Cost and Care Models for Acutely Ill Nursing Home Residents in Germany: The example of pneumonia

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Cost and Care Models for Acutely Ill Nursing Home Residents in Germany: The example of pneumonia

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ABSTRACT

Background

Hospitalisation of acutely ill nursing home residents is associated with health risks such as infections, complications, or falls, and results in high costs for the health care system. Taking the case of pneumonia, nursing homes generally can ensure care according to guidelines.

Aim

Extrapolation of overall expenditures for the German statutory health insurance system from the hospitalisation of nursing home residents with respiratory infection/pneumonia; developing alternative cost scenarios to compare nursing home care with hospital care in consideration of patients' condition.

Methods

Data provided by health insurance funds were extrapolated to the German statutory health insurance system and weighted via German-DRG case values. Care processes (hospital vs. nursing home) were modelled, and treatment steps were divided into cost categories. The patient's condition was standardised via Barthel Index.

Results

Total expenditures of € 163.3 million were incurred for inpatient care of nursing home residents transferred to hospitals for respiratory infection/pneumonia in 2013 in Germany. Process modelling reveals lower direct costs for nursing home care as well as better development of patients' condition. Looking at operators of nursing homes, both care scenarios necessitate additional services without reimbursement.

Conclusion

Expenditure projections for the hospital care of nursing home residents with pneumonia reveal high saving potential. Avoidance of hospital admission serves to considerably reduce the insurers' expenditures but also the duration and severity of illness. The study illustrates economic incentive structures for health care providers and indicates courses of action for health policy and nursing homes operators.

Keywords

Costs and Cost analysis; Hospitalization; Nursing Home-Acquired Pneumonia; Nursing Homes; Quality of Life

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INTRODUCTION

Background

Respiratory infections with suspected pneumonia are a frequent reason for the hospitalisation of nursing home residents (Irvine et al. 1984; Jackson et al. 1992; Muder et al. 1996). Compared to nursing home care, hospital care is associated with higher health risks such as nosocomial infection, complications or falls (Boockvar et al. 2005; Dempsey 1995; Dosa 2005; Fried et al. 1997; Gill et al. 2004; Thompson et al. 1997), and results in higher costs for the health care system (Alessi et al. 2003; Boockvar et al. 2008; Kayser-Jones et al. 1989). In view of an increasing economic orientation in the health care system, alternative strategies and interventions gain in importance which may serve to avoid the hospitalisation of acutely ill nursing home residents or support a fast return to the familiar environment (Grabowski et al. 2007). Taking the case of pneumonia we see that the re-commended measures for the elderly – close monitoring round-the-clock, safe medication intake and adequate hydration (Hoffken et al. 2009) – can generally be insured and facilitated in inpatient nursing home care (Ouslander et al. 2010; Saliba et al. 2000).

State of health economics research

For an overview of the current state of relevant literature, an international search for original studies was conducted which explore the reduction of hospital transfers of acutely ill nursing home residents in terms of costs. The databases searched were EMBASE, Medline, CINAHL, Econlit and NHS EED. The bibliography of an identified review was manually scanned in addition. Research was based on relevant search terms such as "health care costs" AND OR "nursing homes" or "long-term care"[1], and no time limit was set.

Included were health economic studies and evaluations which addressed the care of patients over 65 in both types of care facilities as well as preventive measures to avoid hospital transfers from the nursing home. Excluded were studies published in languages other than English, German or French, and those referring to persons under 65 or patients from acute long-term care facilities.

A total of 14 studies were identified (see flow chart in fig. 1). The studies covered cost-effectiveness, cost-utility and cost-benefit analyses (Bohnet-Joschko 2014). Two studies from North America are to be mentioned in particular with reference to respiratory infections/pneumonia. A prospective cohort study among 36 nursing homes in Missouri (US) revealed that the care of residents with low to medium mortality risk in nursing homes is safer and more cost-effective compared to hospital care (Kruse et al. 2004). In a cluster-randomized controlled study among 22 nursing homes in Ontario (Canada), the number of hospital transfers was reduced via standardised care procedures among other things, and costs involved were lower (Loeb et al. 2006).

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[1] A complete list of medical subject headings used in the literature search is available from the authors.

Cross-study results indicated that alternative care models for acutely ill nursing home residents have the potential to avoid and/or reduce health risks and reduce costs at the same time. No health economic study has so far explored hospital transfers of acutely ill nursing home residents in Germany.

Study objective

Against this background, two aims were pursued in particular:

- first, to extrapolate potential cost effects with regard to the care of nursing home residents with respiratory infection/pneumonia for Germany via data provided by major health insurance funds;

- second, to develop cost scenarios to compare costs induced by referring nursing home residents to the hospital for treatment with costs of care in the nursing home.

MATERIAL AND METHODS

Extrapolation of overall macro-economic costs

Cost effects for the care of elderly patients with respiratory infection/pneumonia incurred in the nursing home vs. in the hospital were analysed on the basis of a secondary data collection.

Data base: Data provided by two major German health insurance funds (AOK, Barmer GEK) including details of discharge diagnosis and German-DRG calculation as well as admissions for 2013 formed the basis. Data sets covered more than 63% of recipients of inpatient benefits under statutory nursing insurance in 2013 (total: 740.396).

Data analysis: In a first step, hospital transfers from the nursing home for 2013 were determined by aggregation of data from sickness and nursing funds. For this purpose, recipients of inpatient nursing services in 2013 were identified via data set from the nursing fund, and integrated with a corresponding data set from the sickness fund on hospital transfers with pneumonia as the main diagnosis (ICD-10-Code J18* or J69*) in combination with specific German-DRG billing codes (E77F, E77G, E77I, E42Z) for the year 2013. We selected all hospital cases with pneumonia as the main diagnosis in 2013 who were discharged by 30 June 2014. Subsequently this number of cases was linearly extrapolated to the entire system of statutory insurance funds in proportion to the number of recipients of inpatient care. The analysed DRGs were then weighted, and expenditures were calculated via the respective German-DRG case values (basic rate 2013 without surcharge).

Comparative estimate of two care scenarios

The following approach was chosen in view of the second research objective:

Study design: Costs were estimated via a descriptive comparative cost analysis.

Process design: In a first step, processes of care in the nursing home and in the hospital respectively were sketched on the basis of the literature (Hoffken et al. 2009). For this purpose, a sample nursing home resident was chosen (see fig. 2). Assumptions made for the course of the disease and changes in condition as well as the

medical/organizational extra activities involved were specified via review of records and expert opinion obtained in cooperating nursing homes. Building on this, care processes were synthetically modelled and schematically depicted (see fig. 3) (Kobelt 2005). Changes in condition were categorised as limitations of functional independence requiring additional care activities, and associated with care-giving periods.

Care scenarios: The idea was to depict particularly frequent care patterns with a high level of plausibility for the care of the chosen indication in the nursing home and the hospital respectively, instead of a best/worst care scenario. Respiratory problems were defined as the basic framework condition.

- The assumption for *scenario 1* was that the nursing staff identifies symptoms of deterioration in the patient's overall condition early and interprets them correctly. Consultation of the primary care physician and evidence-based medical and nursing care serve to avoid hospitalisation.

- The assumption for *scenario 2* was that symptoms are recognised late (on day three). Hospitalisation cannot be avoided. Another assumption was that the patient, discharged from the hospital after one week, suffers a complication (urinary infection) requiring extra care activities in the nursing home.

Target parameters: Direct expenses for care and the patient's condition at the hospital and the nursing home respectively were chosen as key target parameters.

- Costs

For the purpose of cost analysis, each care activity in the modelled patterns was associated with general cost categories for transport, medication, medical attendance etc. Efforts and expenses for extra general care and treatment care were determined in addition. Communication requirements were registered in three categories (internal, with relatives, in support of medical care). Table 1 shows a summary of costs and data sources to document the estimated use of resources for the two selected care scenarios in German facilities. Per-case fees of the German DRG catalogue and nursing home fee rates were used to determine the costs for the care scenarios. Costs were evaluated from the perspective of sickness and nursing insurers as cost bearers and also from the perspective of the nursing home as service provider. The purpose of this dual perspective was to illustrate the differences in cost schedules and the conflicting goals of social insurance agencies and nursing home operators (Krauth 2010).

- Patient condition

Care patterns were standardised and visualised via Barthel Index. This assessment tool is used as a standard in German rehabilitation and geriatric care to ascertain the level of independence or care need and changes in condition in terms of daily activities and functions (German Federal Association of Clinical Geriatric Facilities 2004). A score system indicates for which activities a nursing home resident requires assistance [for this approach cf. (Murcia et al. 2010)]. Table 2 shows the initial situation assumed for the sample patient. The forms/characteristics and variations of the index were associated with nursing periods and minutes, in order to calculate and estimate cost developments for additional care activities in minutes[2], for medication etc.

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2   Including:
 -    treatment and documentation activities (measuring blood pressure and body temperature, administering medication (orally/subcutaneous injection), observing respiration, monitoring liquid intake and blood sugar level, respiratory support),
 -    supportive basic care activities (assistance in eating and drinking, taking a shower/bath, washing, dressing and undressing, incontinence care, use of toilet, mobility) and
 -    communicative activities (communication internal care/nursing home, accompanying doctor's visits, communication with family/care-givers).

Quality control: An interdisciplinary panel of experts (project advisory board and nursing team) validated the modelled process stages and assumptions regarding changes in care processes in terms of content and sequence. The panel also checked the (additional) periods of care assigned to the process steps for plausibility.

Ethics committee: The ethics committee of Witten/Herdecke University (chair: Prof. Dr. Petra Thürmann, managing director: Prof. Dr. Peter Gaidzik) assessed the study protocol and approved the research project in June 2013 (proposal number: 41/2013).

RESULTS

Extrapolation of overall macro-economic costs

Incidence: 8 out of 100 recipients of full inpatient nursing care were admitted to hospitals with respiratory infection/pneumonia for inpatient care in 2013 (see Table 3).

Linear projection: 38,044 cases of hospital admissions from nursing homes for respiratory infection/pneumonia were identified as intersection of data sets. In relation to the 740,396 inpatient beneficiaries of statutory nursing care insurance in 2013, the projected figure for the whole of Germany for cases with respiratory infection/pneumonia as the main diagnosis was 54,345 (see Table 4).

Estimated total expenses: The total expenditure for nursing home residents in need of inpatient care who were admitted to hospitals and treated for respiratory infection/pneumonia was found to be *€ 163.3 million* in 2013 (see Table 5).

Comparative estimates for two care scenarios

Additional care requirements: Additional care requirements of 3,055 minutes were determined for scenario 1. 795 minutes are required for extra treatment care, 1,625 minutes for extra activities of general care, and 635 minutes for additional communication. Scenario 2 was found to involve additional care requirements of 3,840 minutes; of these, 925 minutes are for extra treatment care, 1,935 minutes for extra activities of general care, and 980 minutes for additional communication (see fig. 4).

Estimated care costs according to cost bearer: Scenario 1 involves additional costs for nursing home operators to the amount of € 1,077, and € 160 for the statutory health insurance fund. In scenario 2, costs for the nursing home operator increase to € 1,443, and for the statutory health insurer to € 3,302.

Patient condition: The Barthel Index drops from 75 points to 55 points minimum for a short period in scenario 1, whereas in scenario 2 it drops from 75 points to 35 maximum and remains at that level for a longer period (see fig. 5).

DISCUSSION

Overall economic relevance

The first aim of the study was to analyse the macro-economic costs incurred as a consequence of the hospitalisation of nursing home residents with respiratory infection/pneumonia via extrapolation of data provided by health insurance funds. A projection of total expenses by statutory health funds for hospital care of nursing home residents with diagnosed pneumonia alone with an approximate volume of € 163 million in 2013 clearly indicates the macro-economic relevance of avoiding hospital transfers from nursing homes, and also the high savings potential involved. The dimension for the national economy becomes clear when one considers that pneumonia accounts for only approximately 5% of the total number of admissions of nursing home residents to the hospital. At the same time it is important to note that the extrapolation does not allow any conclusion on whether hospitalisation of specific patients may be avoided or not.

Costs for care and patient condition

The second aim was a comparative estimation of costs incurred in two alternative scenarios for the care of nursing home residents with respiratory infection/pneumonia in consideration of health outcomes.

An analysis of the chosen scenarios reveals that hospital care for the sample indication under consideration involves considerable additional costs compared to nursing home care. Scenario 1 with the patient remaining in the nursing home offers a high cost savings potential to insurance funds as cost bearers. In this scenario the nursing home operator also appears to benefit from keeping the patient in the home since this requires less additional effort and expense. A marginal analysis (without offsetting) does not reveal any saving potentials for hospitalisation.

An examination of the two alternative care models shows a clearly improved recovery process if the disease condition is recognised early. Scenario 2 involves a notable increase in care requirements due to respiratory infection and complications after return to the nursing home (see fig. 4). An additional effect of high relevance to dementia patients in particular is that scenario 1 does not require patients to leave their familiar environment and care givers. Finally it should be noted that residents treated in the nursing home are less likely to develop subsequent complications such as urinary infection, medication problems etc.

Apart from lower costs, treatment in the nursing home for the sample indication of respiratory infection/ pneumonia also presents a better progress in changes of patient condition. The Barthel Index shows a quick recovery of the patient in case of early treatment in the nursing home. For diagnosis and treatment at a later time and hospitalisation as a consequence, the Barthel Index shows a clearly poorer progress and slower recovery (see fig. 5). In the final analysis, process modelling of treatment alternatives revealed that in avoiding hospitalisation (scenario 1) it is possible to reduce the duration and severity of illness as measured via Barthel Index, and in addition to reduce expenditure for the cost carriers considerably.

Economic incentive structures and organizational courses of action

Steps to be taken in order to avoid hospitalisation and thus save costs are sensitisation, knowledge transfer, coordination at the point of care and for health policy an examination of economic incentive structures in the treatment of acutely ill patients in nursing homes. The standards-compliant treatment of respiratory/infection with suspected pneumonia in the nursing home is basically possible; however, nursing homes receive no separate remuneration for extra nursing and coordination efforts due to acute illness. Also, the current remuneration scheme does not provide for organisational costs and challenges facing the operators of nursing homes. Examples are the necessary reorganisation of shift schedules, payment and handling of overtime, or strain on staff resulting from overtime. In both scenarios, acute illness of the sample resident requires considerable additional care service without additional remuneration. If the nursing home could use the hospitalisation of residents to reduce overtime, to ease the burden on staff or to save costs, the hospitalisation of acutely ill residents would involve not only less organisational effort but also the expectation of cost savings for the nursing home operator.

Looking at the physician care for acutely ill nursing home residents, it has to be stated that access to outpatient physician care is limited outside consultation hours, and frequently uneconomical for the physician.

With a view to the future treatment of acutely ill nursing home residents, the following courses of action need to be addressed in particular:

- A first aim must be to improve outpatient physician care in terms of access and quality. This applies in particular to alternative remuneration schemes for house calls in the nursing home, e.g. via integrated care contracts.
- Alternative remuneration schemes are required which cover additional care services provided by the nursing home in case of acute illness.
- In addition, the level of qualification for nursing home staff needs to be raised, in particular for the identification and handling of changes in condition.
- Guidelines for nursing staff and documented patients' provisions will help to outline a structured course of action, easing the burden of decision making for nursing staff and making sure that patients' wishes are respected.

Apart from these systemic factors, it must be noted for the specific indication that an x-ray examination which is desirable in case of suspected pneumonia may involve substantial transport expenses and excessive waiting times, with dehydration and deterioration in the patient's overall condition as a consequence. The use of mobile x-ray equipment is one of the options that should be considered in view of the economic relevance.

Alternative care models for acutely ill nursing home residents have not been sufficiently researched in Germany to date but are of increasing importance in view of changing age structures. Against the background of about 1 million hospital transfers from nursing homes estimated on the basis of AOK data, of which only about 5% corresponded to the sample indication, an intervention study to reduce avoidable hospitalisation for acutely ill nursing home residents with a larger number of nursing homes promises valuable insights.

Limitations

Some methodological limitations must be noted which apply to extrapolation as well as process modelling and cost estimation.

Extrapolation: For the linear extrapolation of data provided by insurance funds, we assumed an evenly distributed and health fund-independent degree of morbidity among recipients of full-time inpatient care, and thus the same ICD (International Classification of Diseases) and DRG distribution as in the provided data sets. It is possible that the limitation to selected ICD/DRG combinations leads to an underestimation of total expenses for the system of statutory health insurance. It must further be noted that secondary diagnoses or longer hospital stays were not considered in the study, nor were nursing home residents with private health insurance included.

Process illustration/cost estimation: The presented care processes were generated synthetically via documentary analysis and feedback from experts. The modelling and validation of plausible care processes enable the visualization of treatment steps and facilitate the attribution of economic data. A disadvantage of this approach is that the care processes are based on a set of assumptions concerning the development in patients' condition or the expertise on the part of nursing staff. Moreover, only selected cost categories for hospital stay, medication, aids and appliances etc. were used to estimate costs (see Table 1). Any facility-specific (extra) costs for overtime, training units etc. or direct non-medical costs were not included. The latter comprise e.g. costs for additional medical equipment (Krauth 2010). So called indirect costs were not taken into account, such as productivity loss due to work overload. Another aspect to note is that analysed resource consumptions may fluctuate over time and may vary between facilities due to specifics in their organisation.

Marginal analysis was used for cost estimation in this study. This means that in the case under consideration, only the additionally required care effort in the nursing home was analysed but not set off against a possible reduction in expenditure during hospitalisation. The assumption was that staff cannot be called off on short notice but works according to fixed working hours and deployment plans.

The Barthel Index which for the sample case illustrates changes in the patient's condition as well as developments and changes in additionally required care efforts and costs is subject to methodological limitations in itself. This concerns, for example, the fact that it does not focus on those dimensions of communication and cognition that are of relevance to daily life (Dewing 1992).

Despite these limitations, the study provides a valuable basis for future research. Starting from here, an interventional study to reduce hospitalisations from German nursing homes might be planned, including a larger number of nursing homes, and waiving the restriction to pneumonia, on the hypothesis that interventions in the process can reduce hospital referrals and cost as well as the severity and duration of acute illness of nursing home residents.

Conflict of interest

The authors declare that they have no conflict of interests.

Presentation

Selected results were presented at the 14th German Congress on Health Services Research in Berlin, Germany (Bohnet-Joschko et al. 2015).

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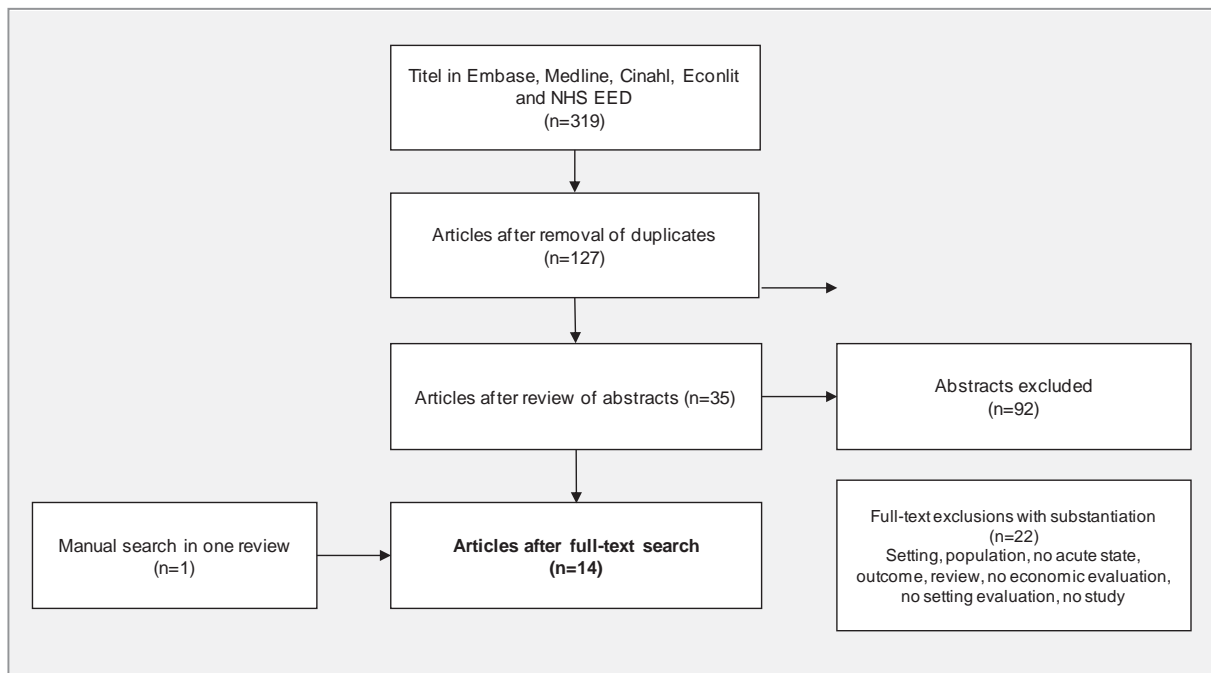
Fig. 1: Search strategy and result of literature search for original articles on strategies to reduce hospitalisation of acutely ill nursing home residents which also consider the economic perspective.

*Mrs. Theresa S. is **82 years** of age and a widow for the past 11 years.*

*She suffers from **coronary heart disease** and **diabetes mellitus**.*

*She shows no symptoms of dementia. She is classified in **care level II** and requires **assistance for the following functions: taking a shower, washing, incontinence control, toilet use and climbing stairs**. She moved to the nursing home three years ago. Her son lives in the south of Germany and visits her twice per year: around Christmas and for her birthday. He also visited her when she had a problematic hospital stay. Her sister is two years older and lives in another nursing home in the neighbouring city. No contacts to other relatives.*
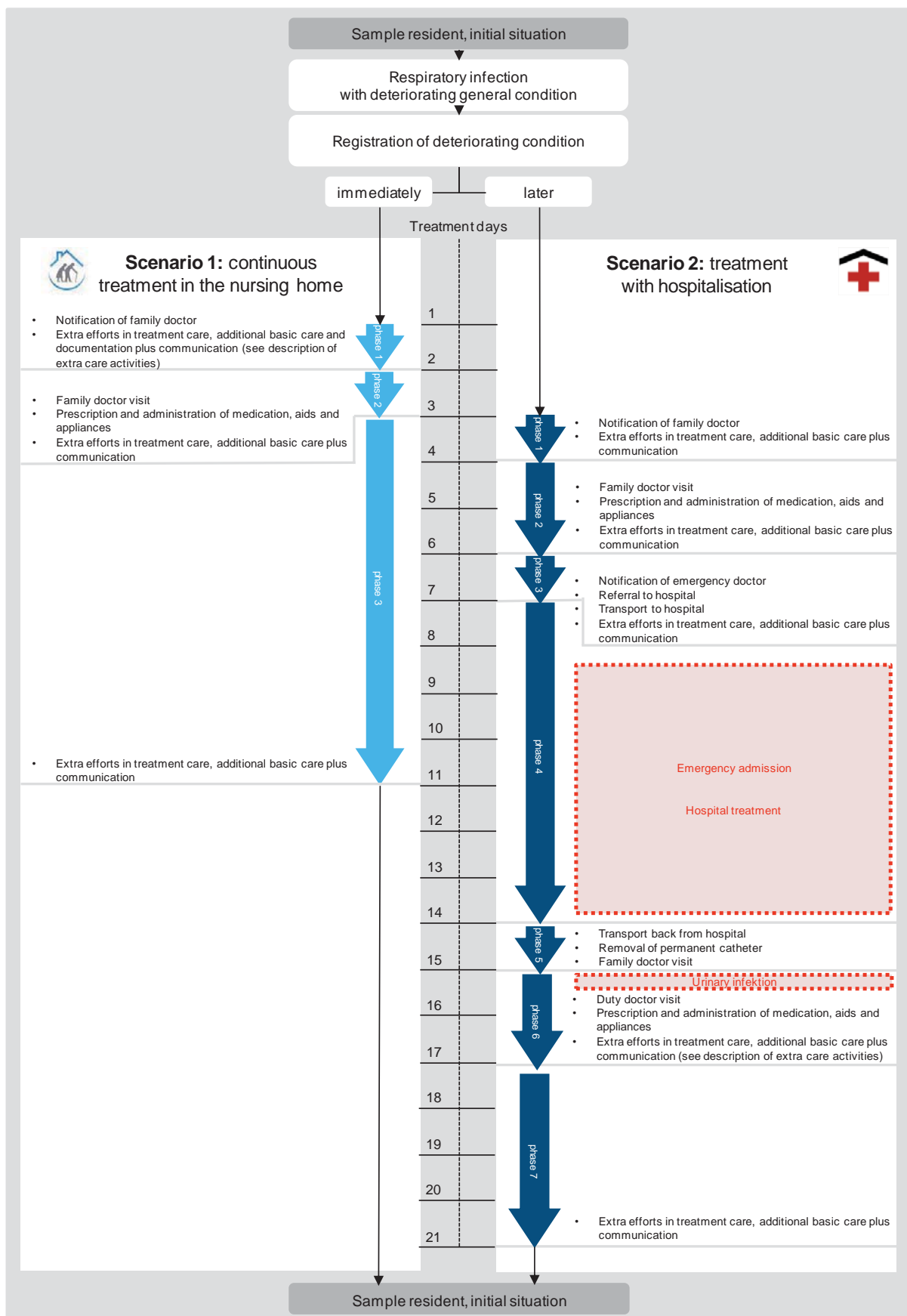
Fig. 2: Description of sample resident.

Fig. 3: Schematic representation of scenarios 1 and 2 for the treatment of the acutely ill sample resident with respiratory infection/pneumonia.
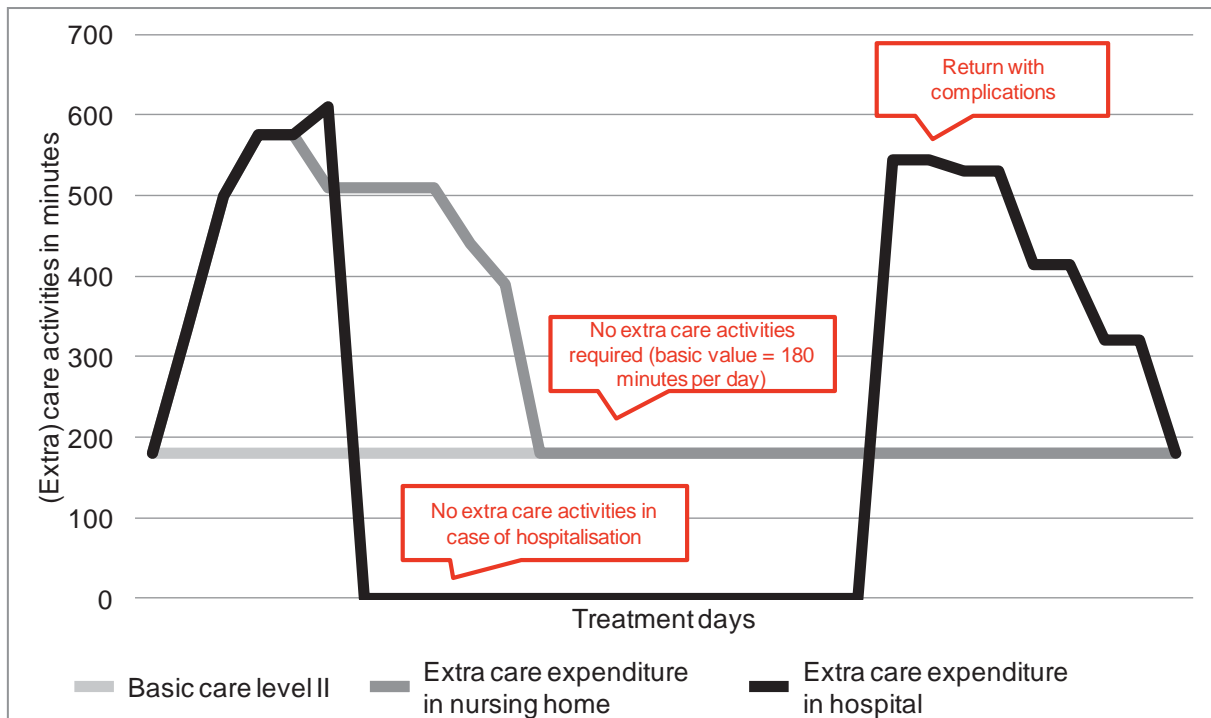
Fig. 4: Care expenditure according to scenarios over time. Initial situation (basic value) of average care expenditure per day with currently 180 minutes.
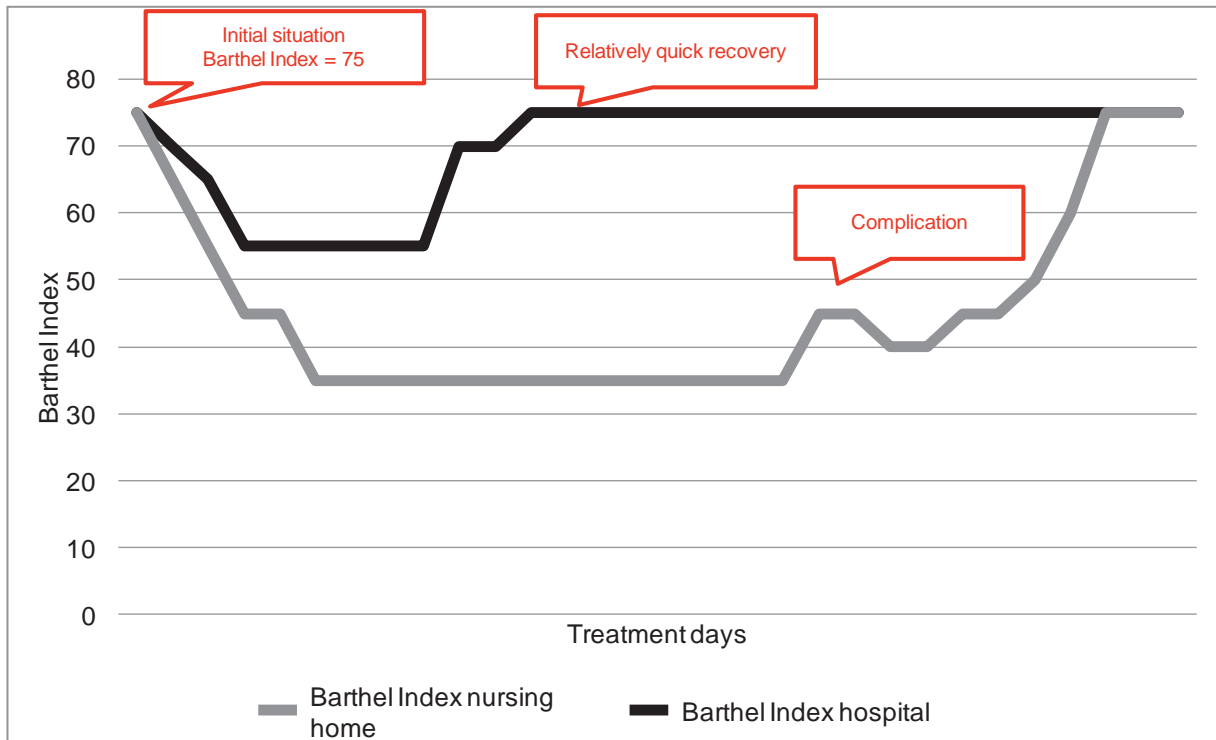
Fig. 5: Barthel Index trend according to scenarios.

Tab. 1: Considered cost categories and sources of resources.

Cost category	Scenario 1 Nursing home (in €)	Scenario 2 Hospital (in €)	Source of resources
Family doctor visit	21,22 per visit		German fee schedule for family doctors (uniform assessment standard) (2013)
Prescription and administration medication, aids, appliances	74,85 for seven days		Antibiotic Sultamicillin – costs for adolescents and adults (> 12 years) (German Association of Statutory Health Insurance Physicians 2013)
Hospital transport	-	126,00	Fee schedule of the Ennepe-Ruhr District in Germany (Ennepe-Ruhr District 2013)
Emergency doctor	-	472,00	
Income reduction nursing home due to hospitalisation (§87b SGB XI)	-	89,90	Home costs according to "Diakonie Germany Ruhr" – care level II (2013)
Equivalent labour costs for extra care services	1.076,89	1.542,25	Collective agreement AVR (German Caritas Association 2015)[*]
Hospital DRG (E77I)	-	2.236,84	National base rate (2013), Base cost weight

[*] Work contract guidelines (AVR) of the German Caritas Association, appendix 3, 2015b – wage group 5, level 3 (West Germany), including employer contribution.

Tab. 2: Initial situation for sample resident – Barthel Index single indicators and scores (German Federal Association of Clinical Geriatric Facilities 2004).

Functional capacity (Item)	Current state of sample resident (Max.)	Reason
Eating and drinking	10 (10)	No limitation
Taking a bath/shower	0 (5)	Takes bath/shower with assistance
Personal hygiene/washing	0 (5)	Has a wash with assistance
Dressing and undressing	10 (10)	autonomous
Bowel movement control	10 (10)	autonomous
Urinary control	5 (10)	Occasional incontinence
Use of toilet	5 (10)	Needs assistance
Transfer from bed to chair	15 (15)	autonomous
Mobility (autonomous walking/ use of wheel chair)	15 (15)	Moves autonomously
Climbing stairs	5 (10)	
Total (max. 100)	75	

Tab. 3: Description of the data set for extrapolation.

	Health Insurer 1 (AOK)	Health Insurer 2 (Barmer GEK)	Total
Insured persons in need of care	1.252.740	276.089	1.528.829
Persons in need of full-time inpatient care	381.519	86.184	467.703
Hospital transfers from the nursing home	515.552	116.461	632.013
of these: respiratory infection/pneumonia (J18*, J69*)	31.195	6.849	38.044
Incidence (sample indication /full-time inpatient hospital care)	8,18%	7,95%	**8,13%**

Tab. 4: Linear extrapolation of cases (primary diagnosis respiratory infection/pneumonia).

Considered DRGs	Data set	thereof AOK	thereof Barmer GEK	Extrapolation (2013)
E77F	15.751	14.302	1.449	24.951
E77G	401	265	136	666
E77I	17.155	12.700	4.455	27.173
E42Z	973	737	236	1.555
Total	34.280	28.004	6.276	**54.345**

Tab. 5: Estimation of expenditure based on DRG case values (Base rate 2013 without surcharge).

DRG	National base rate 2013 in €	Base cost weight	Base rate in €	x case number	Estimated total costs in €
E77F		1,166	3.577,72	24.951	89.267.677
E77G	3.068,37	0,901	2.764,60	666	1.841.225
E77I		0,729	2.236,84	27.173	60.781.700
E42Z		2,384	7.314,99	1.555	11.374.816
Total					**163.265.418**