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## Nursing Home Prices and Quality of Care - Evidence from Administrative Data

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## Nursing Home Prices and Quality of Care - Evidence from Administrative Data

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- Evidence from Administrative Data**

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Arndt R. Reichert and Magdalena A. Stroka<sup>1</sup>

# Nursing Home Prices and Quality of Care - Evidence from Administrative Data

## Abstract

*There is widespread concern about the quality of care in nursing homes. Based on administrative data of a large health insurance fund, we investigate whether nursing home prices affect relevant quality of care indicators at the resident level. Our results indicate a significantly negative price effect on inappropriate and psychotropic medication. In contrast, we find no evidence for fewer painful physical sufferings for residents of nursing homes with higher prices.*

*JEL Classification: I10*

*Keywords: Quality of care; nursing homes; inappropriate medication; psychotropic drugs; panel data analysis*

*January 2014*

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## 1 Introduction

In several industrialized countries, policy makers and researchers are worried about the quality of care provided by nursing homes (Fahey et al., 2003; Kirkevold and Engedal, 2006; Institute of Medicine, 1986, 2001). Although operating in a commonly highly regulated market, nursing homes have been criticized for underproviding their residents with care (see e.g. Dowideit, 2012; Fahey et al., 2003).

In Germany, nursing homes regularly react to such criticism by calling for increased funding. However, due to information asymmetries in the care market (see e.g. Arrow, 1963), quality improvements may not necessarily be achieved by, for instance, increasing nursing home reimbursement rates.<sup>1</sup> In fact, information advantage of nursing homes probably enables them to translate additional funding into profits (rather than into quality of care). Therefore, health politicians are increasingly interested in whether quality of care provided by nursing homes varies with changes in reimbursement rates.

This is the first study that analyses the influence of prices on treatment quality at the individual level in German nursing homes. We use an extensive administrative data set provided by Germany's largest sickness fund and study the effect of nursing home reimbursement rates on treatment quality approximated by the prescribed doses of potentially inappropriate substances, psychoactive substances as well as pain killers and the incidence of injuries or poisoning at the resident level. We improve upon the existing literature by using an arguably richer and better suited set of quality indicators. Moreover, we use more timely data and difference out time-invariant individual heterogeneity by estimating fixed effects regressions (in Section 2, we discuss our contribution to the literature in more detail).

The argument for the hypothesized link between reimbursement rates and quality of provided care is that nursing homes are able to improve their nursing service through an increase in the quantity of well-trained staff and, hence, effective nursing time per resident.<sup>2</sup> In fact, numbers of nurses per resident are larger in nursing homes with higher reimbursement rates (see e.g. Grabowski, 2001b; Cohen and Spector, 1996). Nevertheless, the empirical literature has not yet been able to satisfactorily settle whether, and especially, to what extent higher reimbursement rates affect outcome quality (see Section 2). While some of the studies face methodological

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<sup>1</sup> In Germany, the price for in-patient services in a nursing home is the reimbursement rate, which is prospectively negotiated between the long-term care insurance fund, the municipalities, and the nursing home. The insurance pays a fixed amount per month, depending on the severity of care, while the residents – their relatives or social aid – bear the rest of the costs. The current share of expenditures that is covered by the insurance amounts to roughly 50% (Augurzky et al., 2011).

<sup>2</sup> Augurzky et al. (2008) actually observe that in German regions with higher nursing homes prices, residents are offered more social activities that aim to promote physical and mental fitness.

limitations, we explain inconclusive results of the most credible analyses by their inability to encompass the multidimensional nature of nursing home quality (rather than information asymmetries that enable profits). Nursing homes with a lower reimbursement rate may be able to mask a potentially underprovision of care by the administration of relatively cheap sedative drugs (Hughes and Lapane, 2005).<sup>3</sup> These drugs can reduce the extent of resident care needs and prevent adverse physical events through immobilization. The problem of strategically (over-) applying sedative drugs is that they have a well-known negative effect on the quality of life and a deteriorating long-term impact on both mental and physical health (see e.g. Harrington et al., 1992; Bauer et al., 2012; Thapa et al., 1998; Fincke, Miller, and Spiro, 1998).<sup>4</sup> In fact, it is a long-lasting societal concern that nursing homes provide their residents with inappropriate medication and excessively administer psychotropic drugs (see e.g. Waxman, Klein, and Carner, 1985; Ruths, Straand, and Nygaard, 2001; Beers et al., 1992; Pittrow et al., 2003). Based on the same data source as used in this paper, Stroka (2013) finds significant differences in prescriptions of antipsychotics, antidepressants, and analgesics between the German in- and out-patient care sectors, which points to over-medication in nursing homes.

Although German nursing homes are only allowed to apply psychoactive substances that were prescribed by the resident's physician, they have a relevant impact on a resident's medication by deciding on the frequency of doctor visits, selecting physicians, and providing information on the resident's mental and physical condition.<sup>5</sup> For German physicians, serving a nursing home usually is not a lucrative business (Gross, 2011). In fact, they have an incentive to minimize time spent examining and talking with residents. Following the nursing home's medication policy arguably is an effective strategy to save time. For instance, they can reduce the length of patient consultations if they gather information on the residents' condition and (medical) needs from the nurses.<sup>6</sup>

Compared to obvious physical restraints (or injuries), inappropriate medication, over-medication or medical immobilization is for both the quality inspector and the consumer more difficult to identify. Hence, according to our previous argumentation, we expect to find negative effects of reimbursement rates on prescriptions of potentially inappropriate medication,

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<sup>3</sup> As described in the next paragraph, German nursing homes are able to influence medical use of residents. Note that German nursing homes do not carry the costs for medication as they are paid by the health insurance fund or the patients themselves.

<sup>4</sup> Sedative drugs may actually be used as less visible substitutes for physical restraints whose application is frequently considered as bad quality (Park and Tang, 2007).

<sup>5</sup> An average German nursing home cooperates with 23 physicians. Nurses decide in roughly 86% of all cases about the need of a medical check-up and choose in 72% of all cases the respective physician (Van den Bussche et al., 2009).

<sup>6</sup> While, in Germany, physicians generally have adverse financial incentives to exceed quarterly volumes of prescriptions that were agreed with the social health insurance, prescriptions to nursing home residents are irrelevant for respective volumes.



psychotropic drugs as well as the overall prescribed amount of drugs but no (pronounced) effect on physical health outcomes.

After an overview of the existing literature on this topic (Section 2), the paper describes the data source and the study population (Section 3), and discusses the empirical strategy (Section 4). Results are presented in Section 5, followed by a discussion of policy implications.

## 2 Literature and Contribution

Our study contributes to a large literature on the effect of reimbursements on the quality of formal care in the U.S. Nyman (1989; 1988) finds no evidence of a significant correlation between care quality (as measured by regulatory violations) in nursing homes and reimbursement rates, whereas Nyman (1985) and Gertler (1989; 1992) show that higher reimbursements decrease the quality of care (considering violations and home expenditures on nursing service). Cohen and Spector (1996) as well as Grabowski (2001a) find rather mixed evidence: depending on the indicators used, nursing home reimbursement rates either significantly improve the quality of care or are immaterial for the provided quality.<sup>7</sup> Considering staffing levels and output-oriented quality measures, including pressure ulcers and physical restraints, more recent studies of Grabowski report *small* positive effects of reimbursement rates on the quality of formal care (Grabowski, 2001b; Grabowski, 2004; Grabowski, Angelelli, and Mor, 2004; Grabowski and Angelelli, 2004).

Only Konetzka, Norton, and Stearns (2006) find *large* positive effects of reimbursement rates on the quality of formal care (considering pressure sores and urinary tract infections). They use a policy change (Medicare reform) as a natural experiment and pursue a difference-in-differences approach. Even though the study has merits, a central weakness is the disregard of general equilibrium effects. While the policy change affected all nursing homes, the authors argue that nursing homes in the control group (homes with fewer Medicare residents at the baseline) were less affected by the policy change. However, this is not assured since the share of Medicare residents within a nursing home may change very quickly over time. This aspect is of high importance as Medicare residents have, on average, a lower length of stay.

We improve upon this literature in various ways. First, while much of the existing literature criticizes the medication standards in nursing homes (see e.g. Waxman, Klein, and Carner, 1985; Avorn et al., 1992; Ruths, Straand, and Nygaard, 2001; Beers et al., 1992; Stroka, 2013), no study

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<sup>7</sup> Cohen and Spector (1996) find significant results for staffing intensity and insignificant results considering the home residents' functional status, bedsores and probability to die. Grabowski (2001a) finds significantly positive effects regarding professional staffing and insignificant results for nonprofessional staffing and quality as measured by the medication error rate and use of feeding tubes, catheters, as well as physical restraints.

so far has examined the link between nursing home prices and medication practices – differentiated by certain drug classes – on the individual level.<sup>8</sup> Psychotropic drugs can serve the purpose of masking shortcomings in understaffed institutions. Despite likely harmful effects on life satisfaction and health, their application is seldom considered as bad quality by public authorities. The reason is that many residents actually require them and, for quality inspectors, it is very difficult to identify residents whose need for psychotropic drugs may be reduced or even entirely avoided by adequate provision of care. For instance, social activities may calm down anxious residents as effectively as sedative drugs. If nursing homes are actually able to mask quality shortcomings by the application of such drugs, previous studies have probably underestimated the effect of reimbursement rates.

Second, except the studies of Konetzka, Norton, and Stearns (2006) and Cohen and Spector (1996), all papers are based on facility level data. Our detailed resident level data enable us to control for relevant individual characteristics to prevent that observed effects erroneously capture differences in the mixture of residents with certain diseases. They furthermore allow the use of outcome-based quality measures on the resident level that help us to prevent that we confound efficiency with bad quality. Facility level analysis commonly rely on input-oriented facility level quality indicators such as the shares of professional and non-professional staff, which make it difficult to disentangle whether low input levels reflect quality shortcomings or a better efficiency in the provision of care. However, this distinction is essential because neither in the U.S. nor in Germany nursing home prices are established on a competitive market, wherefore quality of care might be low regardless of the relative price (Grabowski and Angelelli, 2004).

Third, this is one of the very few panel data analyses (the data cover the years 2007-2009). Except two other studies (Grabowski, 2004; Konetzka, Norton, and Stearns, 2006), all relevant studies are based on cross-sectional data. Panel data methods allow to difference out time-invariant heterogeneity, which otherwise may bias the results. Our identification strategy bases on fixed effects models that were previously employed only by Grabowski (2004), who bases the analysis on relatively old data.

Fourth, in contrast to previous studies, all records in our data are of administrative nature, whose advantages relative to survey data are coverage and completeness of information. Moreover, data reliability is relatively high because most resident level records are reported by experts such as physicians. This is important because home residents are often senile people

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<sup>8</sup> A first attempt to consider medication as a possible quality measure was made by Grabowski (2001a). However, his quality measure (the facility level medication error rate, which condenses information from a nursing home survey on the compliance with a selected number of medication guidelines [medication passes]) suffers from aggregation bias. Hence, we argue that it approximates medication quality much worse compared to our detailed individual level information on doses of prescribed drugs.

who suffer from several severe diseases. Their relatives may not dispose of all relevant information. Hence, routine data are very suitable for performance comparisons across health care providers (Smith and Street, 2013).

Fifth, we are the first to analyse the causal link between nursing home reimbursement rates and the quality of care for another country than the U.S. Thus, we are able to assess the extent to which findings for the U.S. are transferable to other countries such as Germany. We expect considerable heterogeneity in the effects across countries because nursing home markets largely differ in their structure and regulatory framework.

The paper also relates to another strain of the literature which addresses the response of health care providers to financial incentives. There is abundant evidence that providers actually adjust their treatment practices to incentives and, thereby, adjustments affect the provided quality of care in different respects (see e.g. Hensen et al., 2008; Gilman, 2000; Liu, Yang, and Hsieh, 2009; Yip, 1998; Grant, 2009; Kaestner and Guardado, 2008; Schmitz, 2013). Moreover, it is linked to the emergent literature on health care provider pay-for-performance schemes aimed to improve service quality by reforming payments, which also analyze the link between payments and quality (McClellan, 2011; Siciliani, 2009).

### **3 Data and Descriptive Statistics**

Our analysis is based on data from two different sources. The main source is a resident-level administrative data set provided by Techniker Krankenkasse. Among others, it includes detailed information on personal characteristics, ascertained International Classification of Diseases 10 (ICD-10) diagnoses, and the Anatomical Therapeutic Chemical (ATC) code together with the daily defined doses (DDDs) of prescribed drugs.<sup>9</sup>

This data is merged to information on nursing home reimbursements (i.e. the rate for nursing services, the fee for accommodation and catering, as well as the investment costs) obtained from the Association of Health Insurance Companies. While the fee for accommodation and catering and the investment costs are fixed for all residents within one nursing home, the rate for nursing services depends on the care level of the residents.

Our analysis is restricted to individuals in nursing homes aged 65 years and older, who are officially considered to be in need of care and assigned to one of three care levels by the

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<sup>9</sup> As shown by Schmitz and Stroka (2013b) this kind of administrative data is very representative considering health outcomes.

independent Medical Review Board of the Statutory Health Insurance Funds.<sup>10</sup> The data comprise 13,981 person-year observations, resulting from 7,221 individuals observed over up to three periods (2007-2009).

As outcome variables, we use the DDDs of seven drug types prescribed in the course of one year, including drugs from the Priscus-list, psychotropic medication (antipsychotics, antidepressants, hypnotics and sedatives as well as anxiolytics), analgesics, and the total sum of DDDs of all prescribed drugs. The Priscus-list is an official register of potentially inappropriate medication for frail elderly people in Germany (Holt, Schmiedl, and Thürmann, 2010) that resembles similar international lists such as the Beers-list (Beers, 1997). The list identifies medical drugs that pose potential risks (including harmful side effects that may be life-threatening and other adverse drug events) that outweigh potential benefits for people 65 and older. The use of such inappropriate medication is associated with a high risk of adverse health outcomes especially in the elderly living in nursing homes (Perri et al., 2005).

Besides the drugs from the Priscus-list, we analyse psychotropic medication. The literature considers psychotropic drugs as the most commonly misused or overprescribed drugs by physicians in nursing homes, leading to many potential adverse health risks of the elderly (see e.g. Waxman, Klein, and Carner, 1985; Montamat and Cusack, 1992; Harrington et al., 1992; Shah, 2000; Yip and Cumming, 1994; Bauer et al., 2012). In addition, we concentrate on drugs that provide us with information on the physical condition of residents. Analgesics serve as a proxy for both general physical condition and, specifically, pressure ulcers (Twillman et al., 1999), as well as for other sufferings due to external causes. Hence, analgesics consumption may be regarded as a direct measure of the quality of care. We also consider the overall medication in order to obtain further interesting insights into drug prescriptions in nursing homes. This variable may reveal whether effects on certain drugs are due to an overall higher prescription trend.

Higher prescriptions of drugs are not per se bad for health, especially for people with related diseases. We nevertheless interpret a negative effect of reimbursement rates on the prescribed amount of drugs as indication for a better quality of care in expensive nursing homes because (i) levels of drug prescriptions are, in general, already excessively high in nursing homes,<sup>11</sup> (ii)

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<sup>10</sup> While care level 1 goes along with nursing needs of, on average, at least 90 minutes per day, care levels 2 and 3 include at least 180 and 300 minutes of daily nursing needs, respectively.

<sup>11</sup> It is well documented that prescription rates of the considered drugs are already on a very high level, indicating over-medication in nursing homes (see e.g. Waxman, Klein, and Carner, 1985). In fact, controlling for a long list of diseases, previous studies have shown that drug consumption by German nursing home residents is much higher than by non-institutionalized care recipients (see e.g. Stroka, 2013). Moreover, there is evidence for initiation of psychotropic drug treatment after nursing home admission (Wancata et al., 1997; Bronskill et al., 2004).

misuse of medications in nursing homes is frequently reported (Dowideit, 2012), and (iii) it is well known that polypharmacy and high drug doses exert detrimental effects on morbidity and mortality in elderly (see e.g. Routledge, O'Mahony, and Woodhouse, 2004; Hajjar, Cafiero, and Hanlon, 2007; Ziere et al., 2006). Note that by the inclusion of a large set of health outcomes, such as indicators for mental diseases, as covariates into the econometric model, we rule out that our effect estimates capture differences in the case-mix across nursing homes. As an additional outcome variable, we use the number of injuries and poisonings that a home resident suffers in the course of one year.

The key independent variable of interest is the per resident daily reimbursement rate  $R_{it}$  of the nursing home. It constitutes the sum of three care level specific rates (the product of the institution's daily price for respective care services and the nationwide share of the care level in all in-patient institutions)<sup>12</sup> plus the fee for accommodation and catering as well as investment costs:

$$\forall i = 1 \dots n; t = 1 \dots n: R_{it} = \left( \sum_{c=1}^3 P_{ict} S_{ct} \right) + C_{it} + I_{it}, \quad (1)$$

where

$P_{ict}$  denotes institution's  $i$  price for nursing services of a certain care level  $c$  in year  $t$ ,

$S_{ct}$  the share of a certain care level  $c$  over all institutions in year  $t$ ,

$C_{it}$  the fee for accommodation and catering of institution  $i$  in year  $t$ , and

$I_{it}$  the investment costs of institution  $i$  in year  $t$ .

A series of resident level variables, such as gender, age, care level, and various dummy variables indicating different types of diseases are included as controls in the regression analysis. The latter jointly capture individual morbidity.

Table 1 (Column 1) displays descriptive statistics for our study population. Overall, we observe that the amounts of prescribed drugs are very high in nursing homes of both price classes: the prescribed amount of DDDs of antidepressants, for instance, is about eight times higher compared to the average dose consumed by adult individuals in Germany (OECD, 2009).

Prima facie evidence on the relationship between applied drugs in nursing homes and reimbursement rates is displayed in Columns 2 and 3 of the table. They present the means of individual characteristics in nursing homes with prices below/above the average nursing home

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<sup>12</sup> The nursing home specific shares of each care level are not available in the data. In 2009, the shares of dependent persons in nursing homes with care level 1, 2, and 3 were 37%, 41%, and 21%, respectively. This information is biennial, lacking for 2008. However, since it does not change much over time (as assessed by comparing shares between 2007 and 2009 of the Statistisches Bundesamt, 2011), we use the information from 2009 for the care level in 2008.

reimbursement rate. The prescribed DDDs of antipsychotics and the number of injuries or poisoning indicate better care in nursing homes with above average reimbursement rates. This relationship is not confirmed by other quality measures. In contrast, higher prescribed DDDs of anxiolytics in nursing homes with above average prices are indicative for a negative effect of reimbursements on quality.

**Table 1: Descriptive Statistics**

Variable	Overall		Reimbursement rate above average		Reimbursement rate below average	
	Means	St. D.	Means	St. D.	Means	St. D.
<b>Dependent variables measured in DDDs, count of diagnoses</b>						
Priscus-list	58.208	117.318	60.129	118.468	56.252	116.111
Antipsychotics	35.737	73.977	33.841*	71.014	37.667*	76.834
Antidepressants	81.496	155.961	83.166	158.010	79.797	153.841
Hypnotics and sedatives	16.041	58.034	16.587	58.832	15.485	57.210
Anxiolytics	10.236	34.138	11.106*	35.432	9.352*	32.747
Analgesics	58.876	107.834	59.710	108.280	58.026	107.379
All drugs	1473.940	1028.047	1481.676	1020.355	1466.065	1035.833
Injuries and poisoning	0.776	2.144	0.709*	2.084	0.844*	2.202
<b>Dependent variables measured binary</b>						
Priscus-list	0.382	0.486	0.390	0.329	0.374	0.485
Antipsychotics	0.445	0.497	0.436	0.496	0.454	0.498
Antidepressants	0.331	0.471	0.334	0.472	0.328	0.469
Hypnotics and sedatives	0.135	0.341	0.137	0.344	0.132	0.338
Anxiolytics	0.163	0.370	0.172	0.344	0.155	0.362
Analgesics	0.521	0.500	0.538	0.499	0.504	0.500
All drugs	1.000	0.000	1.000	0.000	1.000	0.000
Injuries and poisoning	0.302	0.459	0.288	0.453	0.316	0.465
<b>Nursing home characteristics</b>						
Average reimbursement	89.710	10.365	97.581*	6.940	81.698*	6.364
Total number of places	113.089	69.179	118.512*	78.774	107.568*	57.279
<b>Individual characteristics</b>						
Male	0.350	0.477	0.340*	0.474	0.360*	0.480
Age	82.732	8.332	82.876*	8.164	82.585*	8.497
Care level 2	0.450	0.497	0.463*	0.499	0.436*	0.496
Care level 3	0.255	0.436	0.248	0.432	0.261	0.439
<b>Health status</b>						
Depression and bipolar disorder	0.353	0.478	0.363*	0.481	0.343*	0.475
Schizophrenia, schizotypal and delusional disorders	0.089	0.284	0.090	0.286	0.087	0.282
Dementia	0.658	0.474	0.670	0.470	0.645	0.479
Mental disorders due to psychoactive substance use	0.083	0.277	0.080	0.271	0.087	0.282
Other mental disorders	0.088	0.283	0.091	0.288	0.085	0.279
Stroke	0.312	0.463	0.302*	0.459	0.322*	0.467
Cardiac infarction	0.066	0.248	0.067	0.250	0.065	0.246
Other diseases of the circulatory system	0.906	0.292	0.907	0.290	0.904	0.295
Invasive neoplasms	0.198	0.399	0.201	0.400	0.196	0.397
Diseases of the musculoskeletal system	0.628	0.483	0.624	0.484	0.632	0.482
Diseases of the genitourinary system	0.586	0.493	0.596	0.491	0.576	0.494
Parkinson's disease	0.169	0.375	0.165	0.371	0.173	0.379
Number of consultations	42.576	24.060	42.125*	24.154	43.036*	23.957
Number of hospitalizations	1.021	1.396	1.044*	1.468	1.319*	0.000
Death	0.199	0.400	0.203	0.402	0.196	0.397
<b>Other variables</b>						
East Germany	0.049	0.215	0.001*	0.024	0.097*	0.297
N	13,981	13,981	7,053	7,053	6,928	6,928

Notes: t-Test for difference in means significant at \*: 5% level. See Table A1 in the Appendix for definition of variables.

#### 4 Empirical Methodology

For each of the eight quality measures  $\mathbf{Y}_{jit}$  (doses of drugs from the Priscus-list, antipsychotics, antidepressants, tranquilizers, anxiolytics, analgesics, all consumed drugs, and adverse physical events), we perform regression analyses with facility-level characteristics  $\mathbf{X}_{it}$ , including the reimbursement rate, and a set of individual-level variables  $\mathbf{Z}_{jit}$  as control variables. We estimate the following regression equation:

$$\mathbf{Y}_{jit} = \beta_0 + \mathbf{X}_{it} \beta_1 + \mathbf{Z}_{jit} \beta_2 + \lambda_j + \varepsilon_{jit}. \quad (2)$$

Subscript  $j$  denotes the individual,  $i$  the nursing home and  $t$  the year,  $\varepsilon$  represents a random error term and time-invariant factors are captured by  $\lambda$ , while the  $\beta$ 's are coefficients subject to estimation.

Four different methods are employed. First, we start with a pooled ordinary least squares model (OLS), followed by fixed effects estimations, which enable us to account for time-invariant unobserved heterogeneity.<sup>13</sup> As the residents nearly never change the nursing home, variation in reimbursement rates can be considered exogenous to residents.<sup>14</sup> Moreover, as prices are prospectively set in negotiations between nursing home owners and the sponsors (i.e. representatives of the long-term care insurance and the social assistance office) for a period of time (about one year), reverse causality does not represent a serious problem. Also during the negotiations quality aspects play no more than a minor role as the negotiating parties focus on the comparison of disclosed costs with national average costs. We further argue that individual health outcomes should have no impact on current or future facility-level reimbursement rates.

As shown in Table 1, the dependent variables are characterized by a high share of zeros. Consequently, a two-part model might be an alternative way to model drug consumption. Hence, following Schmitz and Stroka (2013b), who also analyse prescribed DDDs of drugs, we model the extensive and intensive margins of nursing home prices. For this purpose, we use a linear probability model with fixed effects and apply linear fixed effects models on the sample of positive outcomes. In the linear probability model, the dependent variable  $\mathbf{Y}_{jit}$  takes on the value 1 for residents with any intake of the considered drug and 0 otherwise.<sup>15</sup> In the 'conditional' fixed effects model, we restrict the sample to residents who consumed at least one

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<sup>13</sup> As displayed in Table A2 in the Appendix, there is substantial within-variation over time in both the outcome variables and the reimbursement rate. Note that the null hypothesis of the Hausman test is rejected.

<sup>14</sup> In our sample, almost no resident (0.06 percent) changed the nursing home in the course of 3 years and only very few (0.29 percent) changed from inpatient to outpatient care.

<sup>15</sup> We do not estimate a fixed effects logit model because it requires too much variation of the dependent variable over time.

dose of the respective drug in the course of one year. We control for selection into drug consumption to the extent that selection is on individual time-invariant characteristics that will be captured in the fixed effects. To take account of the non-negative and skewed dependent variable, we use a linear regression of the logged outcome variables. Analogously, we model the extensive and intensive margins for injuries and poisoning (we do not consider overall medication in the two-part model because all observed individuals take at least one dose of drug). This model makes the assumption that the likelihood of any drug intake and the amount of drugs conditional on drug intake are results of two different processes. Hence, it allows for different effects of changes in reimbursement rates on both parts of the distribution.

## 5 Results

This section presents the results from empirical models that relate the level of reimbursement rates to prescribed medication and adverse physical events. We present results in Table 2, displaying the effect of the reimbursement rate on each of the employed quality indicators. Results for the control variables are presented in Tables A3-A6 in the Appendix.

With the exception of the significantly positive coefficient of reimbursement rates in the 'overall medication'-regression, we find insignificant relationships between reimbursement rates and each individual drug category and adverse physical events in the pooled OLS model (Column 1). Once we control for time-invariant unobserved heterogeneity, results considerably change. This indicates the importance of time-invariant unobserved heterogeneity in our analysis and gives rise to a preference for the fixed effects model.

In the fixed effects model (Column 2), we find that an increase in the reimbursement rate goes along with a statistically significant decrease in the prescribed doses of Priscus-listed drugs, antipsychotics, hypnotics and sedatives, as well as the overall prescribed dose of drugs. An increase of the reimbursement rate of 1 EUR leads to a decrease of 1.0, 0.4, 0.5 and 8.1 DDDs of inappropriate drugs, antipsychotics, hypnotics and overall medication, respectively. In terms of elasticity (as shown in Table 3 for a better comparability of the results from different estimation methods), a 1 percent increase in the reimbursement rate causes a 1.6, 1.1., 2.8, and 0.5 percent decrease in respective doses. Our results can be considered as evidence for a reduced application of inappropriate and psychotropic drugs in nursing homes with higher reimbursements rates. As the coefficients of the reimbursement rate on analgesics and injuries and poisonings turn out to be insignificant, our results can be seen as further indication for less costly nursing homes compensating for the underprovision of care with the application of psychoactive substances.



The results from the two-part model (Column 3 and 4) qualitatively confirm results from the fixed effect model although respective coefficients of the reimbursement rate turn statistically insignificant. Regarding the first part, we find that an increase of the reimbursement rate of 1 EUR reduces the probability of taking analgesics by 0.4 percentage points. The probabilities of taking any of the other drugs and suffering from injuries or poisoning, in contrast, are not significantly affected by the reimbursement rate.<sup>16</sup> Regarding the second part, we find in most cases negative but throughout insignificant effects of the reimbursement rates.<sup>17</sup> Quantitative differences to results from the linear fixed effects model may arise due to, first, a lower within-variation of the dependent variables in both parts of the two-part model and, second, substantially fewer observations in the second part of the model. Provided that the effects on the extensive (first part) and intensive margins (second part) are similar in terms of magnitude (Table 3), i.e., the assumption that the considered outcome variables are the result of two different processes does not seem to apply to frail elderly people, we pay greater attention to the results from the linear fixed effects model.

Results are furthermore robust to the exclusion of individuals who changed the nursing home and individuals who moved from inpatient care to outpatient care. They are also robust considering the actual nursing home price paid by individuals instead of the average nursing home price (results are available upon request).

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<sup>16</sup> Results are robust to trimming observations with a predicted probability outside the  $[0,1]$  interval and re-estimating the LPM as suggested by Horrace and Oaxaca (2006), see Table A7 in the Appendix.

<sup>17</sup> As we observe that selection into drug consumption and adverse physical events is unrelated to the reimbursement rate (except analgesics), the price effect in the second part is unlikely to capture considerable selection effects.

**Table 2: Estimation Results for the Effect of Nursing Home Reimbursements**

Outcome variable	Linear Model				Two-Part Model			
	Pooled OLS <sup>1</sup>		Fixed Effects <sup>1</sup>		Linear Probability Fixed Effects <sup>1</sup>		Fixed Effects log (Y>0) <sup>2</sup>	
	β	Std. E.	β	Std. E.	β	Std. E.	β	Std. E.
<b>Inappropriate medication [DDD per year]</b>								
Priscus-list	0.192	(0.139)	-1.038*	(0.400)	-0.001	(0.001)	-0.005	(0.005)
<b>Psychotropic medication [DDD per year]</b>								
Antipsychotics	-0.140	(0.087)	-0.430*	(0.149)	-0.003	(0.002)	-0.003	(0.003)
Antidepressants	0.242	(0.175)	0.916	(0.675)	0.002	(0.002)	-0.001	(0.003)
Hypnotics and sedatives	0.058	(0.066)	-0.502*	(0.240)	2*10 <sup>-4</sup>	(0.001)	-0.006	(0.004)
Anxiolytics	0.073	(0.038)	-0.113	(0.076)	-0.001	(0.001)	0.003	(0.008)
<b>Drugs on physical health [DDD per year]</b>								
Analgesics	0.154	(0.120)	-0.499	(0.260)	-0.004*	(0.002)	-0.014	(0.008)
<b>Overall medication [DDD per year]</b>								
All drugs	2.549*	(1.000)	-8.062*	(3.066)				
<b>Adverse physical events [count per year]</b>								
Injuries and poisoning	-0.007*	(0.002)	0.034	(0.018)	0.003	(0.002)	0.029	(0.015)

Notes: <sup>1</sup>: N = 13,981; <sup>2</sup>: different N depending on outcome variables: Priscus-list = 5,345; Antipsychotics = 6,220; Antidepressants = 4,625; Hypnotics and sedatives = 1,881; Anxiolytics = 2,285; Analgesics = 7,286; Injuries and poisoning = 4,219; Significant at \*: 5% level.

**Table 3: Elasticities for the Effect of Nursing Home Reimbursements**

Outcome variable	Linear Model				Two-Part Model			
	Pooled OLS <sup>1</sup>		Fixed Effects <sup>1</sup>		Linear Probability Fixed Effects <sup>1</sup>		Fixed Effects log (Y>0) <sup>2</sup>	
	M.E.	Std. E.	M.E.	Std. E.	M.E.	Std. E.	M.E.	Std. E.
<b>Inappropriate medication [DDDs per year]</b>								
Priscus-list	0.296	(0.214)	-1.599*	(0.616)	-0.230	(0.298)	-0.449	(0.489)
<b>Psychotropic medication [DDDs per year]</b>								
Antipsychotics	-0.351	(0.219)	-1.079*	(0.375)	-0.627	(0.377)	-0.275	(0.236)
Antidepressants	0.267	(0.192)	1.008	(0.743)	0.669	(0.467)	-0.105	(0.274)
Hypnotics and sedatives	0.326	(0.367)	-2.808*	(1.340)	0.165	(0.680)	-0.543	(0.372)
Anxiolytics	0.638	(0.332)	-0.992	(0.665)	-0.289	(0.702)	0.252	(0.754)
<b>Drugs on physical health [DDDs per year]</b>								
Analgesics	0.234	(0.182)	-0.761	(0.396)	-0.711*	(0.295)	-1.246	(0.714)
<b>Overall medication [DDDs per year]</b>								
All drugs	0.155*	(0.061)	-0.491*	(0.187)				
<b>Adverse physical events [count per year]</b>								
Injuries and poisoning	-0.842*	(0.226)	3.988	(2.127)	0.869	(0.631)	2.619	(1.365)

Notes: <sup>1</sup>: The formula  $d(\ln y)/d(\ln x)$  is used for the calculation of elasticities in all models except the Fixed Effects model for log (Y>0), where the formula  $d(y)/d(\ln x)$  is applied. Elasticities are calculated at means. N = 13,981; <sup>2</sup>: different N depending on outcome variables: Priscus-list = 5,345;

Antipsychotics = 6,220; Antidepressants = 4,625; Hypnotics and sedatives = 1,881; Anxiolytics = 2,285; Analgesics = 7,286; Injuries and poisoning = 4,219;

Significant at \*: 5% level.

## 6 Conclusion

This study contributes to the literature on the quality of care provided by nursing homes. It presents effects of reimbursement rates on eight separate measures of care outcomes in German nursing homes. Our quality indicators include prescriptions of potentially inappropriate medication, sedatives, medication related to physical health, and adverse physical events such as injuries. Rather than relying on facility-level measures, which may not be suitable to satisfactorily establish the empirical relationship between reimbursements and quality of care, we use rich and detailed resident-level data.

In accordance with our initial argumentation, the preferred fixed effects model yields mixed evidence regarding the effect of reimbursement rates on quality of provided care. On the one hand, reimbursements have an insignificant effect on the number of injuries and poisoning as well as on antidepressants and anxiolytics. On the other hand, we find that residents in nursing homes with higher reimbursement rates consume less inappropriate (Priscus-listed) drugs, antipsychotics, hypnotics and sedatives as well as fewer drugs overall. Results from the two-part model tend to confirm these findings although the relevant coefficients all turn statistically insignificant.

We interpret these findings as a first hint for less costly nursing homes compensating for the underprovision of care with the application of psychoactive substances. We argue that strategically over-applying these drugs is tantamount to a low quality of provided care because, in general, levels of drug prescriptions are already excessively high in German nursing homes, causing known detrimental effects on quality of life and a negative long-term impact on morbidity in the elderly.

Although nursing home information advantage generally seems plausible in the German nursing care market, our results argue against the economic reasoning that information asymmetries enable nursing homes to translate increasing reimbursement rates one to one into profits. Paradoxically (but as expected), we only find effects of reimbursement rates on care outcomes that are relatively difficult to associate with low quality (we call them 'hard identifiable' care outcomes). This is explained by all nursing homes strategically focusing on the avoidance of visible impairments of physical health outcomes that may easily be attributed to insufficient care such as injuries and poisonings. The plausible rationale of nursing homes is that, in contrast to substandard 'hard identifiable' care outcomes, poor 'easy identifiable' outcomes might lead to severe consequences. In fact, German home inspections concentrate on 'easy identifiable' outcome quality measures such as the incidence of pressure ulcers, and the long term care

insurance can cancel the contract with the nursing home in case of fatal quality deficits (Roth, 2002). A high quality elasticity of demand of individuals, who require formal care for the first time, may likewise cause serious financial troubles to nursing homes that are criticized for underproviding their residents with care.<sup>18</sup> In consequence, we attribute the absence of effects on 'easy identifiable' care outcomes to causes other than information asymmetry.

The large positive link between reimbursement rates and 'hard identifiable' care outcomes does not necessarily imply that information asymmetries do not play any role at all. In fact, our results are perfectly in line with the general idea that nursing home information advantage attenuates the link between price and quality.

Important policy implications arise from our finding of improved quality of care in response to increasing reimbursement rates. We see a potential for quality improvements (at least with respect to medication) by increasing nursing home funding through nursing care reforms that focus on the establishment of market prices in combination with strict regulatory assurance of critical levels of care quality. We argue that rewarding nursing homes for quality of care will diversify the care sector. In Germany, we do not see enough nursing-home price flexibility, especially since nursing home residents (and their relatives) are excluded from reimbursement rate negotiations. Hence, one essential step in the direction of market prices is to strengthen the role of nursing home residents in these negotiations.

We advocate annual quality reports by an independent auditor to reduce likely information asymmetries with respect to the quality of provided care because we are not able to rule out their importance for the effect of nursing home prices. Such a measure may improve the ability of care recipients to determine their willingness to pay, and hence, enable them to reward good quality (provided that advocated nursing care reforms are implemented).

With the introduction of quality report cards in 2009, the German government undertook attempts to provide information on the quality of nursing homes. The objective was to improve the consumer's ability to compare the quality of nursing homes through access to comparable quality measures. However, their general acceptance by the public has been rather low. In order to be widely used in nursing home choices, quality report cards have to be revised and tailored to the needs and information preferences of care recipients.

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<sup>18</sup> While Schmitz and Stroka (2013a) find no significant relationship between the newly introduced quality report cards and individual nursing home choice, they provide descriptive evidence for individuals considering the nursing home price as quality indicator by showing that a considerable share of care recipients opt for relatively expensive nursing homes.

In summary, liberalization of care prices (and if necessary providing monetary transfers to poor people in need of professional care) need to be accompanied by rigorous quality reports that are made public and a strict regulatory quality assurance.

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## Appendix

**Table A1:** Definition of Variables

Variable	Coefficient
<b>Dependent variables:</b>	
Antipsychotics	sum of prescribed DDDs of antipsychotics (ATC: N05A) in the considered year
Antidepressants	sum of prescribed DDDs of antidepressants (ATC: N06A) in the considered year
Analgesics	sum of prescribed DDDs of analgesics (ATC: N02) in the considered year
Hypnotics and sedatives	sum of prescribed DDDs of hypnotics and sedatives (ATC: N05C) in the considered year
Anxiolytics	sum of prescribed DDDs of anxiolytics (ATC: N05B) in the considered year
Priscus-list	sum of prescribed DDDs of drugs from the Priscus-list in the considered year
All drugs	sum of prescribed DDDs of all drugs in the considered year
Injuries and poisoning	sum of injuries and poisonings (ICD-10: S00-T98) in the considered year
<b>Independent variables:</b>	
<b>Nursing home characteristics</b>	
Average reimbursement	average reimbursement rate of the nursing home
Total number of beds	total number of beds of the nursing home
<b>Individual characteristics</b>	
Male	=1 if male, 0 otherwise
Age	age of individual
<b>Care dependency</b>	
Care Level 2	=1 if care dependent on care level 2, 0 otherwise
Care Level 3	=1 if care dependent on care level 3, 0 otherwise
<b>Health status</b>	
Depression and bipolar disorder	=1 if depression or bipolar disorder (ICD-10: F31-F38, F06.3) were diagnosed in the considered year, 0 otherwise
Schizophrenia, schizotypal and delusional disorders	=1 if schizophrenia, or schizotypal and delusional disorders (ICD-10: F20-F29) were diagnosed in the considered year, 0 otherwise
Dementia	=1 if dementia (ICD-10: F00-F03) was diagnosed in the considered year, 0 otherwise
Mental disorders due to psychoactive substance use	=1 if mental disorders due to psychoactive substance use (ICD10: F10-F19) were diagnosed in the considered year, 0 otherwise
Other mental disorders	=1 if other mental disorders ICD10: F04-F06.2, F06.4-F09, F30, F39-F99) were diagnosed in the considered year, 0 otherwise
Stroke	=1 if stroke (ICD10: I61, I63, I64) was diagnosed in the considered year, 0 otherwise
Cardiac infarction	=1 if cardiac infarction (ICD-10: I21-I22) was diagnosed in the considered year, 0 otherwise
Other diseases of the circulatory system	=1 if other diseases of the circulatory system (ICD-10: I00-I99 without I21-I22, I61, I63, I64) were diagnosed in the considered year, 0 otherwise
Invasive neoplasms	=1 if invasive neoplasms (ICD-10: C00-C97) were diagnosed in the considered year, 0 otherwise
Diseases of the musculoskeletal system	=1 if diseases of the musculoskeletal system (ICD-10: M00-M99) were diagnosed in the considered year, 0 otherwise
Diseases of the genitourinary system	=1 if diseases of the genitourinary system (ICD-10: N00-N99) were diagnosed in the considered year, 0 otherwise
Parkinson's disease	=1 if Parkinson's disease (ICD-10: G20-G22) was diagnosed in the considered year, 0 otherwise
Number of consultations	Number of consultations in the considered year
Number of hospitalizations	Number of hospitalizations in the considered year

**Table A2: Detailed Descriptive Statistics (Main Variables)**

Variable	Variation	Mean	Std. Dev.	Min	Max
Priscus-list	overall	58.208	117.318	0.000	764.186
	between		108.903	0.000	743.335
	within		42.940	-388.459	472.430
Antipsychotics	overall	35.737	73.977	0.000	624.669
	between		68.430	0.000	624.669
	within		26.171	-295.596	373.737
Antidepressants	overall	81.496	155.961	0.000	810.5000
	between		145.254	0.000	810.500
	within		589.875	-401.837	595.940
Hypnotics and sedatives	overall	16.041	58.034	0.000	380.000
	between		54.694	0.000	380.000
	within		23.020	-197.293	259.506
Anxiolytics	overall	10.236	34.138	0.000	280.000
	between		32.476	0.000	280.000
	within		13.473	-131.430	180.237
Analgesics	overall	58.876	107.834	0.000	633.324
	between		104.043	0.000	633.324
	within		40.906	-232.238	424.617
All drugs	overall	1473.940	1028.047	1.000	5300.503
	between		977.355	3.200	5230.422
	within		403.581	-1318.033	3907.634
Injuries and poisoning	overall	0.776	2.143	0.000	46.000
	between		1.617	0.000	34.000
	within		1.581	-15.224	31.443
Average reimbursement	overall	89.710	10.365	37.605	221.690
	between		10.412	52.619	221.690
	within		1.787	34.127	145.294

*Notes:* Variables measured in DDD, count of diagnoses.

**Table A3: Estimation Results for the Effect of Nursing Home Reimbursements: Pooled Ordinary Least Squares Model**

Variable	Priscus-list	Anti-psychotics	Anti-depressants	Hypnotics and sedatives	Anxiolytics	Analgesics	All drugs	Injuries and poisoning
<b>Nursing home characteristics</b>								
Average reimbursement	0.192 (0.139)	-0.140 (0.087)	0.242 (0.175)	0.058 (0.066)	0.073 (0.038)	0.154 (0.120)	2.549* (1.000)	-0.007* (0.002)
Total number of beds	-0.002 (0.018)	-0.009 (0.013)	0.001 (0.022)	-0.015 (0.008)	-0.011* (0.004)	0.002 (0.014)	-0.169 (0.138)	2*10 <sup>-4</sup> (2*10 <sup>-4</sup> )
<b>Individual characteristics</b>								
Age	-1.383* (0.196)	-1.167* (0.118)	-1.783* (0.218)	0.043 (0.090)	-0.168* (0.054)	0.369* (0.160)	-9.714* (1.329)	0.010* (0.002)
Male	-3.517 (3.117)	4.019* (1.880)	-12.622* (3.691)	-0.923 (1.502)	-3.330* (0.843)	-19.107* (2.571)	-63.177* (22.026)	-0.061 (0.037)
Care level 2	-5.601 (3.176)	7.085* (1.725)	6.842 (3.839)	-1.834 (1.663)	0.099 (0.829)	6.845* (2.757)	-143.679* (23.730)	-0.091* (0.046)
Care level 3	-2.641 (3.905)	11.416* (2.349)	-15.717* (4.364)	-7.052* (1.801)	3.224* (1.118)	5.548 (3.126)	-434.526* (26.438)	-0.110* (0.053)
<b>Health status</b>								
Depression and bipolar disorder	25.142* (2.845)	4.963* (1.638)	115.382* (3.877)	8.590* (1.418)	4.023* (0.834)	10.470* (2.501)	177.742* (20.230)	0.019 (0.038)
Schizophrenia, schizotypal and delusional disorders	24.412* (5.646)	73.590* (4.910)	2.825 (6.250)	5.158 (2.826)	6.575* (1.781)	-13.391* (3.535)	-68.280* (32.352)	-0.143* (0.058)
Dementia	-12.950* (2.855)	11.174* (1.552)	-5.994 (3.384)	-0.424 (1.408)	-0.874 (0.808)	-17.034* (2.515)	-233.636* (20.772)	-0.035 (0.040)
Mental disorders due to psychoactive substance use	-2.753 (4.736)	6.838 (3.613)	1.987 (6.329)	2.943 (2.397)	1.779 (1.550)	3.494 (4.193)	-74.532* (36.438)	0.015 (0.069)
Other mental disorders	-6.734 (3.524)	22.848* (3.159)	-6.892 (4.846)	0.088 (1.873)	3.059* (1.322)	-6.306 (3.489)	-65.006* (29.666)	0.069 (0.082)
Stroke	-0.299 (2.877)	-14.593* (1.523)	9.966* (3.563)	-1.895 (1.363)	-1.058 (0.812)	-1.160 (2.506)	198.457* (21.526)	-0.130* (0.038)
Cardiac infarction	-4.932 (4.387)	-5.436* (2.282)	-4.729 (5.343)	-0.742 (2.297)	1.355 (1.441)	4.242 (4.394)	345.979* (39.456)	0.051 (0.088)
Other diseases of the circulatory system	-0.252 (4.746)	-12.590* (3.544)	-0.857 (5.750)	-0.665 (2.198)	-1.692 (1.493)	6.760* (3.184)	420.003* (27.232)	0.004 (0.048)
Invasive neoplasms	-3.273 (2.976)	-3.789* (1.702)	-3.553 (3.688)	-1.495 (1.479)	-1.189 (0.821)	6.393* (2.872)	17.433 (23.717)	-0.119* (0.041)
Diseases of the musculoskeletal system	5.524* (2.591)	-6.874* (1.660)	2.536 (3.128)	0.010 (1.270)	-0.499 (0.742)	27.464* (2.095)	143.999* (18.767)	0.123* (0.032)
Diseases of the genitourinary system	1.597 (2.574)	-4.912* (1.588)	-1.535 (3.206)	-1.999 (1.300)	-1.582* (0.724)	4.719* (2.283)	148.078* (18.523)	-0.065 (0.041)
Parkinson's disease	-2.661 (3.584)	0.305 (2.365)	7.112 (4.571)	2.513 (1.783)	0.182 (1.125)	-5.573 (3.010)	87.996* (24.366)	-0.076 (0.048)
Number of consultations	0.264* (0.051)	0.232* (0.032)	0.452* (0.066)	0.169* (0.028)	0.093* (0.016)	0.593* (0.049)	10.043* (0.409)	0.023* (0.001)
Number of hospitalizations	0.659 (0.873)	-1.701* (0.512)	-3.053* (1.011)	0.528 (0.416)	0.579* (0.271)	4.296* (0.815)	72.734* (6.788)	0.163* (0.019)
Death	-45.778* (1.907)	-10.236* (1.265)	-29.120* (2.699)	-4.018* (1.094)	-0.537 (0.701)	-1.307 (2.305)	-513.369* (18.498)	0.176* (0.042)
<b>Other variables</b>								
East Germany	-7.393 (6.844)	1.243 (4.357)	11.542 (8.397)	-6.009* (2.251)	-3.935* (1.484)	-4.025 (5.176)	152.336* (54.383)	-0.065 (0.072)
R squared	0.072	0.179	0.171	0.018	0.022	0.069	0.300	0.085
N	13,981	13,981	13,981	13,981	13,981	13,981	13,981	13,981

Notes: Significant at \*: 5% level. Clustered robust standard errors in parentheses.

**Table A4: Estimation Results for the Effect of Nursing Home Reimbursements: Fixed Effects Model**

Variable	Priscus-list	Anti- psychotics	Anti- depressants	Hypnotics and sedatives	Anxiolytics	Analgesics	All drugs	Injuries and poisoning
<b>Nursing home characteristics</b>								
Average reimbursement	-1.038* (0.400)	-0.430* (0.149)	0.916 (0.675)	-0.502* (0.240)	-0.113 (0.076)	-0.499 (0.260)	-8.062* (3.066)	0.034 (0.018)
<b>Individual characteristics</b>								
Age	-1.556 (1.274)	1.286 (0.706)	7.489* (1.822)	2.130* (0.654)	0.658 (0.385)	11.202* (1.079)	139.258* (9.434)	-0.688* (0.044)
Care level 2	-2.893 (5.259)	10.366* (2.701)	1.210 (6.500)	5.915* (2.846)	0.124 (1.046)	6.972 (4.552)	-41.862 (34.700)	-0.399* (0.150)
Care level 3	-5.889 (7.518)	9.346* (4.063)	0.676 (9.236)	1.558 (3.833)	3.301 (1.859)	17.403* (6.339)	-93.014 (50.523)	-0.686* (0.221)
<b>Health status</b>								
Depression and bipolar disorder	7.626* (3.141)	3.631* (1.713)	34.172* (4.852)	0.852 (1.664)	1.648 (1.033)	-0.748 (2.811)	125.917* (26.139)	-0.045 (0.092)
Schizophrenia, schizotypal and delusional disorders	7.816 (6.156)	14.844* (4.868)	-2.971 (7.781)	5.985 (3.385)	1.079 (1.821)	-3.771 (4.413)	35.119 (41.033)	-0.516* (0.151)
Dementia	-3.542 (2.645)	3.039 (1.551)	3.188 (4.153)	-0.064 (1.511)	-1.732* (0.865)	2.345 (2.654)	-1.756 (23.429)	-0.035 (0.103)
Mental disorders due to psychoactive substance use	-4.311 (6.362)	3.147 (4.350)	-3.885 (8.499)	-3.837 (4.117)	1.218 (1.867)	11.929* (6.022)	-37.981 (49.157)	0.078 (0.199)
Other mental disorders	-4.534 (4.013)	3.636 (2.481)	-1.829 (5.976)	-0.540 (2.485)	1.574 (1.524)	-0.581 (3.705)	4.772 (30.073)	0.152 (0.172)
Stroke	-1.237 (3.911)	0.981 (2.270)	8.883 (4.925)	1.030 (2.102)	-0.570 (1.048)	4.497 (3.559)	35.449 (29.631)	-0.152 (0.112)
Cardiac infarction	-2.214 (5.753)	-0.261 (2.908)	6.963 (5.724)	-1.405 (3.295)	0.063 (1.923)	-11.731 (6.422)	78.720 (50.805)	-0.180 (0.215)
Other diseases of the circulatory system	4.902 (4.018)	-0.058 (2.859)	7.373 (5.313)	0.514 (2.194)	1.162 (1.330)	-2.743 (3.255)	48.509 (30.018)	0.102 (0.200)
Invasive neoplasms	1.479 (3.862)	-6.202* (1.916)	-8.824* (4.495)	-0.321 (1.928)	0.690 (0.976)	4.592 (3.467)	30.985 (29.191)	-0.143 (0.107)
Diseases of the musculoskeletal system	-0.592 (2.455)	-2.039 (1.529)	-0.397 (3.737)	-0.627 (1.442)	0.245 (0.795)	6.220* (2.300)	78.893* (20.692)	0.067 (0.073)
Diseases of the genitourinary system	0.118 (2.312)	-0.174 (1.359)	-0.296 (3.157)	-1.428 (1.271)	-0.156 (0.768)	-1.509 (2.197)	14.946 (17.847)	-0.102 (0.083)
Parkinson's disease	5.088 (4.991)	3.153 (3.098)	0.548 (6.515)	6.451 (3.459)	1.894 (1.596)	-3.905 (4.262)	57.591 (36.698)	-0.160 (0.154)
Number of consultations	0.230* (0.051)	0.243* (0.032)	0.444* (0.070)	0.181* (0.031)	0.079* (0.018)	0.500* (0.051)	8.483* (0.443)	0.026* (0.002)
Number of hospitalizations	0.582 (0.843)	-0.999* (0.482)	-2.398* (1.088)	-0.250 (0.395)	-0.179 (0.296)	1.621 (0.831)	18.156* (6.793)	0.233* (0.032)
Death	-13.688* (2.530)	-9.913* (1.562)	-35.295* (3.406)	-6.310* (1.441)	-1.846* (0.829)	-14.085* (2.584)	-663.712* (23.381)	0.452* (0.086)
R squared	0.032	0.046	0.051	0.024	0.011	0.047	0.316	0.206
N	13,981	13,981	13,981	13,981	13,981	13,981	13,981	13,981

Notes: Significant at \*: 5% level. Clustered robust standard errors in parentheses.

**Table A5: Estimation Results for the Effect of Nursing Home Reimbursements: Linear Probability Fixed Effects Model**

Variable	Priscus-list	Anti- psychotics	Anti- depressants	Hypnotics and sedatives	Anxiolytics	Analgesics	Injuries and poisoning
<b>Nursing home characteristics</b>							
Average reimbursement	-0.001 (0.001)	-0.003 (0.002)	0.002 (0.002)	2*10 <sup>-4</sup> (0.001)	-0.001 (0.001)	-0.004* (0.002)	0.003 (0.002)
<b>Individual characteristics</b>							
Age	-0.022* (0.006)	0.003 (0.006)	0.004 (0.005)	-0.006 (0.004)	0.002 (0.005)	0.054* (0.007)	-0.099* (0.008)
Care level 2	0.026 (0.025)	0.115* (0.023)	4*10 <sup>-4</sup> (0.020)	0.029 (0.019)	0.029 (0.018)	-0.020 (0.028)	-0.066* (0.031)
Care level 3	0.025 (0.037)	0.120* (0.034)	-0.027 (0.028)	-0.006 (0.029)	0.067* (0.027)	-0.013 (0.038)	-0.127* (0.045)
<b>Health status</b>							
Depression and bipolar disorder	0.018 (0.016)	0.054* (0.017)	0.172* (0.016)	0.020 (0.013)	0.015 (0.012)	0.024 (0.019)	0.031 (0.022)
Schizophrenia, schizotypal and delusional disorders	0.069* (0.027)	0.169* (0.027)	0.011 (0.021)	0.024 (0.022)	0.029 (0.023)	-0.010 (0.031)	-0.048 (0.034)
Dementia	0.020 (0.014)	0.033* (0.012)	0.017 (0.011)	0.018 (0.010)	-0.004 (0.011)	0.035* (0.017)	0.024 (0.020)
Mental disorders due to psychoactive substance use	-0.009 (0.027)	0.011 (0.028)	-0.006 (0.022)	0.022 (0.021)	0.042 (0.027)	0.018 (0.032)	0.017 (0.041)
Other mental disorders	0.008 (0.019)	0.077* (0.018)	0.036 (0.018)	0.047* (0.017)	0.028 (0.017)	0.001 (0.023)	0.021 (0.026)
Stroke	0.012 (0.018)	0.057* (0.017)	0.019 (0.014)	-0.012 (0.014)	0.016 (0.015)	0.033 (0.022)	-0.019 (0.024)
Cardiac infarction	-0.011 (0.028)	0.033 (0.025)	0.012 (0.022)	0.019 (0.026)	-0.038 (0.021)	-0.025 (0.034)	-0.034 (0.041)
Other diseases of the circulatory system	0.003 (0.020)	-0.013 (0.019)	0.026 (0.016)	0.009 (0.017)	-0.012 (0.018)	-0.035 (0.025)	0.011 (0.028)
Invasive neoplasms	-0.017 (0.019)	-0.033* (0.015)	-0.010 (0.014)	-0.009 (0.013)	-0.015 (0.014)	0.026 (0.022)	0.017 (0.025)
Diseases of the musculoskeletal system	0.024 (0.013)	-0.005 (0.012)	0.012 (0.010)	0.016 (0.010)	0.019 (0.011)	0.071* (0.016)	0.039* (0.018)
Diseases of the genitourinary system	0.021* (0.011)	0.018 (0.010)	0.011 (0.009)	0.005 (0.009)	0.010 (0.009)	0.022 (0.014)	0.043* (0.016)
Parkinson's disease	0.023 (0.023)	0.027 (0.021)	0.015 (0.022)	0.004 (0.021)	0.023 (0.019)	0.040 (0.032)	-0.023 (0.032)
Number of consultations	0.001* (2*10 <sup>-4</sup> )	0.001* (2*10 <sup>-4</sup> )	0.001* (2*10 <sup>-4</sup> )	0.001* (2*10 <sup>-4</sup> )	0.001* (3*10 <sup>-4</sup> )	0.002* (3*10 <sup>-4</sup> )	0.004* (3*10 <sup>-4</sup> )
Number of hospitalizations	0.020* (0.004)	0.008* (0.003)	0.010* (0.003)	0.008* (0.003)	0.012* (0.003)	0.036* (0.005)	0.055* (0.006)
Death	-0.009 (0.012)	-0.005 (0.013)	-0.024* (0.010)	-0.011 (0.010)	0.030* (0.011)	0.020 (0.016)	0.042* (0.018)
R squared	0.028	0.049	0.061	0.020	0.012	0.035	0.143
N	13,981	13,981	13,981	13,981	13,981	13,981	13,981

Notes: Significant at \*: 5% level. Clustered robust standard errors in parentheses.

**Table A6** Estimation Results for the Effect of Nursing Home Reimbursements: Fixed Effects Model Based on Observations with Logged Positive Outcomes

Variable	Priscus-list	Anti- psychotics	Anti- depressants	Hypnotics and sedatives	Anxiolytics	Analgesics	Injuries and poisoning
<b>Nursing home characteristics</b>							
Average reimbursement	-0.005 (0.005)	-0.003 (0.003)	-0.001 (0.003)	-0.006 (0.004)	0.003 (0.008)	-0.014 (0.008)	0.029 (0.015)
<b>Individual characteristics</b>							
Age	0.008 (0.023)	0.040* (0.008)	0.128* (0.021)	0.069 (0.044)	0.099* (0.043)	0.198* (0.029)	-0.461* (0.033)
Care level 2	-0.039 (0.087)	0.072* (0.025)	0.087 (0.085)	0.397* (0.172)	-0.012 (0.154)	0.185 (0.105)	-0.050 (0.100)
Care level 3	-0.097 (0.135)	0.037 (0.033)	0.218 (0.153)	0.248 (0.241)	0.358 (0.241)	0.444* (0.149)	0.036 (0.139)
<b>Health status</b>							
Depression and bipolar disorder	0.059 (0.066)	0.024 (0.018)	0.073 (0.049)	0.076 (0.119)	0.063 (0.128)	-0.012 (0.066)	-0.058 (0.088)
Schizophrenia, schizotypal and delusional disorders	0.040 (0.100)	0.029 (0.022)	-0.081 (0.089)	0.187 (0.202)	-0.198 (0.165)	-0.067 (0.124)	0.051 (0.154)
Dementia	-0.023 (0.056)	0.018 (0.018)	-0.030 (0.051)	-0.198 (0.121)	-0.205 (0.105)	0.004 (0.063)	-0.096 (0.079)
Mental disorders due to psychoactive substance use	-0.086 (0.097)	-0.042 (0.028)	0.064 (0.107)	0.046 (0.189)	-0.076 (0.198)	-0.034 (0.132)	-0.047 (0.137)
Other mental disorders	0.020 (0.073)	-0.020 (0.020)	-0.094 (0.070)	-0.180 (0.160)	0.065 (0.134)	0.083 (0.075)	0.031 (0.081)
Stroke	-0.037 (0.074)	-0.013 (0.020)	0.025 (0.073)	-0.075 (0.126)	0.003 (0.140)	0.127 (0.076)	-0.012 (0.077)
Cardiac infarction	-0.019 (0.123)	-0.021 (0.042)	0.094 (0.107)	-0.091 (0.220)	-0.061 (0.214)	-0.157 (0.104)	-0.138 (0.132)
Other diseases of the circulatory system	0.167* (0.078)	0.038 (0.020)	0.043 (0.078)	0.001 (0.172)	0.242 (0.171)	-0.016 (0.108)	0.011 (0.134)
Invasive neoplasms	0.139 (0.079)	0.008 (0.022)	-0.083 (0.062)	0.342* (0.127)	0.140 (0.091)	0.004 (0.076)	-0.031 (0.092)
Diseases of the musculoskeletal system	0.018 (0.048)	-0.023 (0.014)	-0.005 (0.046)	0.010 (0.097)	0.091 (0.088)	0.083 (0.062)	-0.007 (0.065)
Diseases of the genitourinary system	-0.003 (0.044)	-0.012 (0.012)	0.027 (0.041)	-0.142 (0.111)	0.015 (0.072)	-0.020 (0.050)	-0.077 (0.055)
Parkinson's disease	0.144 (0.097)	0.022 (0.025)	-0.024 (0.078)	0.186 (0.208)	0.192 (0.195)	0.036 (0.126)	-0.067 (0.127)
Number of consultations	0.003* (0.001)	0.003* (3*10 <sup>-4</sup> )	0.005* (0.001)	0.009* (0.002)	0.006* (0.002)	0.009* (0.001)	0.005* (0.001)
Number of hospitalizations	-0.021 (0.014)	-0.011* (0.005)	-0.040* (0.016)	-0.073* (0.028)	-0.033 (0.023)	0.005 (0.016)	0.064* (0.019)
Death	-0.654* (0.065)	-0.140* (0.016)	-0.554* (0.051)	-0.346* (0.117)	-0.388* (0.087)	-0.227* (0.056)	0.049 (0.073)
R squared	0.077	0.085	0.108	0.186	0.106	0.085	0.316
N	5,345	6,218	4,625	1,881	2,285	7,286	4,219

Notes: Significant at \*: 5% level. Clustered robust standard errors in parentheses.



**Table A7** Estimation Results for the Trimmed Linear Probability Fixed Effects Model

Variable	Priscus-list	Anti- psychotics	Anti- depressants	Hypnotics and sedatives	Anxiolytics	Analgesics	Injuries and poisoning
<b>Nursing home characteristics</b>							
Average reimbursement	-0.001 (0.002)	2*10 <sup>-4</sup> (0.002)	0.002 (0.002)	5*10 <sup>-4</sup> (0.001)	-0.001 (0.001)	-0.006* (0.002)	0.001 (0.005)
<b>Individual characteristics</b>							
Age	-0.022* (0.006)	-0.001 (0.006)	0.004 (0.005)	-0.006 (0.004)	0.002 (0.005)	0.059* (0.009)	-0.107* (0.015)
Care level 2	0.023 (0.026)	0.116* (0.023)	4*10 <sup>-4</sup> (0.020)	0.030 (0.019)	0.029 (0.018)	-0.014 (0.033)	0.010 (0.055)
Care level 3	0.023 (0.037)	0.122* (0.034)	-0.027 (0.028)	-0.005 (0.029)	0.067* (0.027)	-0.009 (0.045)	-0.052 (0.080)
<b>Health status</b>							
Depression and bipolar disorder	0.020 (0.016)	0.053* (0.017)	0.172* (0.016)	0.021 (0.013)	0.015 (0.012)	-0.003 (0.023)	0.086* (0.036)
Schizophrenia, schizotypal and delusional disorders	0.065* (0.028)	0.170* (0.027)	0.011 (0.021)	0.023 (0.022)	0.029 (0.023)	-0.024 (0.041)	-0.057 (0.059)
Dementia	0.025 (0.014)	0.033* (0.012)	0.017 (0.011)	0.020 (0.010)	-0.004 (0.011)	0.029 (0.020)	0.006 (0.038)
Mental disorders due to psychoactive substance use	-0.009 (0.027)	0.011 (0.028)	-0.006 (0.022)	0.023 (0.021)	0.042 (0.027)	0.026 (0.037)	-0.059 (0.076)
Other mental disorders	0.007 (0.019)	0.078* (0.018)	0.036 (0.018)	0.047* (0.017)	0.028 (0.017)	0.008 (0.028)	-0.003 (0.045)
Stroke	0.013 (0.018)	0.057* (0.017)	0.019 (0.014)	-0.011 (0.014)	0.016 (0.015)	0.038 (0.027)	-0.003 (0.041)
Cardiac infarction	-0.011 (0.029)	0.033 (0.025)	0.012 (0.022)	0.018 (0.026)	-0.038 (0.021)	-0.009 (0.038)	0.009 (0.063)
Other diseases of the circulatory system	0.001 (0.020)	-0.014 (0.019)	0.026 (0.016)	0.013 (0.017)	-0.012 (0.018)	-0.021 (0.033)	-0.025 (0.046)
Invasive neoplasms	-0.016 (0.019)	-0.033* (0.015)	-0.010 (0.014)	-0.009 (0.013)	-0.015 (0.014)	0.034 (0.028)	0.014 (0.045)
Diseases of the musculoskeletal system	0.022 (0.013)	-0.006 (0.012)	0.012 (0.010)	0.017 (0.010)	0.019 (0.011)	0.063* (0.021)	0.036 (0.032)
Diseases of the genitourinary system	0.022* (0.011)	0.018 (0.010)	0.011 (0.009)	0.006 (0.009)	0.010 (0.009)	0.012 (0.016)	0.068* (0.027)
Parkinson's disease	0.025 (0.023)	0.025 (0.021)	0.015 (0.022)	0.005 (0.022)	0.023 (0.019)	0.056 (0.037)	-0.002 (0.056)
Number of consultations	0.001* (2*10 <sup>-4</sup> )	0.001* (2*10 <sup>-4</sup> )	0.001* (2*10 <sup>-4</sup> )	0.001* (2*10 <sup>-4</sup> )	0.001* (2*10 <sup>-4</sup> )	0.002* (4*10 <sup>-4</sup> )	0.005* (0.001)
Number of hospitalizations	0.021* (0.004)	0.008* (0.003)	0.010* (0.003)	0.008* (0.003)	0.012* (0.003)	0.041* (0.005)	0.054* (0.009)
Death	-0.014 (0.013)	-0.006 (0.013)	-0.024* (0.010)	-0.011 (0.010)	0.030* (0.011)	0.016 (0.020)	0.052 (0.032)
R squared	0.028	0.048	0.061	0.021	0.012	0.035	0.141
N	13,740	13,979	13,981	13,790	13,981	9,803	5,538

Notes: Significant at \*: 5% level. Clustered robust standard errors in parentheses.