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Original Research Article

Health Care Service Utilization of Dementia Patients before and after Institutionalization: A Claims Data Analysis

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Key Words

Longitudinal analysis · Generalized estimation equation · Trend · Profile · Nursing home placement · Costs · Administrative data · Statutory health insurance · Payer perspective

Abstract

Background: Community-based and institutional dementia care has been compared in cross-sectional studies, but longitudinal information on the effect of institutionalization on health care service utilization is sparse. **Methods:** We analyzed claims data from 651 dementia patients via Generalized Estimation Equations to assess health care service utilization profiles and corresponding expenditures from four quarters before to four quarters after institutionalization. **Results:** In all domains, utilization increased in the quarter of institutionalization. Afterwards, the use of drugs, medical aids, and non-physician services (e.g., occupational therapy and physiotherapy) remained elevated, but use of in- and outpatient treatment decreased. Cost of care showed corresponding profiles. **Conclusion:** Institutional dementia care seems to be associated with an increased demand for supportive services but not necessarily for specialized medical care.

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Background

Owing to demographic aging, dementia has been identified as a major economic and societal issue, and several studies have investigated the economic impact of dementia on health care systems around the world [1–7]. There is broad agreement that the clinical course

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of dementia (ongoing physical and cognitive decline combined with challenging behavior) strongly promotes nursing home placement. Many studies have been performed to identify the crucial risk factors for institutionalization in individuals with dementia [8–11]. In Germany, one acts on the assumption that every year up to 25% of previously community-living dementia patients transfer to nursing homes [12] and that only 20% of the patients eventually die at home [13].

Institutional care is reported to be a major cost driver in dementia care – especially in more advanced disease stages [14–16] – but there are only a few cross-sectional studies comparing costs of community-based and institutional dementia care [1, 17–20]. To ensure comparability with our own data referring to 2006 as the base year, we first converted the reported figures to euros by applying the average currency exchange rate of the corresponding year and then inflated these figures to 2006 values by applying the German gross domestic product deflator.

The following paragraph focuses on expenditures borne by the health care system and does not account for out-of-pocket payments and informal care. According to our own previous research, per capita expenditures for institutionalized dementia patients are substantially higher than those for community-living ones (approx. EUR 21,400 p.a. vs. approx. EUR 9,800 p.a.) [17]. This is in line with the results from the Belgian NADES study (institutional care approx. EUR 13,300 p.a. vs. community-based care approx. EUR 3,300 p.a.) [1] and the work of Reese et al. [19] (institutional care approx. EUR 14,500 p.a. vs. community-based care approx. EUR 4,200 p.a.). However, these aggregated figures seemingly fail to answer the question whether costs are equally distributed across the entire observation period. In this regard, the work of Sands et al. [18], which compared health care spending for community-living and nursing home-based Medicaid recipients with dementia over a 12-month time frame, is an important advancement. It revealed almost constant monthly expenditures in the institutionalized population (approx. EUR 2,650 in month 1 vs. approx. EUR 2,600 in month 12) but steadily increasing expenditures in the community-living population (approx. EUR 1,100 in month 1 vs. approx. EUR 1,560 in month 12).

It has to be kept in mind that all the studies cited contrasted two patient strata with different socioeconomic and clinical characteristics, rendering a scientifically sound comparison of both care settings at least to some extent questionable. Moreover, the research described does not address the question to what extent a change in health care setting might influence the provision of health care services. Corresponding knowledge is essential to detect potential shortfalls and to improve continuity of care provision for individuals with dementia after institutionalization, and is thus highly relevant for health economics and health care services research.

To the best of our knowledge, no longitudinal study dealing with these issues by following a defined patient population over a distinct time horizon before and after institutionalization has been published yet. Based on longitudinal patient level data from a large German Statutory Health Insurance (SHI) fund, this paper aims (a) to describe the health care service utilization patterns of individuals with dementia from four quarters before until four quarters after transfer to a nursing home (hereafter institutionalization) and (b) to assess the thereby incurred overall SHI expenditures (i.e., cost of care from a payer perspective).

Methods

Background Information on the German Health Care System

Within Germany, health and long-term care insurance is a legal obligation, and about 85% of the resident population is insured within statutory funds. These funds are organized

by the principles of pay-as-you-go financing and income-dependent but risk-independent contributions. Health insurance is designed as a full coverage insurance, which allows access to a broad range of medical services for a small co-payment [21]. Nursing care services are not covered by SHI but fall under the scope of compulsory long-term care insurance (LTCI). In order to make a claim for LTCI support, insurants with impaired capabilities in their activities of daily living have to file an application with their SHI. Their need for care is appraised by the Medical Review Board – an independent statutory corporation that is directly supervised by the state's Ministry of Social Affairs. If the application is accepted, applicants are assigned to one of three care levels (i.e. ADL dependency groups). Only individuals with a care level assignment receive LTCI support in the form of partial reimbursement of nursing care services up to a legally fixed ceiling amount, which depends on the type of services provided and the recipient's care level [22].

Data Source and Sample Selection

Sample selection was based on 2005–2007 insurance claims data from AOK Bavaria, a large regional SHI fund, which had been provided for a previous excess cost study. Within this sample, 9,147 individuals with dementia had been identified based on 2005 and 2006 inpatient and outpatient diagnosis codes (ICD-10 codes 'F00', 'F01', 'F02', 'F03', and 'G30') and anti-dementia drug prescriptions (ATC codes 'N06DA' and 'N06DX01'). To be classified as a dementia patient, the documentation of at least one of these 'dementia indicators' within three of four consecutive quarters was required. Detailed information on the selection process is described elsewhere [23].

We identified the residential setting of the 9,147 dementia patients based on 2006 data from the LTCI. LTCI data only exist for individuals who have made a claim for LTCI services, i.e., for subjects who are considered to be in need of nursing care according to the Code of Social Law. Similar to previous research [24], we classified all individuals without an LTCI claim as community living ($n = 3,110$). This decision is based on the assumption that individuals without an LTCI claim have no need to transfer to a nursing home.

For individuals with an LTCI claim, the care setting can be assessed based on the provision of distinct LTCI services [25]. The LTCI service 'institutional care' is conditional on nursing home residency, and all nursing home residents but no community-living individuals receive corresponding payments. Therefore, the starting date of payments for institutional care equals the date of transfer to a nursing home, and the end date of payments for institutional care – if different from the date of death – reflects a transfer from a nursing home to the community setting.

We classified the remaining 6,037 individuals with an LTCI claim as continuously community living in 2006 if 'institutional care' was never documented between January 1 and December 31 ($n = 2,425$), as continuously institutionalized in 2006 if 'institutional care' was documented without interruptions from January 1 to December 31 ($n = 2,933$), and as transferring between community-based and institutional care in 2006 if payments for 'institutional care' started during 2006 ($n = 679$).

In 2006, 18 of the transferring individuals shifted back to community-based care, and 10 individuals showed multiple shifts between community-based and institutional care. These 28 individuals were dropped, and 651 permanently institutionalized individuals were finally included in our analyses. Figure 1 visualizes the selection process in a flow chart.

Observation Period

Within the German SHI system, physician services are documented and billed on a quarterly basis. Therefore, the quarter of the year was chosen as the reference period for our analyses. To define the quarter of institutionalization (QI) for each individual, we identified

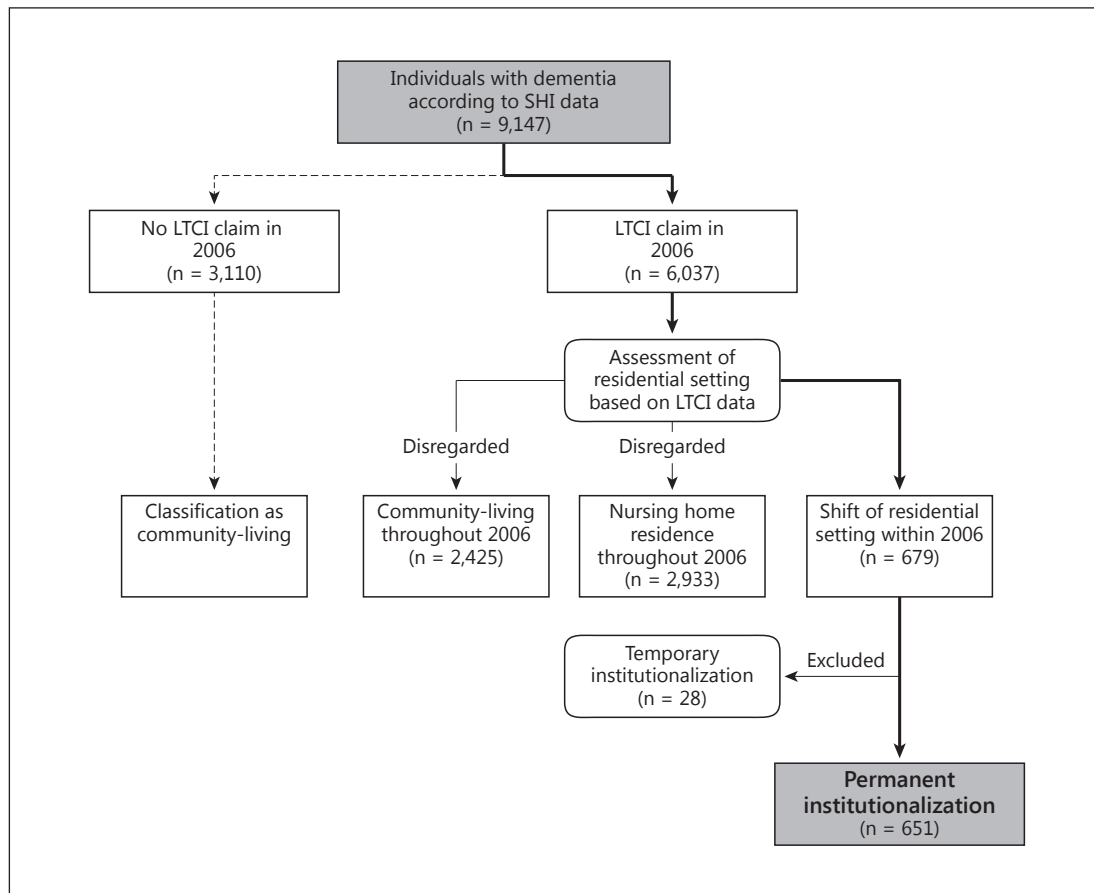


Fig. 1. Sample selection process.

the first documentation of ‘institutional care’ in 2006 – which is reported on a daily basis – and determined the respective quarter. For example, for an individual transferring to a nursing home on June 15, 2006, QI would have been q2/2006; for an individual shifting on October 2, 2006, it would have been q4/2006 and so on. Based on QI, for each individual, the four quarters before (i.e., the period of community-based care) and after (i.e., the period of institutional care) were identified. Given that transfer to a nursing home could take place from q1/2006 earliest to q4/2006 latest, the individual observation periods lasted from q1/2005 to q1/2007 (for transfers in q1/2006) up to q4/2005 to q4/2007 (for transfers in q4/2006).

Outcome Parameters

The main outcome parameter of our analysis was service utilization within the different service domains of SHI. These are care of general practitioners and medical specialists, drugs, hospital care, non-physician services, medical aids, rehabilitation, and home health care.

Within this paper, ‘non-physician services’ refer to non-medicinal remedies covered by the SHI, such as physiotherapy, occupational therapy, or medicinal massages. The term ‘home health care’ is used to describe the provision of temporary medical nursing care, which – contrary to permanent nursing care – falls within the scope of SHI.

The services of general practitioners and medical specialists were already reported as visits per quarter but, for the remaining domains, transformation was necessary. For drugs

and medical aids, the exact date of prescription was given. To reach per quarter values, all prescriptions within the distinct time frame were added. Home health care, non-physician services, hospital care, and rehabilitation do not refer to a distinct point in time but to a distinct time frame. As home health care is usually prescribed on a monthly basis, we assessed each month of prescription, assigned it to the corresponding quarter, and summed up the prescriptions within a quarter. However, this straightforward approach was not applicable for hospital care, rehabilitation, and non-physician services, as the duration of these services can range over several quarters. Regarding these domains, we distributed service utilization to the distinctive phases whenever treatment took place in different quarters (e.g., if a hospital stay lasted from June 25 to July 4, 6 days were assigned to q2/2006 and 4 days to q3/2006).

In addition to service utilization, we also analyzed the corresponding expenditure trends as a secondary outcome parameter. To do so, we either summed up costs per unit of utilization (drugs, medical aids, home health care) or attributed them proportionally to time of resource use implying constant amounts per day (hospital, rehabilitation, non-physician services). To ensure the comparability of quarter-specific costs, all amounts have been inflated to 2006 values (year of institutionalization) by applying the gross domestic product deflator.

Statistics

To account for the longitudinal nature of the data and the accompanying intra-subject correlation, the analyses were based on the Generalized Estimation Equation (GEE) approach [26, 27], which represents a marginal model with robust parameter estimates [28]. Contrary to mixed models, which would have been an alternative approach to account for intra-subject correlation, marginal models calculate population averages instead of subject-specific trajectories [28, 29].

The applied GEE estimates the quarter-specific utilization and cost figures within the study sample accounting for the intra-subject correlation as a nuisance variable. Assuming that service utilization and costs of care within a distinct quarter depend on the values observed within the previous quarter, first-order autoregression was chosen as the working correlation. Q1 was set as the point of reference to describe longitudinal trends. The GEE provides the quarter-specific β estimators. Exponentiation of the calculated group-based estimators describes service utilization and costs for each quarter as a percentage of the reference quarter.

The distribution of service utilization and costs is zero bounded and positively skewed to the right. To best possibly fit this non-normal distribution, we assumed a negative binomial distribution for service utilization and a gamma distribution for costs. As individuals with zero costs would have been dropped in a gamma model, we assigned all individuals without costs the small positive amount of EUR 0.5 to keep them in the analyses.

Age, gender, comorbidity, and dementia duration were included as cofactors in all analyses. Comorbidity was reflected by a modified version of the Charlson index [30], which accounts for all index diseases except for dementia. To reflect the patient-individual morbidity burden at the point of institutionalization, inpatient and outpatient diagnoses in the last two quarters before Q1 were used to calculate the index. Dementia duration was expressed by a dummy variable indicating whether dementia was already prevalent within the year prior to institutionalization or whether dementia was newly developed during the year of institutionalization.

We also performed extended models accounting for all possible interactions between age, gender, incidental versus prevalent dementia, and observation quarter. As these interaction terms turned out to be not statistically significant, we decided on the simple model without interaction terms, which allows a more straightforward interpretation of p values.

Table 1. Percentage of service users within the distinct observation quarters

	q4_ prior_i	q3_ prior_i	q2_ prior_i	q1_ prior_i	QI	q1_ post_i	q2_ post_i	q3_ post_i	q4_ post_i
General practitioner	87.9	90.9	91.7	94.9	99.5	98.9	98.7	99.3	99.1
Medical specialist	55.3	52.2	53.5	56.4	65.6	67.4	64.6	62.6	60.0
Drugs	89.2	89.7	89.6	90.6	98.9	98.9	98.4	97.4	98.5
Hospital	15.1	15.5	18.3	40.2	58.2	23.7	21.1	21.3	20.1
Non-physician services	10.6	10.1	11.2	12.3	24.6	27.8	27.7	26.8	28.4
Medical aids	13.5	13.8	16.1	17.7	60.2	70.5	75.7	76.9	79.8
Home health care	24.6	26.4	30.0	32.4	26.1	n.p.	n.p.	n.p.	n.p.
Rehabilitation	1.8	1.7	2.3	6.3	9.7	0.6	0.5	0.0	0.0

n.p. = Not provided.

Within an additional sensitivity analysis, we excluded individuals who died during the observation period (n = 91). The results of this analysis differed only marginally from those of the main analysis; thus, the corresponding results are not included in the paper.

All analyses were performed using SAS version 9.2, and a p value of at least 0.01 was defined as being statistically significant.

Results

Baseline Characteristics

The transferees were almost equally distributed across the four quarters of 2006 (q1: 24.3%, q2: 27.5%, q3: 27.0%, and q4: 21.2%). A total of 497 (76.3%) of the transferring dementia patients were female, and 456 (70.1%) had been diagnosed with dementia prior to the year of transfer. Individuals transferring to a nursing home were on average 82.8 years old (SD 6.9) and, given a mean Charlson index of 3.9 (SD 2.9), their comorbidity burden was substantial. Ninety-one individuals died within the first year after institutionalization.

Utilization of Health Care Services

User Quota within the Distinct Services

Table 1 describes the percentage of transferring individuals with service utilization in the distinct SHI categories for each observation quarter. By trend, the quota of service users increased over time with a particularly strong increase in QI. Home health care was the only exception to this rule, as corresponding services are dispensed with after nursing home transfer.

The analysis of the distinct service categories showed three different patterns. The first pattern was characterized by a steadily increasing user quota from the beginning of the observation period until the phase of institutionalization (i.e., QI and, if required, the adjacent quarter) and stabilization at a higher level afterwards. This pattern applied to general practitioner services, drugs, and non-physician services. However, non-physician services represented an exception in that their user quota literally escalated within QI (duplication), whereas the increase was more continuous in the other three domains. The second pattern showed an increasing user quota from the beginning of the observation period until the phase of institutionalization and a decrease afterwards. This pattern was observed in the use of medical specialists, hospitals, and rehabilitation. The third pattern presented an increasing

Table 2. Mean volume of per capita service utilization within the distinct observation quarters

	q4_prior_i	q3_prior_i	q2_prior_i	q1_prior_i	QI	q1_post_i	q2_post_i	q3_post_i	q4_post_i
General practitioner visits	1.02 (0.97; 1.07)	2.69 (2.36; 3.07)	4.48 (4.08; 4.91)	7.02 (6.54; 7.53)	13.87 (13.35; 14.41)	11.75 (11.13; 12.40)	7.98 (7.38; 8.63)	4.46 (3.99; 4.98)	1.32 (1.25; 1.39)
Medical specialist visits	1.14 (1.01; 1.28)	1.42 (1.21; 1.67)	1.74 (1.47; 2.05)	2.27 (1.92; 2.69)	3.47 (2.98; 4.05)	3.14 (2.75; 3.58)	2.51 (2.16; 2.91)	1.90 (1.60; 2.27)	1.10 (0.98; 1.23)
Drug prescriptions	6.17 (5.72; 6.65)	6.60 (6.12; 7.12)	6.72 (6.23; 7.24)	7.64 (7.10; 8.21)	10.66 (10.04; 11.31)	10.22 (9.61; 10.87)	9.74 (9.13; 10.39)	9.21 (8.60; 9.86)	8.59 (8.01; 9.20)
Hospital days	1.85 (1.43; 2.40)	2.10 (1.63; 2.70)	2.31 (1.84; 2.89)	6.78 (5.84; 7.88)	10.69 (9.59; 11.93)	2.91 (2.40; 3.52)	2.38 (1.92; 2.94)	2.22 (1.77; 2.77)	2.12 (1.65; 2.72)
Non-physician service prescriptions	0.13 (0.10; 0.17)	0.12 (0.09; 0.16)	0.13 (0.10; 0.18)	0.16 (0.12; 0.21)	0.30 (0.24; 0.38)	0.41 (0.33; 0.50)	0.41 (0.33; 0.50)	0.30 (0.30; 0.45)	0.39 (0.31; 0.49)
Medical aid prescriptions	0.20 (0.16; 0.25)	0.26 (0.20; 0.33)	0.25 (0.21; 0.31)	0.28 (0.23; 0.34)	0.89 (0.80; 0.98)	1.05 (0.95; 1.17)	1.06 (0.96; 1.17)	1.03 (0.93; 1.14)	1.10 (0.99; 1.23)
Home health care prescriptions	0.53 (0.46; 0.62)	0.58 (0.50; 0.68)	0.66 (0.57; 0.75)	0.68 (0.60; 0.78)	0.35 (0.29; 0.41)	n.p.	n.p.	n.p.	n.p.
Rehabilitation days	0.22 (0.12; 0.42)	0.26 (0.13; 0.54)	0.38 (0.20; 0.76)	0.85 (0.56; 1.31)	1.14 (0.81; 1.62)	0.08 (0.03; 0.21)	0.08 (0.03; 0.24)	0.00 (0.00; 0.00)	0.00 (0.00; 0.00)

Values in parentheses are 95% CI. n.p. = Not provided.

Table 3. Mean per capita SHI and LTCI expenditures within the distinct observation quarters

	q4_ prior_i	q3_ prior_i	q2_ prior_i	q1_ prior_i	QI	q1_ post_i	q2_ post_i	q3_ post_i	q4_ post_i
Costs of SHI, EUR	908	1,110	1,296	2,466	3,755	1,565	1,200	943	770
Relation QI, %	24.2	29.6	34.5	65.7	100.0	44.1	32.0	25.1	20.5
p value	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001
Costs of LTCI, EUR	406	454	543	775	2,503	3,202	3,127	3,003	2,868
Relation QI, %	16.2	18.1	21.7	31.0	100.0	127.9	124.9	120.0	114.6
p value	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001	0.0035

user quota over the entire observation period with a remarkable level shift from QI onwards (quadruplication). This was the case for medical aids.

Mean Volume of Service Utilization

The trend of the mean per capita service utilization across the nine observation quarters as estimated by the GEE is shown in table 2. Within all service domains (except for home health care), the estimated volume of service utilization was higher in QI than in the four previous quarters. During the year after institutionalization, the volume of service utilization of general practitioner visits and medical specialist visits decreased gradually to approximately the initial level. Regarding hospital and rehabilitation days, there was an abrupt decrease immediately within the first quarter after institutionalization. The number of drug prescriptions, medical aid prescriptions, and non-physician service prescriptions in the institutional setting evened out at a higher level than in the community setting. Regarding the last two service domains, this level was remarkably higher than in QI.

Concerning all service domains, the volume of service use within each quarter prior to institutionalization as well as within each quarter after institutionalization differed significantly from the volume of service use in QI. The only exception was found during the first quarter after institutionalization regarding medical specialist visits and drug prescriptions, which did not differ significantly (p values of 0.10 and 0.07, respectively).

Figure 2 visualizes the longitudinal trend in service utilization for the distinct service domains by pointing out the relative difference from QI. It demonstrates that institutionalization had only a temporary effect on acute medical needs represented by physician visits or inpatient treatment, but a long-lasting effect on supportive services such as medical aids and non-physician services.

Costs within the Distinct Service Domains

As shown in table 3, SHI expenditures followed an inverse U-shape peaking in QI. Indeed, the rise in SHI expenditures was already quite pronounced one quarter before institutionalization.

Figure 3 indicates that escalating expenditures within the quarter prior to institutionalization and QI were almost exclusively explained by hospital expenditures, which accounted for about two thirds of the entire SHI expenditures in these two quarters. Even from q2_prior

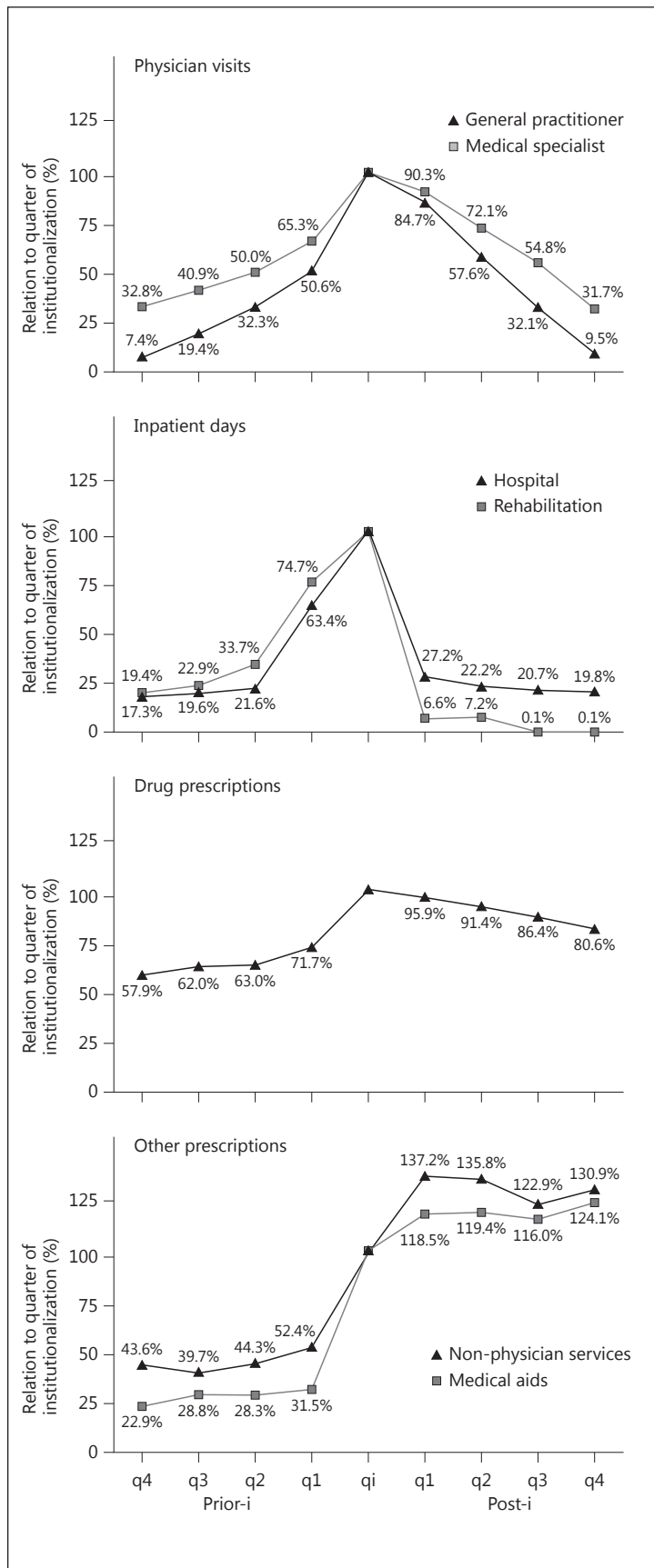


Fig. 2. Service utilization within the distinct quarters of observation in relation to QI.

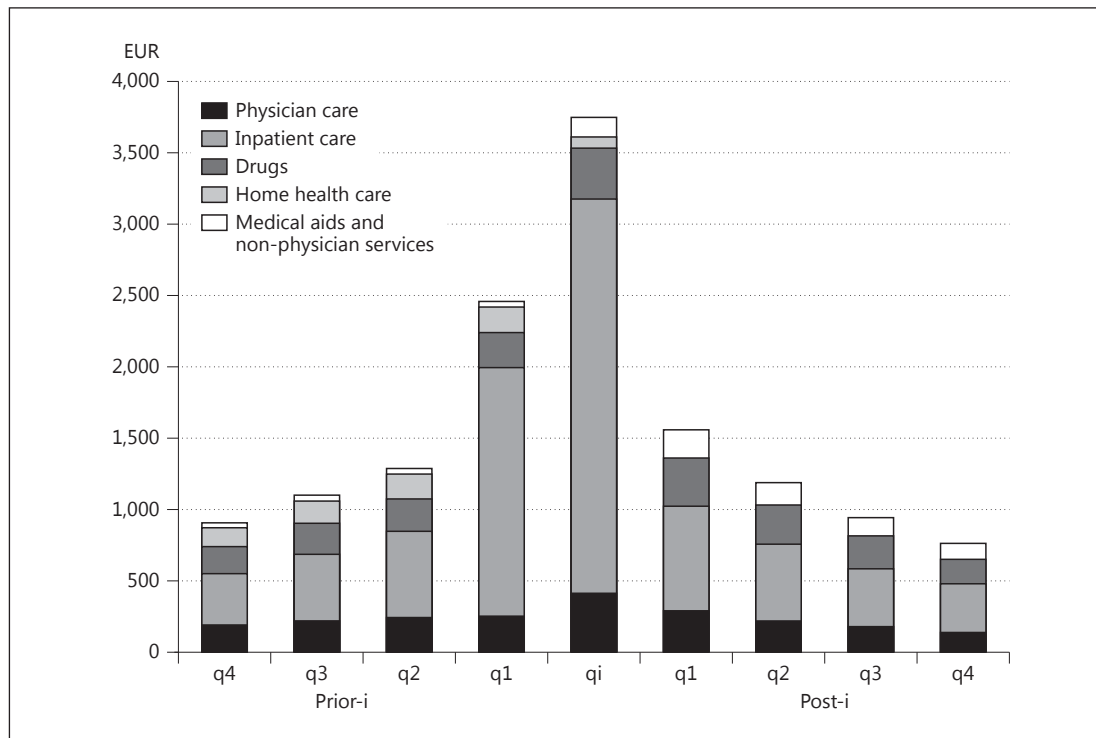


Fig. 3. Trend of SHI expenditures within the distinct service domains.

to q1_prior, hospital costs almost tripled, whereas the increase did not exceed 20% within the other service domains. Expenditures on hospital care, rehabilitation, general practitioners, and medical specialists decreased after institutionalization, but expenditures on drugs and particularly on medical aids and non-physician services remained elevated. The relative importance of the last two domains increased in the institutional setting. They accounted for approximately 5% of SHI expenditures during the four quarters before institutionalization but ranged between 15 and 25% within the four quarters after institutionalization. Payments for home health care are dispensed with after institutionalization.

The nursing care expenditures of LTCI, which were incurred in addition to the health care expenditures of SHI, escalated in the context of institutionalization and remained substantially increased afterwards (table 3).

Discussion

Our analysis of patient-level SHI data from 651 dementia patients covering a period from four quarters before to four quarters after nursing home transfer revealed that, within all SHI domains, the volume of quarterly per capita utilization escalated in QI compared with the directly adjacent quarter. Once institutionalization had taken place, the trend in the level of service utilization did not increase further but stabilized (drugs: level of QI; non-physician services and medical aids: increased level) or even decreased to the initial level (physician services and inpatient treatment).

Correspondingly, SHI expenditures presented a parabolic curve peaking in QI. LTCI expenditures increased substantially after institutionalization because payments for institu-

tional long-term care per legal definition exceed payments for community-based long-term care. Summing up the quarter-specific expenditures resulted in higher health care expenditures during the year prior to institutionalization than during the year after institutionalization (EUR 5,780 vs. 4,478). Regarding long-term care expenditures, the situation was reversed (EUR 2,178 vs. 11,699), and they accounted for the most part of the total costs of care.

These spending structures within the German SHI/LTCI system are in line with previous cross-sectional research on expenditures borne by the health care system [1, 17–19]. However, it has to be kept in mind that a payer perspective disregards out-of-pocket payments and particularly does not account for non-monetary cost components such as unpaid family care. Valued informal care in the community setting is substantially higher than in the institutional setting [1, 19, 20]. Thus, from a societal perspective, which accounts for monetary and non-monetary cost components, institutional care might even be the less costly option, as has been recently shown by Koenig et al. [31].

Compared with cross-sectional studies, our disaggregated longitudinal design allows the analysis of utilization and expenditure trends in the context of nursing home transfer. The results suggest that the period of institutionalization has to be considered as an ‘exceptional time frame’. Regarding outpatient and inpatient treatment, a substantial increase in service utilization is already observed within the quarter prior to institutionalization. Obviously, changes in health status which precipitate the decision to institutionalize are already manifest some months before the definite date of transfer.

This observation indicates that the health care-seeking behavior of individuals who will be shortly institutionalized is different from the health care-seeking behavior of individuals who will stay in the community setting. Indeed, a comparison of cost data between the 651 transferring dementia patients and the 2,425 dementia patients who were continuously community living in 2006 revealed significantly higher health care expenditures within the four quarters prior to institutionalization than within a ‘usual’ year. Therefore, the analytical approach to consider ‘institutionalization’ as a censoring event within cross-sectional analyses on community-living populations and to calculate correspondingly adjusted average per capita costs and utilization figures [32] might be biased towards overestimation. It seems more advisable to consider individuals as a distinct subgroup shortly before institutionalization and to run stratified analyses.

Moreover, the analyses illustrate that institutionalization is rather associated with an increased demand for continuous care and support (e.g., medical aids and drugs) than with an increased demand for acute medical care (e.g., inpatient and outpatient care). Indeed, outpatient and inpatient care decrease to the initial level after peaking in Q1. Hence, it can be concluded that the decision to institutionalize is triggered by acute health-deteriorating events such as a hospital stay, but that acute illnesses, which require specialized medical care, do not occur more frequently within the institutional setting. However, dementia is a progressive syndrome, and the patients’ ongoing physical and cognitive decline is not affected by the residential setting per se. The increased demand for medical aids and non-physician services after nursing home transfer matches the hypothesis of deteriorating health in the context of dementia progression. Nevertheless, no similar trend within the post-institutionalization period was observed regarding physician services. Therefore, the reduced contact frequency with general practitioners and medical specialists in the institutional setting might be an indicator of undersupply in individuals with more advanced dementia. According to a recent health technology assessment (HTA) analysis on behalf of the German Institute of Medical Documentation and Information (DIMDI), there is a common opinion among physicians working in Germany that visits to nursing homes are not financially interesting, and thus this service is often not offered [33].

To judge our findings comprehensively, the limitations of the applied approach need to be taken into consideration. First, claims data-based analyses are linked to some intrinsic caveats [34], such as lacking information on disease severity and socioeconomic factors (household size, income). There is broad scientific consensus that these parameters influence health care service utilization, costs of care, and the final decision to transfer to a nursing home [16, 35, 36]. Despite these undocumented parameters definitively influence the absolute utilization level, there is no reason to assume that they affect utilization trends themselves, especially within the post-institutionalization period.

Second, the GEE approach required the assignment of small positive values to individuals with zero costs. Thus, there is an overestimation of quarter-specific costs, especially in service domains with a generally low user quota (e.g., rehabilitation). We are aware that this aspect is of particular relevance if cost trends within distinct SHI domains are looked at, but we strongly believe that it is not a major issue if the entire SHI expenditures are estimated. Indeed, the percentage of insurants without any SHI costs in a distinct quarter ranged between 6.5 and 0.0%. Given this low quota combined with the small amount replaced in case of zero costs (EUR 0.5), we are convinced that we have not introduced substantial bias.

Third, our analyses did not include a control sample of individuals without dementia transferring to a nursing home. Thus, it is not possible to conclude whether the observed profiles are dementia specific or context specific, i.e., whether they apply to individuals without dementia as well. As institutionalization of individuals without dementia does not happen very often, most studies on risk factors for institutionalization do not compare individuals with and without dementia [37–39]. Such a comparative design was chosen by Schoenmakers et al. [40] who reported ‘lack of self-management’ and ‘problems with care’ to be the most important motifs for institutionalization in individuals with and without dementia. Age, functional impairment, and comorbidity are other shared risk factors for transfer to a nursing home [37–39, 41]. Thus, we assume that individuals with and without dementia show similar health care service utilization profiles in the context of institutionalization, even though there might be a dementia-specific level effect.

Despite these drawbacks, our study design offers some noteworthy advantages. First of all, claims data provide information on all individuals insured including the oldest of the old, frail individuals, and those in the terminal phase of life. These individuals have a particularly high risk of institutionalization but are often not enrolled in primary data-based studies. Moreover, information on service utilization and costs can be obtained directly from the data. Basically, this eliminates the issues of non-response [42] and recall bias [43], which would have occurred, for example, if nursing home residents had been retrospectively asked about their utilization patterns before and after transfer. Therefore, we believe that, for our particular research question, claims data yield more reliable results than primary data.

Additionally, our analyses did not only consider overall costs but also domain-specific trends. This itemized view enables the investigation of common hypotheses regarding interactions between the distinct domains. For example, our analyses did not find a substitution effect between care from medical specialists and general practitioners (parallel trend) or a complementary relationship between drug prescriptions and physician visits. Finally, changes in the cost structure, which reflect the changing relevance of distinct service domains, are traceable. Such information is necessary to soundly judge expenditure trends.

In conclusion, our study provides novel insights into dementia-related health care services research. In particular, it provides evidence that the months around the date of institutionalization represent an exceptional time frame regarding the level of service utilization. This has methodological implications in that the use of setting-related adjusted average per capita figures needs to be scrutinized carefully in further studies. Moreover, the analysis demonstrated that institutional dementia care seems not necessarily to be associated with an

increased demand for specialized medical care. Assuming dementia progression over time, a decrease in specialized medical care services during the post-institutionalization period seems counterintuitive. To comprehensively interpret this observation, further evidence is required to establish to what extent institutionalization affects the quality of care provision.

Acknowledgements

We thank the AOK Bavaria SHI fund for providing data for the described analyses. Moreover, we are grateful to Matthias Hunger for his support regarding the choice of the appropriate statistical model. In addition, we acknowledge the input of the anonymous referees whose comments and suggestions significantly improved both the clarity and the precision of the article.

Disclosure Statement

The authors declare that they have no conflicting interests.

References

- 1 Scuvee-Moreau J, Kurz X, Dresse A; National Dementia Economic Study Group: The economic impact of dementia in Belgium: results of the National Dementia Economic Study (NADES). *Acta Neurol Belg* 2002;102:104–113.
- 2 Schwarzkopf L, Menn P, Kunz S, et al: Costs of care for dementia patients in community setting: an analysis for mild and moderate disease stage. *Value Health* 2011;14:827–835.
- 3 Wimo A, Jönsson L, et al: The worldwide economic impact of dementia 2010. *Alzheimers Dement* 2013;9:1–11.e13.
- 4 Wimo A, Jönsson L, Gustavsson A, et al: The economic impact of dementia in Europe in 2008 – cost estimates from the Eurocode project. *Int J Geriatr Psychiatry* 2011;26:825–832.
- 5 Allegri RF, Butman J, et al: Economic impact of dementia in developing countries: an evaluation of costs of Alzheimer-type dementia in Argentina. *Int Psychogeriatr* 2007;19:705–718.
- 6 Suh GH, Knapp M, Kang CJ: The economic costs of dementia in Korea, 2002. *Int J Geriatr Psychiatry* 2006;21:722–728.
- 7 Olesen J, Gustavsson A, et al: The economic cost of brain disorders in Europe. *Eur J Neurol* 2012;19:155–162.
- 8 Wattmo C, Wallin AK, et al: Risk factors for nursing home placement in Alzheimer’s disease: a longitudinal study of cognition, ADL, service utilization, and cholinesterase inhibitor treatment. *Gerontologist* 2011;51:17–27.
- 9 Coelho DP, Hooker K, Bowman S: Institutional placement of persons with dementia: what predicts occurrence and timing? *J Fam Nurs* 2007;13:253–277.
- 10 Banerjee S, Murray J, Foley B, Atkins L, Schneider J, Mann A: Predictors of institutionalisation in people with dementia. *J Neurol Neurosurg Psychiatry* 2003;74:1315–1316.
- 11 Eska K, Graessel E, et al: Predictors of institutionalization of dementia patients in mild and moderate stages: a 4-year prospective analysis. *Dementia Geriatr Cogn Disord Extra* 2013;3:426–445.
- 12 Weyerer S, Bickel H: *Epidemiologie psychischer Erkrankungen im höheren Lebensalter, Grundriss Gerontologie*. Stuttgart, Kohlhammer, 2007, vol 14.
- 13 Weyerer S: *Gesundheitsberichterstattung des Bundes; Heft 28: Altersdemenz, 2005*.
- 14 Quentin W, Riedel-Heller SG, et al: Cost-of-illness studies of dementia: a systematic review focusing on stage dependency of costs. *Acta Psychiatr Scand* 2009;121:243–259.
- 15 Leicht H, Koenig HH, et al: Predictors of costs in dementia in a longitudinal perspective. *PLoS One* 2013;8:e70018.
- 16 Kronborg Andersen C, Lauridsen J, et al: Cost of dementia: impact of disease progression estimated in longitudinal data. *Scand J Public Health* 2003;31:119–125.
- 17 Schwarzkopf L, Menn P, et al: Are community-living and institutionalized dementia patients cared for differently? Evidence on service utilization and costs of care from German insurance claims data. *BMC Health Serv Res* 2013;13:2.
- 18 Sands LP, Xu H, et al: Comparison of resource utilization for Medicaid dementia patients using nursing homes versus home and community based waivers for long-term care. *Med Care* 2008;46:449–453.

- 19 Reese JP, Hessmann P, et al: Cost and care of patients with Alzheimer's disease: clinical predictors in German health care settings. *J Alzheimers Dis* 2011;27:723–736.
- 20 Kuo Y-C, Lan C-F, et al: Dementia care costs and the patient's quality of life (QOL) in Taiwan: home versus institutional care services. *Arch Gerontol Geriatr* 2010;51:159–163.
- 21 Busse R, Riesberg A: Health care systems in transition: Germany; in WHO Regional Office for Europe on behalf of the European Observatory on Health Systems and Policies (ed). Copenhagen, 2004.
- 22 Rothgang H: Social insurance for long-term care: an evaluation of the German model. *Soc Policy Admin* 2010; 44:436–460.
- 23 Schwarzkopf L, Menn P, et al: Excess costs of dementia disorders and the role of age and gender: an analysis of German health and long-term care insurance claims data. *BMC Health Serv Res* 2012;12:165.
- 24 Sauer S, Mueller R, Rothgang H: Institutionalised dying in Germany: trends in place of death distribution: home, hospitals and nursing homes (in German). *Z Gerontol Geriatr* 2013, Epub ahead of print.
- 25 Rothgang H, Mueller R, et al: Barmer GEK Pflegereport 2012 – Schriftenreihe zur Gesundheitsanalyse, Band 17. St. Augustin, 2012.
- 26 Ballinger GA: Using generalized estimating equations for longitudinal data analysis. *Organ Res Methods* 2004; 7:127–150.
- 27 Liang K-Y, Zeger SL: Longitudinal data analysis using generalized linear models. *Biometrika* 1986;73:13–22.
- 28 Alencar AP, Singer JM, Rocha FM: Competing regression models for longitudinal data. *Biom J* 2012;54:214–229.
- 29 Fitzmaurice G, Laird N, Ware J: *Applied Longitudinal Analysis*, ed 2. New York, Wiley, 2011.
- 30 Charlson ME, Pompei P, et al: A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis* 1987;40:373–383.
- 31 Koenig HH, Leicht H, et al: The costs of dementia from the societal perspective: is care provided in the community really cheaper than nursing home care? *J Am Med Directors Assoc* 2014;15:117–126.
- 32 Ellis RP, Ash A: Refinements to the Diagnostic Cost Group (DCG) model. *Inquiry* 1995;32:418–429.
- 33 Balzer K, Butz S, et al: Beschreibung und Bewertung der fachärztlichen Versorgung von Pflegeheimbewohnern in Deutschland – Health Technology Assessment No. 125. Deutsches Institut für Medizinische Dokumentation und Information (DIMDI) (ed): Köln, 2013. http://portal.dimdi.de/de/hta/hta_berichte/hta298_bericht_de.pdf (accessed February 11, 2014).
- 34 Schubert I, Köster I, et al: Versorgungsforschung mit GKV-Routinedaten. *Bundesgesundheitsblatt – Gesundheitsforschung – Gesundheitsschutz* 2008;1095–1105.
- 35 de Meijer C, Koopmanschap M, et al: Determinants of long-term care spending: age, time to death or disability? *J Health Econ* 2011;30:425–438.
- 36 Del Duca GF, Silva SG, et al: Predictive factors for institutionalization of the elderly: a case-control study. *Rev Saude Publica* 2012;46:147–153.
- 37 Wimo A, Sjolund BM, et al: Incremental patterns in the amount of informal and formal care among non-demented and demented elderly persons: results from a 3-year follow-up population-based study. *Int J Geriatr Psychiatry* 2011;26:56–64.
- 38 Nihtila EK, Martikainen PT, et al: Chronic conditions and the risk of long-term institutionalization among older people. *Eur J Public Health* 2008;18:77–84.
- 39 Luppá M, Luck T, et al: Prediction of institutionalization in the elderly. A systematic review. *Age Ageing* 2010; 39:31–38.
- 40 Schoenmakers B, Buntinx F, et al: The process of definitive institutionalization of community dwelling demented vs non demented elderly: data obtained from a network of sentinel general practitioners. *Int J Geriatr Psychiatry* 2009;24:523–531.
- 41 Luppá M, Luck T, Matschinger H, et al: Predictors of nursing home admission of individuals without a dementia diagnosis before admission – results from the Leipzig Longitudinal Study of the Aged (LEILA 75+). *BMC Health Serv Res* 2010;10:186.
- 42 Gundgaard J, Ekholm O, et al: The effect of non-response on estimates of health care utilisation: linking health surveys and registers. *Eur J Public Health* 2008;18:189–194.
- 43 Bhandari A, Wagner T: Self-reported utilization of health care services: improving measurement and accuracy. *Med Care Res Rev* 2006;63:217–235.