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Lea Bergmann, Dörte Heger, and Christiane Wuckel*

Nursing Home Shortage and Hospital Bed-Blocking

Abstract

A hospital stay dramatically increases the risk that an elderly person will require long-term care. Due to increasing staff shortages in German nursing homes, patients who require nursing home care directly after a hospital stay often struggle to find a nursing home bed. This paper studies how hospital length of stay differs between care dependent individuals requiring and not requiring a nursing home bed, controlling for potential health differences between these groups. We find that the need for a nursing home bed is associated with approximately a 40% increase in length of stay. Since hospital care is much more expensive than nursing home care, bed-blocking is not only a concern for the patients but also for public policy.

JEL-Codes: I11, J63

Keywords: Capacity; personnel shortage; long-term care; nursing and care homes; bed-blocking

September 2024

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1. Introduction

Finding an adequate nursing home bed is often a challenging process for care dependent persons as well as their families (Skudlik et al., 2023). While price, quality, proximity to family and amenities may influence the demand for a particular nursing home, the choice is often limited by the number of available nursing home beds. For one, due to a high level of bureaucratic regulation, the expansion of nursing home beds has fallen short of the growth of care dependent persons. For another, if nursing homes cannot recruit sufficient nursing personnel as a result of the increasing nursing shortage, beds must be left unoccupied due to strict staffing regulations (Heger et al., 2023). When care dependency occurs suddenly, for example after a health shock, these challenges of finding a nursing home bed are even magnified. Consequently, if no nursing home bed is available, patients requiring nursing home care after a hospital stay may remain in hospital longer than medically necessary (Gellner, 2023; Report Report Mainz, 2023; Springer Springer Pflege, 2023). However, patients with unnecessarily prolonged hospital stays may experience negative effects on their physical mobility as well as on their mental fitness (Lim et al., 2006; Rosman et al., 2015).

In general, hospital length of stay (LOS) is influenced by several factors, the most important ones being the diagnosis and age of the patient (Lu et al., 2015; Peltola & Group, 2012). In addition, hospital characteristics and the patient's social environment determine hospital LOS (Lu et al., 2015). Since hospital care is typically more expensive than, e. g., ambulatory care or nursing home care, prolonged LOS for non-medical reasons is a major public policy concern (Cannoodt & Knickman, 1984; Rojas-García et al., 2018). This phenomenon is part of what is known as “bed-blocking”, indicating that “a patient is deemed medically fit to leave hospital but is unable to do so for non-medical reasons” (Rojas-García et al., 2018, p. 41).

Waiting for long-term care (LTC) arrangements has been shown to be one of the main factors for bed-blocking among older patients (Costa-Font et al., 2018; Forder, 2009; Kverndokk & Melberg, 2021; Picone et al., 2003; Tiessen et al., 2013). In light of ageing populations and dwindling financial and personnel resources in the health care sectors, bed blocking has gained increasing attention among political decision makers as well as in the academic literature (see, e. g., Landeiro et al., 2019). Previous literature demonstrates that waiting for a nursing home bed increases hospital LOS in Spain and England (Challis et al., 2014; Moore et al., 2018; Pellico-López et al., 2019). Using administrative data from England, Gaughan et al. (2015) find that if the number of home care beds were to increase by 10%, delayed bed days could be reduced by 7.8-9.2%. Additionally, patients who transfer to a nursing home and not back home stay in hospital for, on average, 12 additional days (Gaughan et al., 2017), while policies targeted at facilitating transfers from hospitals to LTC reduce bed blocking by 1.8 days (Kverndokk & Melberg, 2021).

To the best of our knowledge no empirical evidence exists of the relationship between nursing home shortage and hospital bed-blocking in Germany. Like other developed countries, Germany has experienced an enormous increase in nursing home residents. While the number of nursing personnel also increased, its growth has been fundamentally lower, leading to an acute shortage of registered nurses as well as nursing assistants (Heger et al., 2021; Heger & Korfhage, 2018). Based on a ranking of the German Federal Employment Agency to assess the extent of labor shortage within a profession, registered LTC nurses receive the highest ranking of shortage in five of six categories (Statistik der Bundesagentur für Arbeit, 2024): average duration of vacancies, the jobseeker-job ratio, the job-specific unemployment rate, the chance of leaving unemployment, and the salary development. In the category assessing the change in employment of foreign workers the profession of registered LTC nurses the shortage indicator was somewhat lower but still showed signs of a shortage, resulting in an above average rating in all of the six categories. To safeguard the quality of care, minimum staffing levels prevent nursing homes to react to the lack of nursing personnel by reducing the nurse-to-resident ratio below a certain level (Heger et al., 2023). If nursing homes cannot comply with staffing regulations, beds must remain unoccupied. The staff shortage is therefore directly linked with a shortage of nursing home beds.

Our paper addresses this important issue by estimating whether, and to what extent, care dependent persons who transfer into a nursing home after a hospital stay experience longer hospital LOS and evaluate if the lack of LTC nursing personnel and beds contributes to hospital bed-blocking in Germany. Our empirical analysis exploits rich individual information from health insurance data, administrative regional data as well as statistics on LTC in Germany. Employing entropy balancing to control for observed differences between care dependent individuals, we compare patients who have lived at home before hospital admission and then transfer into a nursing home with two control groups: (1) patients who already have lived in a nursing home before hospital admission and return to nursing home care after discharge and (2) patients who have lived at home before hospital admission and return home. While the first control group might consist of care dependent persons who are unobservably sicker, we interpret these estimates as a lower bound of bed-blocking duration. Care dependent persons returning home after hospital discharge might be unobservably healthier, thus we interpret these estimates as upper bound of bed-blocking duration. We find that patients that transfer into a nursing home experience a 40% longer hospital LOS (approximately three to four more days) and show that a longer LOS is associated with a lower capacity of nursing personnel and beds in nursing homes. Our results are robust to a variety of robustness checks. Furthermore, we calculate the additional hospital costs billed to the health insurance for the prolonged hospital stay. Our estimates show that, on average, the prolonged hospital stay leads to an additional €420 in hospital costs. While these results do not represent a full cost-benefit analysis since

they rely on hospital costs reimbursed by the health insurance rather than the actual accrued costs and do not include, e.g., the potential cost savings from fewer days in a nursing home nor the additional costs of the potential reduction in health due to the prolonged hospital stay, they suggest a large potential for cost savings if bed-blocking is reduced.[1]

The contribution of this paper is threefold: First, we are the first to provide empirical evidence for hospital bed-blocking in Germany. Second, we relate this finding to the availability of nursing personnel and nursing home beds. Third, we provide evidence that the lack of LTC personnel and beds leads to a costly misallocation of resources, which has important health policy implications.

The remainder of this paper is organized as follows: Section 2 provides an overview of the literature and the institutional background, section 3, describes our data, section 4 discusses our estimation strategy, and section 5 presents our results. Finally, section 6 discusses the results and concludes.

2. Institutional Background

In Germany, if an individual's health deteriorates and it is probable that LTC services are required for at least six months, she must undergo an assessment by the medical advisory service of the statutory health insurance. After the assessment each eligible individual is assigned to one of the three (since 2017: five[2]) care levels with a higher care level indicating a larger need for care. Following the assessment, individuals can choose among various LTC options, such as cash benefits, ambulatory care, and nursing home care. Depending on the care level and the kind of LTC, the individual (or, for professional care, the service provider directly) receives a predefined payment from the LTC insurance (Geyer et al., 2023).

Nursing homes in Germany operate either for-profit or not for-profit (operated by communities, welfare or private organizations). In order to receive payments from the compulsory LTC insurance for care-related expenditures, nursing homes need to comply with staffing as well as infrastructural regulations. Since the reimbursements only cover parts of the care-related expenditures residents must pay for the remainder. Residents also pay for food and accommodation as well as any investment costs not covered by state subsidies. These co-payments are the same within a nursing home but vary widely across Germany. If residents cannot afford these costs according to a means and wealth test the payments are covered by social assistance (in 2020 this was true for nearly 50% of the nursing home inhabitants (Geyer et al., 2023)). Since nursing homes' revenues are closely tied to the number of residents, they have

[1] The costs for an average hospital day amounted to 707 euros (Destatis, 2021, 2011) while the average nursing home price, excluding investment costs, amounted to 98 euros per day in 2019 (Heger et al., 2021).

[2] The five care categories existing since 2017 have been converted to the original three care levels. Care level 1 comprises the new categories 1 and 2, care level 2 comprises the new category 3, and care level 3 comprises the new categories 4 and 5.

an incentive to fill any empty bed as soon as possible. However, if a nursing home cannot recruit sufficient nursing personnel it might be required to leave beds empty (Heger et al., 2021).

Many people prefer home care to nursing home care and therefore stay at home for as long as their health permits (Lehnert et al., 2018; Rudel et al., 2017). Besides health status, socio-economic status and the availability of informal care also influence the decision to move into a nursing home (Pilny & Stroka, 2016). When choosing a nursing home, care-dependent persons are free to choose any nursing home with free beds that accepts new residents. While most patients are admitted to a nursing home from home, around 24% are admitted to a nursing home from hospital (Rothgang et al., 2015). In this case, the search for a nursing home might come as a sudden task that the care-dependent persons or their family are ill-prepared for. Since 2007, hospitals are therefore mandated to provide discharge management to their patients (SGB V §39 (1a)). Since October 2017, hospitals have to guarantee a seamless transition of patients to subsequent care areas. This includes arranging an assessment by the medical advisory service of the statutory health insurance to evaluate the patient's care needs and organizing LTC. While hospitals are mandated to prefer ambulant care arrangements to stationary care arrangements (Rahmenvertrag Entlassmanagement § 2 (4)), this mandate also includes arranging for a bed in a nursing home. The goal of these measures is to achieve uninterrupted care for the patients as well as to reduce any unnecessary and expansive time spent in hospitals. In addition, hospitals have a strong financial incentive to discharge patients as soon as medically possible since their reimbursement is set by fixed payments based on DRGs (diagnostic related groups). Each DRG is assigned an upper limit of days for which the hospital is reimbursed for. If a patient surpasses this limit, the hospital is only partly compensated for the additionally incurred costs (Schreyögg et al., 2006).

3. Data

Our empirical analysis draws from individual-level data from a large German health insurance company for the years 2011 to 2019. The sample is nationally representative and covers approximately 10% of the German population. These data include all billing-related information and encompass individuals' hospital stays, comorbidities, and their LTC situation. We calculate our main variable of interest, an individual's hospital LOS, by the difference between the admission and discharge date. We drop all observations with a LOS of zero days, as those are not full inpatient stays. Moreover, the data provide information on the costs of the hospital stay, which we use as our secondary outcome of interest[3], each individual's age and gender, the year of the hospital stay, whether the hospital stay is an emergency, the admission day, the

[3] Costs are adjusted by the base rate for the German hospital system for the corresponding years, thereby making them comparable across years.

DRG, their Elixhauser score as a measure of health status (Elixhauser et al., 1998), and the hospital.

Further, we combine the health insurance data with data on regional characteristics (Bundesinstitut für Bau-, Stadt- und Raumforschung, 2024) as women's labor force participation rate, share of women and migrants, age structure of the population (the share of the population aged 75 and above, and the share of women aged 65 and above), household income, public sector cash loans, rurality and number of hospital beds per 1,000 inhabitants, as well as data from the official German LTC statistic (FDZ der FDZ der Länder, 2011; FDZ der FDZ der Länder, 2017; FDZ der FDZ der Länder, 2019; FDZ der FDZ der Länder, 2021), where we draw from the number of nursing home beds, the number of care recipients and how many employees and nurses are employed in nursing homes.[4]

Since we want to study transitions from hospitals to nursing homes, we limit our sample to care-dependent individuals aged 65 and above who experience a full-station hospitalization. We split our sample into three distinct groups: One treatment group and two control groups. Our treatment group consists of individuals who live at home before the hospitalization and switch into a nursing home immediately after hospital discharge. We focus on the first hospitalization after which they enter a nursing home, either for long-term or short-term care. Our first control group consists of patients who already have lived in a nursing home before hospital admission and return to nursing home care after discharge. The second control group consists of patients who have lived at home before hospital admission and return home after being discharged. Additionally, in a robustness analysis, we only consider individuals with either the diagnosis stroke, cerebral infarction (ICD codes I63 and I64), femur fracture (ICD code S72), or hypovolemia (ICD code E86) as the main reason for their hospital stay.

To measure nursing home capacity and the extent of nursing shortage, we use the number of all nursing home beds per county as well as the number of vacancy postings by nursing homes for registered nurses registered by the German Federal Employment Agency (BA; Statistik der Bundesagentur für Arbeit 2023), respectively. Since receiving nursing home care rather than care at home – either professionally or from a family member – represents a choice which might be influenced by capacity and staff limits, we divide both measures by the number of care dependent individuals with care level two or higher in a county, which proxies for nursing home care needs within a county.

4. Estimation Strategy

To investigate whether individuals who newly enter a nursing home directly after a hospital admission stay longer in the hospital as they are waiting for a nursing home bed, we compare

[4] This data is only available for every second year (2011, 2013, 2015, 2017 and 2019). For the intervening years we impute the average of the adjacent years.

this group to our two control groups. To make these groups comparable we use entropy balancing (Hainmueller, 2012).[5] We consider each individual's year of birth, the year of the hospital stay, sex, Elixhauser score, the hospital, admission weekday, whether hospital admission was coded as an emergency admission, hospital ownership (public versus non-public), LTC level 1 (low care needs) to 3 (high care needs), and hospital ward, as well as ICD categories and several county characteristics[6] as our covariates for entropy balancing. We then specify our balance conditions to match the first moments of covariates. After the entropy balancing, the treatment and nursing home control group (Table 1) as well as the treatment and home control group (Table 2) are nearly identical, where nursing home control and home control refers to the group of patients returning to a nursing home and returning home after their hospital stay, respectively.

The statistics reveal that the samples are mainly female, which aligns with the typical demographic trend observed in nursing homes, primarily influenced by factors such as life expectancy and living arrangements. The treatment group is on average 85 years old and has an Elixhauser score of 10. Nearly all of them already received care before the hospitalization, half of them were assigned to care level 1. Descriptively, for the nursing home sample the difference in LOS between the treatment and control group is six days. For the home sample, it is slightly lower with, on average, 4.5 days.

Table 1: Descriptive Statistics – Nursing Home Sample. Means, SDs and the test are calculated based on entropy balancing weights.

	Nursing Home Control		**Treatment**		
Variable	Mean	SD	Mean	SD	Test
Female	0.75	0.43	0.74	0.44	F = 0.015
Age	85.06	7.85	85.07	7.14	F = 0.022
Elixhauser Score	10.35	9.55	10.36	9.55	F = 0.005
Care level 1 before	0.43	0.50	0.50	0.50	F = 0.001
Care level 2 before	0.38	0.48	0.35	0.48	F = 0.003
Care level 3 before	0.19	0.39	0.14	0.35	F = 0.004
LOS	8.67	8.25	13.87	7.76	F = 13079.06***
Costs	3,814	4,714	4,480	2,296	F = 289.169***
Observations	225,468		37,891		

Notes: Test is a F-test for differences between the control and treatment group. SD is standard deviation. Further entropy balancing variables include year of the hospitalization, admission day, admission ward, emergency admission, Charlson Score, public hospital, first three digits of ICD, county, hospital as well as county characteristics (GDP per inhabitant, rurality, share of women, share of migrants, share of population aged 65 and above, share of population aged 75 and above, share of women aged 65 and above, mean age of the population, number of hospital beds, household income, registered nurses in nursing homes, nursing assistants in nursing homes, care dependent individuals).

[5] Entropy balancing is data preprocessing method used to achieve covariate balance. When estimating an average treatment effect on the treated (ATT), the method creates weights for each control unit meeting pre-defined balance conditions. These balance conditions concern the sample moments of the covariate distributions. Entropy balancing has a higher estimation accuracy and lower calculation burden than other reweighting methods such as inverse probability weighting (Harvey et al., 2017).
[6] A full list of all variables used for Entropy Balancing can be found in the notes of Tables 1 and 2.

Table 2: Descriptive Statistics - Home Sample. Means, SDs and the test are calculated based on entropy balancing weights.

	Home Control		Treatment		
Variable	Mean	SD	Mean	SD	Test
Female	0.74	0.44	0.74	0.44	F=0.1
Age	85.07	7.36	85.07	7.14	F=0.032
Elixhauser Score	10.35	9.55	10.36	9.55	F=0.012
Care level 1 before	0.50	0.50	0.50	0.50	F=0.311
Care level 2 before	0.35	0.48	0.35	0.48	F=0.13
Care level 3 before	0.14	0.34	0.14	0.35	F=0.433
LOS	9.44	7.32	13.87	7.76	F=12100.051***
Costs	3,676	2,201	4,480	2,296	F=4426.069***
Observations	291,534		37,891		

Notes: Test is a F-test for differences between the control and treatment group. SD is standard deviation. Further entropy balancing variables include year of the hospitalization, admission day, admission ward, emergency admission, Charlson Score, public hospital, first three digits of ICD, county, hospital as well as county characteristics (GDP per inhabitant, rurality, share of women, share of migrants, share of population aged 65 and above, share of population aged 75 and above, share of women aged 65 and above, mean age of the population, number of hospital beds, household income, registered nurses in nursing homes, nursing assistants in nursing homes, care dependent individuals).

The specification for our estimation regression is:

$$Y_i = \beta_0 + \beta_1 D_i + \beta_2 X_i + \beta_3 C_k + \delta_d + \mu_h + S_s + w_a + \epsilon$$

which we estimate using ordinary least squares estimation. Y_i represents our outcome of interest and D_i defines the treatment status, i.e. whether the patient has been transferred to a nursing home following the hospital stay, of each individual *i*. X_i and C_k represent individual and county level control variables, respectively. We further incorporate hospital (μ_h), admission ward (w_a), federal state (S_s) and DRG (δ_d)[7] fixed effects. Thus, we compare patients with the same condition and exhibiting the same severity of symptoms based on our observable measures. By using both entropy balancing and control variables we make our estimation doubly robust, ensuring that we receive the true estimates even when not correctly specifying one of the models (Kang & Schafer, 2007). As hospital LOS is a left-skewed count variable we use the logarithm in our main specification.[8] ϵ is the error term. Standard errors are clustered at the individual and hospital level.

To investigate whether capacity and staff shortages in nursing homes drive our results, we interact the treatment indicator with our measures for nursing home beds capacity and nursing shortage, respectively. Second, we estimate whether the treatment group experiences differences between counties with low and high nursing home bed capacity and nurse shortage. To do so, we run separate regressions on counties with below the 25% percentile and above the 75% percentile of nursing home bed capacity and nurse shortage, respectively.

[7] The point estimates for both LOS and costs increase when using the first three digits of the ICD instead of DRG fixed effects. Our preferred specification, however, uses DRG fixed effects to control for the severity of the treatment.

[8] Estimation of the model using log(LOS) implicitly assumes homoskedasticity (Manning, 1998; Winkelmann, 2001). The results are similar but slightly smaller when using a poisson regression model.

5. Results

In this section, we first present the results on LOS and hospital costs for individuals who enter a nursing home for the first time after hospital compared to individuals who return home (Home Control Group) or have previously resided in a nursing home and return there (Nursing Home Control Group) for our full sample. In a second step we show whether this is driven by a lack of nursing home capacity and staff.

The first set of results is presented in Table 3. We add fixed effects and control variables stepwise with the full model being our preferred specification. Column (1) shows our estimate without including hospital ward, DRG and hospital fixed effects: care-dependent individuals who newly move to a nursing home have a 56% higher LOS compared to those returning home and a 69% higher LOS compared to those returning to a nursing home. After including hospital and DRG fixed effects in column (2) the estimate drops to 43% (+4.2 days) and 52% (+4.5 days), respectively, and remains robust when controlling for individual and county characteristics in column (3).[9] Additionally, hospital costs increase by approximately €418 and €336 (around 10%), respectively. The increase in the LOS does not proportionately lead to a significant rise in costs due to the structure of the DRG payment system. Since the tariffs for DRGs are predetermined, an additional day of hospital stay does not substantially impact overall costs. This is because DRGs primarily cover the costs of treatment rather than day-to-day care. Furthermore, once the upper limit of the recommended LOS is surpassed, the reimbursement for each extra day is significantly reduced. Thus, the financial impact of extending the stay beyond this threshold, as measured by the additional (reimbursed) hospital costs, becomes minimal and does not reflect the true marginal costs of the hospital. This lower cost increase relative to LOS might therefore reflect the reduced compensation once the assigned treatment specific upper limit of LOS has been reached under the DRG system. All estimates are highly significant at the 0.1% level.

[9] The estimate's decrease after including fixed effects points out the relevance of the diagnosis, hospital and admission ward for the individuals' LOS and hospital costs. Considering the higher increase in LOS when using ICD fixed effects, the main drop appears to be driven by the diagnosis and its severity.

Table 3: Regression Results: Full Sample

	LOG(LOS) (1)	LOG(LOS) (2)	LOG(LOS) (3)	COSTS (4)
Panel A: Home Control				
Treatment	0.555***	0.429***	0.428***	418.42***
	(0.007)	(0.007)	(0.007)	(8.801)
Hospital and Diagnosis FE	No	Yes	Yes	Yes
Individual & county controls	No	No	Yes	Yes
R^2	0.039	0.465	0.470	0.794
Mean Y		9.9		3,768
Observations	329,425	329,425	329,425	329,425
Panel B: Nursing Home Control				
Treatment	0.691***	0.523***	0.521***	336.87***
	(0.009)	(0.008)	(0.009)	(10.727)
Hospital and Diagnosis FE	No	Yes	Yes	Yes
Individual & county controls	No	No	Yes	Yes
R^2	0.067	0.520	0.525	0.852
Mean Y		8.7		3,534
Observations	263,359	263,359	263,359	263,359

*Notes: Standard errors (in parentheses) are clustered at the hospital and county level. Individual and county covariates refer to age, gender, admission day, the individual's county's population structure, income situation, hospital beds and women's employment. Hospital FE include fixed effects for hospital ward and hospital. *p < 0.05, ** p < 0.01, *** p < 0.001.*

We now turn to studying the influence of the lack of nursing home beds and staff to explore potential mechanisms behind our observed treatment effects. More nursing home beds per care dependent individual with high care needs represent a higher capacity of nursing home beds. A higher number of vacancy postings by nursing homes for registered nurses per care dependent individual with high care needs demonstrates higher nurse shortage. Intuitively, a higher capacity of nursing home beds should reduce bed-blocking while a more pronounced nurse shortage should increase bed-blocking ceteris paribus. Our results when examining the lack of capacity and registered nurses in nursing homes are presented in Table 4.

Table 4: Regression Results: Heterogeneity by Nursing Home Capacity

	CAPACITY			VACANCIES		
	Interaction	Low	High	Interaction	Low	High
Panel A: Home Control Group – log(LOS)						
Treatment	0.485***	0.451***	0.413***	0.424***	0.427***	0.443***
	(0.033)	(0.015)	(0.011)	(0.016)	(0.019)	(0.011)
Interaction	-0.050			0.591		
	(0.030)			(0.861)		
R^2	0.483	0.515	0.476	0.483	0.502	0.482
Mean Y	9.9	10	9.8	9.9	10	9.3
Observations	256,991	64,150	64,135	256,991	64,082	64,027
Panel B: Home Control Group – Costs						
Treatment	806.34***	518.97***	344.03***	475.48***	478.43***	398.97***
	(47.611)	(19.875)	(15.232)	(18.831)	(21.147)	(16.193)
Interaction	-358.03***			-2766.26*		
	(41.867)			(1110.103)		
R^2	0.804	0.811	0.815	0.803	0.810	0.810
Mean Y	3,768	4074	3,675	3,768	3,998	3,722
Observations	256,991	64,150	64,135	256,991	64,082	640,27
Panel C: Nursing Home Control Group – log(LOS)						
Treatment	0.590***	0.541***	0.503***	0.516***	0.518***	0.544***
	(0.034)	(0.015)	(0.014)	(0.018)	(0.020)	(0.012)
Interaction	-0.060*			0.820		
	(0.029)			(0.886)		
R^2	0.540	0.563	0.530	0.540	0.555	0.537
Mean Y	8.7	8.8	8.5	8.7	9.1	7.9
Observations	174,891	43,721	43,571	174,891	43,673	43,284
Panel D: Nursing Home Control Group – Costs						
Treatment	596.42***	410.51***	291.949***	364.93***	366.13***	337.56***
	(52.470)	(21.578)	(17.077)	(24.490)	(23.025)	(22.800)
Interaction	-236.067***			-586.89		
	(44.918)			(1567.278)		
R^2	0.863	0.918	0.888	0.862	0.891	0.906
Mean Y	3,534	3,771	3,401	3,534	3,785	3,451
Observations	174,891	43,721	43,571	174,891	43,673	43,284
Hospital & Diagnosis FE	Yes	Yes	Yes	Yes	Yes	Yes
Individual & county controls	Yes	Yes	Yes	Yes	Yes	Yes

*Notes: Standard errors (in parentheses) are clustered at the hospital and county level. Individual and county covariates refer to age, gender, admission day, the individual's county's population structure, income situation, hospital beds and women's employment. Hospital FE include fixed effects for hospital ward and hospital. *p < 0.05, ** p < 0.01, *** p < 0.001.*

Compared to the home control group, the interaction term for capacity is negative yet close to zero. Despite its small magnitude, it suggests that an increase in nursing home bed capacity leads to a reduction in LOS for the treatment group. Individuals in counties with higher capacity experience, on average, a 0.4 days smaller increase in LOS compared to those with lower capacity if they require a nursing home bed following their hospital stay. Correspondingly, the estimates for costs decrease by about €150. When using the nursing home control group, the estimates are similar.

Turning to our measure of nurse shortage, we observe a similar pattern. Compared to the home control group, the interaction term for nurse shortage is positive, suggesting that an increase in nurse shortage might lead to an increase in LOS for the treatment group. However, the estimate is statistically insignificant. In counties with low nurse shortage the estimated treatment increase in LOS is 0.2 days smaller than in counties with high nurse shortage. For costs, the estimates point in the opposite direction. However, this finding can be explained by the difference in mean LOS in counties with high versus low nurse shortage. Again, the results are similar when using the nursing home control group. Therefore, nursing home beds capacity and nurse shortage are arguably mechanisms contributing to bed-blocking in German hospitals, although the association to those is rather small as nearly all German counties experience shortage in nursing home capacity and staff.

6. Robustness Analyses

In this section, we analyze how our results hold up regarding different intensities of care needs and across different years, as several reforms regarding LTC and hospital dischargement occurred during our analyzed time period.[10] In addition, we examine whether our results still hold if we consider more homogeneous subgroups based on the diagnosis made in the hospital.

Table 5 shows that average hospital LOS decreases with higher care levels, while the estimated treatment effect increases. Compared to patients in the home control group with the same care level the LOS increases by 40.3% for patients with care level 1 and by 48.4% for patients with care level 3. Compared to the nursing home control group the treated individuals' LOS increases by 50.6% for patients with care level 1 and by 60.6% for patients with care level 3. Hence, for both samples, the results show that having higher care needs is, on average, associated with an increase in days spent in hospital. The prolonged average LOS also translates into increasing hospital costs with higher care levels (Panels B and D). Hence, while our general result on bed-blocking can be found for all care levels, our findings are consistent with anecdotal evidence that nursing homes prefer patients with lower care needs due to staffing constraints.

[10] Our results hold when only considering women as well as for individuals aged 85 and above.

Table 5: Regression Results: Heterogeneity by Care Needs

Care level	1	2	3
Panel A: Home Control Group – log(LOS)			
Treatment	0.403***	0.434***	0.484***
	(0.009)	(0.008)	(0.012)
R^2	0.494	0.466	0.437
Mean Y	10	9.9	9.6
Observations	184,536	99,564	37,267
Panel B: Home Control Group – Costs			
Treatment	336.635***	418.923***	571.903***
	(11.163)	(12.930)	(20.926)
R^2	0.814	0.793	0.759
Mean Y	3,745	3,761	3,885
Observations	184,536	99,564	37,267
Panel C: Nursing Home Control Group – log(LOS)			
Treatment	0.494***	0.532***	0.587***
	(0.010)	(0.010)	(0.012)
R^2	0.532	0.523	0.533
Mean Y	8.8	8.7	8.3
Observations	113,984	99,223	49,957
Panel D: Nursing Home Control Group – Costs			
Treatment	277.549***	324.111***	459.310***
	(13.288)	(15.504)	(27.395)
R^2	0.877	0.837	0.877
Mean Y	3,519	3,535	3,596
Observations	113,984	99,223	49,957
Hospital and Diagnosis FE	Yes	Yes	Yes
Individual & county controls	Yes	Yes	Yes

*Notes: Standard errors (in parentheses) are clustered at the hospital and county level. Individual and county covariates refer to age, gender, admission day, the individual's county's population structure, income situation, hospital beds and women's employment. Hospital FE include fixed effects for hospital ward and hospital. *p < 0.05, ** p < 0.01, *** p < 0.001. Care levels indicate the severity of the individual's care need. 1 includes low, 2 moderate and 3 severe care needs.*

Further, we verify that our results are not driven by a particular time period due to different reforms during our study period. First, in January 2015 the first Care Strengthening Act (Pflegestärkungsgesetz) came into force. This included a significant increase in all long-term care insurance benefit amounts, especially for short-term and respite care. Second, in January 2017 the second Care Strengthening Act came into force. This reform replaced the three care levels with five care grades. In addition, the need for care no longer depends solely on the need for physical support, but also on the independence of the person in need of care. Additionally, since October 2017 every hospital is required to provide standardized discharge management. This includes arranging an assessment by the medical advisory service of the statutory health insurance to evaluate the patient's care needs and organizing LTC, for example a bed in a nursing home and should decrease hospital LOS for our treatment group. We therefore split our sample into three groups: First, patients who stay in the hospital between 2011 and 2014 (pre-reform). Second, patients who are hospitalized between 2015 and 2016 (after the first Care Strengthening Act). And finally, patients who enter a hospital between 2017 and

2019, that is after the second Care Strengthening Act and the mandate for hospital discharge management.

Table 6: Regression Results: Heterogeneity by Years

	2011-2014	2015-2016	2017-2019
Panel A: Home Control Group – log(LOS)			
Treatment	0.399***	0.403***	0.448***
	(0.008)	(0.010)	(0.009)
R^2	0.448	0.493	0.501
Mean Y	10	10	9.7
Observations	103,974	81,231	144,128
Panel B: Home Control Group Costs – Costs			
Treatment	316.22***	351.28***	495.52***
	(11.524)	(14.032)	(13.745)
R^2	0.805	0.823	0.812
Mean Y	3,504	3,704	3,987
Observations	103,974	81,231	144,128
Panel C: Nursing Home Control Group – log(LOS)			
Treatment	0.49***	0.49***	0.55***
	(0.010)	(0.012)	(0.010)
R^2	0.492	0.536	0.560
Mean Y	9.1	8.8	8.3
Observations	114,800	56,029	92,454
Panel D: Nursing Home Control Group Costs – Costs			
Treatment	283.75***	295.48***	412.02***
	(13.377)	(17.241)	(18.264)
R^2	0.872	0.880	0.875
Mean Y	3,280	3,503	3,722
Observations	114,800	56,029	92,454
Hospital and Diagnosis FE	Yes	Yes	Yes
Individual & county controls	Yes	Yes	Yes

*Notes: Standard errors (in parentheses) are clustered at the hospital and county level. Individual and county covariates refer to age, gender, admission day, the individual's county's population structure, income situation, hospital beds and women's employment. Hospital FE include fixed effects for hospital ward and hospital. *p < 0.05, ** p < 0.01, *** p < 0.001.*

Table 6 shows that, qualitatively, our result holds for all time periods. For the treated group, the LOS is slightly larger in later periods. For the home control sample, between 2011 and 2014 treated individuals stay in the hospital for 39.9% longer. There is no qualitative change in the second period. In the last period, the LOS for the treated individuals increases strongly by 44.8%. Likewise, compared to the nursing home control group treated individuals experience an increase in LOS over time, though it is smaller than the increase in LOS compared to the home control group. Hence, the Care Strengthening Act and the mandate for hospital discharge management do not appear to have reduced the LOS. Therefore, despite the efforts to improve discharge management, transitions from hospitals to nursing homes do not take place faster. Arguably, the increasing staff shortage and the resulting shortage of nursing home beds cannot be compensated by better discharge regulations. With respect to our cost outcome, we observe the total hospital costs for the samples increase over time. Additionally, the costs

increase more for the treatment group compared to the according control group over time. This suggests that the waiting period for a nursing home bed increases over time.

In the following, we check the robustness of our results by spitting up our full sample into more homogeneous groups of patients. For our full sample, it might be possible that the higher LOS for treated individuals is driven by a big health shock experienced by the individuals in our treatment group that necessitates a move into a nursing home. Even when controlling for DRG fixed effects and the Elixhauser score, there might be differences in the severity of the sickness or the comorbidities between the control and treatment group. Additionally, we do not know for sure whether the LOS increase in our treatment group can be justified with medical reasons or not. To rule out these explanations we focus on individuals who have all experienced a health shock that often leads to a nursing home admission following a hospital stay and that is comparable in its severity. These diagnoses are a cerebral infarction or stroke, femur fractures and hypovolemia.[11]

Table 7 shows that for cerebral infarctions and strokes (Panel A) we find that the LOS increases by 24% (+2.9 days) compared to the home control group and by 35% (3.9 days) compared to the nursing home control group. The hospital costs increase by €254 (+5%) to €312 (+6%). Since the treatment group, on average, exceeds the upper limit of length of stay based on their assigned DRG, hospital costs are only partially reimbursed and the actually occurring hospital costs are likely to be higher. For femur fractures (Panel B) we find a 19% increase in LOS (+2.7 days) compared to the home control group and a 26% (+3.4 days) increase compared to the nursing home control group. The associated additional hospital costs amount to €262 (+4%) and €176 (+3%), respectively. Finally, we consider the results for patients with hypovolemia. Hypovolemia is a special case as it does not cause an urgent need for LTC but is one of the most frequent diagnoses before patients enter a nursing home in Germany. Considering the home control group (Panel C), the LOS increases by 46% (+3.5 days) and by 58% (+3.9 days) compared to the nursing home control group. The costs increase by 9.2% (+€260) and by 10.0% (+€276), respectively. These results confirm the results of the main analysis and show that patients regardless of the diagnosis stay in the hospital for additional three days if they must wait for a nursing home bed. Comparing the results using the home control and the nursing home control group, LOS increases more for all diagnoses when using the home control group, while the findings for costs are mixed.

[11] We do not know whether it is the first time the patient is hospitalized with the diagnosis.

Table 7: Regression Results for Home Control Group by Diagnosis

	HOME CONTROL		NURSING HOME CONTROL	
	log(LOS) (1)	Costs (2)	log(LOS) (3)	Costs (4)
Panel A: Cerebral Infarction or Stroke				
Treatment	0.239***	254.11***	0.355***	312.54***
	(0.019)	(44.164)	(0.019)	(44.574)
Hospital and Diagnosis FE	Yes	Yes	Yes	Yes
Individual & county controls	Yes	Yes	Yes	Yes
R^2	0.706	0.785	0.685	0.813
Mean Y	12	5,183	11	5,084
Observations	8,127	8,127	7,350	7,350
Panel B: Femur Fracture				
Treatment	0.188***	262.31***	0.262***	176.18***
	(0.013)	(29.260)	(0.012)	(31.246)
Hospital and Diagnosis FE	Yes	Yes	Yes	Yes
Individual & county controls	Yes	Yes	Yes	Yes
R^2	0.503	0.743	0.600	0.791
Mean Y	14	6,309	13	6,370
Observations	9,076	9,076	12,221	12,221
Panel C: Hypovolemia				
Treatment	0.456***	259.37***	0.581***	276.34***
	(0.014)	(21.005)	(0.018)	(26.051)
Hospital and Diagnosis FE	Yes	Yes	Yes	Yes
Individual & county controls	Yes	Yes	Yes	Yes
R^2	0.392	0.789	0.411	0.746
Mean Y	7.6	2,806	6.7	2,677
Observations	11,890	11,890	11,189	11,189

*Notes: Standard errors (in parentheses) are clustered at the hospital and county level. Individual and county covariates refer to age, gender, admission day, the individual's county's population structure, income situation, hospital beds and women's employment. Hospital FE include fixed effects hospital ward and hospital. *p < 0.05, ** p < 0.01, *** p < 0.001.*

7. Discussion

In this paper, we analyze patients' claims data, combined with LTC statistics and detailed regional information, to explore the relationship between hospital LOS and subsequent nursing home residency in Germany. Our findings confirm that bed-blocking is largely driven by a shortage of both nursing home capacity and staff, contributing to the growing body of literature on the impact of nursing home shortages on hospital bed-blocking. Specifically, we find that patients waiting for a nursing home bed stay an average of three to four additional days in the hospital, representing an approximate 40% increase in LOS. This extended stay is associated with additional hospital costs of around €420. Moreover, patients newly entering a nursing home in regions with fewer available beds and a more acute nursing shortage experience even longer hospital stays, underscoring the role of LTC capacity in driving bed-blocking.

The relative increase in LOS is smaller for conditions like strokes and femur fractures, which often necessitate urgent transfers to nursing homes, potentially indicating a prioritization of patients with immediate needs. Additionally, our results show that patients with higher care

needs experience a greater increase in LOS than those with lower care needs. This suggests that, in the context of the LTC staff shortage in Germany, nursing homes may prioritize admitting patients with lower care requirements due to the reduced staffing intensity needed for their care.

Interestingly, patients hospitalized for hypovolemia who transition to nursing homes experience a relatively longer LOS compared to patients with other diagnoses, despite hypovolemia not requiring urgent LTC. However, the absolute increase in LOS across diagnoses remains consistent, indicating that, regardless of diagnosis, there is a baseline number of days required to secure a nursing home bed. Additionally, recent LTC and hospital dischargement reforms aimed at streamlining the transfer process from hospitals to nursing homes have not succeeded in reducing these waiting periods.

Our results highlight that hospital LOS and costs increase significantly when patients are transferred to nursing homes, highlighting the impact of shortages in both nursing home beds and staff. These findings align with those of Gaughan et al. (2015), who suggest that hospitals and nursing homes act as substitutes in the short term. Extrapolating our results to all care recipients in Germany we estimate a 0.1% increase in hospital occupancy days across Germany due to nursing home shortages—a critical issue for health policy given the association between extended LOS, higher healthcare expenditures, and potentially negative impacts on patient health.

Our point estimates do not suggest that patients who have already resided in a nursing home and therefore already have a nursing home bed available for them are discharged earlier. One might expect earlier transfers due to the availability of professional care at the nursing home. In fact, patients returning to nursing homes tend to have longer hospital stays compared to those discharged back home. While we cannot entirely rule out the possibility that this is due to higher care needs or more comorbidities among nursing home residents, we have made efforts to address this issue through our entropy balancing approach and by selecting a control group with the same DRG as the treatment group. Moreover, Kümpel (2019) found that nursing homes hospitalize their patients frequently for short stays as they are fully compensated for short absences.

In comparing our treatment group to patients returning home (potentially healthier) and those re-entering a nursing home (potentially sicker), we provide a range of estimates for the effect of waiting for a nursing home bed on hospital LOS. Although unobserved heterogeneity may exist between patients already in nursing homes and those living at home prior to admission, we expect nursing home residents to generally be in poorer health, which would likely result in longer hospital stays. On the other hand, nursing homes may act as a substitute for certain hospital care, potentially allowing for earlier discharges. Patients returning home, while likely healthier, may face delays in discharge due to the need to arrange new care services,

potentially extending their LOS. Thus, any observed differences in LOS between the treatment and home control or control group may be underestimated due to these factors. Moreover, by comparing two different control groups, we interpret our findings as upper and lower bounds on the potential impact of the growing nursing shortage in LTC on hospital LOS in Germany.

While our results cannot not be interpreted as causal effects of the lack of nursing personnel and nursing bed shortage on the time transferring to a nursing home, we believe that it is reasonable to assume that these factors contribute to the differences in LOS. To provide evidence that the nursing home shortage drives our results we include the nursing home capacity for each county as well as a measure for nurse shortage into our analysis. Our results verify that counties with a low nursing home bed capacity or high nurse shortage have on average longer LOS for hospital patients newly transferring to a nursing home than in counties with a high nursing home bed capacity or low nurse shortage. As nursing home capacity in Germany is mainly driven by the number of available LTC nurses due to strict staffing regulations we suggest that the shortage of LTC staff leads to bed-blocking in German hospitals.

Nevertheless, some limitations of the study should be noted. For one, while we use comparable control groups to rule out other factors that might influence hospital LOS, our capability to do so is closely linked to the data available. In particular, we do not know anything about the individuals' socio-economic status or family situation, which have been found to determine the choice of LTC received (Heger & Korfhage, 2018). For another, we do not observe whether an individual's discharge is actually delayed, i.e. whether an earlier hospital discharge would have been medically appropriate assuming that for patients with LTC needs an appropriate continuation of care was guaranteed. Further research might overcome these data issues and would allow for a deeper understanding of nursing home transitions.

Finally, our results demonstrate that the lack of nursing home staff and beds leads to an increase in costs for the health system, therefore uses up hospital resources and might deteriorate patients' health, e. g. through a prolonged time of limited mobility. To mitigate these negative consequences, recruiting more LTC nurses and thereby securing sufficient supply of nursing home beds should be a prime goal for health policy makers.

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