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Working Paper

The effect of staffing on objective quality of nursing home care

Ruhr Economic Papers, No. 1144

Provided in Cooperation with:
RWI – Leibniz-Institut für Wirtschaftsforschung, Essen

Suggested Citation: Bergschneider, Henrik; Heger, Dörte (2025) : The effect of staffing on objective quality of nursing home care, Ruhr Economic Papers, No. 1144, ISBN 978-3-96973-327-1, RWI - Leibniz-Institut für Wirtschaftsforschung, Essen, https://doi.org/10.4419/96973327

This Version is available at:
https://hdl.handle.net/10419/312429

RUHR
ECONOMIC PAPERS

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RWI #1144

Imprint

Ruhr Economic Papers

Published by

RWI – Leibniz-Institut für Wirtschaftsforschung
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Ruhr Economic Papers #1144

Responsible Editor: Ansgar Wübker

ISSN 1864-4872 (online) – ISBN 978-3-96973-327-1

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RWI

Bibliografische Informationen der Deutschen Nationalbibliothek

The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available on the Internet at **http://dnb.dnb.de**

RWI is funded by the Federal Government and the federal state of North Rhine-Westphalia.

https://dx.doi.org/10.4419/96973327
ISSN 1864-4872 (online)
ISBN 978-3-96973-327-1

Henrik Bergschneider and Dörte Heger*

The Effect of Staffing on Objective Quality of Nursing Home Care

Abstract

Growing needs for long-term care coupled with a dwindling supply of nursing personnel is a common challenge for developed countries. To uphold care standards, many countries introduced measures to safeguard staffing levels, e.g. by introducing minimum staffing regulations for nursing homes. However, evidence on the causal relationship of nurse staffing levels and quality of care is still inconclusive. This paper adds to the sparse evidence of the effect of nursing personnel employed in nursing homes and objective quality of care and accounts for different qualification levels of nursing personnel. We find that more registered nurses lead to better quality outcomes for nursing home residents while nursing assistants do not influence our objective quality measures.

JEL-Codes: I110, I180, J630

Keywords: Quality of care; long-term care; nursing shortage

February 2025

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1 Introduction

Nurses are a central element of any patient-centered health care system and provide essential services not only in hospitals but also in the long-term care (LTC) sector (OECD, 2023). While several studies document a positive impact of nurse staffing levels on quality of care in hospitals (Dall'Ora et al., 2022), causal evidence on the relationship between the number of nurses and quality of care in LTC is still rare. This accounts particularly for the German geriatric care sector. To the best of our knowledge, there are no papers that claim to provide causal evidence on the relationship between nurse staffing levels and quality of care outcomes in Germany. Our paper aims to fill this gap by analysing the effect of nursing personnel (NP) on objective health outcomes of German nursing home (NH) residents. To address endogeneity concerns we instrument the employed staffing level using administrative data on nursing vacancies.

Most of the current literature on the relationship between nurse staffing and quality of care refers to the U.S. NH sector. Its setting is particularly advantageous for causal examinations as the U.S. geriatric care sector has been subject to several policies regulating minimum staffing levels which led to a significant rise in nurse staffing (Park and Stearns, 2009; Bowblis, 2011; Chen and Grabowski, 2015; Matsudaira, 2014). Using these policies as exogeneous shocks to instrument staffing characteristics and to claim causal evidence, literature finds a positive effect of higher nurse staffing levels on quality of care in the U.S. (Grabowski and Zhang, 2004; Lin, 2014; Brunt, 2023).

Moreover, there are other works that show positive effects of nursing input and care quality with different identification strategies. Konetzka et al. (2008) find evidence of better quality due to higher registered nurse staffing using data from five U.S. states. The instrumental variable is a change in Medicare payment policy that resulted in a financial shock to nursing homes that affected staffing levels. Lee et al. (2014) instrument staff hours per resident day with the percentage of the population over 65 and the percentage of women in the workforce. The authors find significant negative effects of staffing on the prevalence of pressure ulcers whereas other quality measures are not significantly associated with staffing levels. Using the unemployment rate as an instrument for nurse turnover, Antwi and Bowblis (2018) show a negative effect on quality indicators of NH care and a positive effect on mortality in NHs in California.

However, little is known about this relationship in other countries. In Korea, higher nurse staffing levels are associated with an increase in quality indicators (Cho et al., 2020; Shin, 2018). Pfaff and Zimmermann (2018) find a positive association between staffing levels and quality in German NHs. Boscart et al. (2018) show that nursing assistants provide most of the direct care in Canadian NHs, and that their staffing ratios are significantly associated with higher quality of care. In Italy, higher nurse staffing ratios are associated

with a lower likelihood of being admitted from a nursing home to a hospital (Cherubini et al., 2012).

This paper uses insurance claims data to create three measures for nursing care quality based on diagnosed decubitus or pressure ulcers, urinary tract infections (UTIs), and prescriptions of antipsychotics, respectively. Decubitus are pressure sores on the skin caused by reduced blood supply due to constant pressure on the skin, which is mainly caused by increased immobility of the patient. Given that decubitus are preventable and treatable by good nursing care makes their diagnosis an appropriate quality indicator (Grabowski, 2001). Likewise, the diagnosis of UTIs is another outcome-oriented quality indicator relating to the health of a care recipient. UTIs are infections caused by inadequate preventive measures, especially poor hand hygiene and incorrect handling of urinary catheters. Older nursing home residents, especially women, are at increased risk of developing a UTI (Schwinger et al., 2018).

Contrary, the prescription of antipsychotic drugs is a process-oriented quality indicator. Many NH residents suffer from cognitive disorders such as dementia or Alzheimer disease, which are associated with behavioral or psychiatric symptoms (Lucas et al., 2014). These symptoms may include crying, aggression, anxiety or wandering. While an appropriate treatment for these symptoms would be the use of non-medical, personal intensive approaches such as activities or exercise programs, antipsychotic medication, which is much less personal intensive, might be used to calm or immobilize the patient (Schwinger et al., 2018). Medication with antipsychotics is associated with considerable health risks, which is why the German Association for Psychiatry, Psychotherapy and Psychosomatics (DGPPN) only recommends a temporary use of these kind of treatment (DGPPN and DGN, 2023) and the prescription of antipsychotic drugs is the responsibility of the general practitioner or a specialist such as a neurologist, gerontologist or psychiatrist rather than nurses. However, a survey of nursing staff in Germany shows that 57% of registered nurses in NHs occasionally work towards a medical prescription of antipsychotics to treat residents. 64% of nurses say that those antipsychotics are prescribed for more than one year (Jacobs et al., 2017).

In using these measures, we build on a large health economics literature that uses the same indicators and has found them to be valid proxies for quality of nursing care (Lin, 2014; Konetzka et al., 2008; Bowblis, 2011; Chen and Grabowski, 2015; Lee et al., 2014; Brunt, 2023; Schwinger et al., 2018). However, while most of this literature is settled in the U.S. NH market and uses OSCAR (Online Survey, Certification, and Reporting System) data or MDS (Minimum Data Set) assessments based on self-reports, our data relies on exact administrative records.[1] To allow for a causal interpretation of the effect of nurse staffing

[1]OSCAR data are reported annually at the facility level and are collected through self-reporting and on-site inspections to assess compliance with federal regulations. MDS assessments are reported quarterly at the resident level and collected by nursing staff using a standardized scheme.

on quality of care, we draw from information on nursing shortage based on vacancy data in an instrumental variable setting.

We contribute to the literature in several ways. First, we add to the sparse evidence on the effect of nurse staffing on the quality of care in NHs, relying on regional NH staffing shortages to identify causal effects. Second, we use insurance claims data from a large German insurance company to provide objective medical indicators of NH quality. Since we exploit data of one of the biggest German health insurers that covers about 9 million individuals which is over 10% of the German population we are confident that these indicators can be considered as a valid measure to indicate quality of care in German NHs (Grobe and Szecsenyi, 2023). Third, we examine the extent to which the skill mix of registered nurses (RNs) and nursing assistants (NAs) plays a role in safeguarding care quality.

Section 2 gives an overview of LTC in Germany. Section 3 describes the data and variables used. The empirical strategy is outlined in Section 4, followed by the results in Section 5. Section 6 concludes.

2 Institutional background

In Germany, the mandatory LTC insurance covers care related expenses up to a specified limit that varies based on an individual's care needs as well as the type of care received. To be eligible for assistance, a care dependent person must be expected to require LTC for at least six months and undergo an assessment to determine her care needs. Care needs are grouped into five care levels with higher care levels indicating more care needs.[2]

Once eligibility has been confirmed, the care dependent person or her relatives can chose between nursing care received at home – either informally by family members or friends – or formally by professional NP through a ambulatory nursing service. Since the LTC insurance only pays parts of the care related expenses, the care dependent person is required to pay for any additional expenses. Furthermore, NH residents have to pay for food and accommodation out-of-pocket. If the additional costs exceed the care dependent's ability to pay based on means and wealth test, the payments are covered by social assistance (for details, see Geyer et al. (2023)).

Besides health status, the care type someone chooses also depends on their socio-economic status and the availability of informal care options (Pilny and Stroka, 2016). Since many people prefer home care to NH care they often rely on home based care for as long as their

[2]Prior to 2017 care needs have been assessed based on three care levels with three being the highest level of care needs. We treat the original care level 1 identical to the new levels 1 and 2, the original care level 2 identical to the new care level 3, and the original care level 3 identical to the new levels 4 and 5.

health permits (Lehnert et al., 2018; Rudel et al., 2017). As a consequence, NH residents are often of advanced age and suffer from severe care needs.

To safeguard quality standards, minimum staffing regulations apply in German NHs, which vary between federal states and depend on the care levels of the residents (Heger et al., 2023). While, in order to receive payments from the LTC insurance, NHs need to comply with these staffing regulations, short-time deviations are possible. The nursing shortage, however, might reduce NHs ability to recruit new NP, leading to staffing levels below the desired level. In the extreme case that minimum staffing levels are not met, NHs might have to leave rooms empty, which negatively affects NHs revenues (Heger et al., 2023).

Since quality of LTC remains an ongoing concern, a new method for the allocation of nursing staff was introduced in July 2023. This reform, which took place after our study period, replaced the previous guidelines with a target nurses to residents-ratio at the national level. The new staffing regulations (Personalbemessungsverfahren - PeBeM) introduced a new calculation method at national level, based on the distribution of care levels among NH residents and differentiating between three qualification levels of care staff (BMG, 2024). During the current transition period, complying to the new staffing targets is optional, which makes allowance for the general nursing shortage.

3 Data

Our analysis combines data from three different data sources covering the years 2011 to 2019. First, for individual level information we use insurance claims data from a large German health insurance company, which provides a representative sample of approximately 10 % of the German population (Grobe and Szecsenyi, 2023). This data contains individuals' medical information such as medical diagnosis and prescriptions, LTC status and, if applicable, level of care as well as individual characteristics such as age, sex, year of birth, and county of residence. We restrict our sample to persons receiving inpatient NH care. Since we do not have any information on the NH level (other than county), we aggregate all variables at the county level.[3]

Second, we use the German Care Statistics, which is published biannually and provides information on German NHs, their staff, and their residents; home health care providers, their staff, and their clients; and informal care recipients (FDZ der Länder, 2011, 2017, 2019, 2021). We use county level information on the number of nursing staff in NHs measured in FTE and the number of formal and informal care recipients. To obtain yearly data, we fill in missing years by averaging neighboring years.[4]

[3]Figure A1 in the appendix shows the regional distribution of insurees by state.
[4]Our estimates remain stable when we drop the extrapolated years instead.

Third, we use administrative vacancy data from the Research Institute of the Federal Employment Agency. This data provides us with the annual averages of vacancies in NHs aggregated at the county level (Statistik der Bundesagentur für Arbeit, 2023). In this paper, we use the vacancies for all NP in NHs. We also split up NP by training level and distinguish between RNs and NAs.

Finally, we merge all data sources at the county level.[5] This leaves us with 400 counties observed over a nine year period and hence, 3,600 county-year observations. Due to a small number of dropped observations due to missing staffing information, our final sample includes 3,586 county-year observations.

3.1 Quality of care

To quantitatively measure our outcome variable, quality of care, we use three medical indicators that have been identified to be associated with poor treatment of NH residents (Schwinger et al., 2018): i) decubitus or pressure ulcers, ii) UTIs, and iii) prescriptions of antipsychotics. Each indicator defines a different negative measure of quality, i.e. a larger number of diagnoses or prescriptions per resident is associated with worse quality. The identification of the diagnoses and drug prescription is based on ICD-10 codes and the Anatomical Therapeutic Chemical Classification System (ATC), respectively. Table A1 provides an overview of the ICD-10-GM and ATC codes used. We only consider confirmed diagnoses.

We define our quality indicators as the rates of decubitus, UTIs or antipsychotic prescriptions measured per 100 NH residents. Since we do not have information on single NHs, the level of observation is the county. To measure newly diagnosed decubitus and UTIs, a maximum of one diagnosis is counted per quarter, and only if there was no diagnosis in the previous quarter, to avoid counting the same decubitus or UTI twice, resulting in a maximum of two diagnoses per year per resident (Schwinger et al., 2018). Since we only observe the quarter in which a diagnosis was made, we assign the date of diagnosis to the midpoint of a quarter. This allows to assess whether the diagnosis was made during a NH stay and to match the insured person's county of residence. We proceed similarly for drug prescriptions with the benefit that we observe the exact date of a prescription. Moreover, we count up to one prescription each quarter, resulting in a maximum of four prescriptions per year and NH resident which takes into account an inappropriate long-term use of the medication. As the number of diagnoses and prescriptions per county is highly

[5] During our study period some counties were merged together in the course of county area reforms. In the German Care Statistics, we observe variables based on the status defined by the respective observation year, the data on administrative vacancies are observed at the status of 2019, whereas the data on administrative insurance claims are observed at their current status. In order to harmonize the information on the location between the datasets, we set the state of observation to 2021 and add together counties of previous years that are subject to a county reform in a later year.

dependent on the number of NH residents, we calculate outcome rates per NH resident and extrapolate them to a standard of 100.[6]

3.2 Explanatory variables

Our main explanatory variable of interest is the quantity of nursing care provided, which we proxy by several staffing variables. Given that our data is aggregated on the county level, we define our staffing variables accordingly. To adjust for county differences, we therefore calculate the rates of NP employed in NHs (in FTE) per 100 NH residents in a county.[7] We calculate separate staffing measures for RNs, NAs, as well as total NPs, which is the sum of RNs and NAs. The RN category includes nurses with at least three years of training, while NAs have undergone at least one year of training. We exclude other professions that either do not require specific training, are specialized health professionals or do not have direct care contact with residents. Table A2 in the Appendix provides a full overview on the included as well as excluded professions.

Since the quantity of NP employed might be highly endogenous with respect to quality of care, we instrument county-level NH staffing levels using information on nurse vacancies in NHs. We thereby follow Heger et al. (2023) who show that nurse-to-resident ratios and vacancy ratios are strongly related. We calculate the ratio of job vacancies on all budgeted positions in a county c in a given year t as is shown in Equation (1). Budgeted positions refer to the sum of both vacant and filled positions and thus define the desired level of NP in NHs. The instrument therefore provides a ratio of open positions relative to the full demand for care staff in NHs, which we interpret as nursing shortage. We argue that these shortages are due to demographic or structural and systematic reasons in the German labor market. As before we distinguish between NP, RN and NA. Since nursing homes in Germany often report fewer vacancies than they actually require, the true staffing shortage may be underestimated. This measurement error in the instrument may lead to attenuation bias, resulting in a conservative estimation of the staffing effects in the first stage.

$$\text{vac-ratio}^{i}_{c,t} = \frac{\text{vac}^{i}_{c,t}}{\text{bud. pos.}^{i}_{c,t}} = \frac{\text{vac}^{i}_{c,t}}{\text{filled pos.}^{i}_{c,t} + \text{vac}^{i}_{c,t}}, \quad \text{where } i \in \{\text{NP, RN, NA}\} \tag{1}$$

[6] We calculate the number of continuously occupied NH beds in each county to adjust for differences in length of stay of the residents across NHs. This refers to an indication of NH residents in FTE (Schwinger et al., 2018).

[7] One might argue that the nursing shortage influences whether a person enters a nursing home or receives care at home. Only dividing by care recipients receiving NH care might therefore underestimate the need for NH care. For this reason, we conduct a supplementary analysis where we redefine our staffing measure by dividing by all care recipients - regardless of whether they receive NH care or are cared for at home and rerun all estimations. Considering all care recipients for the staffing ratios leaves our qualitative results unchanged.

Further, we construct additional control variables from the insurance claims data that define the characteristics of NHs within a county. These characteristics define average age of residents, proportion of female residents and proportion of residents with severe care needs, indicated by the care levels 4 or 5 based of the new classification system.

4 Empirical Strategy

For each of our quality measures (diagnoses of decubitus, UTI, and prescriptions of antipsychotics), we estimate the relationship of nurse staffing in NH and quality of care as is shown by our baseline OLS model:

$$\begin{aligned} Y_{c,t} &= \rho^{OLS}\ \textit{staff-ratio}^{i}_{c,t} + X'_{c,t}\beta^{OLS} + \gamma_c^{OLS} + \lambda_t^{OLS} + \epsilon^{i}_{c,t}{}^{OLS} \\ &\qquad \text{where } i \in \{\text{NP, RN, NA}\} \end{aligned} \tag{2}$$

Y represents care quality in county c and year t and *staff-ratio* represents nurse staffing ratios for either all NP, RNs or NAs. Further controls regarding NH characteristics are represented in X and define average age of residents, proportion of female residents and proportion of residents with care level 4 or 5. γ_c and λ_t indicate county and year FE and ϵ captures a random error term.

However, the number of nursing personnel in a nursing home may be endogenous, since staffing decisions depend, e.g., on financial considerations, care demand, or management priorities. Even at the county level, staffing may still be endogenous due to reverse causality – facilities with lower quality may hire more staff to compensate – or omitted variable bias, e.g., through differences in regional funding, investments, and facility ownership that affect both staffing and care quality. As a consequence, the estimated effect of nurse staffing on care quality would be biased. We address these potential endogeneity concerns by using an instrumental variable approach and estimate the following 2SLS regression to obtain unbiased causal estimates:

$$\textit{staff-ratio}^{i}_{c,t} = \alpha\ \textit{vac-ratio}^{i}_{c,t} + X'_{c,t}\beta^{FS} + \gamma_c^{FS} + \lambda_t^{FS} + \epsilon^{i}_{c,t}{}^{FS} \tag{3}$$

$$\begin{aligned} Y_{c,t} &= \rho^{2SLS}\ \widehat{\textit{staff-ratio}}^{\,i}_{c,t} + X'_{c,t}\beta^{2SLS} + \gamma_c^{2SLS} + \lambda_t^{2SLS} + \epsilon^{i}_{c,t}{}^{2SLS} \\ &\qquad \text{where } i \in \{\text{NP, RN, NA}\} \end{aligned} \tag{4}$$

The vacancy ratio (*vac-ratio*), which indicates staff shortages or unmet demand of care personnel hereby serve as the instrumental variable for nurse staffing (Heger et al., 2023).

Different assumptions need to hold for the instrument to be valid. First, the instrumental variable needs to be relevant, which means that it is strongly related to the treatment variable, defined by staffing ratios. Vacancy ratios are useful indicators of labor market shortages, reflecting both structural and systematic labor deficits driven by regional workforce dynamics (migration, nurse supply, demographic changes). These effects are present at a broader scale than individual NH conditions. We demonstrate the strength of the instrument in the first stage regression.

Next, the exclusion restriction needs to hold which means that vacancy ratios affect care quality only through staffing levels. County and year fixed effects help to account for long-term regional differences and nationwide trends that could bias the estimation. However, they do not fully eliminate concerns about dynamic labor market shocks or short term fluctuations in vacancy rates that may still be associated with care quality through other channels. We further test robustness by using lagged values of vacancy ratios that we believe are free of other potential channels that affect current care quality.

Finally, exogeneity of the instrument needs to be fulfilled. This means that vacancy ratios may not be correlated with unobserved factors that simultaneously affect care quality. One potential violation arises from reverse causality: NHs with poor care quality may have worse working conditions that lead to higher vacancies. Estimating effects on the county level mitigates this concern due to aggregating across facilities. As above, general regional quality differences are captured by county and time FE and we further address this by using lagged values of vacancy ratios that correlate with current staffing but are not affected by current care quality in a robustness test. Together, these approaches strengthen the plausibility of our instrument and the credibility of our results.

5 Results

In this section, we first provide an overview of our data and then present our estimation results. For transparency, we present both the OLS as well as the 2SLS results. Since we believe that the former results may be biased, the latter results represent our preferred specification. In addition, we present several robustness tests to confirm the reliability of our results.

Table 1 shows descriptive statistics for all variables used pooled over our sample period. Besides mean values, the 20th– and 80th–percentiles are shown. The average age of NH residents in a county was 85 years, 78% of the residents were women and 38% had a care level of four or above, which indicates high care needs. With regard to our quality measures, we observe, on average, approximately 10 newly diagnosed cases of decubitus, 12 newly diagnosed incidents of UTI and 104 prescriptions of antipsychotics per 100 NH

residents per year in a single county. As for staffing levels, the average number of nursing personnel per 100 NH residents was 35. Close to 24 registered nurses and 11 nurse aids care, on average, for 100 NH residents, resulting in a RN-share of nearly 70%. Vacancy ratios were 2.4% for both RNs and NPs and 2.5% for NAs.

Table 1: Descriptive statistics

			2011–2019	
Variable	Mean	SD	20th-percentile	80th-percentile
NH characteristics				
Average age	84.847	7.696	82.377	86.521
Share of women	0.779	0.086	0.731	0.818
Share of care level 4 or 5	0.383	0.074	0.327	0.434
Quality outcomes				
Decubitus	37.492	55.028	11.000	53.000
UTI	44.302	59.913	13.000	62.000
Antipsychotics	371.232	460.377	119.000	522.200
Decubitus ratio (per 100 NH residents)	10.194	4.633	6.638	13.252
UTI ratio (per 100 NH residents)	12.240	5.736	7.700	16.379
Antipsychotics ratio (per 100 NH residents)	104.037	39.869	71.679	134.226
Staffing ratios (per 100 NH residents)				
Nursing personnel (NP-ratio)	35.127	4.673	30.940	39.001
Registered nurses (RN-ratio)	24.206	2.937	21.621	26.753
Nurse aides (NA-ratio)	10.921	3.322	8.053	13.684
Skill-mix (RN-share)	0.693	0.066	0.635	0.750
Vacancy ratios				
NP vacancy ratio	0.024	0.015	0.012	0.035
RN vacancy ratio	0.024	0.015	0.012	0.035
NA vacancy ratio	0.025	0.021	0.009	0.037
No. of counties			400	
Observations			3,586	

Note: This table shows descriptive statistics on the county level. Mean, standard deviation as well as the 20th and 80th percentile are reported. NH characteristics and quality outcomes are derived using insurance claims data. Staffing rations and vacancy ratios are based on the German Care statistics and administrative vacancy data from the Research Institute of the Federal Employment Agency.

Next, we turn to our estimation results. Table 2 shows results for the effect of all nursing personnel, i.e. RNs and NAs combined, on our three quality measures in Panel A as well as separate effects of RNs and NAs in Panel B to account for different qualification levels simultaneously. For our 2SLS estimation we also report the first stage results for our instruments. In each case, estimates are highly significant. As explained above, the 2SLS results represent our preferred specification due to the endogeneity concerns discussed above.

For all NP (panel A), the OLS results indicate a small negative correlation between staffing and incidents of decubitus, UTIs, and the prescription of antipsychotics, with the results only being statistical significant for the last measure. However, we believe that this result is non-causal and might underestimate the true relationship between staffing and quality of

Table 2: 2SLS Estimates of nurse staffing ratios on quality

	Decubitus		UTI		Antipsychotics	
	OLS	2SLS	OLS	2SLS	OLS	2SLS
Panel A: Model with NP						
NP	-0.038	-0.359*	-0.018	-0.350	-0.448***	-1.964*
	(0.027)	(0.201)	(0.035)	(0.229)	(0.160)	(1.087)
First stage:		-26.096***		-26.096***		-26.096***
NP-vacancy-ratio		(3.758)		(3.758)		(3.758)
Panel B: Model with RN and NA						
RN	-0.028	-0.466*	-0.024	-0.308	-0.029	-3.145**
	(0.042)	(0.253)	(0.057)	(0.293)	(0.258)	(1.395)
NA	-0.047	-0.247	-0.011	-0.430	-0.846***	-0.475
	(0.039)	(0.231)	(0.045)	(0.262)	(0.230)	(1.327)
First stage:		-26.163***		-26.163***		-26.163***
RN-vacancy-ratio		(3.045)		(3.045)		(3.045)
First stage:		-20.237***		-20.237***		-20.237***
NA-vacancy-ratio		(2.063)		(2.063)		(2.063)
Mean of DV:	10.194		12.240		104.037	
	(4.633)		(5.736)		(39.869)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,586	3,586	3,586	3,586	3,586	3,586

Note: Controls include nursing home characteristics as mean age of residents, share of women in nursing homes and proportion of residents with care level 4 or 5. F-Statistics of the instruments in the first stages are 33.00 for NP-vacancy-ratio, 73.84 for RN-vacancy-ratio and 96.21 for NA-vacancy-ratio. Standard errors in parentheses, clustered on the county level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

care since i) more personnel might be more likely to detect decubitus, UTIs or the need for antipsychotics and ii) that nursing homes with sicker individuals require more personnel and the residents more often suffer from decubitus or UTIs or require antipsychotics.

Once we control for such potential endogeneity, the relationship between NP staffing and quality of care indeed becomes stronger. Specifically, one additional nurse (RN or NA) per 100 NH residents leads to a 0.4 reduction of decubitus diagnoses, which represents a reduction of 4% of the sample mean. This effect is significant at the 10% level. With respect to diagnosis of UTI, the estimate of the effect of NP staffing is also negative though insignificant and accounts for 3% of the sample mean. Lastly, more NP staffing is significantly related to fewer prescriptions of antipsychotics (2% of the sample mean): one additional nurse per 100 NH residents reduces the average number of prescriptions per 100 NH residents by two prescriptions.

When we consider RNs and NAs separately within the same regression (Panel B), the estimates for RNs qualitatively mirror the effects for all NPs, indicating a small positive relationship between RN staffing and quality of care in our OLS estimation and a larger positive relationship in our 2SLS estimation. However, with the exception of the rela-

tionship between NAs and prescriptions of antipsychotics, none of the OLS estimates are statistically significant. In our 2SLS regression, as before, we find statistically significant causal effects for the diagnosis of decubitus (-0.5 diagnoses per one additional RN/100 NH residents, which corresponds to 5% of the sample mean) as well as prescriptions of antipsychotics (-3.1 prescriptions per one additional RN/100 NH residents or 3% of the sample mean). For NAs, the 2SLS estimates are consistently negative but statistically insignificant. We therefore conclude that the positive effect of staffing on quality of care is driven by more RNs rather than more NAs. Given that RNs have undergone at least three years of professional training, it seems reasonable to assume that the additional skills and experience of RNs contribute to better quality of nursing care in NHs, which is manifested by reduced cases of decubitus, e.g. since RNs are better at detecting the risk for and therefore preventing decubitus, and fewer prescriptions of antipsychotics. In the latter case one might argue that RNs are better trained to and therefore capable of appropriately treating dementia patients, which reduces the prescription of antipsychotics.

Robustness checks

Next, we present several robustness checks. As discussed earlier our vacancy ratios could be driven by reversed causality if poor nursing home quality leads to more vacant positions among care staff. Even though, we believe that aggregating quality and vacancies on the county level mitigates this potential threat we check for robustness by introducing lagged vacancy ratios as a new instrumental variable and show results in Table 3. This comes with the advantage that current quality of care does not affect past vacancies, hence exogeneity of the instrument is given. Since our data ranges between 2011 and 2019 we are forced to drop year 2011 due to lack of observations in 2010. As shown in Table 3, the relevance of the lagged instruments in the first stages remains. Nevertheless, our results largely confirm the positive relationship between staffing and care quality from our main results (Table 2). Again, we find statistically significant reductions on incidences of decubitus (-0.5 or 5% of the mean) and on prescriptions of antipsychotics (-1.9 or 2% of the mean). Likewise, our previous results that positive quality outcomes are achieved through more RNs rather than more NAs is confirmed. We find a 7% reduction in incidences of decubitus and a 3% reduction in prescriptions of antipsychotics for each additional RN per 100 nursing home residents. Estimates for NA remain insignificant.

Table 3: 2SLS estimates with lagged vacancy-ratios as IV

	Decubitus	**UTI**	**Antipsychotics**
	2SLS	2SLS	2SLS
Panel A: Model with NP			
NP	-0.459**	-0.238	-1.928*
	(0.227)	(0.250)	(1.135)
First stage:	-20.616***	-20.616***	-20.616***
NP-vacancy-ratio$_{t-1}$	(3.943)	(3.943)	(3.943)
Panel B: Model with RN and NA			
RN	-0.652**	-0.184	-2.963**
	(0.283)	(0.318)	(1.415)
NA	-0.352	-0.300	0.127
	(0.257)	(0.256)	(1.443)
First stage:	-15.943***	-15.943***	-15.943***
RN-vacancy-ratio$_{t-1}$	(2.536)	(2.536)	(2.536)
First stage:	-15.044***	-15.044***	-15.044***
NA-vacancy-ratio$_{t-1}$	(1.951)	(1.951)	(1.951)
Mean of DV:	9.200	11.094	97.357
	(3.465)	(4.464)	(34.421)
Controls	Yes	Yes	Yes
County FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	3,190	3,190	3,190

Note: Controls include nursing home characteristics as mean age of residents, share of women in nursing homes and proportion of residents with care level 4 or 5. When using lagged vacancies, the F-Statistics of the instruments in the first stage are 27.41 for NP-vacancy-ratio$_{t-1}$, 39.52 for RN-vacancy-ratio$_{t-1}$ and 59.48 for NA-vacancy-ratio$_{t-1}$. Standard errors in parentheses, clustered on county level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

As a second robustness test, we drop all even years for which we have averaged the data from the German Care Statistics, which is provided for odd years only. Though this imputation only affects the treatment variables, not our outcome measures, we check whether results are driven by potentially misspecified values in the missing years. The dropped years – 2012, 2014, 2016 and 2018 – account for 45% of our data, which implies a significant loss of power. To test the robustness of our findings, we drop these years and compare the resulting estimates with our main results in Table 4. Again, our results remain largely unchanged. We still observe a significant negative effect of NPs and RNs on the prescription of antipsychotics. Looking at the results for decubitus shows that on the one hand we lose significance due to larger standard errors, but on the other hand the estimates remain negative and hardly change in magnitude compared to our main results. These results demonstrate the robustness of our results to the omission of survey waves.

Table 4: 2SLS estimates without even years

	Decubitus	**UTI**	**Antipsychotics**
	2SLS	2SLS	2SLS
Panel A: Model with NP			
Main Results:			
NP	-0.359*	-0.350	-1.964*
	(0.201)	(0.229)	(1.087)
Drop even years:			
NP	-0.276	-0.214	-2.419*
	(0.223)	(0.250)	(1.289)
Panel B: Model with RN and NA			
Main Results:			
RN	-0.466*	-0.308	-3.145*
	(0.253)	(0.293)	(1.395)
NA	-0.247	-0.430	-0.475
	(0.231)	(0.262)	(1.327)
Drop even years:			
RN	-0.478	-0.183	-3.754**
	(0.303)	(0.340)	(1.772)
NA	0.010	-0.249	-0.450
	(0.215)	(0.266)	(1.367)
Mean of DV:	10.733	12.717	105.304
	(5.202)	(6.346)	(41.113)
Controls	Yes	Yes	Yes
County FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	1,993	1,993	1,993

Note: Controls include nursing home characterisitics as mean age of residents, share of women in nursing homes and proportion of residents with care level 4 or 5. For better readability, we do not show the first stages. When dropping averaged years, the F-Statistics of the instruments in the first stages are 26.01 for NP-vacancy-ratio, 41.46 for RN-vacancy-ratio and 104.04 for NA-vacancy-ratio. Standard errors in parentheses, clustered on county level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

6 Conclusion

This paper examines the effect of nurse staffing levels on objective medical indicators of care quality in nursing homes, specifically the diagnoses of decubitus ulcers and UTIs, as well as prescriptions of antipsychotic drugs. We use insurance claims data for our outcome measures and staffing data from the German Care Statistics.

With this study, we contribute to the sparse causal evidence on the relationship between staffing levels and quality of care in nursing homes. Our results suggest that higher nurse staffing levels are associated with improved care quality, particularly in terms of lower rates of decubitus ulcers and reduced prescriptions of antipsychotic medications. While we find a negative association between staffing and UTI diagnoses, this effect does not

reach statistical significance. Importantly, when distinguishing between RNs and NAs, we find that quality improvements are driven by higher RN staffing levels, whereas NAs show no significant effects. While we believe these findings to be intuitive due to the, on average, higher skill level and additional experience of RNs relative to NAs, they also align with existing literature, particularly from the United States, which has found similar effects for RN-staffing on care quality (Lin, 2014; Cho et al., 2020). To the best of our knowledge, this study is the first to provide causal evidence on this relationship for the German LTC sector.

Our findings have important policy implications for the German nursing home sector in particular, but are also highly relevant for other countries that face the challenge of a lack of nursing personnel. For one, by showing a causal relationship between NP and objective quality of care, our results support the implementation and enforcement of minimum staffing requirements as a potential mechanism helping to maintain high care quality. However, our findings also suggest that such regulations should not only focus on overall nurse-to-resident ratios but explicitly consider the qualifications of care staff. In Germany, policy efforts to provide sufficiently qualified NP have led to the new national personnel allocation regulation, which came into force in July 2023 (BMG, 2024). Nevertheless, political staffing regulations cannot create additional nurses and up to now the new regulations only recommend staffing ratios rather than implementing them. NHs are free to recruit additional NP or comply with the pre-existing federal regulations. As in other countries, the ongoing staffing shortages in the healthcare sector renders compliance with minimum staffing levels difficult to achieve. Addressing this challenge requires policies that aim to improve nurse education, retention programs, and working conditions to counteract the declining availability of highly qualified personnel in the profession.

While this study covers a highly relevant issue and uses detailed administrative data to explore causal relationships, some limitations remain. Since our analysis is conducted at the county level, we cannot account for potential differences in care quality at the facility level. Future research should address this issue and investigate differences in staffing effects within individual nursing homes to better understand heterogeneity in care quality. Additionally, our IV approach relies on the assumption that staffing shortages, measured by vacancy rates, provide a valid source of exogenous variation. While our robustness checks using lagged vacancy rates help to mitigate concerns about endogeneity, we probably underestimate the nursing shortage since NHs might, e.g. combine multiple vacancies to a single posting. More comprehensive data sources, e.g. from online vacancy databases, might be able to address this issue in the future.

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Appendix: Additional tables and figures

Table A1: Diagnosis and prescriptions codes)

Code	Description
Decubitus ulcer and pressure area (ICD-Code)	
L89.0	Stage I decubitus ulcer and pressure area
L89.1	Stage II decubitus ulcer
L89.2	Stage III decubitus ulcer
L89.3	Stage IV decubitus ulcer
L89.9	Decubitus ulcer and pressure area, unspecified
Urinary tract infections (ICD-Code)	
N10	Acute tubulo-interstitial nephritis
N30.0	Acute cystitis
N30.9	Cystitis, unspecified
N39.0	Urinary tract infection, site not specified
Psycholeptics and psychoanaleptics (ATC-Code)	
N05A	Antipsychotics

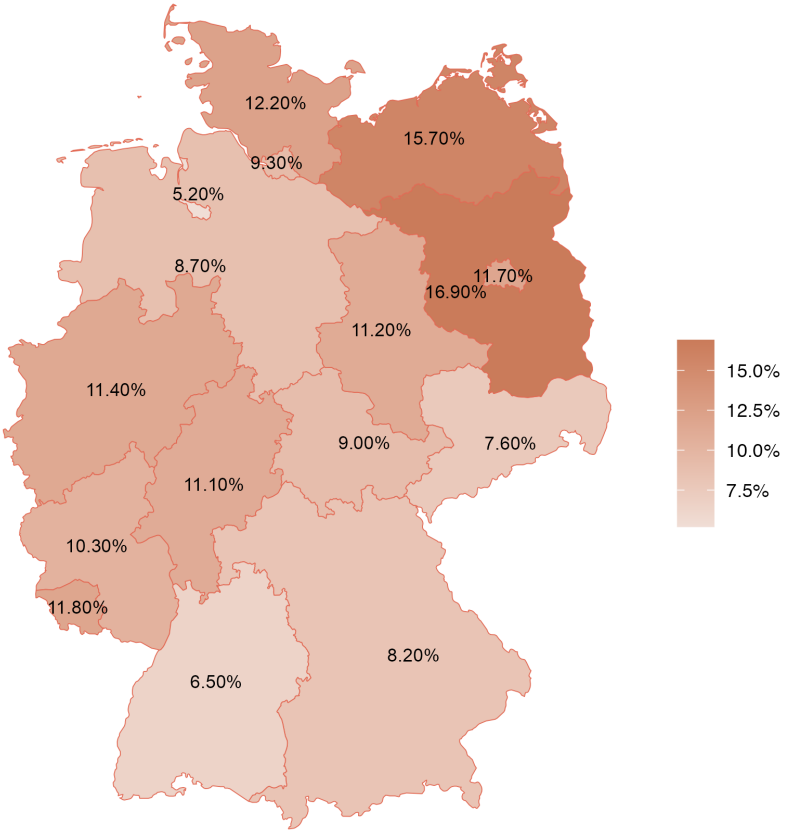
Note: This table shows the ICD-10-GM and ATC codes used as outcome variables.

Table A2: Nurse qualifications

Registered Nurses (RNs)	**Nurse Assistants (NAs)**	**Others (Excluded)**
State-approved geriatric nurse	State-approved geriatric NA	Curative education nurse
Nurse/nurse practitioner	Non-medical health care professional	Curative educator
Pediatric nurse	Social pedagogic	Occupational therapist
Nursing science degree (technical college/university)	Social worker	Physiotherapist
	Other nursing profession	Family nurse
	Other professional degree	Housekeeping
	No professional degree/in training	Non-health-related tasks

Note: We show the table based on the representation in Heger et al. (2023). The definitions of qualifications follows Bundesagentur für Arbeit (2011). Registered nurses (RN) are professional care givers with a specific vocational training of 3 to 5 years. They provide basic care, medical treatments, and administrative support. Nurse assistants (NA) are care givers with a vocational training of 1 to 2 years. They assist with personal hygiene, meal assistance, and, under supervision, administer medications and work alongside other RN. We exclude professions that do not involve direct care contact with residents.

Figure A1: Distribution of insured persons by state



Note: This map shows the proportion of all insured persons from the health insurance data in individual federal states, as found in Grobe and Szecsenyi (2023).