

Hospital transfer of people with dementia: results of the European RightTimePlaceCare project on their frequency, factors associated and costs

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Keywords: Aged, Dementia, Geriatric syndrome, Home care, Hospitalisation, Nursing home

Posted Date: April 22nd, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-22961/v1>

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Version of Record: A version of this preprint was published on November 5th, 2020. See the published version at <https://doi.org/10.1186/s12877-020-01835-x>.

Abstract

Background

Hospitalisation is a critical moment for people with dementia and a major challenge for health care systems. The aims of this study were 1) to describe the frequency of hospital transfer among people with dementia from eight European countries, 2) to examine the factors associated with hospital transfer and 3) to evaluate the costs related with it.

Methods

The present study is a secondary data analysis of the *RightTimePlaceCare* European project. A cross-sectional survey was carried out with data collected from people with dementia who lived either at home or had been admitted to a nursing home in the last three months, as well as from their caregivers. Data on hospital transfers at three months were gathered with the "The Resource Utilization in Dementia" instrument. Demographic data, functional, cognitive and neuropsychiatric symptoms, comorbidity, polypharmacy, caregiver burden, nutritional status and falls were evaluated with validated tools. Multivariate regression models were used to investigate the factors associated with hospital transfers. Costs were estimated by multiplying quantities of resources used with the unit cost of each resource and inflated to the year 2018.

Results

The study sample comprised 1,700 people with dementia and their informal caregivers. Within three months, 16.7% experienced ≥ 1 hospital transfers. Multivariate logistic regression model showed a higher probability of hospital transfers among people with dementia with unintentional weight loss, polypharmacy, falls and those living in the community. The estimated costs per person with dementia/year among the participants living in a nursing home were 980.56 euros and 2,535.39 euros among those receiving home care.

Conclusion

Transfer to hospital is frequent among people with dementia, especially among those living in the community. These events are associated with the onset of geriatric syndromes such as involuntary weight loss, accidental falls and polypharmacy, and impose a remarkable economic burden. These results suggest that there is a need to develop and implement cost-effective supportive interventions that focus on the identification of people with dementia at risk of hospital transfer, the assessment and management of these geriatric syndromes and the promotion of individualised care planning for them, in order to prevent unnecessary hospital transfers.

Background

Dementia is a major cause of disability and dependency among older people worldwide and has a physical, psychological, social and economic impact on the persons affected, their families and caregivers, and the society. According to the World Health Organization (WHO), the number of people living with dementia worldwide is estimated to be at 47 million, rising to 75 million in 2030 and 132 million in 2050 (1).

People with dementia have increasing needs for care and supervision through the trajectory of the disease and, in advanced stages, the difficulties for these people to be cared for at home increase, with many of them needing to receive care in nursing homes (NH) (2). People with dementia represent a high percentage of the people living in nursing homes. Seitz *et al.* reported a prevalence of 58% worldwide over a 20-year period (3).

Studies carried out in community settings has shown that people with dementia are significantly more likely to be hospitalized (4,5) with a percentage between 60 and 70% (6), to have longer lengths of hospital stay (7), and higher health care costs (8) than people without cognitive disorders.

In the nursing home setting, research has shown that older adults living in these facilities, including those with dementia, are frequently transferred to hospital Emergency Departments (ED) for acute health crisis management. Up to 78% of the referred residents may experience an in-hospital stay (9). Reasons for hospital admission include infections, falls, coronary and gastrointestinal disease or feeding tube-related complications (10,11).

Thus, transfer to ED and hospitalisation appear to be common events for people with dementia both in the community and in nursing homes. However, there is a lack of studies that provide data on the frequency of ED transfers and hospitalisation among people with dementia both in the community and nursing home settings.

Despite the benefits of receiving specialized care, multiple negative health outcomes have been associated with the admission to hospital of frail older people, including fall-related injuries, nosocomial infections, pressure ulcers, delirium, functional decline and an elevated risk of mortality (12–14). The identification of factors associated with hospitalisation may help preventing unnecessary adverse events (15,16). However, only few studies have investigated which factors may be associated with hospital admissions among people with dementia. Higher comorbidity, older age, male sex, previous acute hospitalisation and shorter duration of dementia symptoms have been identified as factors associated with hospitalisation among people with dementia living in the community (6,17). These factors are less known among older people with dementia who live in nursing homes (16). In addition, there is a lack of studies comparing hospital or ED use of people with dementia living the community with those living in nursing homes (18).

Healthcare costs, including inpatient care, outpatient care and pharmaceutical costs represent a significant burden on the total costs of dementia care. Several reviews of cost-of-illness (COI) studies of dementia have been conducted in previous years (19–23) highlighting the heterogeneities and important limitations existing because of methodological differences(24). Although there is still no consensus on how to carry out these studies, different aspects such as disease severity, care setting and cost perspective, have been identified as main factors to be considered for future research (21,22,25).

Analysis of the costs associated with the hospital admission of people with dementia living in the community and in NH is a research area of interest, as the optimisation of resources or their refocusing towards targeted interventions in the area of home care or in nursing homes can lead to the prevention of unnecessary and costly events of hospital transfer (26).

Aim

The aims of the present study are: 1) to describe the frequency of hospital transfer (including emergency department and hospital admissions), among people with dementia from eight European countries living in the community or in nursing homes settings; 2) to examine the factors associated with hospital transfer; 3) to evaluate the costs associated with hospital transfer.

Methods

Design

This study is a secondary analysis of a large European research project called *'RightTimePlaceCare'* (RTPC). The RTPC survey was a longitudinal prospective study, conducted in eight European countries (Estonia, Finland, France, Germany, Netherlands, Spain, Sweden, and the United Kingdom). The project aimed to improve health and social care services for European citizens with dementia and focused on the transition from professional home care towards institutional nursing care. Further details are published elsewhere (27).

Participants

The RTPC survey comprised two groups of participants: 1) People with dementia newly admitted to NH (i.e. within one to three months after admission) and their informal caregivers; 2) People with dementia who received professional home care and were at risk of institutionalization (as judged by a professional responsible for their care) along with their informal caregivers.

Inclusion criteria for people with dementia were if they (1) had a primary diagnosis of dementia as diagnosed by an expert (e.g. physician, psychiatrist, neurologist, geriatrician, or general practitioner, depending on countries' diagnostic procedures); (2) scored 24 points or lower on the Standardized Mini Mental State Examination (S-MMSE) (28); and (3) had an informal caregiver who visited the people with dementia at least twice a month. People with dementia were excluded when they (1) were younger than

65 years; (2) had a primary psychiatric diagnosis or Korsakoff syndrome; and, for the group recently admitted to NH, (3) were only temporarily resident in the NH (e.g. rehabilitation, respite of the informal caregiver) with the intention of moving back home.

Procedures

Each country obtained ethical approval from a country specific legal authority for research on human beings (for example an ethical committee specialized in medical or nursing science) to conduct the study in accordance with their national standards and regulations. Country-specific consent procedures were followed.

Data were collected by trained interviewers at baseline between November 2010 and April 2012 and follow-up interviews were conducted after 3 months (27). All interviewers were professionals in health or social care or medical/nursing/social care students with practical experience and at least a Bachelor's degree. The interviews were conducted with informal caregivers as informants (usually spouses/partners or children), formal caregivers and the people with dementia (to assess cognitive impairment).

Measures

Sample characteristics

At baseline, information on the age, sex, country and living situation (i.e. home care (HC) vs nursing home (NH)) of the people with dementia was collected. Cognitive status was assessed with the S-MMSE (range 0–30), with higher scores indicating less cognitive impairment (28). The disease severity was defined as mild (S-MMSE > 21), moderate (10–21), or severe (< 10) (29). Missing values were considered when no valid S-MMSE value was available and were included in the severe dementia group. Medical history of past and current clinical conditions were recorded based on the Charlson Comorbidity Index (CCI) (range 0–37), with higher scores indicating more clinical conditions and a score > 2 indicating moderate comorbidity (30). Independence in activities of daily living (ADL) was measured by the Katz index (range 0–6); we categorised dependency as mild (Katz index 5–6), moderate (2–4), or severe (< 2) (31). Behavioural and psychiatric symptoms in dementia were evaluated with the Neuropsychiatric Inventory Questionnaire (NPI-Q). The NPI-Q comprises 12 domains: agitation and aggression, delusions, hallucinations, depression, euphoria, aberrant motor behavior, apathy, irritability, disinhibition, anxiety, sleep, and eating, with 2 scores reported for each domain: (1) presence of symptoms and (2) severity on a 0–3 scale (0 = none, 1 = mild, 2 = moderate, 3 = severe; range 0–36), with higher scores indicating more (severe) symptoms (32). Presence of depressive symptoms was assessed using the Cornell Scale for Depression in Dementia (CSDD) (33). A higher score (range 0–38) indicates greater depressive symptomatology.

Furthermore, several quality of care indicators based on recent literature (34) were assessed at baseline: nutritional status (one item question 'did the patient experience a weight loss of 4% or more of his/her weight in the past year?') (35), polypharmacy (≥ 5 drugs) (36) and the occurrence of falls during the preceding three months.

Finally, caregiver burden was measured using the Zarit Burden Interview (ZBI) (37) which consists of 22 self-reported items. Total scores range from 0–88, with a higher score indicating higher perceived burden; three severity groups were defined: little or no burden ($ZBI < 21$), mild burden ($ZBI \geq 21-40$), or moderate to severe burden ($ZBI > 40$) (38).

Information on hospital transfer

The Resource Utilization in Dementia (RUD) instrument was used to determine the health care resources used for people with dementia (39). The RUD instrument captures medical care resources use (e.g. medication, inpatient and outpatient care), community care services (e.g. home care, transportation, meals on wheels, day care), special accommodation (e.g. nursing home) and time spent with caring activities by informal caregivers. Information on hospital transfer since the baseline interview was gathered using an adapted version of the RUD instrument in the follow-up assessment that included the two concepts Hospital Admission (HA) and Emergency Department Admissions (EDA). With regard to HA, caregivers were asked: “since the last visit, was the person with dementia admitted to a hospital (for more than 24 hours)?”; “how many times was your relative/the resident hospitalised?”; “for each hospitalisation, please provide the diagnosis or reasons for hospitalisation”; “for each hospitalisation, please specify the total number of nights spent in each type of ward”. The following types of ward were asked about: geriatric ward, surgery ward, internal medicine ward, psychiatry ward and other hospital stays. With regard to EDA, caregivers were asked: “Since the last visit, did the person with dementia receive care in an accident and emergency hospital department (for less than 24 hours)?”; and if yes, “how many times”? Participants with at least one episode of HA or EDA were considered to have experienced a hospital transfer.

Estimate of cost for hospital transfer

While the costs of dementia were previously measured from a societal perspective in the RTPC project (40–42), our study focused on the assessment of direct medical costs generated by EDA and HA and calculated as average costs per capita and year in Euros (€). In the absence of valid and comparable unit costs for all participating countries, a common price vector based mainly on Swedish sources was used for all countries (40,43). For HA, the length of stay in each medical department was taken into account in the measurement. In the case of fees not being available for daily stay in departments other than internal medicine, geriatrics or surgery it was decided to assume a cost per day similar to the daily expense in the department of geriatrics. In addition, we calculated the average costs per capita and year specifically among those people with dementia who had suffered ≥ 1 hospital transfer. All costs were inflated to the year 2018 and currency conversion adjustments based on 2018 exchange rates were made for the non-EURO countries. Cost components, unit costs, the international adjustment schemes and their sources are shown in Table 1 (43,44).

Table 1. Unit costs and international price adjustments (inflated to the year 2018)

	Estonia	Finland	France	Germany	Netherlands	Spain	Sweden	UK
International price adjustment								
Exchange rates; local currency / Euro	1.00	1.00	1.00	1.00	1.00	1.00	10.25	0.88
Medical Care (Inpatient care)								
Costs* per day hospital (geriatric)	92.63	330.09	332.12	302.51	285.28	167.61	353.10	262.07
Costs per day hospital (internal medicine)	101.81	362.80	365.04	332.49	313.54	185.09	388.09	288.03
Costs per day hospital (surgery)	149.67	533.30	536.59	488.75	460.90	272.07	570.47	423.39
Costs Emergency room visit	63.39	226.01	227.39	207.11	195.32	115.30	241.76	179.42

Organisation for Economic Co-operation and Development (OECD). Prices, purchasing power parities (PPP) and Exchange rates (45)

*Costs are expressed in Euros

Statistical Analyses

The characteristics of people with dementia and their informal caregivers as well as the HA and EDA episodes are described using means and standard deviations (SD) for continuous variables and percentages for discrete variables. The assessment of the hospital transfer rates was made taking into account the estimated annual ED transfers and HA episodes, respectively, in addition to the total number of people with dementia participating in the study.

Univariate analyses were used to evaluate the independent variables (CCI, S-MMSE, Katz Index, NPI-Q scores, ZBI, CSDD, weight loss, polypharmacy, falls and setting) potentially associated with the occurrence of a Hospital Transfer (at least one episode of HA or EDA) using Mann-Whitney's U test for continuous variables, Fisher's exact test for dichotomous variables and Chi-squared tests for categorical variables with more than two categories. Statistically significant factors from these analyses were included in a logistic regression model.

All analyses considered a significance level α of 0.05 (two-sided) and were conducted with IBM SPSS Statistics version 25 (IBM Corporation, Chicago, IL).

Results

Sample characteristics

The total RTPC sample at baseline comprised 2,014 dyads of people with dementia and their informal caregivers. For the present study, only participants with data available on EDA and HA were included. Thus, the study sample comprised 1,700 people with dementia and their informal caregivers (n = 1,054 (62%) from the HC setting and 646 (38%) from the NH setting).

The mean age of the study sample was 82.8 years (standard deviation (SD) 6.5), and 68.5% were women. The characteristics of the study participants are summarized in Table 2.

Table 2. Baseline characteristics of the study sample

Variables	Overall (n=1,700)
Setting	
Nursing home, n (%)	646 (38%)
Home care, n (%)	1,054 (62%)
Age (years), mean (SD)	82.8 (6.5)
Women, n (%)	1,165 (68.5%)
Charlson Comorbidity Index (range 0-37)*, median (IQR)	2 (2)
S- MMSE (range 0-30)*, median (IQR)	14 (10)
Missing values	258
Katz Index (range 0-6)*, median (IQR)	3 (4)
Missing values	13
Severity of neuropsychiatric symptoms (range 0-36)*, median (IQR)	7 (9)
Zarit Burden Interview (range 0-88)*, median (IQR)	27 (22.3)
Missing values	6
Cornell Scale (range 0-38)*, median (IQR)	6 (7)
Missing values	149
Weight loss ($\geq 4\%$, yes), n (%)	292 (17.7%)
Missing values	53
Polypharmacy (≥ 5 drugs, yes), n (%)	1,044 (61.4%)
Mean number of drugs (SD)	5.5 (3.1) [5]
Falls in preceding 3 months (baseline)	387 (22.8%)
Missing values	4
Country, n (%)	
United Kingdom	115 (6.8%)
Estonia	225 (13.2%)
Finland	268 (15.8%)

France	186 (10.9%)
Germany	190 (11.2%)
Netherlands	269 (15.8%)
Spain	240 (14.1%)
Sweden	207 (12.2%)

*Underlined scores are most favourable.

SD: Standard Deviation. IQR: Interquartile Range

Missing values declared when present.

Hospital transfer

Two-hundred and eighty-four of the people with dementia (16.7%) experienced at least one EDA (< 24 hours) or HA between the baseline and follow-up assessments. Out of the people with dementia experiencing at least one EDA and HA episode, the frequency of experiencing 2 or more episodes was 27.8% and 19.5%, respectively. We found an estimated HA rate per person with dementia/year of 0.45 and ED transfers rate per person with dementia/year of 0.55. Internal medicine was the department to which people with dementia were most frequently admitted and for a longer time period. Table 3 describes the frequencies of hospital transfer (EDA and HA) as well as, for HA, the frequencies of admission and the average length of stay in days in the different medical departments evaluated.

Table 3. Description of hospital transfer: Emergency Department Admissions (EDA) and Hospital Admission (HA)

Overall (n=1,700)	
PwD with at least 1 hospital transfer (EDA or 1 HA), n (%)*	284 (16.7%)
PwD with at least 1 EDA (with <24 hours stay), n (%)	171 (10.1%)
PwD with valid number of EDA**	158
PwD with 1 admission, n (%)	114 (72.2%)
PwD with 2 or more admissions, n (%)	44 (27.8%)
Total number of EDA episodes	236
PwD with at least 1 HA (with >24 hours stay), n (%)	193 (11.4%)
PwD with valid number of HA**	190
PwD with 1 admission, n (%)	153 (80.5%)
PwD with 2 or more admissions, n (%)	37 (19.5%)
Total number of HA	327
Department of HA, n (%)	
Geriatric	55 (28.5%)
Internal Medicine	61 (31.6%)
Surgical	30 (15.5%)
Other	58 (30.1%)
Length of stay during HA admission in days, mean (SD) [Median]	
Geriatric	11.8 (11.3) [8]
Internal Medicine	12.7 (11.7) [7.5]
Surgical	10.9 (13.2) [6]
Other	15.5 (23.3) [7]

Note: SD: Standard Deviation.

*: A PwD may have suffered both EDA and HA episodes.

** : Data on the number of EDA or HA available only for these participants.

Factors associated with hospital transfer

Table 4 (see Additional file 1: Table 4) contains the univariate analyses comparing the characteristics of people with dementia with and without at least one hospital transfer (HA or EDA). People with dementia with at least one hospital transfer compared to people who did not attend hospital were more frequently men, displayed more severe neuropsychiatric symptoms, presented more often polypharmacy, were more likely to suffer falls and weight loss, and had an informal caregiver who experienced a higher burden of care, especially in people living at home. By country, Germany and France recorded the highest percentage of referrals and Sweden the lowest.

The results of the multivariate logistic regression analysis are displayed in Table 5. The factors independently associated with hospital transfer were: a higher number of falls (OR 1.74, CI (1.28–2.37)), weight loss (OR 1.53, CI (1.08–2.15)), polypharmacy (OR 1.78, CI (1.28–2.48)) and living in the HC setting (OR 1.85, CI (1.33–2.58)). Furthermore, the analysis showed an approximately fourfold chance of hospital transfer in the United Kingdom, France and Germany compared to Sweden, the Netherlands or Estonia.

Table 5. Multivariate logistic regression analysis of factors associated with ≥ 1 hospital transfer

	Unadjusted OR [95%CI]	Adjusted OR [95%CI]
Setting, n (%)		
Nursing home	Reference	Reference
Home care	1.42 [1.08-1.87]	1.85 [1.33-2.58]
Age (years)*		
≤80 years	Reference	Reference
>80 years	1.18 [0.89-1.56]	1.20 [0.88-1.63]
Sex, n (%)		
Female	Reference	Reference
Male	1.35 [1.03-1.76]	1.24 [0.92-1.67]
Charlson Comorbidity Index		
≤2	Reference	Reference
>2	1.20 [0.91-1.56]	1.17 [0.85-1.59]
S-MMSE (sample range 0-24) score <10 or missing, n (%)		
Mild dementia	Reference	Reference
Moderate dementia	0.95 [0.66-1.36]	1.00 [0.67-1.48]
Severe dementia	1.14 [0.79; 1.64]	1.14 [0.74-1.76]
Katz Index (ADL, sample range 0-6), mean (SD)		
Severe	1.43 [0.94-2.17]	1.51 [0.92-2.49]
Moderate	1.07 [0.70-1.64]	1.18 [0.74-1.90]
Mild	Reference	Reference
NPI-Q Severity (behavior, sample range 0-30), mean (SD)	1.03 [1.01-1.05]	1.01 [0.98-1.03]
Zarit Burden Index sample range 0-88), mean (SD)		
Little or no burden	Reference	Reference
Mild burden	1.11 [0.82-1.51]	0.91 [0.64-1.28]
Moderate to severe burden	1.56 [1.12-2.18]	1.09 [0.72-1.64]

Weight loss, n (%)		
No	Reference	Reference
Yes	1.56 [1.14-2.13]	1.53 [1.08-2.15]
Polypharmacy (yes), n (%)		
No	Reference	Reference
Yes	2.11 [1.58-2.82]	1.78 [1.28-2.48]
Falls in preceding 3 months		
No	Reference	Reference
Yes	1.84 [1.39-2.43]	1.74 [1.28-2.37]
Country, n (%)		
United Kingdom	3.27 [1.69-6.32]	4.08 [2.00-8.30]
Estonia	1.27 [0.66-2.46]	1.72 [0.84-3.53]
Finland	2.82 [1.58-5.03]	3.34 [1.80-6.21]
France	3.89 [2.14-7.05]	4.50 [2.36-8.58]
Germany	4.10 [2.27-7.40]	4.52 [2.41-8.50]
Netherlands	1.20 [0.63-2.27]	1.46 [0.75-2.86]
Spain	2.17 [1.19-3.96]	2.77 [1.45-5.32]
Sweden	Reference	Reference

CI: Confidence Interval

*Age and Charlson, Katz and S-MMSE indexes were added to the model for adjustment purposes, despite not being statistically significant in the univariate analysis

Costs of hospital transfer

Table 6 shows the estimated health cost per person with dementia/year according to country and setting (NH vs HC). Overall, the estimated medical cost per person with dementia/year related to hospital transfer was 1,944.55 €, with 100.61 € per person with dementia/year estimated for EDA and 1,843.95 € per person with dementia/year estimated for HA. In all countries, we found higher expenses per person with dementia/year in both ED and HA visits for people with dementia living in the HC setting compared to

those living in the NH setting, except in the Netherlands, where a higher expenditure on hospitalisation of people with dementia living in NH was found, even if the global hospital transfer cost per person with dementia/year was lower with respect to the HC group.

Finally, the estimated annual medical costs generated by those people with dementia who suffered at least one EDA or HA were also evaluated according to the department of admission and country, with 270.62 € per person with dementia with EDA/year estimated, 4,103.02 € per person with dementia with HA/year estimated and 2,368.01 € per person with dementia with hospital transfer/year estimated. Table 7 shows the estimated annual medical cost of each person with dementia referred to the emergency department or hospital, according to the department of admission and country.

Table 6. Estimated average annual medical costs per person with dementia in the whole RTPC sample (n=1,700) *, **,***

Medical Care (Inpatient care)	Estonia n=225	Finland n=268	France n=186	Germany n=190	Netherlands n=269	Spain n=240	Sweden n=207	UK n=115	All countries n=1,700
Estimated n of people with dementia	48 (56)	124 (164)	56 (68)	84 (108)	72 (144)	136 (200)	36 (108)	76 (96)	632 (944)
with EDA episodes (estimated EDA episodes/year)									
Cost (NH)	6.34	65.16	129.94	125.52	52.59	54.26	12.56	130.49	66.47
Cost (HC)	20.98	190.02	72.28	109.24	137.32	119.02	178.53	167.46	121.53
Total cost of EDA	15.78	138.30	83.13	117.73	104.56	96.08	116.79	149.78	100.61
Estimated n of people with dementia	72 (816)	148 (2,656)	176 (1,832)	140 (1,072)	44 (204)	56 (1,012)	56 (1,308)	72 (1,000)	764 (9,900)
with HA episodes (estimated HA days/year)									
Cost (NH)	148.57	1,132.29	1,404.39	1,509.49	358.72	411.17	1,468.91	1,254.11	914.09
Cost (HC)	456.55	5,533.05	3,779.74	2,504.99	155.57	1,006.91	3,189.68	3,570.42	2,413.86
Total cost of HA	347.05	3,710.35	3,332.76	1,986.28	234.12	795.91	2,549.59	2,462.62	1,843.95
Estimated n of people with dementia	120	272	232	224	116	192	92	148	1,396
with hospital transfer episodes									
Cost (NH)	154.91	1,197.45	1,534.33	1,635.01	411.31	465.43	1,481.47	1,384.60	980.56
Cost (HC)	477.53	5,723.07	3,852.02	2,614.23	292.89	1,125.93	3,368.21	3,737.87	2,535.39
Total cost of hospital transfer	362.82	3,848.65	3,415.90	2,104.01	338.67	892.00	2,666.38	261.40	1,944.55

*All expenses refer to costs per person with dementia, according to setting and country

**Costs calculated including only people with dementia with data available on the number of EDA or HA

***All costs expressed in €.

EDA: Emergency Department Admissions; HA: Hospital Admissions

Table 7. Estimated average annual medical costs per person with dementia who suffered EDA and/or HA by country^{*,**}

Medical Care (Inpatient care)	Estonia n=92	Finland n=216	France n=192	Germany n=204	Netherlands n=104	Spain n=156	Sweden n=68	UK n=104	All Countries n= 1,136
Estimated n of people with dementia with ≥1 EDA (cost)	48 (73.96)	124 (298.92)	56 (276.12)	84 (266.28)	72 (390.64)	136 (169.56)	36 (671.56)	76 (226.64)	632 (270.62)
Estimated n of people with dementia with ≥1 HA (cost)									764 (4,103.02)
Geriatric Department (cost)	4 (2,778.90)	8 (4,809.88)	144 (3,542.61)	24 (2,470.50)	0 (0)	8 (4,860.69)	0 (0)	8 (1,834.49)	216 (3,559.18)
Internal Medicine Department (cost)	24 (627.83)	52 (5,330.37)	0 (0)	52 (3,222.60)	4 (1,567.70)	20 (2,480.21)	28 (11,642.70)	44 (1,911.47)	224 (4,133.02)
Surgery Department (cost)	4 (748.35)	36 (6,755.13)	8 (3,756.13)	32 (3,115.78)	4 (2,765.40)	8 (5,441.40)	8 (11,979.87)	8 (4,445.60)	108 (5,203.04)
Other Departments (cost)	40 (1,222.72)	32 (10,604.14)	24 (3,321.20)	32 (1,588.18)	36 (1,267.91)	20 (2,949.94)	20 (5,296.50)	12 (12,404.65)	216 (4,065.75)
Estimated n of people with dementia with ≥1 hospital transfer (cost)	120 (680.29)	272 (3,792.05)	232 (2,738.61)	224(1,784.65)	116 (785.37)	192 (1,115.00)	92 (5,999.35)	148 (2,029.90)	1,396 (2,368.01)

*Costs calculated including only people with dementia with data available on the number of EDA or HA; ** All costs expressed in €

EDA: Emergency Department Admissions; HA: Hospital Admissions.

Discussion

In this cross-sectional study, 1,700 people with dementia from eight European countries participating in the RTPC study were investigated. Within a time period of three months, 1 out of 6 people living with dementia were transferred to the hospital at least once, with an estimated rate of hospital admission per person with dementia/year of 0.45 and an estimated rate of emergency department admission per person with dementia/year of 0.55. Four factors were identified as being associated with a higher probability of

suffering at least one hospital transfer: living at home and receiving HC (versus living in NH), suffering weight loss, accidental falls and presenting polypharmacy.

A recently published systematic review on hospitalization rates among PwD people with dementia in the community found hospitalisation rates between 0.37 and 1.26 per person per year in high quality studies (i.e. with low risk of bias), and percentages of hospitalisation between 26% and 65% as reported in four studies with low risk of bias where participants were followed for one year (16). The estimated hospital transfer rate per person with dementia and year observed in our study is therefore within the previously published ranges.

People with dementia living at their homes had a higher risk of hospital transfer than those in the NH setting in the present study. This result could be explained because the people with dementia included in the HC subsample of the present study had to be identified as being at risk for nursing home admission and, therefore were likely to be a selected sample of persons with complex needs, while the people with dementia included in the NH setting had to be recently admitted to the NH. The caregivers of people with dementia who live at home may have had less support in managing health needs or higher levels of care burden (46), leading to a greater need for emergency service utilization and hospital transfer. Other reasons for lower hospital transfer needs in the nursing home setting compared with home care suggested in the literature are that, even if EDA rates at nursing home are high (13), some of these institutions may be equipped with specific care units for people with advanced dementia (47), have a wider availability to perform post-acute attention (48), receive specialized health support from geriatric (49) or end-of-life care more frequently, and they may have policies to prevent transferring those persons to hospital.

Sleeman et al. also found in a retrospective cohort study of 4,867 people with dementia, in their last year of life in England, that being in a nursing home was associated with a significantly lower number of ED visits (49). The authors argued that increasing bed capacity in NHs may have explained their results, as it may have played an important role in reducing pressure on emergency hospital care.

Conversely, other studies analyzing the impact of dementia on hospital and ED use among fee-for-service Medicare beneficiaries reported that people with dementia who lived in nursing homes were significantly more likely to visit the emergency department and be hospitalised than those who resided in their own homes (18). However, these studies included the general population of people with dementia living at home and thus their population was not comparable with the participants of the present study.

Our study evaluated geriatric syndromes as markers of vulnerability and complexity in people with dementia. Geriatric syndromes are known to predict an increased likelihood of hospitalization, affect quality of life (50), increase the use and cost of health care, and raise overall mortality among the general elderly population (51). In the present study, the presence of three geriatric syndromes (malnutrition, history of falls or polypharmacy) was associated with a higher risk of hospital transfer.

Unintentional weight loss has been found associated with increased morbidity and mortality among older adults (52), but the relationship between unintentional weight loss in people with dementia and the risk of hospitalization has been underreported. Conversely, falls are of great concern for people with dementia given their potentially higher number of visits to emergency departments and severe consequences, mainly hip fracture (53). Similarly, the concurrent use of multiple medications by an individual, has been found to be associated with several negative health outcomes including hospital admission (54,55).

Currently, evidence for effective interventions to reduce the risk of falls, to reduce polypharmacy and to improve nutrition is limited and requires further development (56–60). Nevertheless, the results of the present study suggest that the identification and management of these three geriatric syndromes might help preventing hospitalisation events among people with dementia. Furthermore, the promotion of an advanced and individualised care plan among people with dementia showing these geriatric syndromes may be particularly advisable.

In our study, a worse functional status according to the Katz Index was not found to be associated with a higher frequency of hospital transfer. In contrast, previous studies have documented a statistically significant association between an increased dependency on activities of daily living (ADL) and the risk of hospital admission (15,61,62). Furthermore, a lower MMSE and higher NPI scores were not associated with hospital transfer. Conversely, Albert et al. previously reported that advanced dementia was a significant risk factor for hospitalisation in contrast to people with mild or moderate dementia (7). Finally, higher comorbidity was not associated with a higher frequency of hospital transfer, consistent with previous reports (63), but with a different pattern than shown by Sheperd et al. in a recent meta-analysis, where multimorbidities were associated with hospitalisation with moderate confidence (16).

Although the comparison of hospital transfer between countries was not the aim of this study, the results showed some differences, with higher risk of hospital transfer among people with dementia living in United Kingdom, France and Germany. These differences may be explained by the different patterns of organization of health and social care or family support.

In the present study, we found an estimated expenditure per person/year attributable to hospital transfers of 1,944.55 €, with a higher estimated cost for people with dementia included in the HC group (2,535.39 €) compared to the NH group (980.56 €). Other costs related to health and social care (medications, informal and community care) have been evaluated in previous RTPC studies (40–42), highlighting that in most countries the main cost driver in the HC setting were the costs of informal care, followed by the community and medical care costs. In addition, it was noted that NH expenditure in each country was dominated by indirect (non-medical) costs generated by living in nursing homes (institutional care).

Contrary to our expectations and similar to other previous studies (21,64), the argument of rising medical costs resulting from living in NH was not confirmed in the RTPC sample. It was observed that medical costs associated with hospital admission (including EDA) were lower in the NH setting. Possible reasons for this have been argued before: this could be explained by the special characteristics of the participants

in the HC setting of the RTPC study, on one side, but on the other side this could also indicate different diagnostic or therapeutic approaches in the NH group of people. These results may suggest that living in a nursing home may be more cost effective in terms of hospital transfer for those people with dementia with similar characteristics to the participants of the RTPC study, especially if we consider that the nursing home admission is generally not associated with a deleterious impact on their quality of life (65), health or emotional status (66).

Added to the cost calculation, we calculated the average estimated annual expenditures specifically for the group of people with dementia who suffered EDA and/or HA, which were 270.62 € and 4,103 € per person with dementia/year, respectively. It is important to emphasize that no broader direct costs related to medical care are shown since costs generated by the use of outpatient clinics, medication or rehabilitation were not included in our study. Even so, the medical costs of our study are in accordance with previously published European data (40,67,68). In this way, the estimated cost of hospitalisation of 2,368 € per person with dementia/year identified in our study is close to previous findings.

Our results suggest that the identification of people with dementia who are at particular risk of suffering a hospital transfer may be of special interest, as they are those with higher estimated average annual expenditures related with hospital transfer. The provision of interventions aimed at preventing these events and an adequate care planning may be particularly cost-effective for this group of people with dementia.

The findings of our study should be interpreted considering its limitations. First, the time period investigated for each participant was limited to three months, which may not represent the entire population of people with dementia requiring hospital admission over the one-year period, taking into account seasonal fluctuations; however, the prospective character of the study may have facilitated the acquisition of reliable data. Furthermore, the RTPC country samples may not be representative of the general national population of people with dementia. Next, although we accounted for multiple variables that may affect the need for hospital admission, there may also be additional unmeasured confounding factors that influence the use of hospital care, for example, specific health support at the community or nursing home setting in each country or even at the local level. Finally, several years have passed between data compilation and secondary analysis. However, the amount of published data on this topic is still scarce, and we do not expect that important structural and process changes in the health and social care systems have occurred within this time period.

Conclusions

To the best of our knowledge, this is the first study that evaluates internationally (across Europe) the frequency of hospital transfers among people with dementia living in nursing homes and home care settings, and analyses the associated factors and costs. Within three months, 17% of the people with dementia suffered at least one episode of hospital or emergency department admission. People with dementia living in the community were more often transferred to hospital and health care costs due to

hospitalisation were higher, compared with those living in a nursing home. Also, people with dementia with unintentional weight loss, falls and polypharmacy were more frequently transferred to hospital, suggesting a need for supportive interventions that focus on the assessment and management of these geriatric syndromes and that promote individualised care planning for them. The analysis of the health costs associated with hospitalisation show a remarkable economic burden and supports the need to identify those people with dementia at special risk of hospital transfers.

Abbreviations

CCI

Charlson Comorbidity Index

COI

Cost-of-illness

CSDD

Cornell Scale for Depression in Dementia

EDA

Emergency Department Admission

€

Euros

EU

European Union

HA

Hospital Admission

IEA

International Epidemiological Association

KATZ

Katz Index of Independence in Activities in Daily Living

NH

Nursing Home

NPI-Q

Neuropsychiatric Inventory-Questionnaire

OECD

Organisation for Economic Co-operation and Development

OR

Odds Ratio

PPP

Purchasing Power Parities

RTPC

RightTimePlaceCare

RUD

Resource Utilization in Dementia

SD

Standard Deviation

S-MMSE

Standardized Mini-Mental State Examination

WHO

World Health Organization

ZBI

Zarit Burden Interview

Declarations

Ethics approval and consent to participate

The Good Epidemiological Practice guidelines recommended by the International Epidemiological Association (IEA 2007) and the Helsinki declaration are followed. This study was approved by the Ethical Committee of the Hospital Clinic, Barcelona, Spain (2010/6031); the Ethics Review Committee on Human Research of the University of Tartu (196/T-3) and the Ethical Committee of the Hospital District of South-West Finland (8/2010), Finland; the Comité de Protection des Personnes Sud-Ouest et Outre-Mer, Toulouse, France (09 202 07); the Nursing Science Ethical Committee at the University of Witten/Herdecke, Germany; the Medical Ethical Committee of the Academic Hospital Maastricht/Maastricht University, the Netherlands (MEC 10-5-044); the Regional Ethical Review Board in Lund, Sweden (2010/538); and the National Research Ethics Service, North West 5 Research Ethics Committee, the United Kingdom (11/NW/0003) (Verbeek et al., 2012). Participants were informed of the study purpose, and they were free to participate or withdraw from the study at any time. They were asked to sign the informed consent form.

Consent for publication

No identifying information on any individual's data is presented in this paper. All participants gave written informed consent.

Availability of data and materials

The datasets analysed during the current study are available from the RightTimePlaceCare (RTPC) consortium on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

The RightTimePlaceCare study is supported by a grant from the European Commission within the 7th Framework Program (project 242153).

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Anna Renom-Guiteras (ARG), F. Javier Afonso (JA) and Gabriele Meyer (GM) conceptualized the study and planned the statistical analyses. JA prepared the first draft of the manuscript, supported by ARG. All authors critically reviewed and approved the final manuscript.

Acknowledgements

We thank Robert Schmitz for his previous work analyzing transfer episodes among the participants of the RTPC study. We appreciate the collaboration of Georgina Ramírez Rodríguez, M.D. for her support at the cost estimations shown in the study.

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References

1. Prince M, Wimo A, Guerchet M, Ali G-C, Wu Y-T, Prina M. World Alzheimer Report 2015 The Global Impact of Dementia. 2015;1–82.

2. Caron CD, Ducharme F, Griffith J. Deciding on Institutionalization for a Relative with Dementia: The Most Difficult Decision for Caregivers. *Can J Aging / La Rev Can du Vieil*. 2006;25(2):193–205.
3. Seitz D, Purandare N, Conn D. Prevalence of psychiatric disorders among older adults in long-term care homes: A systematic review. *Int Psychogeriatrics*. 2010;22(7):1025–39.
4. Phelan EA, Borson S, Grothaus L, Balch S, Larson EB. Association of Incident Dementia With Hospitalizations. *JAMA*. 2012 Jan 11;307(2):165.
5. Feng Z, Coots L, Kaganova Y, Wiener J. Hospital and Emergency Department Use by People with Alzheimer’s Disease and Related Disorders. Office of Disability, Aging and Long-Term Care Policy. Office of the Assistant Secretary for Planning and Evaluation. U.S. Department of Health and Human Services. 2013.
6. Rudolph JL, Zanin NM, Jones RN, Marcantonio ER, Fong TG, Yang FM, et al. Hospitalization in community-dwelling persons with Alzheimer’s disease: Frequency and causes. *J Am Geriatr Soc*. 2010 Aug;58(8):1542–8.
7. Albert SM, Costa R, Merchant C, Small S, Jenders RA, Stem Gertrude YH, et al. Hospitalization and Alzheimer’s Disease: Results From a Community-Based Study. *J Gerontol Med Sci*. 1999 May 1;54(5):267–27.
8. Bynum JPW, Rabins P V., Weller W, Niefeld M, Anderson GF, Wu AW. The relationship between a dementia diagnosis, chronic illness, medicare expenditures, and hospital use. *Res Pract Alzheimers Dis*. 2005 Feb 1;10(2):160–4.
9. Vossius CE, Ydstebø AE, Testad I, Lurås H. Referrals from nursing home to hospital: Reasons, appropriateness and costs. *Scand J Public Health*. 2013;41(4):366–73.
10. Givens JL, Selby K, Goldfeld KS, Mitchell SL. Hospital transfers of nursing home residents with advanced dementia. Vol. 60, *J Am Geriatr Soc*. NIH Public Access; 2012. p. 905–9.
11. Gruneir A, Bell CM, Bronskill SE, Schull M, Anderson GM, Rochon PA. Frequency and pattern of emergency department visits by long-term care residents - A population-based study. *J Am Geriatr Soc*. 2010 Mar 1;58(3):510–7.
12. Dwyer R, Gabbe B, Stoelwinder JU, Lowthian J. A systematic review of outcomes following emergency transfer to hospital for residents of aged care facilities. *Age Ageing*. 2014 Nov 1;43(6):759–66.
13. Graverholt BB, Riise T, Jamtvedt G, Ranhoff AH, Krüger K, Nortvedt MW. Acute hospital admissions among nursing home residents: A population-based observational study. *BMC Health Serv Res*. 2011;11(126).
14. Pedone C, Ercolani S, Catani M, Maggio D, Ruggiero C, Quartesan R, et al. Elderly patients with cognitive impairment have a high risk for functional decline during hospitalization: The GIFA study. *Journals Gerontol - Ser A Biol Sci Med Sci*. 2005 Dec 1;60(12):1576–80.
15. Toot S, Devine M, Akporobaro A, Orrell M. Causes of Hospital Admission for People With Dementia: A Systematic Review and Meta-Analysis. Vol. 14, *J Am Med Dir Assoc*. 2013. p. 463–70.

16. Shepherd H, Livingston G, Chan J, Sommerlad A. Hospitalisation rates and predictors in people with dementia: A systematic review and meta-analysis. *BMC Med*. 2019 Jul 15;17(1).
17. Maxwell CJ, Amuah JE, Hogan DB, Cepoiu-Martin M, Gruneir A, Patten SB, et al. Elevated Hospitalization Risk of Assisted Living Residents With Dementia in Alberta, Canada. *J Am Med Dir Assoc*. 2015;16(7):568–77.
18. Feng Z, Coots LA, Kaganova Y, Wiener JM. Hospital and ed use among medicare beneficiaries with dementia varies by setting and proximity to death. *Health Aff*. 2014;33(4):683–90.
19. Wimo A, Ljunggren G, Winblad B. Costs of dementia and dementia care: A review. *Int J Geriatr Psychiatry*. 1997 Aug 1;12(8):841–56.
20. Quentin W, Riedel-Heller SG, Luppá M, Rudolph A, König HH. Cost-of-illness studies of dementia: A systematic review focusing on stage dependency of costs. Vol. 121, *Acta Psychiatrica Scandinavica*. John Wiley & Sons, Ltd (10.1111); 2010. p. 243–59.
21. Schaller S, Mauskopf J, Kriza C, Wahlster P, Kolominsky-Rabas PL. The main cost drivers in dementia: A systematic review. *Int J Geriatr Psychiatry*. 2015;30(2):111–29.
22. Gustavsson A, Jonsson L, Rapp T, Reynish E, Ousset PJ, Andrieu S, et al. Differences in resource use and costs of dementia care between European countries: Baseline data from the ICTUS study. *J Nutr Heal Aging*. 2010 Oct 8;14(8):648–54.
23. Jönsson L, Wimo A. The Cost of Dementia in Europe. *Pharmacoeconomics*. 2009 May;27(5):391–403.
24. Rapp T, Andrieu S, Molinier L, Grand A, Cantet C, Mullins CD, et al. Exploring the Relationship between Alzheimer’s Disease Severity and Longitudinal Costs. *Value Heal*. 2012 May;15(3):412–9.
25. Costa N, Derumeaux H, Rapp T, Garnault V, Ferlicq L, Gillette S, et al. Methodological considerations in cost of illness studies on Alzheimer disease. Vol. 2, *Health Economics Review*. BioMed Central; 2012. p. 1–12.
26. Hirschman KB, Hodgson NA. Evidence-Based Interventions for Transitions in Care for Individuals Living with Dementia. *Gerontologist* 2018 p. S129–40.
27. Verbeek H, Meyer G, Leino-Kilpi H, Zabalegui A, Hallberg IR, Saks K, et al. A European study investigating patterns of transition from home care towards institutional dementia care: The protocol of a RightTimePlaceCare study. *BMC Public Health*. 2012;12(1):68.
28. Molloy DW, Alemayehu E, Roberts R. Reliability of a standardized mini-mental state examination compared with the traditional mini-mental state examination. *Am J Psychiatry*. 1991 Jan 1;148(1):102–5.
29. Molloy DW, Standish TIM. A Guide to the Standardized Mini-Mental State Examination. *Int Psychogeriatrics*. 1997 Dec 10;9(S1):87–94.
30. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis*. 1987;40(5):373–83.

31. Katz S, Ford AB, Moskowitz RW, Jackson BA, Jaffe MW. The Index of ADL: A Standardized Measure of Biological and Psychosocial Function. *JAMA J Am Med Assoc.* 1963 Sep 21;185(12):914–9.
32. Kaufer DI, Cummings JL, Ketchel P, Smith V, MacMillan A, Shelley T, et al. Validation of the NPI-Q, a Brief Clinical Form of the Neuropsychiatric Inventory. *J Neuropsychiatry Clin Neurosci.* 2000;12(2):233–9.
33. Alexopoulos GS, Abrams RC, Young RC, Shamoian CA. Cornell scale for depression in dementia. *Biol Psychiatry.* 1988 Feb 1;23(3):271–84.
34. Du Moulin MFMT, van Haastregt JCM, Hamers JPH. Monitoring quality of care in nursing homes and making information available for the general public: State of the art. *Patient Educ Couns.* 2010 Mar 1;78(3):288–96.
35. Wallace JI, Schwartz RS, LaCroix AZ, Uhlmann RF, Pearlman RA. Involuntary Weight Loss in Older Outpatients: Incidence and Clinical Significance. *J Am Geriatr Soc.* 1995 Apr 1;43(4):329–37.
36. Masnoon N, Shakib S, Kalisch-Ellett L, Caughey GE. What is polypharmacy? A systematic review of definitions. *BMC Geriatr.* 2017;17(1):230.
37. Zarit SH, Reever KE, Bach-Peterson J. Relatives of the impaired elderly: Correlates of feelings of burden. *Gerontologist.* 1980 Dec 1;20(6):649–55.
38. Hebert R, Bravo G, Prévaille M. Reliability, Validity and Reference Values of the Zarit Burden Interview for Assessing Informal Caregivers of Community-Dwelling Older Persons with Dementia. *Can J Aging / La Rev Can du Vieil.* 2000 Jan 1;19:494–507.
39. Wimo A, Gustavsson A, Jonsson L, Winblad B, Hsu MA, Gannon B. Application of resource utilization in dementia (RUD) instrument in a global setting. *Alzheimer's Dement.* 2013 Jul 1;9(4):429-435.e17.
40. Wübker A, Zwakhalen SMG, Challis D, Suhonen R, Karlsson S, Zabalegui A, et al. Costs of care for people with dementia just before and after nursing home placement: primary data from eight European countries. *Eur J Heal Econ.* 2015;16(7):689–707.
41. Costa N, Wübker A, De Mauléon A, Zwakhalen SMG, Challis D, Leino-Kilpi H, et al. Costs of Care of Agitation Associated With Dementia in 8 European Countries: Results From the RightTimePlaceCare Study. *J Am Med Dir Assoc.* 2018;19(1):95.e1-95.e10.
42. Farré M, Haro JM, Kostov B, Alvira C, Risco E, Miguel S, et al. Direct and indirect costs and resource use in dementia care: A cross-sectional study in patients living at home. *Int J Nurs Stud.* 2016 Mar 1;55:39–49.
43. Jönsson L, Jönhagen ME, Kilander L, Soininen H, Hallikainen M, Waldemar G, et al. Determinants of costs of care for patients with Alzheimer's disease. *Int J Geriatr Psychiatry.* 2006 May 1;21(5):449–59.
44. Organisation for Economic Co-operation and Development. OECD [Internet]. 2019 [cited 2019 Jul 9]. Available from: <https://stats.oecd.org/Index.aspx?DataSetCode=PPPGBP>
45. OECD iLibrary | PPPs and exchange rates [Internet]. [cited 2020 Mar 28]. Available from: https://www.oecd-ilibrary.org/economics/data/aggregate-national-accounts/ppps-and-exchange-rates_data-00004-en

46. Maust DT, Kales HC, McCammon RJ, Blow FC, Leggett A, Langa KM. Distress Associated with Dementia-Related Psychosis and Agitation in Relation to Healthcare Utilization and Costs. *Am J Geriatr Psychiatry*. 2017 Oct;25(10):1074–82.
47. Cadigan RO, Grabowski DC, Givens JL, Mitchell SL. The quality of advanced dementia care in the nursing home: the role of special care units. *Med Care*. 2012 Oct;50(10):856–62.
48. Tyler DA, Feng Z, Leland NE, Gozalo P, Intrator O, Mor V. Trends in postacute care and staffing in US nursing homes, 2001-2010. *J Am Med Dir Assoc*. 2013 Nov;14(11):817–20.
49. Sleeman KE, Perera G, Stewart R, Higginson IJ. Predictors of emergency department attendance by people with dementia in their last year of life: Retrospective cohort study using linked clinical and administrative data. *Alzheimer's Dement*. 2018 Jan 1;14(1):20–7.
50. Yang Y, Lin M, Wang C, Lu F, Wu J, Cheng H, et al. Geriatric syndromes and quality of life in older adults with diabetes. *Geriatr Gerontol Int*. 2019 Jun 8;19(6):518–24.
51. Inouye SK, Studenski S, Tinetti ME, Kuchel GA. Geriatric syndromes: clinical, research, and policy implications of a core geriatric concept. *J Am Geriatr Soc*. 2007 May;55(5):780–91.
52. Ryan C, Bryant E, Eleazer P, Rhodes A, Guest K. Unintentional weight loss in long-term care: predictor of mortality in the elderly. *South Med J*. 1995 Jul;88(7):721–4.
53. Allan LM, Ballard CG, Rowan EN, Kenny RA. Incidence and prediction of falls in dementia: A prospective study in older people. *PLoS One*. 2009;4(5):e5521.
54. Kongkaew C, Hann M, Mandal J, Williams SD, Metcalfe D, Noyce PR, et al. Risk factors for hospital admissions associated with adverse drug events. *Pharmacotherapy*. 2013;33(8):827–37.
55. Kongkaew C, Noyce PR, Ashcroft DM. Hospital admissions associated with adverse drug reactions: A systematic review of prospective observational studies. *Ann Pharmacother*. 2008;42(7–8):1017–25.
56. Shafiee Hanjani L, Long D, Peel NM, Peeters G, Freeman CR, Hubbard RE. Interventions to Optimise Prescribing in Older People with Dementia: A Systematic Review. Vol. 36, *Drugs and Aging*. Springer International Publishing; 2019. p. 247–67.
57. Rankin A, Cadogan CA, Patterson SM, Kerse N, Cardwell CR, Bradley MC, et al. Interventions to improve the appropriate use of polypharmacy for older people. Vol. 2018, *Cochrane Database of Systematic Reviews*. John Wiley and Sons Ltd; 2018.
58. Alldred D, Kennedy M, Hughes C, Chen T, Miller P. Interventions to optimise prescribing for older people in care homes (Review). *Cochrane Database Syst Rev*. 2016;(2):68.
59. Booth V, Logan P, Harwood R, Hood V. Falls prevention interventions in older adults with cognitive impairment: A systematic review of reviews. *Int J Ther Rehabil*. 2015;22(6):289–96.
60. Abdelhamid A, Bunn D, Copley M, Cowap V, Dickinson A, Gray L, et al. Effectiveness of interventions to directly support food and drink intake in people with dementia: Systematic review and meta-analysis. *BMC Geriatr*. 2016 Jan 22;16(1):26.
61. Voisin T, Andrieu S, Cantet C, Vellas B. Predictive factors of hospitalizations in Alzheimer's disease: A two-year prospective study in 686 patients of the REAL.FR study. *J Nutr Heal Aging*. 2010 Apr

2;14(4):288–91.

62. Wiener JM, Feng Z, Coots LA, Ruby Johnson M. What is the effect of dementia on hospitalization and emergency department use in residential care facilities? Office of Disability, Aging and Long-Term Care Policy. Office of the Assistant Secretary for Planning and Evaluation. U.S. Department of Health and Human Services. 2014.
63. Sampson EL, Blanchard MR, Jones L, Tookman A, King M. Dementia in the acute hospital: Prospective cohort study of prevalence and mortality. *Br J Psychiatry*. 2009 Jul 2;195(1):61–6.
64. Daras LC, Feng Z, Wiener JM, Kaganova Y. Medicare expenditures associated with hospital and emergency department use among beneficiaries with dementia. *Inq (United States)*. 2017;54:1–9.
65. Beerens HC, Zwakhalen SMG, Verbeek H, Ruwaard D, Ambergen AW, Leino-Kilpi H, et al. Change in quality of life of people with dementia recently admitted to long-term care facilities. *J Adv Nurs*. 2015 Jun;71(6):1435–47.
66. Sury L, Burns K, Brodaty H. Moving in: adjustment of people living with dementia going into a nursing home and their families. *Int Psychogeriatrics*. 2013 Jun 21;25(6):867–76.
67. Michalowsky B, Flessa S, Eichler T, Hertel J, Dreier A, Zwingmann I, et al. Healthcare utilization and costs in primary care patients with dementia: baseline results of the DelpHi-trial. *Eur J Heal Econ*. 2018;19(1):87–102.
68. Beerli MS, Werner P, Adar Z, Davidson M, Noy S. Economic cost of Alzheimer disease in Israel. *Alzheimer Dis Assoc Disord*. 2002;16(2):73–80.

Additional Files

Additional file 1:

Table 4. Univariate analyses with the characteristics of people with dementia with or without ≥ 1 hospital transfer

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