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Did Avoiding Post-Acute Skilled Nursing Facility Care During the COVID-19 Pandemic Save Lives?

RESEARCH

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ABSTRACT

Context: During the COVID-19 pandemic, patients using post-acute care generally avoided skilled nursing facilities, presumably to reduce their chance of illness and death. However, staying at home after an acute inpatient hospitalization carries its own risks.

Objectives: To assess whether avoiding skilled nursing facilities in 2020 saved lives and whether this behavior also led to a change in readmission rates.

Methods: Retrospective cohort study using Medicare Fee-for-Service medical claims data for patients in Michigan.

Findings: Between 2019 and 2020, use of skilled nursing facilities fell by 8 percentage points, which was not due to a change in patient characteristics. The reduction in use of post-acute skilled nursing facility care was associated with a 23.3% lower 90-day mortality rate during the COVID-19 pandemic than otherwise expected, and 117 saved lives. There was also a small increase in the readmission rate across years. Finally, between-group disparities worsened, with the vast majority of the reduction in both mortality and readmissions seen among patients who were not dually eligible for Medicaid.

Limitations: The data are limited to the state of Michigan.

Implications: Findings from this study should be used to inform health professionals of the benefits and risk of post-acute care following hospitalization during times of increased disease transmission. Extra consideration should be given to the post-acute care and outcomes of dual-eligible patients.

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INTRODUCTION

The COVID-19 pandemic significantly changed people's access to healthcare in the United States (US), and use of post-acute care generally decreased during the pandemic (Abrashkin, Zhang and Poku, 2021). The downstream effects of avoiding post-acute care, and skilled nursing facility (SNF) care in particular, have not been studied yet would shed further light on the effects of the COVID-19 pandemic on US healthcare and could inform future best practices. It is possible that avoiding SNF care during the COVID-19 pandemic may have decreased patients' risks of infection and mortality from COVID-19. However, at the same time, avoidance behavior may have also increased the risks of adverse health outcomes as a result of patients not receiving beneficial rehabilitative care provided at SNFs. In this study, we aim to assess whether mortality and readmission rates were better or worse for patients who avoided post-acute SNF care during the first calendar year of the pandemic. We hypothesized that avoiding post-acute SNF care during the COVID-19 pandemic resulted in fewer adverse outcomes among a cohort of patients aged 65 and older in Michigan.

Another important question is whether the change in behavior to avoid post-hospitalization SNF use affected economic disparities among US patient populations. Studies have shown that underprivileged and minority populations have greater risk of adverse COVID-19 outcomes such as hospitalization, and that disparities in some mortality and health outcomes worsened during the pandemic (Gu *et al*., 2020; Schwandt *et al*., 2022; Tipirneni *et al*., 2022). Underprivileged populations may also have a greater need for SNF care due to a lack of resources for alternatives such as informal care by family members at home (Charles and Sevak, 2005). Some minority groups (e.g., people of Asian ethnicity) traditionally rely more on informal care from family members and therefore have lower demand for formal care, perhaps due to social stigma (Hanaoka and Norton, 2008). During the COVID-19 pandemic, when individuals with more resources may have had greater ability to stay home therefore experiencing less exposure to infection, socioeconomic status could have had significant impact on use of skilled nursing facility care and associated outcomes. This paper explores whether avoiding SNFs exacerbated disparities in mortality and readmission rates by examining differences in these outcomes by a proxy for socioeconomic status: patients' dual-eligibility insurance status for Medicare and Medicaid. Dual-eligible beneficiaries who qualify for both Medicare and Medicaid coverage are likely at a financial disadvantage, which can affect access to healthcare as well as health outcomes (Dickman, Himmelstein and Woolhandler, 2017). Dual-eligible beneficiaries may also be in worse health, conditional on age, than non-dual eligibles, which on its own would lead to higher mortality rates and hospital readmission rates. We are interested in whether the difference in these rates between dual-eligible and non-dual-eligible beneficiaries changed after the start of the pandemic. If the behavior of avoiding SNF affected mortality and readmission rates, then it is of interest whether this change in behavior exacerbated disparities between dual-eligible and non-dual-eligible beneficiaries.

Among 65,394 claims-based episodes of care for Medicare patients in Michigan, findings indicate that hospital discharges to SNF decreased by about 8 percentage points from 2019 to 2020. Patient dual-eligibility status and COVID-19 risk in SNFs were significantly associated with lower SNF use. Mortality within 90 days of hospital discharge increased by 2.3 percentage points from 2019 to 2020, with a minimal increase in 90-day readmission rates. Based on predicted probability of mortality, we estimate that approximately 117 lives were saved as a result of the decreased SNF use in 2020. Findings also indicate that from 2019 to 2020 disparities worsened between dual-eligible and non-dual-eligible beneficiaries in terms of both lives saved and readmissions avoided.

BACKGROUND

Two programs provide the majority of public health insurance in the United States: Medicare and Medicaid. Serving over 50 million beneficiaries and administered by the Centers for Medicare & Medicaid Services (CMS), Medicare provides care primarily to US residents aged 65 and older and Medicaid serves low-income residents (Altman and Frist, 2015). The elderly Medicare population is particularly well-suited to analyses of long-term care in the United States, and the intersection of patients eligible for both Medicare and Medicaid (dual-eligible beneficiaries) provides a rich opportunity to examine the differential impact of socioeconomic status on care outcomes. In the United States, nursing homes have on average about 100 beds (Norton, 2000) and RNs and LPNs together provide about an hour of care per resident day (Konetzka *et al*., 2018). About two-thirds are private for-profit, a quarter are private nonprofit, and the rest are government owned (Norton, 2000).

Between 2019 and 2020 there was a significant drop in the observed rate of discharge from acute hospitalization stays to SNFs among Medicare beneficiaries. One hypothesis for the cause of this decrease is that the characteristics of the Medicare enrollees using hospital care changed from 2019 to 2020. It is possible that patients going to the hospital in 2020 had more acute health needs or a larger number of comorbidities than those in 2019, as hospitals were only able to accommodate a limited number of patients and healthier patients may have stayed home. There also may have been differences in patient socioeconomic status. We assessed dual eligibility in this study to identify those who may be socioeconomically disadvantaged, and therefore more prone to worse outcomes due to COVID-19, as those on Medicaid are more likely to have limited income and resources for obtaining substitute care.

In the early months of the COVID-19 pandemic, communities struggled to contain the spread of cases for several reasons. There was no vaccine, personal protective equipment shortages were common among healthcare workers, and nursing homes in particular were hotspots for high rates of COVID-19 among staff and patients (Gorges and Konetzka, 2020; Wilson-Davies *et al*., 2021). Among US nursing homes, those with higher CMS quality ratings or with union workers had lower COVID-19 mortality rates (Cronin and Evans, 2022; Dean *et al*., 2022). Ownership status may have also been associated with a SNF's COVID-19 outcomes (Kruse *et al*., 2021). These factors contributed to a wide distribution of COVID-19 prevalence at SNFs. We hypothesized that the current severity of COVID-19 in local SNFs might have been an important factor in determining whether patients entered SNF care following their index hospitalization. Under this hypothesis, the higher the risk of contracting COVID-19 at a nearby SNF, the less likely a provider would be to discharge a patient to that SNF as opposed to arranging alternative care such as home health.

Given that SNFs with active COVID-19 cases experienced significant increases in mortality and functional decline during the early months of the pandemic (Barnett *et al*., 2022; Gilstrap *et al*., 2022), we suspected that a decrease in discharges to SNF could have saved lives. One challenge of this research question is the inability to measure whether an individual's need for nursing home care outweighed the risk of COVID-19 illness or mortality at the time. If a patient were to avoid a SNF they may not have received the post-acute care that they needed, despite a likely reduced chance of contracting COVID-19 compared to if they were discharged to home. However, it is still prudent to examine the overall reduction in probability of mortality if someone were to be discharged home instead of to a SNF.

Because readmissions are costly for hospitals and patients, this paper also examines the potential for reducing readmissions in addition to saving lives as a result of averted SNF use. Between 2019 and 2020, inpatient readmission rates remained relatively stable overall in the Medicare patient population examined here.

The state of Michigan experienced the early stages of the COVID-19 pandemic in multiple waves which affected different areas of the state at different times. The pandemic hit the metro Detroit area first before spreading throughout Michigan to the north and west. The first peak was during the first week of April, then after a lull in mid-June there was a modest rise through the end of the summer, and finally a surge from October through the end of the calendar year. We hypothesized that when the risk of COVID-19 was higher, patients would have been more likely to avoid SNF care. To confirm this, we examined whether people were less likely to be discharged to SNF when the COVID-19 rate in the area increased.

METHODS

The objective of this study was to model the decision to enter a SNF upon discharge from a hospital, compare how that decision changed during the COVID-19 pandemic, and estimate how many lives may have been saved and how many hospital readmissions avoided as a result of patients avoiding SNFs in 2020. In addition, we examined if differences in the change in the probability of going to SNFs was due to patient demographic differences, along with whether changes in behavior during the pandemic also exacerbated disparities in mortality and readmission rates between demographic groups.

We start by predicting the probability of a Medicare patient being discharged from a hospital directly to a SNF, using claims data from 2019. The probability of being discharged to a SNF, as opposed to home or to inpatient rehabilitation, is a function of the patient's demographics, condition (reason for admission), comorbidities, hospital length of stay, and insurance status (dual eligible for Medicaid or not). Because the probability of being discharged to a SNF varies by hospital, even after controlling for patient characteristics, we also include hospital fixed effects in all regressions. We then re-estimate the model using claims data from 2020 on the same set of covariates (but not including any measures of COVID prevalence, those measures will be added in a later analysis). The goal of this initial modeling exercise is prediction, not estimating the marginal effects of specific covariates. We estimate a logistic regression twice, once for 2019 and once for 2020, to predict the probability of discharge to a SNF based on personal characteristics of person *i*. In the following equation, $\boldsymbol{x}$ represents the vector of covariates and β represents the corresponding vector of coefficients.

$$\Pr[SNF_i \mid x_i] = logistic(x_i'\beta) \text{ for 2019 and for 2020} \quad (1)$$

The overall probability of being discharged to SNF declined by about 8 percentage points in 2020 compared to 2019. To assess whether this decrease was due to a change in the makeup of hospitalized patients between 2019 and 2020 or due to patients avoiding SNFs more in 2020, Kitagawa-Blinder-Oaxaca decomposition was used to quantify the relative importance of each of those two explanations (Blinder, 1973; Kitagawa, 1955; Oaxaca, 1973). We use the standard threefold decomposition (the third being an interaction between the change in covariates and the change in coefficients) as implemented by the Stata command **oaxaca** (Jann, 2008). The Kitagawa-Blinder-Oaxaca threefold decomposition represents the difference in the expected value of the probability of going to a SNF at discharge (2020 compared to 2019) as the sum of three terms: the change in endowments (covariates), the change in coefficients, and the interaction of the changes in endowments and coefficients (Jann, 2008).

$$\begin{aligned} E[SNF_{2020}]-E[SNF_{2019}] &= \left(E[\boldsymbol{x}_{2020}]-E[\boldsymbol{x}_{2019}]\right)' \beta_{2019} \\ &+E[\boldsymbol{x}_{2019}]' (\beta_{2020}-\beta_{2019}) \\ &+\left(E[\boldsymbol{x}_{2020}]-E[\boldsymbol{x}_{2019}]\right)' (\beta_{2020}-\beta_{2019}) \end{aligned} \quad (2)$$

In equation 2, the subscripts on $\boldsymbol{x}$ represent the year of the data and the subscripts on β represent the year of the data that the model was run on. If the patient characteristics did not change appreciably between 2019 and 2020, then the first and third terms should be close to zero and the difference between the predictions would be due predominantly to the change in the coefficients. Because the original regression model is logistic regression, we report the results of the Kitagawa-Blinder-Oaxaca decomposition for a binary logit model. However, we also computed the decomposition using a linear probability model and the decomposition was nearly identical.

Next we explore whether the change in predicted probabilities was associated with any of the patient characteristics. In particular, we are interested in how it changed with age and with dual-eligibility insurance status. We estimate a regression model with a dependent variable equal to the change in predicted probability and the usual set of covariates. The dependent variable is the change in the predicted probability of going to a SNF, comparing 2020 to 2019, or $\Delta\Pr[SNF]$. A negative coefficient would indicate that the corresponding covariate is associated with a decrease in the probability of being discharged to SNF, *beyond* the overall decrease of about eight percentage points, which is reflected in the constant term.

Having established that there was a dramatic decline in the overall probability of being discharged to a SNF, we next test whether patients were responsive specifically to the current risk of COVID-19 in SNFs given changing risk of COVID-19 throughout 2020 both over time and by geographic region. If patients avoided SNFs more when the risk of COVID-19 was higher in their area, that would be evidence that the lower probability of being discharged to a SNF was due to avoiding COVID-19, as opposed to some other trend. To test this hypothesis, we include measures of COVID-19 risk that are specific to the time and location of each patient's discharge decision.

We measured COVID-19 risk at the SNF level in two ways. One is the number of cases of COVID-19 in SNF residents and the other is the number of cases in SNF staff. The number of cases was reported weekly by CMS for each SNF. We aggregated the SNF-level risk to the hospital level, because the risk measure must be based on the potential set of SNFs to which a patient might have gone. The actual choice of a specific SNF is endogenous and most patients do not go to a SNF. Specifically, we computed the weighted average of COVID-19 cases over the SNFs that patients were discharged to, from their index hospital in 2019. Therefore, if COVID-19 cases rose in SNFs that receive many patients from that hospital, we expected the probability of going to any SNF that week from that hospital to decline. The expected signs of the coefficient γ_1 on COVID-19 cases is negative when either of those risk variables are added to the basic regression model.

$$\Pr[SNF_i \mid \boldsymbol{x}_i] = logistic(\gamma_1 COVIDrisk_i + \boldsymbol{x}_i'\gamma) \quad (3)$$

Although the analysis thus far has focused on modeling discharge to SNF, the two outcomes of ultimate interest are mortality and readmissions. Readmissions in this analysis were defined as a re-hospitalization at any time during the 90 days following discharge from the patient's initial index hospitalization. This includes admissions to the hospital through the Emergency Department. We want to know if the shift away from SNFs resulted in fewer deaths and readmissions, and if so, how many. Next we model 90-day mortality and 90-day readmissions. For brevity, we will describe the analysis in terms of mortality, but the modeling for readmissions is identical, other than the dependent variable.

One way to model this is to have mortality $m(t,s(t,\boldsymbol{x}),\boldsymbol{x})$ be a function of both time t and SNF status $s(t,\boldsymbol{x})$, which is also a function of time. Patient covariates are again denoted by a vector of covariates $\boldsymbol{x}$. We know that mortality changed between 2019 and 2020 (therefore it is a function of t), largely due to COVID-19. Mortality may also be a function of whether a person is discharged directly from hospital to SNF, and this relationship may have changed in 2020. Therefore it is a function of s(t). The overall change in mortality is the sum of two terms, the direct change in mortality due to COVID-19 and the behavioral change due to the change in probability of being discharged from the hospital to a SNF. This assumes that the change in patient covariates over time is negligible, which we show is true. Our primary research objective then is to measure the magnitude of the behavioral effect.

$$\begin{aligned} \frac{dm(t,s(t,\boldsymbol{x}),\boldsymbol{x})}{dt} &= \frac{\partial m(t,s(t,\boldsymbol{x}),\boldsymbol{x})}{\partial t} + \frac{\partial m(t,s(t,\boldsymbol{x}),\boldsymbol{x})}{\partial s}\frac{ds(t,\boldsymbol{x})}{dt} \\ &= \text{direct effect} + \text{behavioral effect} \end{aligned} \quad (4)$$

Equation 4 provides inspiration to calculate the number of deaths averted. Conceptually, COVID-19 changed the underlying mortality risk and the probability of discharge to SNF. The number of deaths averted due to avoiding SNFs is the change in mortality risk between those who were discharged to SNF compared to those who were not, multiplied by the difference in the probability of discharge to SNF, summed over all persons.

A rough calculation of this number is as follows. There were 1,748 people (8.0 percent of 21,854 in 2020) who avoided SNFs in 2020. The overall difference in mortality by discharge status in 2020 was 8.4% (=18.8%–10.4%). Multiplying 0.084 by 1,748 yields a rough estimate of 146 lives saved. Similarly, the overall difference in the readmission rate by discharge status in 2020 was 1.5% (=32.7%–31.2%). Multiplying 0.015 by 1,748 yields a rough estimate of 26 fewer readmissions. We can improve on this rough calculation by allowing these probabilities to vary with individual characteristics. For example, the difference in mortality rate between discharge to home and discharge to SNF may be correlated with the change in probability of avoiding SNFs, so we calculate these differences in probabilities for each person and sum over the whole sample.

Our more refined estimate of the number of lives saved uses results from our logistic regressions to predict morality and discharge to SNF. For each person in the 2020 sample, we predict the probability of mortality two ways, if discharged to SNF or not. That difference is multiplied by the change in probability of discharge to SNF between 2020 and 2019 and then summed over the entire sample in 2020.

$$Deaths\,averted = \sum_{i=1}^{N} \Delta \Pr(Mortality_i)\Delta \Pr(SNF_i) \quad (5)$$

This calculation could be an upper bound on the number of lives saved if there is selection in who is discharged to SNF based on unobserved mortality risk. For example, if there is an unobservable risk factor that makes people more likely to die if they go to a SNF, and if those same people avoid SNFs, then we will over-attribute the gain in mortality to observable characteristics and our estimate will be an overestimate of the number of lives saved. Although we control for many important individual characteristics that affect mortality, the claims data has no information on patient's access to informal care, such as a spouse, child, or other caregiver. Marital status and number of children predict informal caregiving and therefore should be included in a model to predict discharge to SNF (Van Houtven and Norton, 2004; Van Houtven and Norton, 2008). However, because our method depends on predicted probabilities and not specific coefficients, as long as the omitted variables are correlated with observable characteristics, which they are, any bias in our predictions should be minimal.

To discover whether avoiding SNFs exacerbated disparities or not, we repeat the above calculations separately by dual-eligibility status.

DATA AND SAMPLE

DATA SOURCES

The data for this study is based on Michigan Value Collaborative (MVC) 90-day claims-based episodes of care for Medicare Fee-for-Service (FFS) beneficiaries living in Michigan, along with associated facility and professional health insurance claims. MVC is a Blue Cross Blue Shield of Michigan funded collaborative quality initiative supporting over 100 acute care hospitals and 40 physician organizations across the state of Michigan, with the goal of improving the health of Michigan residents through sustainable, high-value healthcare. MVC helps hospitals and physician organizations better understand their performance using robust multi-payer claims data and customized analytics centered around episodes of care. The claims used to create the episodes of care used in this analysis came from the Medicare FFS inpatient, outpatient, SNF, hospice, home health, and carrier files. This study also used data from the Medicare Master Beneficiary Summary Files (MBSF) files for information on beneficiary death dates, race and ethnicity, and dual-eligibility status.

The 90-day claims-based episodes of care data used in this analysis are initialized by an index inpatient hospitalization or outpatient procedure for one of 40 medical and surgical conditions. Index conditions are defined according to International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) diagnosis codes, International Classification of Diseases, Tenth Revision, Procedure Coding System (ICD-10-PCS) codes, and Current Procedural Terminology (CPT) codes. In addition to the index hospitalization, episodes include all claims within 90 days following discharge, which contain any related care received after the initial hospitalization. To be eligible to initiate an episode, beneficiaries must have been enrolled in their insurance plan for at least 180 days prior to the index admission and must have at least 90 days of claims available post-index discharge. Episodes are non-overlapping in 90-day windows, meaning that additional inpatient admissions during the 90-day post-discharge period do not result in the creation of a new episode.

Another data source incorporated into this analysis was the CMS Nursing Home COVID-19 Public Files. These data on COVID-19 cases at SNFs were incorporated to account for weekly SNF-level incidence trends for COVID-19 throughout 2020. CMS Nursing Home COVID-19 Public Files provide information on the number of COVID-19 cases recorded among patients and staff at individual SNFs across the United States every week beginning in May 2020. This analysis used CMS data on COVID-19 cases beginning with the week of May 25, 2020.

STUDY SAMPLE

The patient population for this analysis was comprised of Medicare FFS patients aged 65 and older who had a 90-day medical or surgical claims-based episode of care initialized by an inpatient hospitalization or outpatient procedure in Michigan in 2019 or 2020. We focus on the state of Michigan, population 10 million, because we have all the data necessary for the analysis that follows patients post-discharge from hospital to SNF or home, and possibly to death or back to the hospital. Some of the data decisions are made to narrow the sample precisely to those for whom this analysis is relevant. We do not include patients who have essentially no risk of going to a SNF. Several exclusions were applied to the cohort. Patients who were discharged to hospice or who died during the index hospitalization were excluded from the cohort because those patients had no opportunity to be discharged to a SNF. Discharge to hospice and in-hospital mortality were determined by claim discharge disposition codes. Patients whose index hospitalization was at a Critical Access Hospital were further excluded from the analytic cohort. Finally, episodes were excluded from this analysis if the index hospitalization was shorter than three nights, because Medicare typically only covers skilled nursing care if the patient needs these services for a medical condition treated during a qualifying three-day inpatient hospital stay (Centers for Medicare & Medicaid Services, 2022). Though this exclusion reduces our cohort of patients by about 50%, we are not interested in these individuals, as they would have virtually no chance of being discharged to a SNF due to Medicare coverage rules.

Data in 2020 were limited to index admissions in April 2020 through December 2020 to represent the timeframe of the COVID-19 pandemic in Michigan during 2020. Episodes in 2020 were excluded if the patient had a diagnosis of COVID-19 (U07.1) in any diagnosis code position on their index claim as these patients would not be likely to be discharged to a SNF. Finally, episodes were excluded from the 2019 or 2020 cohort if the patient had any SNF stay in the year prior to their index admission, because recent or long-term SNF users may be more likely to return to a SNF upon discharge from their hospitalization. Our research question is about how COVID-19 affected those patients who had a choice whether to go to a SNF or not after a hospital stay, not those who would be expected to return to a SNF. The final analytic sample had 43,540 observations for index admissions in 2019 and 21,854 observations in 2020.

Due to inter-condition variability in episode volume and post-acute care SNF use, for this analysis the cohort was limited to patients whose index hospitalization was for a condition with at least 100 episodes in 2019 and which had a rate of discharge to SNF of at least 10% in that year. This resulted in a total of 21 index hospitalization conditions (see Table 1 for a full list of conditions). The 2020 cohort was limited to episodes with index hospitalizations for these same 21 conditions for consistency. The five most common conditions were sepsis, congestive heart failure, trauma, chronic obstructive pulmonary disease, and pneumonia, which together accounted for 61.5% of episodes in 2019 in the cohort for this analysis.

OUTCOME MEASURES

The outcome measures for this analysis were rates of discharge to SNF, 90-day all-cause mortality, and 90-day inpatient readmissions. Discharge to SNF was determined based on the presence of a SNF claim with an admission date 0 to 1 days following a patient's index hospitalization discharge. Patients meeting these criteria were considered to have been discharged directly to a SNF for this analysis. The goal was not to assess SNF use among patients who went home for some amount of time before deciding to seek care at a SNF. Mortality of

INDEX CONDITION	*N* (2019)	*N* (2020)
Sepsis	8,767	4,540
Congestive Heart Failure	6,206	3,344
Physical Trauma	5,182	2,860
Chronic Obstructive Pulmonary Disease	3,543	1,107
Pneumonia	3,072	1,219
Stroke	2,527	1,443
Acute Myocardial Infarction	2,519	1,361
Joint Replacement (Knee and Hip)	2,222	751
Hip Fracture	2,044	1,271
Atrial Fibrillation	2,111	796
Coronary Artery Bypass Graft	1,194	775
Colectomy (non-cancer)	1,130	679
Spine Surgery	650	378
Cholecystectomy	632	347
Colorectal Cancer	429	216
Surgical Aortic Valve Replacement	354	194
Disc Herniation	301	145
Hernia Repair – Abdominal	297	157
Pancreatectomy	140	70
Kidney Stone Surgery	118	102
Hernia Repair – Groin	102	99
Total number of observations	43,540	21,854

Table 1 Distribution of Index Hospitalization Condition by Year.

any cause within 90 days was identified by a patient's date of death in the Medicare MBSF files within the 1–90 days post-discharge. Any inpatient hospital admission in the 0–90 days post-discharge was considered a 90-day readmission.

DUAL ELIGIBILITY AND OTHER PATIENT CHARACTERISTICS

The following patient demographic and clinical characteristics were assessed and included as model covariates: age category (65–69, 70–74, 75–79, 80–84, 85–89, and 90 or older), gender, race/ethnicity groups (White, Black, Hispanic, Asian/Pacific Islander/Alaska Native/American Indian, and Other Race Categories), length of index stay category (3 nights is equivalent to 4 days) (4–7 days, 8–14 days, 15 or more days), dual-eligibility status, 21 index hospitalization conditions, and 76 comorbidities. Race categories were determined based on the Research Triangle Institute race codes from the Medicare FFS MBSF files and included 'other race categories' inclusive of individuals with unspecified or unknown race.

Dual-eligibility insurance status is a key demographic variable of interest for this analysis. Dual-eligible beneficiaries are individuals who are eligible for both Medicare and Medicaid health insurance. Patients' dual-eligibility status was derived from the Medicare MBSF files. A patient was considered dual eligible for Medicare and Medicaid for a given year if indicated in Medicare enrollment files as being dual eligible for Medicaid during any month within that calendar year. In this cohort 21% of patients were categorized as dual eligible.

The comorbidities included were 76 Hierarchical Condition Categories (HCCs) based on CMS risk adjustment models, in which medical diagnoses are categorized into hierarchical groupings based on resource use (Centers for Medicare & Medicaid Services. n.d.). HCCs were assessed based on the presence of diagnosis codes on patients' claims in the six months prior to each index hospitalization. The five most common comorbidities in 2019 were congestive heart failure, chronic obstructive pulmonary disease, arrhythmia, diabetes with no complications, and diabetes with chronic complications (for a full list, see the Appendix).

RESULTS

In the model predicting whether a patient went to SNF upon discharge, most of the assessed patient characteristics were highly statistically significant and coefficient signs were in the expected direction (Table 3). The probability of going to a SNF increased with age. In 2019, patients in their 90s were roughly 40 percentage points more likely to go to a SNF than patients whose age was 65–69, holding all else constant. In 2020 that difference was about 30 percentage points. Women were more likely to go to a SNF than men, possibly because in the general US population women are more likely to be single; however, marital status was an omitted variable due to lack of availability within claims data (Norton, 2000). In 2019 the difference in likelihood of post-acute SNF use between women and men was about 5.7 percentage points, but that fell to about 2.9 percentage points in 2020. Patients who were dually eligible for Medicaid and Medicare were more likely to be discharged to a SNF than patients without Medicaid eligibility, by about 10 percentage points in 2019 and 9.7 percentage points in 2020.

Most of the 21 index conditions and 76 comorbidities were also strongly correlated with discharge to SNF (results available upon request). It is not surprising that these variables, which provide a rich set of controls for patient health status, would collectively predict the probability of discharge to SNF. Of these 97 covariates, the top five predictors of an increased probability of discharge to SNF were having an index hospitalization for trauma or hip fracture, or having a recorded comorbidity of respiratory arrest, HIV/AIDS, or ALS.

Model fit was assessed by plotting the histograms of the predicted probabilities, which span the full range from just over 0% to nearly 100% (Figures 1 and 2). Comparing the histograms for 2020 to 2019 shows that the shift in mean, from 31.0% down to 22.8%, happened throughout the distribution. In other words, the chance of going to a SNF fell for those who were highly likely, for those who were medium likely, and for those who were least likely to be discharged to SNF. These findings indicate that the COVID-19 pandemic changed healthcare use behavior for all post-acute care patients regardless of their demographic and clinical characteristics.

Next we show in three different ways that although there were fewer patients in 2020 than in 2019, that the characteristics of patients were similar in 2019 and 2020 although those characteristics had a different effect over time on predicting post-discharge SNF use. First, the means of the patient characteristics appear similar in the two years (compare the first two columns of Table 2). Although a chi-squared test comparing the means rejects the null hypothesis that the means are the same for nearly all characteristics, this is likely due to power from the large sample size. Nothing stands out as being drastically different in 2020. Second, in a regression of the difference in the predicted probabilities of going to a SNF, all of the patient characteristics are statistically significant (see third column of Table 3). In summary, we find evidence that the mean patient characteristics did not change appreciably but that those same characteristics had different effects on the probability of discharge to a SNF.

Third, the Kitagawa-Blinder-Oaxaca decomposition shows that essentially all of the difference in predicted

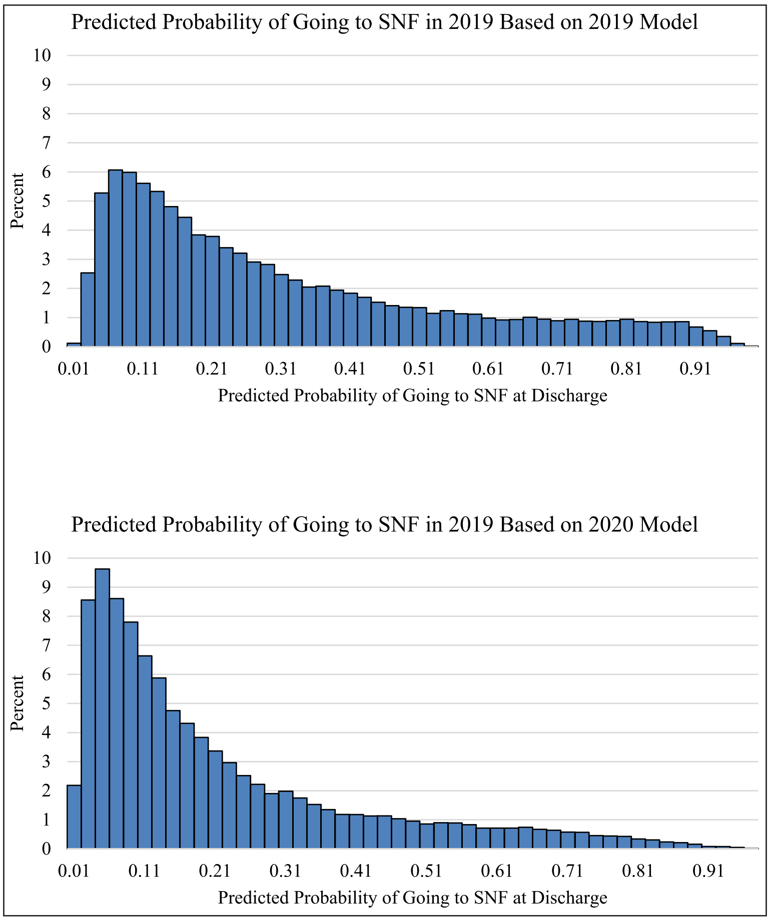

Figure 1 Distribution of Predicted Probabilities of Using Post-Acute SNF Care in 2019.

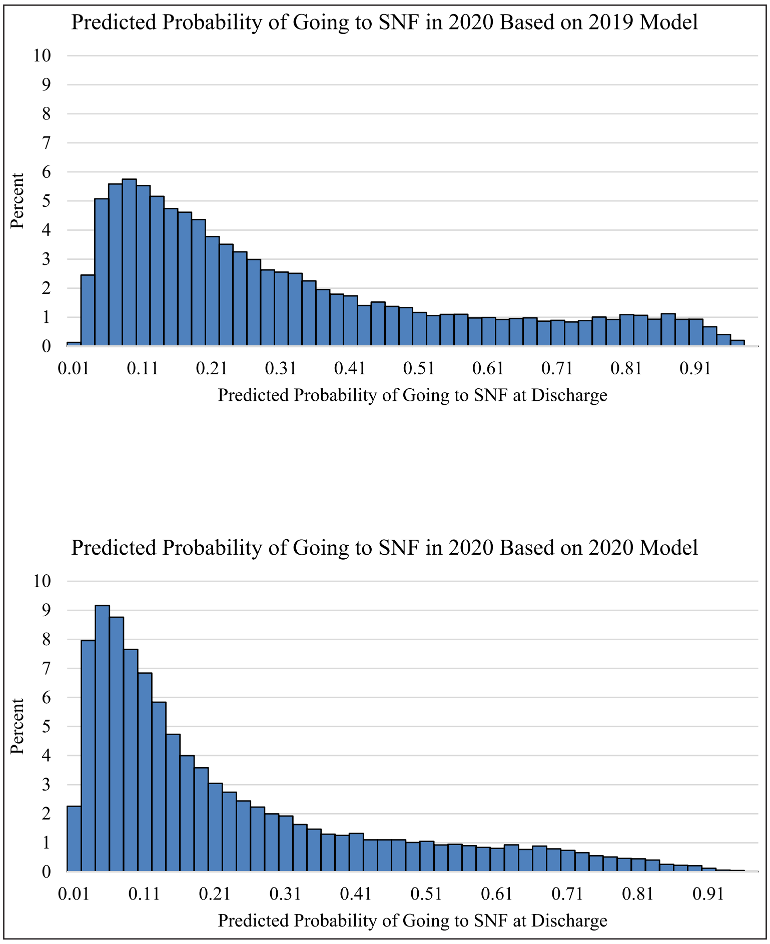

Figure 2 Distribution of Predicted Probabilities of Using Post-Acute SNF Care in 2020.

CHARACTERISTIC	MEAN 2019	MEAN 2020	∆MEAN (2020–2019)
Outcomes			
Discharge to SNF**	0.310	0.228	–0.082
90-Day Mortality**	0.100	0.123	0.023
90-Day Readmissions	0.312	0.316	0.004
Age (Continuous)**	78.1	77.8	0.30
Age Group**			
65–69	0.196	0.200	0.004
70–74	0.205	0.212	0.007
75–79	0.185	0.186	0.001
80–84	0.162	0.163	0.001
85–89	0.135	0.128	–0.007
90+	0.118	0.111	–0.007
Gender**			
Male	0.423	0.445	0.022
Race and Ethnicity**			
White	0.838	0.844	0.006
Black	0.111	0.104	–0.007
Hispanic	0.016	0.015	–0.001
Asian/Pacific Islander/	0.016	0.016	0.000
Alaska Native/American Indian			
Other Race Categories	0.019	0.022	0.003
Insurance Status**			
Dual Eligible for Medicaid and Medicare	0.218	0.200	–0.018
Index Length of Stay**			
4–7 days	0.716	0.689	–0.027
8–14 days	0.226	0.242	0.016
15+ days	0.058	0.068	0.010
Index Conditions	These 21 variables were controlled for in the model. See Table 1 for frequency of each condition.		
Comorbidities	These 76 variables were controlled for in the model. See Appendix for description of comorbidities.		
Hospital Fixed Effects	These 82 hospital fixed effects were controlled for in the model.		

Table 2 Patient Demographics and Descriptive Statistics by Year (*N* = 43,540 in 2019, *N* = 21,854 in 2020).

** Denotes statistical significance between years at 1% level; * Significant at 5% level.

probabilities between 2020 and 2019 is due to the coefficients, not the covariates or endowments (Table 4). Out of the total difference of 0.0826, the difference in coefficients explained 0.0903 and the covariates explained only –0.0109. Even less is explained by the interaction between the coefficients and the covariates (only .0032). In sum, the dramatic shift away from SNFs at discharge was due to an unexpected change in behavior, represented by a change in the coefficients, not a change in the characteristics of the patients who received inpatient or outpatient care.

There is strong evidence that the shift in behavior away from SNFs was directly due to risk of COVID-19. In logistic regressions using the 2020 data, adding either the composite measure of current COVID-19 cases for SNF patients or for SNF staff strongly predicted the outcome of discharge to SNF (Table 5). In particular, the higher the number of cases (a weighted average at the hospital level based on discharge probability to SNFs in 2019) in a given week, the lower the probability of discharge to SNF. As the COVID-19 risk variable varies over time and geography, we cannot simply calculate

COVARIATES	*Pr* (*SNF*)		Δ*Pr* (*SNF*)
	2019	2020	2020–2019
Age			
65–69 (reference)			
70–74	0.340** (0.045)	0.232** (0.073)	–0.02176** (0.00082)
75–79	0.743** (0.049)	0.594** (0.067)	–0.03949** (0.00086)
80–84	1.060** (0.057)	0.803** (0.072)	–0.06301** (0.00091)
85–89	1.485** (0.055)	1.183** (0.077)	–0.0792** (0.0010)
90+	1.888** (0.067)	1.396** (0.091)	–0.1128** (0.0011)
Gender			
Male	–0.268** (0.027)	–0.163** (0.041)	0.02155** (0.00056)
Race			
White (reference)			
Black	–0.048 (0.053)	–0.352** (0.089)	–0.0364** (0.0010)
Hispanic	–0.131 (0.096)	–0.58** (0.18)	–0.0514** (0.0022)
Asian/Pacific Islander/	–0.544**	–0.84**	–0.0203**
Alaskan Native/ American Indian	(0.088)	(0.17)	(0.0021)
Other Race Categories	–0.207* (0.095)	–0.27 (0.14)	–0.0056* (0.0018)
Insurance Status			
Dual Eligible for Medicaid and Medicare	0.463** (0.045)	0.550** (0.069)	0.00200** (0.00071)
Index Length of Stay			
4–7 days (reference)			
8–14 days	0.797** (0.036)	0.867** (0.067)	–0.01009** (0.00065)
15+ days	1.224** (0.098)	1.533** (0.095)	0.0181** (0.0011)
N	43,540	21,854	21,854

Table 3 Probability of Discharge to SNF in 2019 and 2020 (Logistic Regression), and Difference in Predicted Probability of Discharge to SNF Between Years (Linear Regression).

All models also controlled for index conditions, comorbidities, and hospital fixed effects.

Parameter estimates are displayed, with standard errors in parentheses.

** Denotes statistical significance between years at 1% level; * Significant at 5% level.

Pr(DISCHARGE TO SNF)	COEFFICIENT	STD. ERROR	*z*-STATISTIC
Group 1 (2019)	0.3104	0.0021	144.80
Group 2 (2020)	0.2278	0.0027	83.45
Difference	0.0826	0.0035	23.81
Endowments (Explained)	–0.0109	0.0017	–6.54
Coefficients (Unexplained)	0.0903	0.0032	28.20
Interaction	0.0032	0.0013	2.56

Table 4 Kitagawa-Blinder-Oaxaca decomposition estimates.

COVARIATES	ESTIMATE	STD. ERROR
Weekly Patient Cases	–0.0327	0.0188
Weekly Staff Cases	–0.0624	0.0221

Table 5 Estimates for Measures of COVID Risk (Weighted at the SNF Level).

This table reflects beta coefficients and standard errors if each variable is included in our main analysis model by itself. Weekly patient and staff cases are two highly correlated variables ($r = 0.79$), so it was decided to incorporate each variable into the model separately. This model controlled for the same covariates as all other models: hospital fixed effects, MVC conditions, comorbidities, age, length of stay, gender, race, and dual-eligibility status.

	LIVES SAVED	READMISSIONS AVERTED	*N* IN 2020
Non-Dual Eligible	98.7	62.6	17,485
Dual Eligible	19.0	8.7	4,369
Overall	117.7	71.3	21,854

Table 6 Estimate of Lives Saved and Readmissions Averted.

a marginal effect. Instead, we calculate the probability of discharge to SNF for each person in the 2020 data two different ways. First, we calculate the probability assuming there is no risk of COVID-19 and then assuming each person has their assigned value of COVID-19 risk. Taking the difference between these two probabilities for each person and averaging over the data, we find an approximate average decrease in the probability of discharge to SNF of 0.69 percentage points. This means that these measures of COVID-19 risk explain about ten percent of the decline in SNF use. Most of the decline was due to general aversion to SNFs throughout 2020, as opposed to aversion specifically based on the current level of risk.

Next, we show the results for the number of lives saved and the number of readmissions averted, using equation 5. Overall, we calculate that the number of lives saved by the behavioral shift away from discharge to SNF was 117 lives or 0.54% of the cohort (Table 6). This specific result needs to be set in context. During 2020, the overall 90-day mortality rate for this population increased from 10.0% to 12.3%. Given the sample size of 21,854 patients in 2020, this means that about 503 additional people died in 2020 compared to what would have happened without COVID-19. Comparing 117 to 503, we can say that without this behavioral change, the additional mortality rate due to COVID-19 would have been 23.3% higher. Although the pandemic wreaked havoc in nursing homes, to the extent that patients avoided SNFs at discharge, the damage in terms of lives lost was lessened.

The effect on readmissions was much smaller. Between 2019 and 2020, about 71 fewer people were readmitted (0.33% of the cohort) in 2020 compared to what would have happened without COVID-19. The overall readmission rates stayed essentially the same on average for our cohort of patients. This result shows that moving patients away from SNFs to home did not lead to a corresponding increase in readmissions, a result that is encouraging but not necessarily expected.

Finally, we turn to how this behavior affected disparities. Dual-eligible beneficiaries represent approximately 21% of the patients in our sample. If the number of lives saved were proportional for dual-eligible and non-dual-eligible beneficiaries, then we would expect 24 lives saved for dual-eligible patients and 93 for non-dual-eligible beneficiaries. Instead the number of lives saved for dual-eligible beneficiaries was smaller (19) and the number for non-dual-eligible beneficiaries was correspondingly larger (98). Similarly, the benefits from the number of readmissions averted went almost entirely to non-dual-eligible beneficiaries. We estimate that dual-eligible beneficiaries had a minor decrease in readmissions (9) while non-dual-eligible beneficiaries avoided readmission (62). These results show that in this situation, disparities worsened in terms of mortality and readmissions for dual-eligible beneficiaries compared to non-dual-eligible beneficiaries.

ROBUSTNESS CHECKS

We conducted three robustness checks to assess whether the study findings would change significantly if we restricted the sample to one that was even more homogenous. First, we tested whether the results were sensitive to excluding elective conditions. We excluded episodes for four index conditions—joint replacement, COPD, atrial fibrillation, and disc herniation—because they were plausibly more likely to be elective and as a result had fewer than half of the number of cases in the second quarter of 2020 compared to 2019 (all other conditions had a less dramatic falloff in number of cases). This change in the clinical conditions did not significantly affect the findings (results are in the Appendix).

In the second robustness check we repeated the main analysis, but with both the 2019 and 2020 cohorts limited only to episodes from Q3 and Q4 (July through December). Since our original sample includes all of 2019 and only Q2–Q4 2020, this robustness check was performed to better align the cohorts in terms of seasonality and use a timeframe in 2020 after the first few months of the pandemic had passed. Again, findings did not appreciably change (results are in the Appendix).

The third robustness check varied the timing of the outcomes from 90 days down to 30 and 60 days. We compared the raw readmission rates and mortality rates across these three timeframes, by year. We also compared the estimate readmissions averted and deaths averted, both overall and by dual-eligibility status, across the three timeframes. Again, the results are robust with similar patterns, although of course there are fewer readmissions and deaths in 30 days than during the longer periods (results are in the Appendix).

The fourth robustness check compared 90-day inpatient mortality rates between 2019 and 2020. The inpatient mortality rate according to discharge disposition code was 2.5% in 2019 and 3.6% in 2020. These findings indicate that patients in our 2020 cohort who survived the index hospitalization may have been slightly healthier than patients in the 2019 cohort, assuming that patients entering the hospital in both years were equivalently healthy. However, when comparing the final 2019 and 2020 cohorts of patients who survived the index hospitalization, the average number of comorbidities per patient was nearly identical, further evidence that the two cohorts were similar upon discharge.

LIMITATIONS

This study has several limitations, starting with being limited to data from Michigan (for a comparison of state policy responses to COVID-19 in nursing homes, see Van Houtven *et al*., 2021). The results generalize to Medicare patients, age 65 and older, who were hospitalized at general hospitals for conditions that have a reasonably high chance of needing SNF care post-discharge. While this is not everyone, it does allow us to answer the important questions of whether avoiding SNFs lowered mortality and readmission rates for a relevant vulnerable population. In addition, there were several policy changes during the pandemic that affected SNF care. One such policy change was a temporary public health emergency waiver in 2020 allowing some patients to use post-acute SNF care without first staying in the hospital at least three nights, which may have resulted in an increase in SNF use in 2020 (Ulyte *et al*., 2023). Although about half of our observations had a length of stay less than three days, and so would have been eligible for post-acute SNF care in 2020, almost none of them were discharged to SNF. Therefore, in practice leaving out all observations with short stays did not have a noticeable effect on the results. Another difference between 2019 and 2020 was due to a Michigan executive order beginning on March 21, 2020, which temporarily postponed all non-essential procedures until May 29, 2020 (Mich. Exec. Order No. 2020-17; Mich. Exec. Order No. 2020-96). This study included some patients with episodes for conditions considered non-essential (e.g., joint replacement) so due to the statewide executive order and as well as general hospital avoidance there are decreased counts of certain conditions in the 2020 cohort compared to 2019. However, as documented in the limitations section, our results are not sensitive to the inclusion or exclusion of patients admitted April through June or to patients with non-essential procedures.

Although we discuss changes in the probability of discharge to SNF as being primarily due to patient choice, there were also some supply-side constraints. Some SNFs were not accepting residents due to shortages of staff (Xu *et al*., 2020), and facilities with these staff shortages had worse outcomes (Chen *et al*., 2023). Nor did we control for differences between SNFs by type of ownership (Chou, 2002). The State of Michigan also designated some SNFs as COVID Regional Hubs and later Care and Recovery Centers in 2020 (Chang *et al*., 2023), which was intended to isolate patients with COVID away from those who did not. In our analysis, it really does not matter why patients avoided SNF at discharge; we observe a large change and analyze the consequences on mortality and readmissions. We were careful to exclude patients who were known to have COVID, since their choices were limited and their prognosis much worse.

CONCLUSION

This study's findings indicate that the behavioral change in 2020 of decreased SNF use resulted in lives saved and reduced readmissions following acute inpatient hospitalizations or outpatient procedures. Patients that did go to SNFs for post-acute care in 2020 received greater benefit if they were not a dual-eligible beneficiary. In addition, higher rates of COVID-19 illness in certain SNFs resulted in a decreased number of discharges to those SNFs. Fewer lives were endangered as a result of the fewer discharges to SNFs with high percentages of sick patients. We want to emphasize two important strengths of this study: the sample size is large, and our results are robust to several important alternative specifications and robustness checks.

There is insufficient evidence to support the conclusion that the finding of lives saved and readmissions averted as a result of SNF avoidance in 2020 are generalizable beyond the unique impact of the COVID-19 pandemic on the United States. However, findings can be interpreted more broadly to inform health professionals of the benefits and risks of post-acute care following hospitalization during times of increased disease transmission. Dual-eligible beneficiaries should be treated with extra care and consideration because they are more likely to be socially disadvantaged, decreasing their access to quality healthcare. If similar future public health issues arise, it is crucial to take these conclusions into consideration when treating patients, as appropriate care transitions can save lives and reduce disparities in health outcomes.

ADDITIONAL FILE

The additional file for this article can be found as follows:

- **Appendix.** Appendix A to C. DOI: https://doi.org/10.31389/jltc.236.s1

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COMPETING INTERESTS

The authors have no competing interests to declare.

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