-state-median occupancy rate or a higher-than-state-median total deficiency count. To the best of our knowledge, this is the first study that examines the impact of the Medicare three-day rule on SNF discharge and hospital readmission, and quantifies this impact in Medicare overspending.

3. Conceptual Framework

The key question is how the three-day cutoff could create deviations from efficient allocation of health care. We propose a simple conceptual framework to address this question.

Suppose Medicare is a social planner aiming to maximize patient utility of health care minus post-acute care cost. Denote the net value as $V(x|s)=U(x|s)-C(x)$, where x is the type and amount of post-acute care (hospital, SNF, home) and s is patient sickness before treatment. Obviously, patients may differ in many dimensions beyond sickness. For model simplicity, we summarize all patient heterogeneity in the single parameter of s , and assume a monotonic relationship between s and the need for health care. In empirical analysis, we will control for an extensive list of patient characteristics. If we normalize $V(\text{home}|s)=0$ for every s , then $V(\text{hospital}|s)$ represents the net utility of receiving inpatient care with initial condition s and $V(\text{SNF}|s)$ represents the net utility of receiving care from SNF with initial condition s , all relative to staying home.

As shown in Figure 1, we further assume both $V(\text{hospital}|s)$ and $V(\text{SNF}|s)$ are positively sloped, i.e. the value of receiving either care is higher when the patient is sicker. And $V(\text{hospital}|s)$ is more steeply sloped than $V(\text{SNF}|s)$, so that the sicker the patient is, the more utility she will derive from inpatient care than from SNF care. The

intercept of each line is determined by the difference between patient utility and cost of the corresponding care. Inpatient care is the most expensive while staying home is the least among the three types of post-acute care. When the patient is sick enough, inpatient and SNF care are both better than staying home. However, when the patient is healthy enough, $V(\text{hospital}|s)$ and $V(\text{SNF}|s)$ can be negative, implying that it is better (for the social planner) that the patient stays home rather than consume costly care from a hospital or SNF. When patient sickness is somewhere in the middle, it is possible that $V(\text{SNF}|s) > V(\text{hospital}|s) > V(\text{home}|s)$.

In short, Figure 1 shows a monotonic sorting where patients with $s > s_1$ should be hospitalized, $s_2 < s < s_1$ should go to SNF, and $s < s_2$ should stay home. To the extent that patient sickness is observable (to Medicare and hospital) and the hospital is a perfect agent of Medicare, the hospital should keep $s > s_1$ inpatient, discharge $s_2 < s < s_1$ to a SNF, and send $s < s_2$ home. In reality, patient sickness is observable to the hospital but not observable to Medicare. Given the non-trivial agency problem between Medicare and the hospital, Medicare proxies the true patient sickness at hospital discharge by an observable variable such as length of inpatient stay.

To the extent that the three-day rule is an imperfect proxy for patient sickness, it can make two errors: first, those with $s_2 < s < s_1$ (who should go to a SNF in the ideal world) does not satisfy the three-day rule, and they end up going home instead of to SNF. This is suboptimal because patients suffer from inadequate care at home although Medicare saves money. This error is denoted by a green diamond in Figure 1. Second, those with $s < s_2$ (who should go home in the ideal world) satisfy the three-day rule, and the patient may prefer unnecessary SNF care because the care is free. This is a typical moral hazard problem, which wastes money for Medicare, as the cost that Medicare pays to the SNF is more than the utility that the patient receives from the SNF (relative to home). The second error is denoted by a blue circle in Figure 1. To ease future discussion, we refer to the two types of errors as Error 1 (resulting in insufficient care) and Error 2 (driven by moral hazard).

So far, we take the timing and sickness at discharge as given. In reality, both are under the control of the hospital, and the hospital's discharge decision could be distorted by the three-day rule. One may concern whether this will mitigate or exacerbate the

above two errors. Let us consider Error 1 first: those with $s_2 < s < s_1$ cannot go to SNFs because they have not stayed long enough in the hospital. If the hospital is not capacity constrained, allowing the patient to stay longer in the hospital could generate revenue to the hospital⁷ and help the patient to receive the optimal care (SNF) at discharge. This inducement behavior moves the error from the green diamond to the red triangle, which wastes Medicare money in inpatient care. If the hospital is so capacity constrained that it cannot keep the patient in the hospital in order to satisfy the three-day rule, the error stays in the green diamond and the cost is the same as before – the patient is discharged home and suffers from inadequate care after discharge. This could generate worse patient outcomes (such as hospital readmission) in the future. As for Error 2, patients with $s < s_2$ prefer SNF care because it is free. If the hospital is more of an agent for the patient than for Medicare, the patient will be discharged to SNF, generating unnecessary expenditure for Medicare as illustrated in the blue circle. Since we assume SNF care is better than home (before accounting for the cost), this suboptimal discharge to SNFs should only affect patient outcomes positively, if it has an effect at all.

Now let us add a third layer of complication. Suppose some SNF services are of high quality, and some are of low quality. For illustration, assume all SNFs in Figure 1 are high quality. Figure 2 repeats Figure 1, but adds a line below and parallel to the line of $V(\text{SNF})$. Now the two parallel lines represent high and low quality SNFs (SNF_{high} and SNF_{low}) respectively. The cost of these two types of SNFs is the same in the eyes of Medicare, because Medicare pays the same rate regardless SNF quality. For simplicity, we assume the actual cost of care is also the same for all SNFs and all health conditions.⁸ By definition, $V(\text{SNF}_{\text{high}}) > V(\text{SNF}_{\text{low}})$. If SNF_{high} has no capacity constraint, SNF_{low} does not matter at all because it is always dominated by SNF_{high} . In that case we go back to Figure 1.

But in a world where the capacity constraint of SNF_{high} becomes binding at s_c ($s_2 < s_c < s_1$), Medicare would prefer a sorting such that $s > s_1$ stay inpatient, $s_c < s < s_1$ go to SNF_{high} , $s'_2 < s < s_c$ go to SNF_{low} , and $s < s'_2$ go home. Note that the new cutoff for going

⁷ Whether this will generate more revenue for the hospital depends on whether Medicare pays the hospital by procedure (DRG) or by length of stay.

⁸ Under this assumption, high revenue implies high profit margin. Because sicker patients need more units of care, sicker patients bring in more revenue and more profits.

home, s'_2 , is higher than s_2 , because it is determined by $V(\text{SNF}_{\text{low}})$ rather than $V(\text{SNF}_{\text{high}})$. In other words, because of low quality SNF services, Medicare would prefer to send more patients home, as a social planner.

The three-day rule of Medicare is *independent* of SNF quality. If the rule attempts to proxy s_2 in Figure 1, it fails to adjust for the existence of low quality SNFs. This alone will generate a new error as more patients should go home rather than go to SNF_{low} . We denote this new error caused by low quality SNF care as Error 3, in a yellow pentagon in Figure 2. The presence of low quality SNFs also exacerbates the value loss from the overuse of SNF (as denoted in the blue circle), because the overuse occurs in low quality SNFs rather than high quality SNFs. If the quality of SNF_{low} is so low that the patient may suffer more from SNF_{low} than staying home (say higher infection rate), it could increase the risk of adverse patient outcomes. The three types of errors, and their distortion on the health care system, are summarized in Table 1.

In addition to the information and incentive challenges facing Medicare, the presence of SNF_{high} and SNF_{low} also creates an incentive wedge between patients and SNFs. Because we assume SNF_{high} provides better quality care (at the same cost) than SNF_{low} , every patient prefers SNF_{high} to SNF_{low} . However, Medicare commits to a higher SNF reimbursement rate for a sicker patient (to the extent that the sickness is observable). Under the (oversimplified) assumption that the cost of SNF care is the same for all SNFs and all conditions, SNF_{high} is incentivized to accept sicker patients first before it hits the capacity constraint. Bowblis and Brunt (2014) shows that nursing homes prefer patients with more therapy minutes. Since sicker patients tend to require more therapy minutes conditional on the diagnosis, it is reasonable to assume that profit-seeking nursing homes may have incentives to admit sicker patients. The same financial incentive exists for SNF_{low} , but there may be enough SNFs in some market so that SNF_{low} never hits its capacity constraint. In that world, SNF_{high} will admit sick patients until it is full, whereas SNF_{low} accepts all the remaining patients for whom Medicare is willing to pay for SNF care. Such sorting across SNFs with different quality levels is also aligned with patient selection behavior that severe patients are more likely to seek for high quality SNFs for treatment.

The SNF admission priority by patient sickness is in the same order as the sorting

by net value in Figure 2. However, it implies that, when the capacity constraint of SNF_{high} is binding at s_c and the three-day rule is a local proxy for $s_2' < s < s_c$, those that suffer most from the low quality of SNF_{low} will be the relatively healthy patients that should have gone home but end up discharged to SNF_{low} (the yellow pentagon and blue circle).

Overall, we have three predictions:

Prediction 1: The three-day rule may generate extra Medicare expenditure because of overtreatment at SNFs, late discharge at hospitals and adverse health outcomes. All of them tend to focus on relatively healthy patients who are on the margin of a wrongful discharge decision.

Prediction 2: Adverse health outcomes such as hospital readmission will disproportionately affect the relatively healthy patients, because of either over-treatment in low quality SNFs or under-treatment at home. Which one dominates depends on the quality difference between SNFs and home care.

Prediction 3: If we have a good measure of SNF quality, adverse outcomes (conditional on being discharged to SNFs) should be disproportionately concentrated in low quality SNFs. If we do not have a good measure of SNF quality, SNF occupancy rate might be an indirect measure. In that case, adverse outcomes (conditional on being discharged to SNFs) should be disproportionately concentrated in SNFs with a low occupancy rate.

4. Data Summary

We use three databases. The main one is the inpatient discharge data from Arizona (2004-2007), Florida (2005-2013), New York (2005-2013), and Washington (2004-2013) State Inpatient Databases (SID) of the Healthcare Cost and Utilization Project (HCUP).⁹ These datasets contain all inpatient records and thus capture all Medicare patients who have qualifying hospital stays for SNF coverage in our sample states and years. The data also contains important information such as the primary expected payer, length of stay, and discharge destination. In addition, the data provides

⁹ The National Bureau of Economic Research (NBER) provided access to the HCUP data.

encrypted person identifiers, which allow us to track readmissions of the same individual over time.

We merge the SID with the American Hospital Association's (AHA) Annual Survey of Hospitals,¹⁰ which provides additional information about the hospitals in our sample, such as hospital location and facilities.

The third database is the 2003-2013 Online Survey Certificate and Reporting Database (OSCAR), which includes all Medicare and Medicaid certified nursing homes operating in the US. This database provides nursing home characteristics such as facility locations, deficiency citations and occupancy rate. Since OSCAR is collected at the SNF-year level, we cannot link it to the SID data at the individual patient level. To address this shortcoming, we use the discharge hospital's health service area (HSA) to match with the average deficiency count and occupancy rate of SNFs in that HSA.¹¹

Total deficiency count is a well-known measure of SNF service quality (Castle and Ferguson 2010). If the SNFs in a HSA have on average a higher number of deficiency citations¹² than the median of the corresponding state in the preceding year, we classify the HSA as above-median deficiency. Similarly, if the SNFs in a HSA have on average a lower occupancy rate than the median of the corresponding state in the year preceding the admission year, we classify the HSA as below-median occupancy. We use predetermined values of deficiency and occupancy to address potential endogeneity between these quality measures and patients' actual discharge destination.

We restrict our main analysis sample to patients with age between 60 and 79 who are discharged within 24 hours before and after the three-day cutoff.¹³ We also focus on *new* episodes of hospitalization, where an episode is new if the patient has not been hospitalized in the past 180 days. This way, readmissions following a new episode are not included in the sample, but they are used to construct the 30-day and 60-day readmission outcomes for that episode. We drop observations missing the key variables such as

¹⁰ The National Bureau of Economic Research (NBER) also provided access to the AHA data.

¹¹ We drop SNFs with 100% Medicaid patients in computing the average deficiency and occupancy rate since these SNFs focus on long-term care instead of post-acute care.

¹² We right-censor deficiency citations at top 1 percentile to exclude outliers.

¹³ We extend the age range from 65-79 to 60-79 by including some young non-Medicare patients mainly because there are few non-Medicare patients above 65. In the robustness checks (section 5.4), we shorten the age range and the results remain robust.

discharge destination, primary expected payer, encrypted person identifiers, and average SNF quality at the HSA level. We also exclude patients whose initial visit ended with death and thus cannot be tracked over time.

Table 2 presents the share of patients discharged to various destinations, by whether their hospital discharge is above or below the three-day cutoff and whether their insurer is Medicare or non-Medicare. Home discharges are more common for patients discharged on the second day than those discharged on the third day. Non-Medicare patients are more likely to be discharged home than Medicare patients. In contrast, discharges to SNF are more common for discharges on the third day, especially for Medicare patients. Home health care (HHC) is also more common for those who are discharged on the third day, and the share is higher for Medicare patients.

Table 3 compares patient demographics, health conditions, and readmission rates by discharge destination (home or HHC vs. SNF), above/below threshold, and Medicare/non-Medicare. For patients who are discharged to SNF, Panel B also compares SNF characteristics by above/below threshold and Medicare/non-Medicare. Unsurprisingly, Medicare patients are older, more likely to have heart disease, stroke, and various comorbidities. Readmission rates are also higher for Medicare patients than non-Medicare patients. Knee or hip replacement is more common for non-Medicare patients, and patients with knee or hip replacement are much more likely to be discharged on the third day.

Patients discharged to SNFs are generally older than those discharged home or HHC. More than 50% of the patients discharged to SNFs on the third day had knee or hip replacement. Patients discharged on the second day to SNFs are more likely to have comorbidities and are more likely to be readmitted than patients discharged home. However, patients discharged on the third day to SNFs are relatively similar to those discharged home in terms of the probability of having comorbidities and readmission rates. Among patients discharged to SNFs on the third day, Medicare patients tend to stay in HSAs with slightly higher deficiency citations and slightly lower occupancy rates.

Table 4 shows SNF discharge rates and readmission rates by health condition, above/below the cutoff, and Medicare/non-Medicare. The SNF discharge rates are the highest for Medicare patients discharged on the third day for all health conditions. This

pattern is most pronounced for knee or hip replacement (KHR) patients. The 30-day readmission rates are the highest for patients with heart disease (9.1-13.7%), followed by other conditions (7.4-10.3%), stroke (6.5-9%), and knee or hip replacement (2.4-4%). The same order holds for the 60-day readmission rate. Consistently, KHR patients have the lowest Elixhauser Comorbidity Index, no matter whether we compute the Index in readmission score or mortality score. These patterns suggest that KHR patients are healthier than patients with heart disease, stroke and other conditions. Therefore, according to our conceptual framework, they should be more on the margin of discharging to SNFs versus home and more exposed to the capacity constraint of high quality SNFs.

5. Empirical Analysis

We examine the effects of the three-day rule in a difference-in-differences (DID) framework. Specifically, we first examine discharge destinations of Medicare patients (65-79) and non-Medicare patients (60-79), comparing patients who are discharged from a hospital within 24 hours before vs. after the three-day cutoff:

$$Y_i = \delta \text{Day3}_i * \text{Medicare}_i + \alpha_1 \text{Day3}_i + \alpha_2 \text{Medicare}_i + X_i + e_i \quad (1)$$

where i denotes a patient. Day3_i is an indicator for discharges within 24 hours after the three-day cutoff. Medicare_i is an indicator for patients with Medicare as the primary expected payer. $\text{Day3}_i * \text{Medicare}_i$ is the interaction between the two variables. X_i is a vector of discharge characteristics including patients' demographics such as age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities¹⁴), as well as hospital fixed effects. We also control for discharge year and discharge month fixed effects. Moreover, to account for different discharge probabilities throughout the day, we

¹⁴ The list of comorbidities is: Agency for Healthcare Research and Quality (AHRQ) comorbidity measure for acquired immune deficiency syndrome, alcohol abuse, deficiency anemias, rheumatoid arthritis/collagen vascular diseases, chronic blood loss anemia, congestive heart failure, chronic pulmonary disease, coagulopathy, depression, diabetes (uncomplicated), diabetes with chronic complications, drug abuse, hypertension, hypothyroidism, liver disease, lymphoma, fluid and electrolyte disorders, metastatic cancer, other neurological disorders, obesity, paralysis, peripheral vascular disorders, psychoses, pulmonary circulation disorders, renal failure, solid tumor without metastasis, peptic ulcer disease excluding bleeding, valvular disease, weight loss.

include a dummy for each discharge hour as well as a dummy for missing discharge hour. We report robust standard errors clustered at the HSA level.

The key coefficient of interest is δ , which captures the difference between day 3 and day 2 discharges among Medicare patients relative to the difference among non-Medicare patients conditional on patient demographics, health conditions, seasonality, and discharge hour. We consider the probability of discharges to four different destinations as an outcome Y_i : home or home health care (HHC), SNFs, other facilities (including another short-term hospital and a long-term care hospital), and discharge against medical advice (AMA).

We are ultimately interested in examining the effects of SNF discharges on readmission rates.

$$R_i = \beta SNF_i + \alpha_1 Day3_i + \alpha_2 Medicare_i + X_i + e_i \quad (2)$$

where R_i denotes whether the patient is readmitted to a hospital. We consider readmission within 30 days as well as 60 days. The estimate β will be biased upwards if a discharge SNF is correlated with (unobserved) sickness. We instrument SNF_i with $Day3_i * Medicare_i$ to estimate the causal effect of SNF discharge on readmission rates using a two stage least squared (2SLS) method. The 2SLS estimate β describes the local average treatment effect for compliers, i.e. patients who are induced to be discharged to a SNF due to the three-day rule.

The key identification assumption is that all control variables – including hospital fixed effects, patient attributes, major diagnosis, comorbidities, day 3 alone and insurance type alone – are sufficient to capture observable and unobservable health conditions that may affect a hospital’s discharge decision. As the result, the interaction of $day3 * Medicare$ mainly captures the financial incentive of discharging Medicare patients to different destinations. This assumption will be tested by robustness checks in Section 5.4.

We prefer DID to the alternative approach of regression discontinuity (RD), mostly because only a small percent of hospitalization is around the midnight cutoff. Around 90% of patients are discharged from the hospital between 10 am and 6 pm, with the most at 2 pm (13.2%). In Section 5.4, we show that the impact of the three-day rule on discharge to SNF is robust when we zoom in 5 hours before and 5 hours after the

midnight cutoff. However, this window only accounts for 3% of our main sample, and patients discharged in this window are systematically different from other patients in health conditions and local SNF characteristics. Also, because discharge to SNF requires paperwork between hospital and SNF, such paperwork is unlikely to occur around the midnight, which explains why the probability of discharge to SNF in this time window (3%) is much lower than the overall probability of SNF discharge (8%). We worry that severe sample selection could potentially bias the estimation of the overall impact of SNF discharge on hospital readmission.

Including all new hospitalization episodes that are discharged 24 hours before and after the midnight cutoff alleviates the selection problem, but it also make our identification rely more on the comparability between Medicare and non-Medicare patients in this relatively large time window. In Section 5.4, we show that our results are robust if we narrow the age range from 60-79 to 62-67, and the differential effects we observe between Medicare and non-Medicare patients only occur around the three-day cutoff, not around the cutoff on day 4, day 5, day 6 and day 7.

5.1. Results in the pooled sample

We first estimate the effect of the three-day rule on discharge destinations. Table 5 reports δ from equation (1) for each of the four different discharge destinations. Medicare patients who are discharged after the three-day cutoff are 6.8 percentage points more likely to be discharged to a SNF than those who are discharged before the three-day cutoff. This effect is enormous, considering the fact that only 9.4% of Medicare patients (and 8% of all patients) in our sample were discharged to SNFs. The increase in discharge rate to SNFs is offset by a decrease in home and home health care discharges.

Subsequently, we estimate the effect of a SNF discharge on readmission rates using both OLS and 2SLS approaches. Table 6 summarizes the results. Columns 1 and 2 of Panel A show that patients who are discharged to SNF have higher readmission rates, if we use simple OLS. If patients with more severe conditions tend to be discharged to SNF, the unobserved differences in sickness may bias the OLS estimates upwards. Panel B shows that once we instrument the SNF discharge with $\text{Day3}^* \text{Medicare}$, the estimates on 60-day readmission rates become *negative* and statistically significant. This suggests

that holding health conditions constant, SNF care may be more beneficial than home care in terms of reducing hospital readmissions.

We unveil the negative readmission effects further by patient comorbidity. Columns 3 and 4 show that for patients without any comorbidity (12% of the sample), SNF discharge has no effect on readmission rates. Patients with at least one comorbidity drive the negative readmission effects (Columns 5 and 6 in Table 6). If we split the full sample by whether a patient has above- or below-median Elixhauser Comorbidity Index, the significant, negative readmission effects only persist in the above-median subsample for 60-day readmission. In the below-median subsample, discharge to SNF has no significant effect on readmission (Columns 7 and 8 in Table 6). This suggests that SNF service is only effective in reducing hospital readmission for sicker patients.

5.2. Results by health conditions

We further examine the effects of the three-day rule and SNF discharges by health conditions. We separately consider heart disease, stroke, and knee or hip replacement since they are common conditions that may benefit from post-acute care at a SNF (MEDPAC 2010). Other conditions are grouped as the fourth category.

As shown in Table 7, the discharge effect of the three-day rule is the largest for knee or hip replacement. Medicare patients with knee or hip replacement discharged after the three-day cutoff are 14 percentage points more likely to be discharged to a SNF than those who are discharged before the three-day cutoff. This increase in SNF discharges is entirely offset by a decrease in home or HHC discharges. The discharge effect is the smallest for heart disease patients with a 1.8 percentage point increase. The increase in SNF discharges is also offset by a reduction in home discharges for heart disease, stroke, and other conditions. In short, finding the largest SNF discharge effect in KHR patients is consistent with Prediction 1, because KHR patients are healthier than other patients and therefore more on the margin of being discharged to SNFs or going home.

Table 8 presents OLS estimates on readmission rates by health conditions. Given the large discharge effect for KHR patients, we separately examine knee and hip replacement and pool the other conditions. The OLS estimates show that the positive coefficient of SNF discharge on readmission rates is lower for KHR patients than for all

other conditions. This is not surprising because KHR patients have the lowest readmission rates in the raw data.

Table 9 shows the corresponding 2SLS estimates. When we instrument SNF discharge with the three-day rule, we find a significant *increase* in readmission rates for KHR patients. We generally do not find a significant effect on readmission for other conditions. Within knee and hip replacement, the perverse effect of SNF discharge on readmission is *larger* for KHR patients *without* comorbidity. This pattern is consistent with Prediction 2, where we argue that healthier patients are more exposed to low quality SNF services because they are closer to the margin of a wrongful discharge decision.

5.3. Results by local SNF characteristics

We further break down the sample by local SNF characteristics, using deficiency citation and occupancy rate. Panel A of Table 10 shows that the increase in readmission rates for Medicare KHR patients is driven by low occupancy HSAs. Panel B shows that the increase in readmission rates is higher and only significant in high deficiency areas, consistent with the fact that areas with high deficiency are often areas with low occupancy. Consistent with Prediction 3, these results suggest that KHR patients are relatively healthy and on the margin of going to SNF simply because Medicare will pay for it and there is a bed available in nearby low-quality SNFs. Not only does the over-consumption of SNF care increase post-acute care expenditure for Medicare, but it also generates a higher readmission rate, which requires even more spending from Medicare. We will quantify these costs for Medicare when we conduct our back-of-the-envelope calculation in Section 6.

5.4. Robustness checks

5.4.1. Alternative sampling

One key identification question is whether Medicare and non-Medicare patients are truly comparable. They obviously differ in age as Medicare patients are 65 and above but most non-Medicare patients are 60-65, with only a small fraction spreading above 65. We have controlled for a polynomial function of age in all regressions, but one still wonders whether our results could be driven by Medicare patients being systematically

sicker than non-Medicare patients, rather than the three-day rule of Medicare.

To consider this possibility, we employ an event study approach to examine pre-trends, by the exact discharge hour. That is, instead of Day3*Medicare in equation (1), we include a series of interactions between Medicare and each discharge hour within the 24 hour window before and after the three-day cutoff. Panel (a) of Appendix Figure A.1 shows that there is little evidence of pre-trends between Medicare and non-Medicare patients, while the SNF discharge rate increases significantly 10-24 hours after the three-day cutoff. Similar results hold for the subsample of KHR patients only (panel (b) of Appendix Figure A.1), though the parallel shift of SNF discharge rate after the cutoff is less powerful for this subsample.

We then plot the same graph for the hypothetical cutoff at midnight of day 4, day 5, day 6 and day 7. If Medicare patients are systematically sicker than non-Medicare patients, we should observe the effects at these hypothetical cutoffs similar to the three-day cutoff. As shown in Appendix Figure A.2, the difference between Medicare and non-Medicare patients is mostly muted for day 4, day 5, day 6 and day 7.

Appendix Table B.1 runs the same regressions as our main results for these alternative cutoffs. Thanks to our enormous sample, the probability of discharge to SNFs is significantly different between Medicare and non-Medicare patients for day 4, day 5, day 6 and day 7, but the magnitude of this difference is much smaller than for the day 3 cutoff (-0.7 to 1.1 percentage points as compared to 6.8 percentage points). These results suggest that the Medicare-versus-non-Medicare difference is much more salient for the day 3 cutoff, likely because of the three-day rule of Medicare.

Another way to ensure comparability between Medicare and non-Medicare patients is adopting a narrower age range. Tables B.2-B.5 repeat the same regressions as our main results but use the age range 60-69 instead of 60-79. Tables B.6-B.9 further narrow the age range to 62-67. In both scenarios, the estimated impact of the three-day rule on SNF discharge is smaller (5 and 4.4 instead of 6.8 percentage points) but remains significant at 99% confidence. In the second stage, we still observe a contrast between KHR and other conditions, where KHR patients suffer from a higher readmission rate because of the three-day rule but other patients have either similar or significantly lower readmission rate after staying at a SNF. The perverse readmission outcome for KHR

patients continues to concentrate in the HSAs with a higher-than-state-median total deficiency count or a lower-than-state-median occupancy rate.

Similar robustness is achieved when we expand the sample to include all hospitalization episodes instead of new episodes only (Appendix Tables B.10-B.13); drop MA patients (Appendix Tables B.14-B.17); or reduce the sample to 12 hours (instead of 24 hours) before and after the three-day cutoff (Appendix Tables B.18-B.21). Moreover, when we use a regression discontinuity (RD) design focusing on Medicare patients discharged between 5 hours before and after the three-day cutoff, we still find a robust increase in SNF discharge rates above the threshold (Appendix Table B.22).

5.4.2 Selection on patient condition

We also investigate whether selection of patient condition can explain our results. In our main estimations, we already control for all observable differences in patient condition using the DRG fixed effects and indicators for comorbidities. Alternatively, we examine each comorbidity as an outcome using equation (1) (without the comorbidity controls) and find that 15 out of 29 comorbidities have significant difference between Medicare patients who are discharged after vs. before the three-day cutoff relative to non-Medicare patients. We drop patients with these 15 comorbidities so that the remaining sample does not have any comorbidity difference across the threshold on average. For this subsample, we find similar lift in the probability of discharge to SNFs (Appendix Table B.23), and either zero or negative impact of SNF stay on readmission rates for the full sample (Appendix Table B.24). However, we still find significant, positive readmission effects for KHR patients, which are larger for KHR patients without comorbidities and stronger in low occupancy HSAs (Appendix Tables B.25-B.26).

In Appendix B.27-B.30, we examine whether our estimates are robust to an additional set of controls. Patients who intend to take advantage of the three-day rule may differ in their method of admission, admission time, or the total hours in the hospital. We find that our estimates barely change when we include admission time, total hours in the hospital, and whether the initial hospital admission was through the emergency room (ER). Similar results arise when we further restrict the sample to ER admissions only (Appendix B.31-B.32). Such robustness suggests that patients are unlikely to manipulate

their stay in the hospital due to the three-day rule.

To further test the validity of our instrument, we include Day3*Medicare in the OLS equation (2). In theory, this addition should not have a significant impact on readmission outcomes because the OLS regression already includes the endogenous variable, the SNF discharge. Appendix Table B.33 shows that the coefficients on SNF are almost identical to our main OLS estimations in Panel A of Table 6, although the coefficients on Day3*Medicare are statistically significant in the full sample as well as the subsample with any comorbidity. For the subsample without any comorbidity – where we find no readmission effects of SNF discharge due to the three-day rule – we find that adding Day3*Medicare to the OLS has no significant effect on readmission rates. This highlights our findings that SNF care may not improve health outcomes for patients with less severe conditions.

5.4.2. Hospital Bed Availability

We also concern that hospitals could manipulate the length of stay of Medicare patients for SNF coverage. Though Medicare is unlikely to pay for extra length of stay (because Medicare pays by DRG), the doctor may “help” a Medicare patient to stay longer in order to qualify for the SNF coverage. Such “help” is more feasible when the hospital beds are underutilized. Accordingly, we define hospital bed availability as months in which total inpatient days are below the median in a given hospital-year. Appendix Table B.34 shows that the likelihood of discharging Medicare patients to SNFs after the three-day cutoff is 5.2 percentage point more than before the cutoff for hospitals with different levels of bed utilization. Since the discharge effect varies little by hospital bed availability, we believe that hospitals are very unlikely to manipulate the length of stay for SNF coverage.

6. Conclusion and Policy Implications

Overall, we find alarming signs that suggest unnecessary Medicare spending and adverse health outcomes, all related to the three-day rule that Medicare imposes on its FFS reimbursement to SNFs.

More specifically, in the pooled sample, the three-day rule leads to a 6.8 percentage point increase in the probability of discharging a Medicare patient to SNFs within 24 hours after the three-day-cutoff. This effect is enormous, considering the fact that only 9.4% of Medicare patients (and 8% of all patients) in our sample were discharged to SNFs. However, among those that have no comorbidity or below-median Elixhauser Comorbidity Index, there is no significant readmission difference between those discharged to SNF and those discharged somewhere else.

More than 50% of the patients discharged to SNFs on the third day had knee or hip replacement (KHR). For KHR patients alone, the three-day rule increases the probability of SNF discharge by 14 percentage points. Though KHR patients are on average healthier than patients with heart disease, stroke and other conditions, KHR is the only category for which we find a significant *increase* in hospital readmission rate as a result of the three-day rule. This perverse effect is larger and only significant in the HSAs, where the average SNFs have a lower-than-state-median occupancy rate or a higher-than-state-median total deficiency count. This suggests that many KHR patients are discharged to SNFs simply because Medicare will pay for it and there is bed available in nearby SNFs. Unfortunately, discharging KHR patients to SNF is associated with a greater likelihood of hospital readmission within 30 and 60 days.

What do these findings imply for Medicare expenditure? Table 11 presents two sets of back-of-the-envelope calculations, one for the pooled sample, and one for knee and hip replacement only. On the pooled sample, we focus on the patients with no or below-median comorbidities because, within these patients, SNF discharge makes no difference in hospital readmission. Thus, Medicare expenditure on their SNF discharge could be unnecessary. Assuming Medicare pays \$500 a day for FFS care in SNFs and an average Medicare patient stays in a SNF for 37 days per episode (Lu, Rui and Seidmann 2018), a 6.6 percentage point¹⁵ increase in the probability of SNF discharge implies an extra payment of \$139.6 million in our sample. Translating it into the annual spending of the whole Medicare, it amounts to \$99.74 million per year if we only count patients with

¹⁵ We use 6.6 percentage points instead of 6.8, because the former is the estimated effect of the three-day rule on the probability of SNF discharge for patients with no comorbidities, while the latter is the effect for all patients (Table 5).

no comorbidities, or \$446.86 million per year if we include patients with below-median comorbidities. These numbers correspond to 0.32 to 1.43% of total Medicare payment to SNFs.¹⁶

Turning to knee and hip replacement only, we focus on two sources of unnecessary Medicare expenditure. The first one is Medicare payment for SNF discharge, and the second one is Medicare payment for the increased hospital readmission after the SNF discharge. For both of them, we focus on KHR patients with no complications, which accounts for 97.4% of the KHR patients in our sample.¹⁷

Assuming an average KHR patient discharged to a SNF will stay there for 15 days (DeJong et al. 2009) and Medicare pays \$500 per day, a 14 percentage point increase in SNF discharge implies an extra Medicare payment of \$223.2 million in our sample. Projecting it to the whole Medicare population, it implies unnecessary Medicare payment to SNFs by \$112.5 million per year. To calculate Medicare payment for the extra readmission after the SNF discharge, we assume each readmission entails \$10,000 per visit.¹⁸ That implies \$6 million in Medicare spending for our analysis sample, or \$4.24 million per year for the whole Medicare population. In combination, the two sources of unnecessary spending add up to \$83.73 million per year for Medicare, which accounts for 1.2% of the total Medicare expenditure on knee and hip replacement.¹⁹

These back-of-the-envelope calculations may be conservative, because we do not include the potential longer stay in hospital in order to qualify for the SNF discharge

¹⁶ According to CMS (2017b) Table III.6, total Medicare payment to SNFs was \$31.332 billion in fiscal year 2016.

¹⁷ We use procedure codes in the inpatient record to determine whether a KHR patient receives the joint replacement procedure with or without complications. Literature has shown that institutionalized post-acute care can be helpful for KHR patients with complications (McLawn and Buller 2017). Because KHR patients with complications often stay in the hospital longer than three days, our analysis sample has very few of them.

¹⁸ Based on CMS data (<https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Medicare-Provider-Charge-Data/Inpatient2015.html>), the least expensive DRG at readmission for KHR is DRG 946 (Rehabilitation without CC/MCC) with an average payment of \$10,951 in 2014. We assume \$10,000 per readmission to be conservative.

¹⁹ According to CMS (<https://innovation.cms.gov/initiatives/cjr>, accessed May 16, 2018), there were more than 400,000 knee and hip replacement procedures in 2014, costing more than \$7 billion for the hospitalizations alone. We use \$7 billion to proxy for the total Medicare expenditure on knee and hip replacement.

under the three-day rule. It is difficult to quantify this element, as we do not find strong evidence supporting hospital manipulation in length of stay (Appendix Table B.34).

Our findings are consistent with the perceived inefficiency in the Medicare system, which has motivated a number of alternative payment methods. In 2012, CMS experimented with the Bundled Payments for Care Improvement (BPCI) on a voluntary basis. Subsequently in 2016, CMS mandated the Comprehensive Care for Joint Replacement (CJR) reimbursement model in 67 MSAs. In both programs, Medicare commits to a bundled payment to a participating hospital, where the bundle covers inpatient, outpatient and post-acute care related to a particular procedure. In its extreme form, the participating hospital may receive a fixed amount for the whole knee and hip replacement episode, regardless how much care the patient actually receives from inpatient stay, SNF usage, rehabilitation center, or home care up to 90 days since the beginning of the procedure.

As summarized by McLawhorn and Buller (2017), early evidence suggests that bundled payments are able to reduce Medicare cost for the whole KHR episode, without reducing quality of care for most KHR patients. For example, Navathe et al. (2017) study 3,942 KHR patients in the Baptist Health System (BHS), a network of 5 hospitals in San Antonio, Texas. BHS adopted BPCI in October 2013, where the bundled payment covers acute hospitalization and 30 days of post-acute care. Between July 2008 and June 2015, average Medicare expenditure per KHR episode declined 20.8%. In the meantime, readmissions, emergency department visits, and length of inpatient stay all declined. While some of the overall hospital savings came from internal cost reduction, average post-acute care spending declined 27% per case. Most of the post-acute savings were driven by reductions in inpatient rehabilitation and SNF spending, and these savings only occurred when the bundle payment included financial responsibility for post-acute care.

While these results may be specific to BHS, they confirm the conclusion that traditional fee-for-service payment includes unnecessary waste. As shown in our study, the three-day payment rule has encouraged relatively healthy patients to overuse SNFs but stay in SNF does not improve hospital readmission rates. In some cases – such as knee and hip replacement – the overuse of SNFs is also related to higher readmission, leading to even more Medicare spending. Our findings suggest that discharge to SNFs

should be based on a more complete assessment of patient conditions including the existence and severity of comorbidities rather than a single measure of length of stay in hospitals.

Finally, we caution readers that our back-of-the-envelope calculations focus on Medicare spending, not the total welfare. We lack individual records and cost data from SNFs, and do not consider the possibility that admission of Medicare patients may crowd out Medicaid and private-insured patients from capacity-constrained SNFs. Nor do we observe the cost of care provided by family members when a patient is discharged home instead of to SNFs. These costs could be substantial, but they are not included in Medicare spending.

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Figure 1: Sorting of destination with homogenous SNFs

Assume all SNFs are high-quality

Net value of staying at home is normalized to zero conditional on sickness s

s_1 = social optimal threshold to discharge to SNF

s_2 = social optimal threshold to discharge home

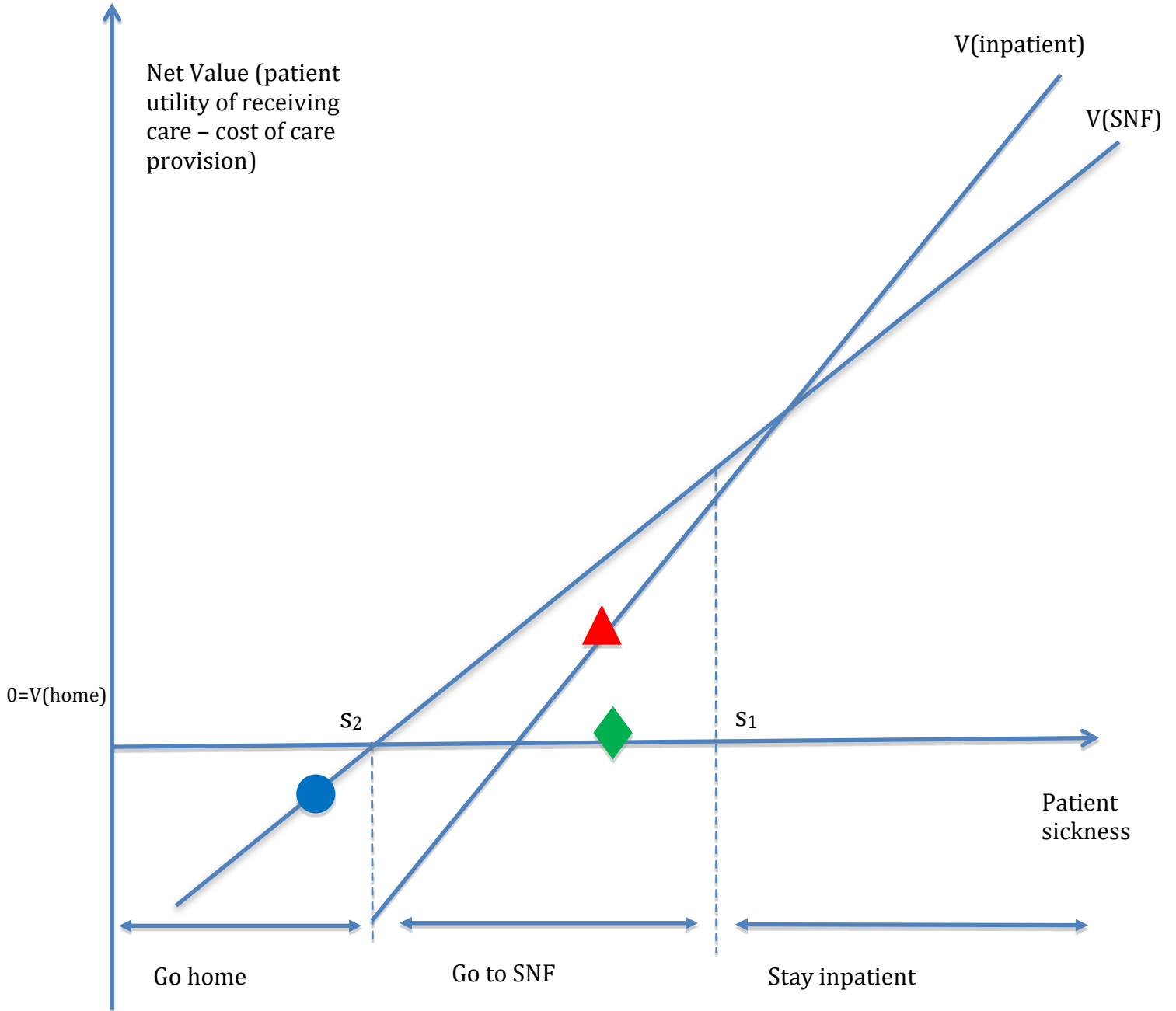


Figure 2: Sorting of destination with SNF_{high} and SNF_{low}

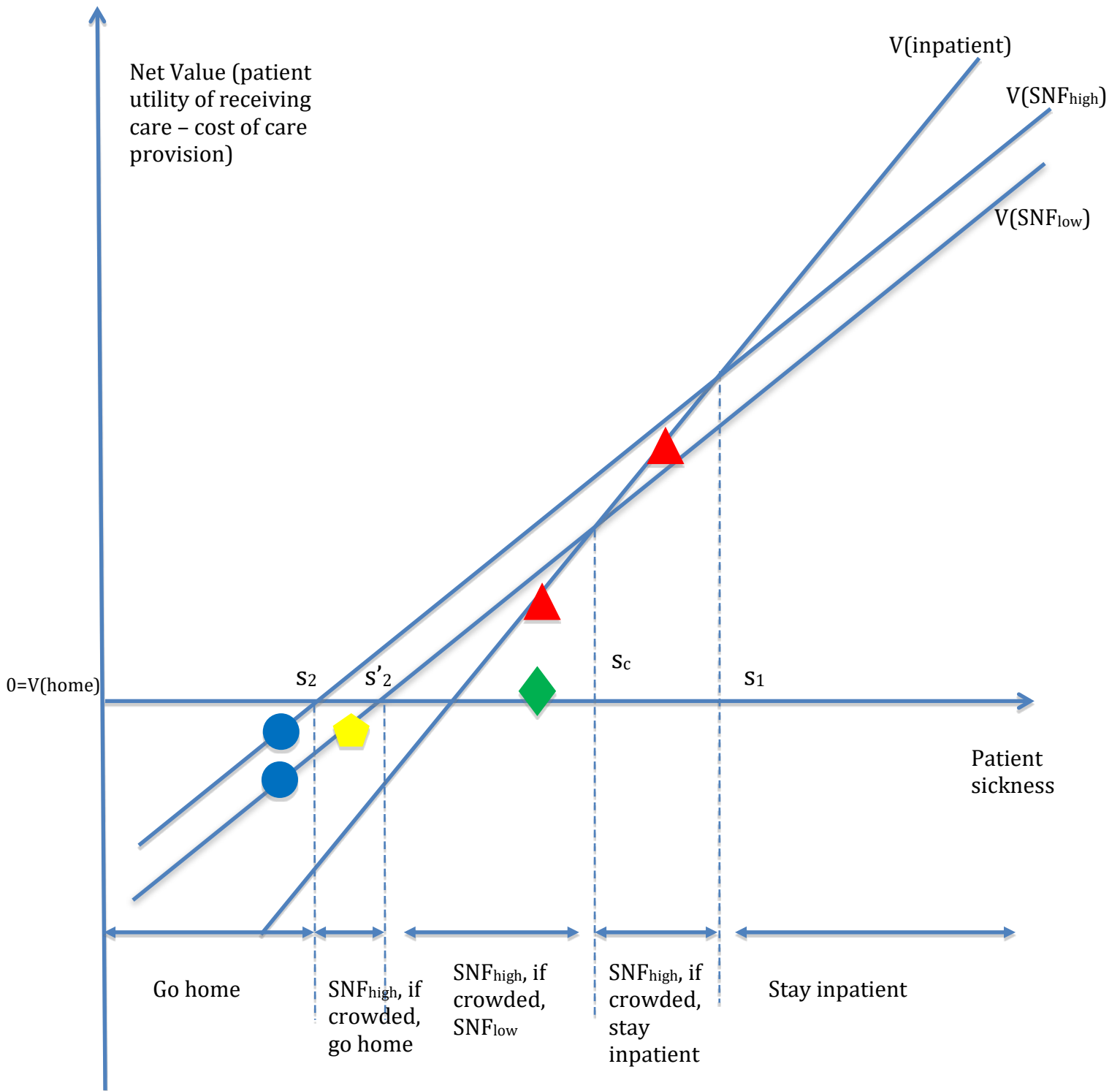


Table 1: Potential distortion from Medicare reimbursement rules for SNFs

	Description	Potential distortion in hospital's discharge decision	Extra cost for CMS (as a social planner)	Any adverse effect on patient readmission	Graphic illustration
Error 1	$s'_2 < s < s_1$ (so the patient should go to SNF _{high} , or SNF _{low} if SNF _{high} is full) but the patient is ready for discharge before reaching the three-day cutoff	Hospital keeps the patient beyond the cutoff and then discharges her to SNF	Medicare pays for extra inpatient stay while patient receives better but unnecessary care in hospital	No	Red triangle in Figure 1 and Figure 2
		Hospital discharges the patient home before the cutoff	Patient suffers from inadequate care after discharge, Medicare saves SNF cost	Yes	Green diamond in Figure 1 and Figure 2
Error 2	$s < s_2$ (so the patient should go home regardless of SNF quality) but the patient is ready for discharge after three-night inpatient stay	Hospital discharges the patient to SNF _{high} or SNF _{low}	Medicare pays for unnecessary SNF care	Potentially yes if SNF _{low} has a risk of providing worse care than home	Blue circle in Figure 1 and Figure 2
		Hospital discharges the patient home	Same as efficient outcome	No	
Error 3	$s_2 < s < s'_2$ (so the patient should go home when SNF _{high} is full) but the patient is ready for discharge after three-night inpatient stay	Hospital discharges the patient to SNF _{low}	Medicare pays for unnecessary SNF care	Potentially yes if SNF _{low} has a risk of providing worst care than home	Yellow pentagon in Figure 2
		Hospital discharges the patient home	Same as efficient outcome	No	

Table 2: Discharge destination by above/below threshold and Medicare/non-Medicare

	Day 2 & Medicare	Day 2 & Non-Medicare	Day 3 & Medicare	Day 3 & Non-Medicare
Home	0.801	0.859	0.582	0.702
SNF	0.022	0.013	0.163	0.077
Short-term	0.022	0.023	0.018	0.018
Other facilities	0.022	0.014	0.050	0.032
HHC	0.123	0.080	0.182	0.163
AMA	0.010	0.011	0.005	0.007
Observations	964,887	488,518	1,012,604	449,129

Notes: SNF denotes skilled nursing facilities; HHC home health care; AMA against medical advice.

Table 3: Summary statistics by discharge destination, above/below threshold, and Medicare/non-Medicare

<i>Panel A. Discharged home or HHC</i>				
	Day 2 & Medicare	Day 2 & Non-Medicare	Day 3 & Medicare	Day3 & Non-Medicare
Age	72.017	64.599	72.019	64.623
Female	0.525	0.493	0.539	0.507
<u>Main diagnosis</u>				
Heart attack or heart failure	0.056	0.055	0.063	0.058
Stroke	0.059	0.048	0.040	0.034
Knee or hip replacement	0.042	0.056	0.137	0.170
Other	0.843	0.842	0.759	0.738
<u>Comorbidity</u>				
Deficiency anemia	0.090	0.067	0.121	0.094
Chronic pulmonary disease	0.170	0.136	0.187	0.150
Diabetes, uncomplicated	0.246	0.222	0.248	0.223
Hypertension	0.674	0.601	0.677	0.607
Hypothyroidism	0.131	0.098	0.138	0.104
Fluid and electrolyte disorders	0.140	0.120	0.171	0.145
Renal failure	0.076	0.044	0.084	0.048
<u>Readmission rates</u>				
30-day readmission rates	0.089	0.072	0.096	0.079
60-day readmission rates	0.132	0.105	0.142	0.116
Observations	891,955	458,452	773,478	388,576
<i>Panel B. Transferred to SNF</i>				
	Day 2 & Medicare	Day 2 & Non-Medicare	Day 3 & Medicare	Day3 & Non-Medicare
Age	73.416	67.050	73.004	66.380
Female	0.611	0.585	0.686	0.657
<u>Main diagnosis</u>				
Heart attack or heart failure	0.029	0.020	0.012	0.006
Stroke	0.063	0.051	0.034	0.020
Knee or hip replacement	0.115	0.256	0.545	0.719
Other	0.793	0.674	0.409	0.255
<u>Comorbidity</u>				
Deficiency anemia	0.156	0.133	0.153	0.136
Chronic pulmonary disease	0.208	0.179	0.177	0.159
Diabetes, uncomplicated	0.304	0.265	0.240	0.227
Hypertension	0.673	0.624	0.700	0.667
Hypothyroidism	0.150	0.125	0.176	0.152
Fluid and electrolyte disorders	0.191	0.150	0.150	0.112
Renal failure	0.112	0.082	0.063	0.041
<u>Readmission rates</u>				
30-day readmission rates	0.126	0.097	0.085	0.063
60-day readmission rates	0.189	0.147	0.126	0.093
<u>SNF characteristics</u>				
Deficiency citations, HSA level	0.574	0.580	0.585	0.580
SNF occupancy, HSA level	88.470	88.601	88.638	89.492
Observations	21,141	6,431	165,103	34,696

Notes: HSA denotes health service area.

Table 4: SNF discharge rate and readmission rates by health condition, above/below threshold, and Medicare/non-Medicare

<i>Panel A. Knee or hip replacement</i>				
	Day 2 & Medicare	Day 2 & Non-Medicare	Day 3 & Medicare	Day3 & Non-Medicare
SNF	0.052	0.056	0.400	0.251
30-day readmission rates	0.029	0.024	0.040	0.031
60-day readmission rates	0.045	0.039	0.058	0.047
<u>Elixhauser Comorbidity Index</u>				
Readmission score	3.633	2.925	5.044	4.002
Mortality score	-0.272	-0.835	-0.099	-0.742
Observations	46,285	29,311	225,132	99,329
<i>Panel B. Heart disease</i>				
	Day 2 & Medicare	Day 2 & Non-Medicare	Day 3 & Medicare	Day3 & Non-Medicare
SNF	0.011	0.004	0.035	0.008
30-day readmission rates	0.119	0.091	0.137	0.113
60-day readmission rates	0.175	0.135	0.204	0.164
<u>Elixhauser Comorbidity Index</u>				
Readmission score	9.751	7.021	11.613	8.239
Mortality score	1.929	0.768	2.596	1.242
Observations	57,182	28,639	56,095	24,866
<i>Panel C. Stroke</i>				
	Day 2 & Medicare	Day 2 & Non-Medicare	Day 3 & Medicare	Day3 & Non-Medicare
SNF	0.023	0.014	0.130	0.044
30-day readmission rates	0.076	0.065	0.090	0.077
60-day readmission rates	0.115	0.098	0.134	0.111
<u>Elixhauser Comorbidity Index</u>				
Readmission score	6.575	5.554	8.030	6.518
Mortality score	1.041	0.456	1.596	0.866
Observations	58,029	23,528	42,904	15,779
<i>Panel D. Other</i>				
	Day 2 & Medicare	Day 2 & Non-Medicare	Day 3 & Medicare	Day3 & Non-Medicare
SNF	0.021	0.011	0.098	0.029
30-day readmission rates	0.090	0.074	0.103	0.088
60-day readmission rates	0.134	0.108	0.152	0.128
<u>Elixhauser Comorbidity Index</u>				
Readmission score	8.888	7.183	10.878	8.790
Mortality score	2.578	1.652	3.506	2.389
Observations	803,391	407,040	688,473	309,155

Notes: We compute Elixhauser Comorbidity Index according to Elixhauser et al. (1998) and the corresponding software developed by AHRQ (<https://www.hcup-us.ahrq.gov/toolssoftware/comorbidity/comorbidity.jsp>).

Table 5: First stage: discharge outcomes

	Home/HHC	SNF	Other facilities	AMA
<i>Panel A. Full sample</i>				
Day 3*Medicare	-0.076*** (0.003)	0.068*** (0.004)	0.008*** (0.003)	-0.000 (0.000)
Observations	2,915,127	2,915,127	2,915,127	2,915,127
Adjusted R^2	0.237	0.215	0.124	0.053
Mean Y	0.862	0.078	0.052	0.008
<i>Panel B. No comorbidity</i>				
Day 3*Medicare	-0.079*** (0.004)	0.066*** (0.005)	0.013*** (0.004)	-0.000 (0.001)
Observations	352,749	352,749	352,749	352,749
Adjusted R^2	0.215	0.184	0.128	0.101
Mean Y	0.904	0.052	0.038	0.006
<i>Panel C. Any comorbidity</i>				
Day 3*Medicare	-0.075*** (0.003)	0.068*** (0.004)	0.008*** (0.003)	-0.000 (0.000)
Observations	2,562,350	2,562,350	2,562,350	2,562,350
Adjusted R^2	0.241	0.219	0.124	0.049
Mean Y	0.856	0.082	0.054	0.008
<i>Panel D. Below-median Elixhauser Comorbidity Index readmission score</i>				
Day 3*Medicare	-0.080*** (0.004)	0.069*** (0.005)	0.012*** (0.004)	-0.000 (0.000)
Observations	1,437,652	1,437,652	1,437,652	1,437,652
Adjusted R^2	0.255	0.229	0.139	0.060
Mean Y	0.877	0.070	0.048	0.006
<i>Panel E. Above-median Elixhauser Comorbidity Index readmission score</i>				
Day 3*Medicare	-0.073*** (0.003)	0.067*** (0.004)	0.006*** (0.002)	0.000 (0.000)
Observations	1,477,450	1,477,450	1,477,450	1,477,450
Adjusted R^2	0.228	0.209	0.116	0.050
Mean Y	0.848	0.086	0.057	0.010

Notes: Each cell shows an estimate from a different regression. In addition to Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table 6: Readmission rates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Full sample		No comorbidity		Any comorbidity		Below-median readmission score		Above-median readmission score	
	30-day	60-day	30-day	60-day	30-day	60-day	30-day	60-day	30-day	60-day
<i>Panel A. OLS</i>										
Discharge to SNF	0.021*** (0.002)	0.031*** (0.002)	0.013*** (0.003)	0.018*** (0.003)	0.022*** (0.002)	0.032*** (0.002)	0.017*** (0.002)	0.024*** (0.002)	0.025*** (0.002)	0.037*** (0.002)
Observations	2,915,127	2,915,127	352,749	352,749	2,562,350	2,562,350	1,437,652	1,437,652	1,477,450	1,477,450
Adjusted R^2	0.031	0.045	0.044	0.053	0.030	0.043	0.028	0.036	0.027	0.039
Mean Y	0.084	0.124	0.061	0.088	0.088	0.129	0.065	0.094	0.104	0.154
<i>Panel B. 2SLS</i>										
Discharge to SNF	-0.011 (0.010)	-0.030*** (0.011)	0.005 (0.023)	0.011 (0.024)	-0.016 (0.011)	-0.037*** (0.012)	-0.004 (0.015)	-0.009 (0.017)	-0.023 (0.015)	-0.056*** (0.019)
Observations	2,915,127	2,915,127	352,749	352,749	2,562,350	2,562,350	1,437,652	1,437,652	1,477,450	1,477,450
Adjusted R^2	0.031	0.043	0.044	0.053	0.029	0.040	0.028	0.036	0.025	0.035
Mean Y	0.084	0.124	0.061	0.088	0.088	0.129	0.065	0.094	0.104	0.154
F statistic	277.995	277.995	166.737	166.737	273.041	273.041	192.903	192.903	337.427	337.427

Notes: Each cell shows an estimate from a different regression. Panel A shows the OLS estimates from a regression of 30- or 60-day readmission rate on SNF discharges, controlling for an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Panel B shows the 2SLS estimates where we instrument SNF discharges with an interaction between Day 3 and Medicare. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table 7: First stage by condition: discharge outcomes

	Home/HHC	SNF	Other facilities	AMA
<i>Panel A. Knee/hip replacement</i>				
Day 3*Medicare	-0.132*** (0.012)	0.139*** (0.014)	-0.007 (0.011)	-0.000 (0.000)
Observations	400,046	400,046	400,046	400,046
Adjusted R^2	0.342	0.279	0.277	0.003
Mean Y	0.587	0.297	0.116	0.000
<i>Panel B. Heart disease</i>				
Day 3*Medicare	-0.019*** (0.003)	0.018*** (0.001)	0.001 (0.003)	0.000 (0.001)
Observations	166,758	166,758	166,758	166,758
Adjusted R^2	0.301	0.054	0.346	0.017
Mean Y	0.880	0.017	0.092	0.011
<i>Panel C. Stroke</i>				
Day 3*Medicare	-0.078*** (0.005)	0.071*** (0.005)	0.007* (0.004)	-0.001 (0.001)
Observations	140,224	140,224	140,224	140,224
Adjusted R^2	0.179	0.100	0.131	0.015
Mean Y	0.848	0.057	0.087	0.008
<i>Panel D. Other conditions</i>				
Day 3*Medicare	-0.053*** (0.002)	0.051*** (0.002)	0.002*** (0.001)	-0.001** (0.000)
Observations	2,208,047	2,208,047	2,208,047	2,208,047
Adjusted R^2	0.160	0.146	0.090	0.058
Mean Y	0.911	0.044	0.036	0.009

Notes: Each cell shows an estimate from a different regression. In addition to Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table 8: OLS by condition: readmission rates

	Full sample		No comorbidity		Any comorbidity	
	Knee/hip replacement	Other conditions	Knee/hip replacement	Other conditions	Knee/hip replacement	Other conditions
<i>Panel A. 30-day readmission rates</i>						
Discharge to SNF	0.018*** (0.001)	0.026*** (0.002)	0.013*** (0.002)	0.017*** (0.004)	0.018*** (0.001)	0.027*** (0.002)
Observations	400,046	2,515,070	62,191	290,531	337,825	2,224,509
Adjusted R^2	0.015	0.028	0.015	0.043	0.015	0.026
Mean Y	0.036	0.092	0.026	0.069	0.037	0.095
<i>Panel B. 60-day readmission rates</i>						
Discharge to SNF	0.024*** (0.001)	0.042*** (0.002)	0.016*** (0.003)	0.032*** (0.004)	0.025*** (0.001)	0.042*** (0.002)
Observations	400,046	2,515,070	62,191	290,531	337,825	2,224,509
Adjusted R^2	0.017	0.040	0.015	0.051	0.017	0.038
Mean Y	0.053	0.136	0.041	0.098	0.055	0.141

Notes: Each cell shows an estimate from a different regression. In addition to the indicator for discharge to SNF, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table 9: 2SLS by condition: readmission rates

	Full sample		No comorbidity		Any comorbidity	
	Knee/hip replacement	Other conditions	Knee/hip replacement	Other conditions	Knee/hip replacement	Other conditions
<i>Panel A. 30-day readmission rates</i>						
Discharge to SNF	0.026** (0.010)	-0.010 (0.015)	0.043** (0.020)	0.014 (0.048)	0.020 (0.013)	-0.014 (0.015)
Observations	400,046	2,515,070	62,191	290,531	337,825	2,224,509
Adjusted R^2	0.015	0.028	0.010	0.043	0.015	0.025
Mean Y	0.036	0.092	0.026	0.069	0.037	0.095
F statistic	94.942	520.255	85.830	308.921	84.136	519.957
<i>Panel B. 60-day readmission rates</i>						
Discharge to SNF	0.039*** (0.013)	-0.020 (0.016)	0.044 (0.028)	0.049 (0.052)	0.036** (0.016)	-0.029* (0.017)
Observations	400,046	2,515,070	62,191	290,531	337,825	2,224,509
Adjusted R^2	0.016	0.039	0.012	0.051	0.016	0.036
Mean Y	0.053	0.136	0.041	0.098	0.055	0.141
F statistic	94.942	520.255	85.830	308.921	84.136	519.957

Notes: Each cell shows an estimate from a different regression. In addition to the indicator for discharge to SNF instrumented with Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table 10: 2SLS by condition & local SNF characteristics, knee and hip replacement

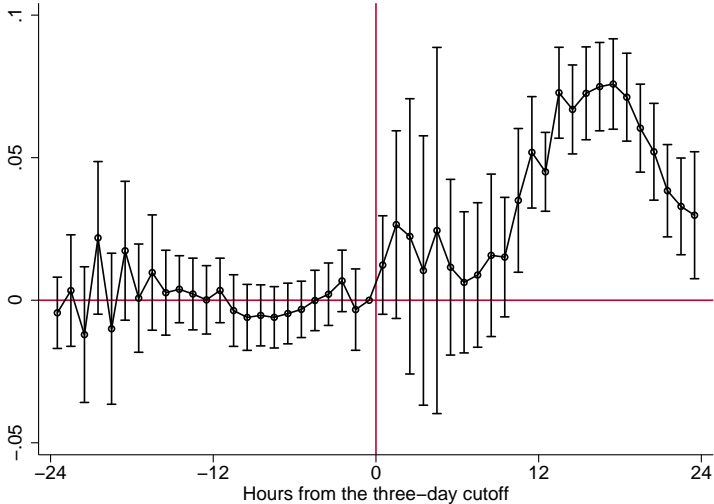
	Low occupancy		High occupancy	
	30-day	60-day	30-day	60-day
<i>Panel A. By occupancy</i>				
Discharge to SNF	0.031*** (0.012)	0.052*** (0.015)	0.008 (0.018)	-0.001 (0.021)
Observations	309,140	309,140	90,892	90,892
Adjusted R^2	0.016	0.016	0.011	0.012
Mean Y	0.035	0.052	0.036	0.054
F statistic	68.795	68.795	135.507	135.507
	Low deficiency		High deficiency	
	30-day	60-day	30-day	60-day
<i>Panel B. By deficiency</i>				
Discharge to SNF	0.012 (0.019)	0.021 (0.025)	0.033*** (0.012)	0.048*** (0.013)
Observations	163,734	163,734	236,295	236,295
Adjusted R^2	0.017	0.019	0.013	0.014
Mean Y	0.035	0.052	0.036	0.053
F statistic	35.374	35.374	139.184	139.184

Notes: Each cell shows an estimate from a different regression. We define low vs high deficiency areas based on the average number of deficiency citations across SNFs in a given HSA relative to the median of the corresponding state in the preceding year. Similarly, we define low vs high occupancy areas based on the average occupancy rate across SNFs in a given HSA relative to the median of the corresponding state in the year preceding the admission year. In addition to the indicator for discharge to SNF instrumented with Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

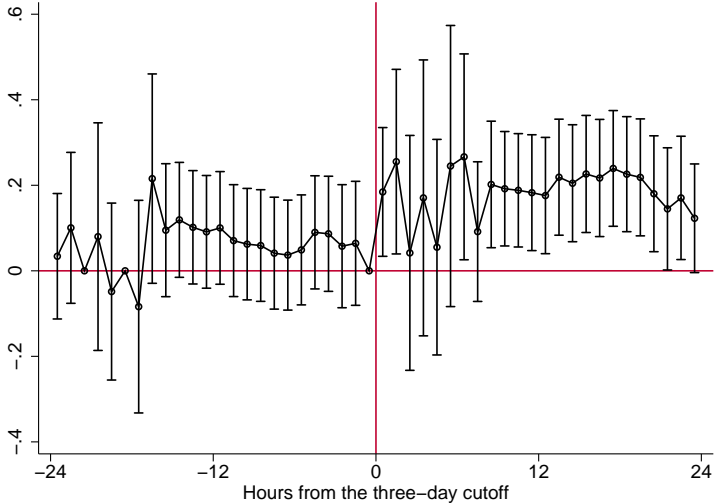
Table 11: Back of the envelope calculation (in million)

	(1)	(2)
<i>Panel A. Full sample</i>		
Total Medicare population in 2015	55.51	
Total Medicare population in our sample states and years	77.91	
Total Medicare population in our data	$.96 + 1.01 = 1.97$	
Share of Medicare population showing up in our sample	$1.97/77.91 = 2.5\%$	
Share of Medicare population showing up in our day-3 sample	$1.01/77.91 = 1.3\%$	
Average SNF care for Medicare	\$500 per day	
Average SNF stay for Medicare	37 days	
	<i>No comorbidity</i>	<i>Below-median comorbidity index</i>
Average increase in SNF admission due to the three-day rule	6.6%	6.9%
Share of patients in each category	11.32%	48.51%
<u>Potential savings of discharges home rather than to SNF</u>		
For our day-3 Medicare sample	$1.01 \times 6.6\% \times 11.32\% \times \$500 \times 37 \text{ days} = 139.60$	$1.01 \times 6.9\% \times 48.51\% \times \$500 \times 37 \text{ days} = 625.42$
Annual savings for the whole Medicare population	$55.51 \times 1.3\% \times 6.6\% \times 11.32\% \times \$500 \times 37 \text{ days} = 99.74$	$55.51 \times 1.3\% \times 6.9\% \times 48.51\% \times \$500 \times 37 \text{ days} = 446.86$
Annual savings as a share of total Medicare payment to SNF	$115.09/31332 = 0.32\%$	$515.60/31332 = 1.43\%$
<i>Panel B. Knee and hip replacement only</i>		
Total joint replacement patients with Medicare in our data	$0.04 + 0.11 = 0.15$	
Share of Medicare population showing up in the subsample	$0.15/77.91 = 0.19\%$	
Share of Medicare population showing up in the day-3 subsample	$0.11/77.91 = 0.14\%$	
Average increase in SNF admission due to the three-day rule	14%	
Share of total joint replacement patients without complications	97.4%	
60-day readmission effect of SNF discharge	4.0%	
<u>Sources of wastes</u>		
(1) Discharge to SNF rather than home	\$500 per day for 15 days	
(2) Readmission to hospital	\$10,000 per readmission	
(3) Longer initial hospital stays to qualify for SNF coverage		
<u>Estimation of wastes</u>		
	<i>For our day-3 Medicare sample with joint replacement</i>	<i>Potential annual savings for the whole Medicare population</i>
(1) Discharge to SNF rather than home	$0.11 \times 97.4\% \times 14\% \times \$500 \times 15 \text{ days} = 112.50$	$55.51 \times 0.14\% \times 97.4\% \times 14\% \times \$500 \times 15 \text{ days} = 79.48$
(2) Readmission to hospital	$0.11 \times 97.4\% \times 14\% \times 4.0\% \times \$10000 = 6.00$	$55.51 \times 0.14\% \times 97.4\% \times 14\% \times 4.0\% \times \$10000 = 4.24$
<u>Total wastes</u>		
	$112.50 + 6.00 = 118.50$	$79.48 + 4.24 = 83.73$
Total Medicare expenditure on total joint replacement		7000
Total waste as a share of total Medicare expenditure		$83.73/7000 = 1.20\%$

Appendix A. Appendix Figures



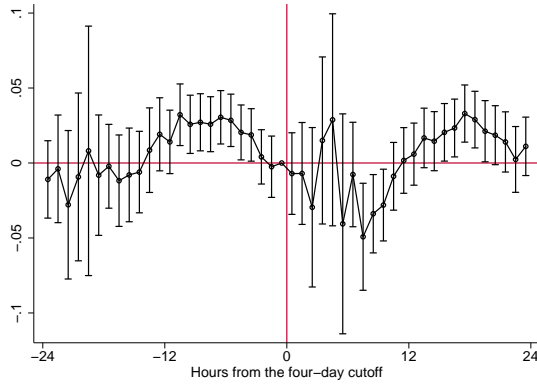
(a) Full sample



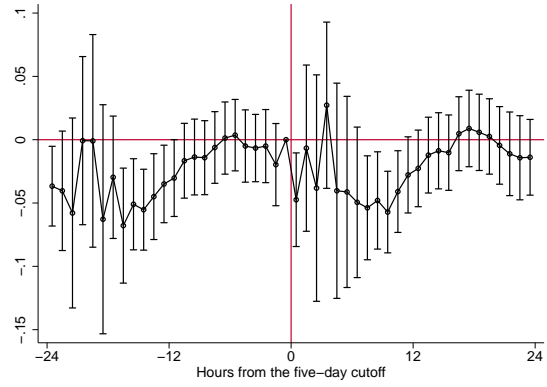
(b) Knee and hip replacement only

Figure A.1: Event study graph, outcome: discharge to SNF

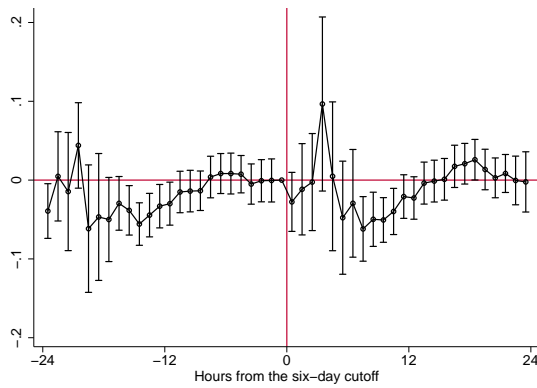
Notes: The corresponding regression is analogous to equation (1), replacing Day3*Medicare with a series of interactions between Medicare and each discharge hour within the 24 hour window before and after the three-day cutoff.



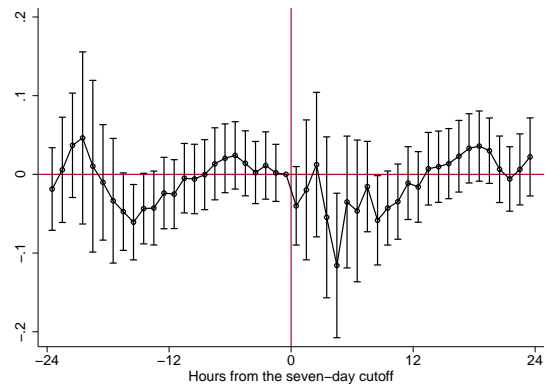
(a) Day 4 cutoff



(b) Day 5 cutoff



(c) Day 6 cutoff



(d) Day 7 cutoff

Figure A.2: Event study graph, outcome: discharge to SNF, placebo cutoffs

Notes: Instead of hours from the three-day cutoff, panels (a), (b), (c), and (d) examine the effects of discharges at hours from the four, five, six, and seven-day cutoffs, respectively.

Appendix B. Appendix Tables

Table B.1: First stage discharge outcomes & 2SLS readmission rates: placebo cutoffs

	First stage				2SLS	
	Home/HHC	SNF	Other facilities	AMA	30-day	60-day
<i>Panel A. Day 3 vs 4</i>						
Day 4*Medicare	0.007*** (0.002)	-0.007*** (0.002)	-0.000 (0.001)	-0.000 (0.000)		
Discharge to SNF					-0.020 (0.121)	-0.174 (0.149)
Observations	2,423,929	2,423,929	2,423,929	2,423,929	2,423,929	2,423,929
Adjusted R^2	0.261	0.224	0.126	0.045	0.032	0.016
Mean Y	0.795	0.133	0.066	0.005	0.093	0.136
F statistic					11.466	11.466
<i>Panel B. Day 4 vs 5</i>						
Day 5*Medicare	0.002 (0.002)	0.004*** (0.001)	-0.006*** (0.002)	0.000 (0.000)		
Discharge to SNF					0.413 (0.400)	0.728 (0.462)
Observations	1,596,859	1,596,859	1,596,859	1,596,859	1,596,859	1,596,859
Adjusted R^2	0.261	0.207	0.125	0.041	-0.103	-0.268
Mean Y	0.791	0.132	0.073	0.005	0.110	0.160
F statistic					10.028	10.028
<i>Panel C. Day 5 vs 6</i>						
Day 6*Medicare	-0.008*** (0.002)	0.010*** (0.001)	-0.002* (0.001)	-0.000 (0.000)		
Discharge to SNF					0.169 (0.128)	0.071 (0.138)
Observations	1,088,767	1,088,767	1,088,767	1,088,767	1,088,767	1,088,767
Adjusted R^2	0.261	0.200	0.118	0.034	0.015	0.043
Mean Y	0.775	0.143	0.077	0.004	0.125	0.179
F statistic					85.073	85.073
<i>Panel D. Day 6 vs 7</i>						
Day 7*Medicare	-0.011*** (0.002)	0.011*** (0.002)	-0.000 (0.001)	0.000 (0.000)		
Discharge to SNF					-0.122 (0.151)	-0.054 (0.170)
Observations	797,400	797,400	797,400	797,400	797,400	797,400
Adjusted R^2	0.246	0.184	0.115	0.029	0.003	0.031
Mean Y	0.753	0.160	0.082	0.004	0.138	0.196
F statistic					43.070	43.070

Notes: Each regression includes an indicator for Day 4, 5, 6, or 7, an indicator for Medicare as well as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. For 2SLS regressions, we instrument SNF discharges with the interaction between Day 4, 5, 6, or 7 and Medicare. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.2: First stage: discharge outcomes, age 60-69

	Home/HHC	SNF	Other facilities	AMA
Day 3*Medicare	-0.057*** (0.003)	0.050*** (0.004)	0.007*** (0.003)	-0.000 (0.000)
Observations	1,414,079	1,414,079	1,414,079	1,414,079
Adjusted R^2	0.207	0.186	0.128	0.075
Mean Y	0.892	0.053	0.046	0.009

Notes: We focus on patients with age between 60 and 69 and repeat the first stage estimations. In addition to Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.3: 2SLS: Readmission rates, age 60-69

	Full sample		No comorbidity		Any comorbidity	
	30-day	60-day	30-day	60-day	30-day	60-day
Discharge to SNF	-0.012 (0.019)	-0.040* (0.021)	0.067 (0.046)	0.051 (0.053)	-0.027 (0.020)	-0.056** (0.023)
Observations	1,414,079	1,414,079	208,702	208,702	1,205,345	1,205,345
Adjusted R^2	0.037	0.049	0.054	0.063	0.033	0.045
Mean Y	0.077	0.113	0.056	0.080	0.080	0.118
F statistic	193.982	193.982	110.744	110.744	186.943	186.943

Notes: We focus on patients with age between 60 and 69 and repeat the 2SLS estimations. Each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. We instrument SNF discharges with an interaction between Day 3 and Medicare. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.4: 2SLS by condition: readmission rates, age 60-69

	Full sample		No comorbidity		Any comorbidity	
	Knee/hip replacement	Other conditions	Knee/hip replacement	Other conditions	Knee/hip replacement	Other conditions
<i>Panel A. 30-day readmission rates</i>						
Discharge to SNF	0.030* (0.016)	-0.012 (0.032)	0.084** (0.036)	0.134 (0.126)	0.018 (0.019)	-0.030 (0.033)
Observations	206,208	1,207,859	36,254	172,414	169,911	1,035,414
Adjusted R^2	0.013	0.034	-0.010	0.053	0.014	0.030
Mean Y	0.031	0.085	0.023	0.063	0.032	0.088
F statistic	87.000	423.672	69.057	196.600	77.840	405.464
<i>Panel B. 60-day readmission rates</i>						
Discharge to SNF	0.046** (0.020)	-0.045 (0.036)	0.066 (0.047)	0.133 (0.144)	0.040* (0.023)	-0.066* (0.037)
Observations	206,208	1,207,859	36,254	172,414	169,911	1,035,414
Adjusted R^2	0.014	0.046	0.005	0.062	0.015	0.042
Mean Y	0.047	0.124	0.037	0.089	0.050	0.129
F statistic	87.000	423.672	69.057	196.600	77.840	405.464

Notes: We focus on patients with age between 60 and 69 and repeat the 2SLS estimations by health conditions. In addition to the indicator for discharge to SNF instrumented with Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.5: 2SLS by condition & local SNF characteristics, knee and hip replacement, age 60-69

	Low occupancy		High occupancy	
	30-day	60-day	30-day	60-day
<i>Panel A. By occupancy</i>				
Discharge to SNF	0.043** (0.017)	0.071*** (0.022)	-0.010 (0.036)	-0.035 (0.045)
Observations	158,831	158,831	47,368	47,368
Adjusted R^2	0.013	0.010	0.008	0.005
Mean Y	0.031	0.047	0.031	0.048
F statistic	65.106	65.106	92.826	92.826
	Low deficiency		High deficiency	
	30-day	60-day	30-day	60-day
<i>Panel B. By deficiency</i>				
Discharge to SNF	0.021 (0.029)	0.017 (0.040)	0.034* (0.018)	0.059** (0.023)
Observations	83,565	83,565	122,618	122,618
Adjusted R^2	0.016	0.017	0.013	0.011
Mean Y	0.030	0.046	0.031	0.048
F statistic	34.430	34.430	116.989	116.989

Notes: We focus on patients with age between 60 and 69 and repeat the 2SLS estimations by local SNF characteristics for knee and hip replacement patients. In addition to the indicator for discharge to SNF instrumented with Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.6: First stage: discharge outcomes, age 62-67

	Home/HHC	SNF	Other facilities	AMA
Day 3*Medicare	-0.049*** (0.003)	0.044*** (0.004)	0.006** (0.003)	-0.001 (0.000)
Observations	845,080	845,080	845,080	845,080
Adjusted R^2	0.207	0.184	0.130	0.071
Mean Y	0.893	0.052	0.046	0.009

Notes: We focus on patients with age between 62 and 67 and repeat the first stage estimations. In addition to Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.7: 2SLS: Readmission rates, age 62-67

	Full sample		No comorbidity		Any comorbidity	
	30-day	60-day	30-day	60-day	30-day	60-day
Discharge to SNF	0.032 (0.029)	-0.013 (0.031)	0.141** (0.071)	0.113 (0.082)	0.009 (0.031)	-0.039 (0.034)
Observations	845,080	845,080	124,813	124,813	720,230	720,230
Adjusted R^2	0.037	0.050	0.044	0.058	0.034	0.047
Mean Y	0.076	0.111	0.055	0.079	0.079	0.117
F statistic	145.295	145.295	78.258	78.258	140.556	140.556

Notes: We focus on patients with age between 62 and 67 and repeat the 2SLS estimations. In addition to the indicator for discharge to SNF instrumented with Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.8: 2SLS by condition: readmission rates, age 62-67

	Full sample		No comorbidity		Any comorbidity	
	Knee/hip replacement	Other conditions	Knee/hip replacement	Other conditions	Knee/hip replacement	Other conditions
<i>Panel A. 30-day readmission rates</i>						
Discharge to SNF	0.067*** (0.023)	0.054 (0.051)	0.103* (0.054)	0.288 (0.188)	0.058** (0.027)	0.022 (0.052)
Observations	125,320	719,738	22,010	102,754	103,259	616,947
Adjusted R^2	0.003	0.034	-0.028	0.042	0.007	0.031
Mean Y	0.030	0.084	0.022	0.062	0.032	0.087
F statistic	63.885	395.781	46.854	112.375	57.546	371.542
<i>Panel B. 60-day readmission rates</i>						
Discharge to SNF	0.071** (0.029)	-0.006 (0.054)	0.056 (0.066)	0.257 (0.213)	0.068** (0.033)	-0.040 (0.057)
Observations	125,320	719,738	22,010	102,754	103,259	616,947
Adjusted R^2	0.009	0.047	0.007	0.056	0.010	0.043
Mean Y	0.047	0.122	0.035	0.088	0.050	0.128
F statistic	63.885	395.781	46.854	112.375	57.546	371.542

Notes: We focus on patients with age between 62 and 67 and repeat the 2SLS estimations by health conditions. In addition to the indicator for discharge to SNF instrumented with Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.9: 2SLS by condition & local SNF characteristics, knee and hip replacement, age 62-67

	Low occupancy		High occupancy	
	30-day	60-day	30-day	60-day
<i>Panel A. By occupancy</i>				
Discharge to SNF	0.092*** (0.029)	0.114*** (0.037)	0.000 (0.044)	-0.046 (0.053)
Observations	96,482	96,482	28,826	28,826
Adjusted R^2	-0.009	-0.007	0.012	0.001
Mean Y	0.031	0.048	0.029	0.046
F statistic	45.157	45.157	88.075	88.075
	Low deficiency		High deficiency	
	30-day	60-day	30-day	60-day
<i>Panel B. By deficiency</i>				
Discharge to SNF	0.053 (0.042)	0.050 (0.054)	0.073*** (0.027)	0.078** (0.035)
Observations	50,948	50,948	74,351	74,351
Adjusted R^2	0.010	0.016	0.000	0.006
Mean Y	0.030	0.047	0.030	0.048
F statistic	25.492	25.492	83.967	83.967

Notes: We focus on patients with age between 62 and 67 and repeat the 2SLS estimations by local SNF characteristics for knee and hip replacement patients. In addition to the indicator for discharge to SNF instrumented with Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.10: First stage: discharge outcomes, all inpatient episodes

	Home/HHC	SNF	Other facilities	AMA
Day 3*Medicare	-0.068*** (0.003)	0.062*** (0.004)	0.007*** (0.002)	-0.000 (0.000)
Observations	4,256,972	4,256,972	4,256,972	4,256,972
Adjusted R^2	0.206	0.179	0.115	0.068
Mean Y	0.846	0.087	0.057	0.009

Notes: We include all inpatient episodes and repeat the first stage estimations. In addition to Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.11: 2SLS: Readmission rates, all inpatient episodes

	Full sample		No comorbidity		Any comorbidity	
	30-day	60-day	30-day	60-day	30-day	60-day
Discharge to SNF	-0.028** (0.012)	-0.040*** (0.011)	0.015 (0.026)	0.019 (0.025)	-0.034*** (0.012)	-0.048*** (0.012)
Observations	4,256,972	4,256,972	444,768	444,768	3,812,181	3,812,181
Adjusted R^2	0.058	0.078	0.103	0.112	0.053	0.072
Mean Y	0.126	0.182	0.086	0.121	0.130	0.189
F statistic	307.899	307.899	152.494	152.494	309.103	309.103

Notes: We include all inpatient episodes and repeat the 2SLS estimations. In addition to the indicator for discharge to SNF instrumented with Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.12: 2SLS by condition: readmission rates, all inpatient episodes

	Full sample		No comorbidity		Any comorbidity	
	Knee/hip replacement	Other conditions	Knee/hip replacement	Other conditions	Knee/hip replacement	Other conditions
<i>Panel A. 30-day readmission rates</i>						
Discharge to SNF	0.024** (0.010)	-0.029* (0.017)	0.044** (0.020)	0.046 (0.053)	0.017 (0.012)	-0.037** (0.016)
Observations	450,738	3,806,223	68,378	376,369	382,336	3,429,830
Adjusted R^2	0.016	0.052	0.009	0.101	0.016	0.047
Mean Y	0.037	0.136	0.027	0.097	0.039	0.140
F statistic	97.255	532.289	88.590	230.071	85.622	543.258
<i>Panel B. 60-day readmission rates</i>						
Discharge to SNF	0.043*** (0.012)	-0.031** (0.015)	0.049** (0.024)	0.082 (0.052)	0.038*** (0.015)	-0.041** (0.016)
Observations	450,738	3,806,223	68,378	376,369	382,336	3,429,830
Adjusted R^2	0.018	0.070	0.011	0.109	0.018	0.064
Mean Y	0.055	0.197	0.042	0.135	0.058	0.204
F statistic	97.255	532.289	88.590	230.071	85.622	543.258

Notes: We include all inpatient episodes and repeat the 2SLS estimations by health conditions. In addition to the indicator for discharge to SNF instrumented with Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.13: 2SLS by local SNF characteristics, knee and hip replacement, all inpatient episodes

	Low occupancy		High occupancy	
	30-day	60-day	30-day	60-day
<i>Panel A. By occupancy</i>				
Discharge to SNF	0.028** (0.012)	0.049*** (0.015)	0.010 (0.016)	0.023 (0.019)
Observations	348,211	348,211	102,510	102,510
Adjusted R^2	0.016	0.018	0.013	0.016
Mean Y	0.037	0.055	0.038	0.057
F statistic	70.602	70.602	135.605	135.605
	Low deficiency		High deficiency	
	30-day	60-day	30-day	60-day
<i>Panel B. By deficiency</i>				
Discharge to SNF	0.018 (0.018)	0.037 (0.025)	0.026** (0.011)	0.044*** (0.013)
Observations	185,616	185,616	265,108	265,108
Adjusted R^2	0.017	0.020	0.015	0.017
Mean Y	0.036	0.054	0.038	0.056
F statistic	36.587	36.587	140.875	140.875

Notes: We include all inpatient episodes and repeat the 2SLS estimations by local SNF characteristics for knee and hip replacement patients. In addition to the indicator for discharge to SNF instrumented with Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.14: First stage: discharge outcomes, dropping MA

	Home/HHC	SNF	Other facilities	AMA
Day 3*Medicare	-0.083*** (0.004)	0.073*** (0.005)	0.011*** (0.004)	-0.000 (0.000)
Observations	2,447,892	2,447,892	2,447,892	2,447,892
Adjusted R^2	0.228	0.198	0.126	0.058
Mean Y	0.862	0.075	0.055	0.008

Notes: We drop patients from NY and FL whom we could identify as enrolled in Medicare Advantage (MA) and repeat the first stage estimations. In addition to Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.15: 2SLS: Readmission rates, dropping MA

	Full sample		No comorbidity		Any comorbidity	
	30-day	60-day	30-day	60-day	30-day	60-day
Discharge to SNF	-0.008 (0.010)	-0.024** (0.011)	0.022 (0.024)	0.021 (0.026)	-0.013 (0.011)	-0.032** (0.012)
Observations	2,447,892	2,447,892	309,438	309,438	2,138,427	2,138,427
Adjusted R^2	0.032	0.045	0.046	0.054	0.030	0.042
Mean Y	0.084	0.123	0.061	0.086	0.087	0.128
F statistic	204.637	204.637	115.857	115.857	202.329	202.329

Notes: We drop patients from NY and FL whom we could identify as enrolled in Medicare Advantage (MA) and repeat the 2SLS estimations. In addition to the indicator for discharge to SNF instrumented with Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.16: 2SLS by condition: readmission rates, dropping MA

	Full sample		No comorbidity		Any comorbidity	
	Knee/hip replacement	Other conditions	Knee/hip replacement	Other conditions	Knee/hip replacement	Other conditions
<i>Panel A. 30-day readmission rates</i>						
Discharge to SNF	0.028*** (0.010)	-0.001 (0.013)	0.048** (0.021)	0.043 (0.042)	0.023* (0.012)	-0.007 (0.014)
Observations	344,350	2,103,530	55,750	253,655	288,563	1,849,846
Adjusted R^2	0.014	0.029	0.007	0.044	0.014	0.026
Mean Y	0.034	0.092	0.026	0.068	0.036	0.095
F statistic	74.181	688.815	62.593	325.946	68.491	709.509
<i>Panel B. 60-day readmission rates</i>						
Discharge to SNF	0.039*** (0.013)	-0.008 (0.014)	0.053* (0.029)	0.058 (0.047)	0.036** (0.015)	-0.016 (0.015)
Observations	344,350	2,103,530	55,750	253,655	288,563	1,849,846
Adjusted R^2	0.016	0.040	0.010	0.052	0.016	0.038
Mean Y	0.051	0.135	0.040	0.097	0.053	0.140
F statistic	74.181	688.815	62.593	325.946	68.491	709.509

Notes: We drop patients from NY and FL whom we could identify as enrolled in Medicare Advantage (MA) and repeat the 2SLS estimations by health conditions. In addition to the indicator for discharge to SNF instrumented with Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.17: 2SLS by condition & local SNF characteristics, knee and hip replacement, dropping MA

	Low occupancy		High occupancy	
	30-day	60-day	30-day	60-day
<i>Panel A. By occupancy</i>				
Discharge to SNF	0.035*** (0.011)	0.055*** (0.015)	0.006 (0.018)	-0.008 (0.022)
Observations	265,032	265,032	79,305	79,305
Adjusted R^2	0.014	0.015	0.011	0.011
Mean Y	0.034	0.051	0.035	0.052
F statistic	54.488	54.488	108.253	108.253
	Low deficiency		High deficiency	
	30-day	60-day	30-day	60-day
<i>Panel B. By deficiency</i>				
Discharge to SNF	0.018 (0.017)	0.025 (0.023)	0.033*** (0.012)	0.047*** (0.014)
Observations	140,156	140,156	204,175	204,175
Adjusted R^2	0.016	0.018	0.013	0.014
Mean Y	0.033	0.050	0.035	0.052
F statistic	28.371	28.371	104.874	104.874

Notes: We drop patients from NY and FL whom we could identify as enrolled in Medicare Advantage (MA) and repeat the 2SLS estimations by local SNF characteristics for knee and hip replacement patients. In addition to the indicator for discharge to SNF instrumented with Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.18: First stage: discharge outcomes, 12-hour window

	Home/HHC	SNF	Other facilities	AMA
Day 3*Medicare	-0.070*** (0.007)	0.054*** (0.006)	0.017** (0.008)	-0.000 (0.000)
Observations	1,111,287	1,111,287	1,111,287	1,111,287
Adjusted R^2	0.213	0.183	0.140	0.062
Mean Y	0.893	0.050	0.048	0.008

Notes: We focus on 12 hours before and after the three-day cutoff and repeat the first stage estimations. In addition to Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.19: 2SLS: Readmission rates, 12-hour window

	Full sample		No comorbidity		Any comorbidity	
	30-day	60-day	30-day	60-day	30-day	60-day
Discharge to SNF	-0.090*** (0.031)	-0.121*** (0.035)	-0.064 (0.046)	-0.092* (0.053)	-0.092*** (0.034)	-0.123*** (0.038)
Observations	1,111,287	1,111,287	134,973	134,973	976,271	976,271
Adjusted R^2	0.026	0.038	0.046	0.052	0.024	0.035
Mean Y	0.080	0.118	0.058	0.083	0.083	0.123
F statistic	79.766	79.766	56.096	56.096	80.340	80.340

Notes: We focus on 12 hours before and after the three-day cutoff and repeat the 2SLS estimations. In addition to the indicator for discharge to SNF instrumented with Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.20: 2SLS by condition: readmission rates, 12-hour window

	Full sample		No comorbidity		Any comorbidity	
	Knee/hip replacement	Other conditions	Knee/hip replacement	Other conditions	Knee/hip replacement	Other conditions
<i>Panel A. 30-day readmission rates</i>						
Discharge to SNF	0.022 (0.013)	-0.168*** (0.054)	0.028 (0.036)	-0.176 (0.136)	0.019 (0.017)	-0.160*** (0.059)
Observations	141,812	969,449	23,918	111,006	117,845	858,400
Adjusted R^2	0.015	0.018	0.017	0.039	0.015	0.017
Mean Y	0.029	0.088	0.022	0.066	0.030	0.090
F statistic	56.955	218.277	38.311	76.606	55.013	219.843
<i>Panel B. 60-day readmission rates</i>						
Discharge to SNF	0.042** (0.017)	-0.174*** (0.058)	0.052 (0.044)	-0.213 (0.146)	0.039* (0.020)	-0.160** (0.062)
Observations	141,812	969,449	23,918	111,006	117,845	858,400
Adjusted R^2	0.014	0.031	0.012	0.046	0.014	0.030
Mean Y	0.043	0.129	0.034	0.093	0.045	0.134
F statistic	56.955	218.277	38.311	76.606	55.013	219.843

Notes: We focus on 12 hours before and after the three-day cutoff and repeat the 2SLS estimations by health conditions. In addition to the indicator for discharge to SNF instrumented with Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.21: 2SLS by condition & local SNF characteristics, knee and hip replacement, 12-hour window

	Low occupancy		High occupancy	
	30-day	60-day	30-day	60-day
<i>Panel A. By occupancy</i>				
Discharge to SNF	0.027* (0.014)	0.056*** (0.020)	0.003 (0.028)	-0.003 (0.033)
Observations	106,029	106,029	35,771	35,771
Adjusted R^2	0.017	0.014	0.008	0.008
Mean Y	0.028	0.043	0.030	0.044
F statistic	44.526	44.526	41.137	41.137
	Low deficiency		High deficiency	
	30-day	60-day	30-day	60-day
<i>Panel B. By deficiency</i>				
Discharge to SNF	-0.008 (0.025)	0.015 (0.030)	0.037** (0.015)	0.054*** (0.018)
Observations	53,674	53,674	88,119	88,119
Adjusted R^2	0.014	0.016	0.014	0.013
Mean Y	0.027	0.040	0.030	0.045
F statistic	27.875	27.875	69.240	69.240

Notes: We focus on 12 hours before and after the three-day cutoff and repeat the 2SLS estimations by local SNF characteristics for knee and hip replacement patients. In addition to the indicator for discharge to SNF instrumented with Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.22: First stage: discharge outcomes, 5-hour window, regression discontinuity (RD)

	Home/HHC	SNF	Other facilities	AMA
Above	-0.044** (0.020)	0.041*** (0.010)	-0.002 (0.019)	0.004 (0.007)
Observations	60,854	60,854	60,854	60,854
Adjusted R^2	0.216	0.117	0.198	0.039
Mean Y	0.868	0.039	0.078	0.016

Notes: We restrict the sample to Medicare patients discharged between 5 hours before and after the three-day cutoff and run a standard RD model, controlling for a linear spline of the running variable, which is the hours from the three-day cutoff. We also control for age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year fixed effects, and discharge month fixed effects. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.23: First stage: discharge outcomes, dropping a subsample with significant comorbidity difference

	Home/HHC	SNF	Other facilities	AMA
Day 3*Medicare	-0.073*** (0.004)	0.063*** (0.004)	0.010*** (0.003)	-0.000 (0.000)
Observations	1,286,994	1,286,994	1,286,994	1,286,994
Adjusted R^2	0.227	0.207	0.132	0.061
Mean Y	0.888	0.060	0.045	0.007

Notes: We drop patients with comorbidities that have a significant difference between Medicare patients who are discharged after versus before the three-day cutoff relative to non-Medicare patients and repeat the first stage estimations. In addition to Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.24: 2SLS: Readmission rates, dropping a subsample with significant comorbidity difference

	Full sample		No comorbidity		Any comorbidity	
	30-day	60-day	30-day	60-day	30-day	60-day
Discharge to SNF	-0.012 (0.016)	-0.029* (0.017)	0.005 (0.023)	0.011 (0.024)	-0.022 (0.019)	-0.048** (0.021)
Observations	1,286,994	1,286,994	352,749	352,749	934,214	934,214
Adjusted R^2	0.031	0.041	0.044	0.053	0.026	0.036
Mean Y	0.071	0.104	0.061	0.088	0.075	0.110
F statistic	202.614	202.614	166.737	166.737	200.242	200.242

Notes: We drop patients with comorbidities that have a significant difference between Medicare patients who are discharged after versus before the three-day cutoff relative to non-Medicare patients and repeat the 2SLS estimations. In addition to the indicator for discharge to SNF instrumented with Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.25: 2SLS by condition: readmission rates, dropping a subsample with significant comorbidity difference

	Full sample		No comorbidity		Any comorbidity	
	Knee/hip replacement	Other conditions	Knee/hip replacement	Other conditions	Knee/hip replacement	Other conditions
<i>Panel A. 30-day readmission rates</i>						
Discharge to SNF	0.025* (0.014)	-0.012 (0.029)	0.043** (0.020)	0.014 (0.048)	0.012 (0.021)	-0.025 (0.032)
Observations	195,314	1,091,664	62,191	290,531	133,095	801,100
Adjusted R^2	0.013	0.029	0.010	0.043	0.013	0.024
Mean Y	0.032	0.078	0.026	0.069	0.034	0.081
F statistic	98.388	329.527	85.830	308.921	86.025	307.054
<i>Panel B. 60-day readmission rates</i>						
Discharge to SNF	0.027* (0.017)	-0.017 (0.032)	0.044 (0.028)	0.049 (0.052)	0.013 (0.023)	-0.043 (0.037)
Observations	195,314	1,091,664	62,191	290,531	133,095	801,100
Adjusted R^2	0.014	0.039	0.012	0.051	0.014	0.034
Mean Y	0.047	0.114	0.041	0.098	0.050	0.119
F statistic	98.388	329.527	85.830	308.921	86.025	307.054

Notes: We drop patients with comorbidities that have a significant difference between Medicare patients who are discharged after versus before the three-day cutoff relative to non-Medicare patients and repeat the 2SLS estimations by health conditions. In addition to the indicator for discharge to SNF instrumented with Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.26: 2SLS by local SNF characteristics, knee and hip replacement, dropping a subsample with significant comorbidity difference

	Low occupancy		High occupancy	
	30-day	60-day	30-day	60-day
<i>Panel A. By occupancy</i>				
Discharge to SNF	0.041*** (0.015)	0.051** (0.020)	-0.028 (0.027)	-0.046 (0.031)
Observations	150,353	150,353	44,951	44,951
Adjusted R^2	0.013	0.013	0.002	0.000
Mean Y	0.032	0.047	0.031	0.047
F statistic	73.379	73.379	89.493	89.493
	Low deficiency		High deficiency	
	30-day	60-day	30-day	60-day
<i>Panel B. By deficiency</i>				
Discharge to SNF	0.027 (0.028)	0.038 (0.034)	0.025 (0.016)	0.022 (0.021)
Observations	79,074	79,074	116,223	116,223
Adjusted R^2	0.015	0.015	0.013	0.014
Mean Y	0.031	0.047	0.032	0.048
F statistic	37.180	37.180	138.196	138.196

Notes: We drop patients with comorbidities that have a significant difference between Medicare patients who are discharged after versus before the three-day cutoff relative to non-Medicare patients and repeat the 2SLS estimations by local SNF characteristics for knee and hip replacement patients. In addition to the indicator for discharge to SNF instrumented with Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.27: First stage: discharge outcomes, additional controls of admission hour, total hours in the hospital, and ER admission

	Home/HHC	SNF	Other facilities	AMA
Day 3*Medicare	-0.077*** (0.003)	0.069*** (0.004)	0.009*** (0.003)	-0.000 (0.000)
Observations	2,915,127	2,915,127	2,915,127	2,915,127
Adjusted R^2	0.238	0.215	0.124	0.053
Mean Y	0.862	0.078	0.052	0.008

Notes: In addition to Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, admission hour, total hours in the hospital, an indicator for ER admission, and a series of indicators for missing values. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.28: 2SLS: Readmission rates, additional controls of admission hour, total hours in the hospital, and ER admission

	Full sample		No comorbidity		Any comorbidity	
	30-day	60-day	30-day	60-day	30-day	60-day
Discharge to SNF	-0.012 (0.010)	-0.030*** (0.011)	0.005 (0.023)	0.010 (0.024)	-0.016 (0.011)	-0.038*** (0.012)
Observations	2,914,288	2,914,288	352,608	352,608	2,561,652	2,561,652
Adjusted R^2	0.031	0.043	0.044	0.053	0.029	0.040
Mean Y	0.084	0.124	0.061	0.088	0.088	0.129
F statistic	270.348	270.348	158.923	158.923	266.238	266.238

Notes: In addition to the indicator for discharge to SNF instrumented with Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, admission hour, total hours in the hospital, an indicator for ER admission, and a series of indicators for missing values. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.29: 2SLS by condition: readmission rates, additional controls of admission hour, total hours in the hospital, and ER admission

	Full sample		No comorbidity		Any comorbidity	
	Knee/hip replacement	Other conditions	Knee/hip replacement	Other conditions	Knee/hip replacement	Other conditions
<i>Panel A. 30-day readmission rates</i>						
Discharge to SNF	0.026*** (0.010)	-0.010 (0.015)	0.041** (0.020)	0.015 (0.049)	0.021 (0.013)	-0.015 (0.015)
Observations	400,000	2,514,277	62,185	290,396	337,785	2,223,851
Adjusted R^2	0.015	0.028	0.011	0.043	0.015	0.025
Mean Y	0.036	0.092	0.026	0.069	0.037	0.095
F statistic	94.978	495.974	84.261	293.335	84.566	495.546
<i>Panel B. 60-day readmission rates</i>						
Discharge to SNF	0.039*** (0.012)	-0.021 (0.016)	0.044 (0.028)	0.049 (0.052)	0.036** (0.015)	-0.030* (0.017)
Observations	400,000	2,514,277	62,185	290,396	337,785	2,223,851
Adjusted R^2	0.016	0.039	0.012	0.051	0.016	0.036
Mean Y	0.053	0.136	0.041	0.098	0.055	0.141
F statistic	94.978	495.974	84.261	293.335	84.566	495.546

Notes: In addition to the indicator for discharge to SNF instrumented with Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, admission hour, total hours in the hospital, an indicator for ER admission, and a series of indicators for missing values. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.30: 2SLS by condition & local SNF characteristics, knee and hip replacement, additional controls of admission hour, total hours in the hospital, and ER admission

	Low occupancy		High occupancy	
	30-day	60-day	30-day	60-day
<i>Panel A. By occupancy</i>				
Discharge to SNF	0.031*** (0.011)	0.052*** (0.015)	0.010 (0.018)	0.001 (0.021)
Observations	309,105	309,105	90,881	90,881
Adjusted R^2	0.016	0.016	0.012	0.013
Mean Y	0.035	0.052	0.036	0.054
F statistic	69.028	69.028	128.890	128.890
	Low deficiency		High deficiency	
	30-day	60-day	30-day	60-day
<i>Panel B. By deficiency</i>				
Discharge to SNF	0.013 (0.019)	0.022 (0.024)	0.033*** (0.011)	0.048*** (0.013)
Observations	163,722	163,722	236,261	236,261
Adjusted R^2	0.017	0.019	0.013	0.014
Mean Y	0.035	0.052	0.036	0.053
F statistic	36.018	36.018	137.429	137.429

Notes: In addition to the indicator for discharge to SNF instrumented with Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, admission hour, total hours in the hospital, an indicator for ER admission, and a series of indicators for missing values. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.31: First stage: discharge outcomes, ER admission only

	Home/HHC	SNF	Other facilities	AMA
Day 3*Medicare	-0.049*** (0.002)	0.048*** (0.002)	0.001 (0.001)	-0.001 (0.000)
Observations	1,708,710	1,708,710	1,708,710	1,708,710
Adjusted R^2	0.181	0.159	0.129	0.047
Mean Y	0.890	0.048	0.050	0.012

Notes: We restrict the sample to those admitted through emergency room only. In addition to Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.32: 2SLS: Readmission rates, ER admission only

	Full sample		No comorbidity		Any comorbidity	
	30-day	60-day	30-day	60-day	30-day	60-day
Discharge to SNF	-0.015 (0.020)	-0.028 (0.021)	0.018 (0.076)	0.116 (0.077)	-0.021 (0.020)	-0.041* (0.022)
Observations	1,708,710	1,708,710	158,620	158,620	1,550,031	1,550,031
Adjusted R^2	0.022	0.032	0.028	0.036	0.021	0.031
Mean Y	0.096	0.141	0.073	0.105	0.098	0.145
F statistic	421.586	421.586	284.574	284.574	418.607	418.607

Notes: We restrict the sample to those admitted through emergency room only. In addition to the indicator for discharge to SNF and Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. We instrument SNF discharges with an interaction between Day 3 and Medicare. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.33: OLS: Readmission rates controlling for Day 3*Medicare

	Full sample		No comorbidity		Any comorbidity	
	30-day	60-day	30-day	60-day	30-day	60-day
SNF	0.021*** (0.002)	0.031*** (0.002)	0.013*** (0.003)	0.018*** (0.003)	0.022*** (0.002)	0.033*** (0.002)
Day 3*Medicare	-0.002*** (0.001)	-0.004*** (0.001)	-0.000 (0.001)	-0.000 (0.002)	-0.003*** (0.001)	-0.005*** (0.001)
Observations	2,915,127	2,915,127	352,749	352,749	2,562,350	2,562,350
Adjusted R^2	0.031	0.045	0.044	0.053	0.030	0.043
Mean Y	0.084	0.124	0.061	0.088	0.088	0.129

Notes: In addition to the indicator for discharge to SNF and Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.34: First stage by hospital bed availability: discharge outcomes

	Home/HHC	SNF	Other facilities	AMA
<i>Panel. Above-median inpatient days</i>				
Day 3*Medicare	-0.068*** (0.004)	0.052*** (0.006)	0.017*** (0.005)	-0.000 (0.000)
Observations	806,372	806,372	806,372	806,372
Adjusted R^2	0.247	0.209	0.143	0.076
Mean Y	0.857	0.077	0.059	0.007
<i>Panel B. Below-median inpatient days</i>				
Day 3*Medicare	-0.067*** (0.004)	0.052*** (0.005)	0.016*** (0.006)	-0.000 (0.000)
Observations	750,707	750,707	750,707	750,707
Adjusted R^2	0.249	0.214	0.138	0.081
Mean Y	0.857	0.077	0.058	0.007

Notes: We define hospital bed availability as months in which total inpatient days are below the median in a given hospital-year. In addition to Day 3*Medicare, each regression includes an indicator for Day 3, an indicator for Medicare as well as a vector of discharge characteristics such as patients' age, age squared, an indicator for sex, a series of indicators for race, health conditions (Diagnosis Related Group (DRG) fixed effects and indicators for all comorbidities), hospital fixed effects, discharge year and discharge month fixed effects, discharge hour fixed effects, and a dummy for missing discharge hour. Standard errors are clustered at the HSA level. * Significant at 10%, ** significant at 5%, *** significant at 1%.