Cogitare Enfermagem

ORIGINAL ARTICLE

Estimated cost of home care for people with Alzheimer's disease: microcusting analysis

HIGHLIGHTS

1. The complications of dementia require more inputs and professional time.
2. Long stay in home care is common in advanced dementia.
3. Nursing devotes more time and activities to home care.
4. Working time is decisive for raising costs.

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ABSTRACT

Objective: Estimate the cost of caring for elderly people with Alzheimer's disease in home care. **Methods:** A cross-sectional, retrospective cost analysis study by the *Time-Driven Activity-Based Costing* method, conducted with a sample of 34 patients treated in 2019 and 2020 by the public service of home care. **Results:** The average age was 83.7 years, with the female sex predominant. The average stay time was 112.2 days. The average cost of care per patient with Alzheimer's disease was estimated at R$4,795.20, of which 44.7% corresponded to the cost with professionals. **Conclusion:** The stay time defines the average cost per person with dementia in home care service because it requires more activities and time from professionals. Managing transitional care from the first signs can provide benefits and reduce costs for the healthcare system.

DESCRIPTORS: Aged; Alzheimer Disease; Costs and Cost Analysis; Home Nursing; Home Care Services.

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INTRODUCTION

Alzheimer's disease (AD) is a type of dementia that compromises a person's cognitive functions, resulting in abstract thinking, changes in memory, judgment, mood, emotions, and behavior. This results in severe impairment of autonomy and the performance of daily life tasks[1]. The World Health Organization estimates that AD is the most common cause of dementia (60% to 70%) in people over the age of 65 and is among the top ten causes of death worldwide [2-3].

The increased prevalence of the disease amid the phenomenon of population aging, causes economic repercussions in hospital and household. The degree of complexity of care increases with the progression of AD, highlighting qualified nursing care, home care and palliative care[4]. In more advanced stages, especially in the presence of comorbidities, the vulnerability associated with dependence is accentuated, raising the cost of treatment for the healthcare system compared to that of other diseases[5].

Home care (HC) is a modality that prioritizes health needs in the family environment[6]. In Brazil, it is classified in HC1, HC2 and HC3, according to the complexity of the clinical framework, frequency of visits, composition of the team and use of technology. HC1 is for stable patients; HC2 for acute or chronic cases that require frequent multi-professional follow-up; and HC3 for situations that require durable equipment and procedures of greater complexity [7-8].

International studies on the economic repercussions on the overall cost of health care for Alzheimer's disease have been conducted in different types of supply of services by the health system, mainly exploiting the health workforce in home care [4-5]. However, no cost study is identified with people admitted to HC services with Alzheimer's disease in the Brazilian care context.

It is assumed that the advanced stage of Alzheimer's disease requires longer stay time in the home care service (HCS), with reflections on the cost of the service. Thus, since it is the most prevalent case among the elderly people treated by Brazilian HC, it is essential to know the cost of the disease in this context to arouse interest in a better approach possible for the individual and for the healthcare system. Therefore, the aim of this study was to estimate the cost of the care of elderly people with Alzheimer's disease in home care.

METHOD

This is an observational, transversal and retrospective study, with a stratified random sample extracted from the elderly population treated in a public HCS in 2019 and 2020. Result from one of the protocols studied by the multicenter research "Cost-effectiveness in Home Care: analysis of the production of care guided by different protocols"[9], completed in 2022 after interruption imposed by the COVID-19 pandemic.

The data were collected using the Time-Driven Activity-Based Costing (TDABC)[10]. (Figure 1). This method proposes the analysis of the cost per microcusting from low to high, based on professional performance and time spent during the care process. In addition, it allows to show a picture close to the reality of the use of specific resources per patient, considering the complexity and variety of activities of the health service[10].

Figure 1. Fluxogram of application of the TDABC methodology in cost analysis of elderly with Alzheimer's disease attended by the Home Care Service in 2019 and 2020. Juiz de Fora, MG, Brazil, 2021

Source: The authors, based on Kaplan and Anderson[10].

The study was conducted in a HCS of Minas Gerais that receives financial subsidy and offers service according to the guidelines of the *Programa Melhor em Casa* (PMC - Better at Home Program) of the Unified Healthcare System[8]. It is based in the Municipal Pronto Socorro Hospital, enjoying maintenance of the infrastructure and logistics. Users have access to benefits from other programs existing in the municipality, prior to the implementation of HCS in the PMC molds, such as nutritional support programs, diapers supply, home oxygen and transportation of strawberries.

In 2019 and 2020, the HCS had 31 professionals distributed into five multi-professional home care teams and two support teams. The working regimes ranged from 40 hours (16 professionals), 30 hours (5 physiotherapists) to 20 hours a week (10 doctors). A team specialized in palliative care served the entire municipality, while the rest operated in urban areas. During the period, 673 patients were treated, of which 552 (82%) were elderly. Eligibility was assessed by a doctor or nurse, according to the criteria of the PMC manual for HC2 or HC3[8].

Due to the absence of microcusting cost studies in the proposed scenario, it was necessary to conduct a cost estimation pilot study in 2021 to calculate the minimum sample size.

With the standard deviation results (273,35), maximum error of estimation (30) and the total Alzheimer's population (67) obtained, the minimum sample of this study (34) was calculated using the following formula:

$$n = \frac{N \cdot \sigma 2 \cdot (Z\alpha/2)^2}{(N-1) \cdot E^2 + \sigma 2 \cdot (Z\alpha/2)^2}$$

Where: n: minimum size, N: population size, $Z\alpha/2$: value associated with confidence level (for 95% confidence level we have Zα/2 = 1.96), σ: population pattern deviation, E: maximum estimate error.

The source of demographic data, health profile, and quantitative inputs were the medical records; and, the computerized system of the HCS, using a collection instrument developed specifically for the study. The demographic variables available in the sources were gender and age. The health profile was described with the variables comorbidities, origin in the health care network, duration of stay in the HCS and clinical outcome.

The source for obtaining activities and salary values were professionals, applying a virtual questionnaire, elaborated with resources of Google Forms. The gross salary of the professionals, the routine activities inherent in the service and the time spent in each of them were calculated. The amount spent on materials, equipment and transportation for the years 2019 and 2020 came from administrative records/boards provided by the management of the HCS, containing the acquisition costs. Survey in these sources began in 2021, after release by health authorities, in the context of the COVID-19 pandemic. The monetary values were calculated and updated according to the current values at the time they were used for the survey, being expressed in Real, the official Brazilian currency.

The *Charlson* Comorbidity Index was used to classify the severity of health conditions according to comorbidities, adjusting by age [11].

The perspective of the study is that of the HCS, therefore, the costs of infrastructure and logistics, such as rental of real estate and telephony, that belong to the municipality were excluded.

Finally, the cost components were named as professional, transport, material, medicine, equipment used by the patient and the team.

Professional: doctors, nurses, nursing technicians, physiotherapists, psychologists, nutritionists and social workers. The unit value per minute of each professional is the average salary of the class divided by the number of hours worked per month and multiplied by the average time of each activity (home visit and indirect activities such as preparation of the visit and telemonitoring).

Equipment: patient: oxygen concentrator, vacuum cleaner, hospital bed, wheelchair and bath chair; staff: sphygmomanometer, stethoscope, oximeter and thermometer. A depreciation rate of 10% per year was established for all equipment[12]. The corresponding value was converted to daily unit for patient equipment and to minutes for team equipment, then multiplied by time of use. The total expenditure on equipment is the sum of the values assigned to the equipment of the staff and the patients.

Procedures: The procedures have type and quantity of material standardized by nursing. The sum of the material used, considering extra materials registered in the inventory, determine the value of the procedure. The cost of the procedure is the value found multiplied by the number of times it was performed.

Transport: The average value of fuel and car rental multiplied by the number of visits per patient was used.

Materials: the total value of materials per patient is the sum of the amount of consumable material used in the procedures, multiplied by the respective unit value. For analysis of the data were calculated: average of quantitative, value and percentage of total value.

Medicaments: the amount of each drug used in the patient was calculated and multiplied by the unit value, resulting in the value per medicine per patient. The expenditure on medicines was derived from the sum of these values and was analyzed with averages and percentages.

The total amount spent by each individual refers to the cost of admission until discharge, or care cycle, over the two-year period. The total value by cost components is the sum of the care cycles.

The data description employed measures of central trend and dispersion (mode, average and standard deviation) for continuous variables and simple and relative frequencies for the categorial variables.

Programs Microsoft Excel version 2403 and Statistical Package for Social Science (SPSS) version 15.0 were used for data organization and statistical analysis.

The research project was approved by the Ethics Committee in Research in Human Beings of the Federal University of Juiz de Fora. 3.420.695).

RESULTS

Of the 34 cases studied, 14 (41.2%) were referred to HCS after hospitalization, 26 (76.5%) were female and 23 (67.7%) were classified as HC3. The most frequent outcome was death 17 (50.0%). The average age was 83.7 (±11.9) and the average stay time was 112.2 (±98.8) days. The most common *Charlson Comorbidity Index score* was 6, which represents a severe level of health condition (score ≥ 5), indicating an estimated relative risk of death 8 times higher in the sample than in the non-comorbid population and representing a 10-year survival rate of 2.25%[11] (Table 1).

Some health conditions were identified in the sample, such as immobility syndrome in 22 (64.7%), wounds and other soft parts infections in 19 (55.9%), infections treated with intravenous antibiotic therapy in seven (20.6%) and acute or chronic respiratory diseases in five (14.7%) cases.

Table 1. Characterization of the sample of cases of Alzheimer's disease treated in the Home Care Service in 2019 and 2020. Juiz de Fora, MG, Brazil, 2021

Variables	n	%
Sex		
Female	26	76.5
Male	8	23.5
Procedure		
Hospital discharge	14	41.2
Spontaneous Demand	8	23.5
Basic Health Unit	10	29.4
Uninformed	2	5.9
Classification in HC		
Home Care2	11	32.4
Home Care 3	23	67.7
Outcome		
High Improved	8	23.5
Hospitalization	1	2.9
Migration Basic Care	8	23.5
Death	17	50.0
	Media	**Standard deviation**
Age	83.7	11.9
Permanence (days)	112.2	98.8
Gravity classification	**Mode**	**RR**
Charlson Comorbidity Index Score	6	9.23

Legend: RR: Estimated relative risk of death.
Source: The authors (2021).

In the cost component "equipment", the hospital bed was the equipment used for the longest time 37.7 days (DP±68.6) and represented 56.3% of the total cost. The oxygen concentrator was the second most representative in this component (25.5%) with an average use time of 20.2 days (DP ±76.3) (Table 2).

The traditional body and limb cure was the most frequent (145 - DP ± 652.70), representing 88.2% of the cost of procedures. Other procedures draw attention to the high cost, despite the low frequency, such as the change of ostomy catheter, nasoenteric tube and delayed vesical catheterization (Table 2).

Table 2. Average use of equipment, performed procedures and their average value and percentage of cost per patient in 2019 and 2020. Juiz de Fora, MG, Brazil, 2021

(continue)

Variables	Media (DP)	Average value (R$)	%
Patient Equipment	**In days**		
Hospital bed	37.7 (68.6)	233.04	56.1
Toilet chair	24. 6 (85.7)	27.75	6.7
Wheelchair	17.7 (52.8)	21.21	5.1
Vacuum	12.0 (70.0)	233.04	6.5
Oxygen concentrator	20.2 (76.3)	105.05	25.5
Total equipment	**112**	**414.16**	**100**

Table 2. Average use of equipment, performed procedures and their average value and percentage of cost per patient in 2019 and 2020. Juiz de Fora, MG, Brazil, 2021

(conclusion)

Variables	Media (DP)	Average value (R$)	%
Procedures	**Quantity**		
Assessment of vital signs	22.3 (28.9)	1.29	0.2
Application medication IM	0.6 (2.9)	1.15	0.1
Application medication IV	3.0 (6.0))	9.10	1.0
Aspiration airways	0.02 (0.2)	0.03	0.0
Vesical catheterization	0.8 (2.0))	18.65	2.2
Collection of exams	1.1 (1.59)	2.87	0.3
Clister	0.02 (0.17)	0.14	0.0
Curative gastrostomy	22.6 (50.80)	13.70	1.6
Traditional body healing	145 (652.70)	696.45	81.2
Traditional member curative	34.58 (94.39)	60.11	7.0
Electrocardiogram	0.1 (0.32)	0.48	0.1
Hypodermoclysis	0.1 (0.85)	1.24	0.1
Peripheral venous puncture	0.8 (1.51)	7.96	0.9
Withdrawal of points	0.02 (0.17)	0.06	0.0
Nasoenteric tube	0.3(0.62)	14.43	1.7
Capillary glucose test	0.4 (1.43)	0.57	0.1
Change of ostomy catheter	0.1 (0.28)	19.18	2.2
Debridement	0.7 (1.63)	11.56	1.3
Total procedures	**216.15 (5165.3)**	**857.66**	**100**
Special coverage for injuries (unit)			
Calcium alginate	8.5 (41.7)	118.59	25.4
Hydrocolloid plate	3.4 (15.23)	48.83	10.5
Hydrogel	2.9 (10.68)	43.24	9.3
Hydrogel with alginate	3.1 ((10.38)	67.94	14.6
Activated charcoal with silver	3.0 (10.38)	144.69	31.0
Collagenases	3.41 (12.39)	17.40	3.7
Film	5.0 (28.72)	14.50	3.1
.... Other*	0.9	11.51	2.5
Total coverage	**30,1**	**466,73**	**100**
Medicine			
Amikacin 250mg/ml amp 2 ml	0.4 (2.40)	0.30	0.8
Cefepime 1g v amp 10 ml	1.1 (3.88)	10.59	29.9
Ceftriaxone 1g v amp 10 ml	1.9 (4.59)	10.64	30.0
Ciprofloxacin 2 mg/ml v 200 ml	0.26 (1.24)	0.26	20.6
Clindamycin 150 mg/ml amp 4 ml	0.29 (1.71)	0.61	1.7
Gentamicin 4 mg/ml amp 2ml	0.09 (0.51)	0.07	0.2
Meropenem 500 mg v 10 ml	0.29 (1.71)	4.03	11.4
Metronidazole 500 mg/100 ml v	0.29 (1.55)	1.18	3.3
Other**	0.53	0.72	2.0
Total	**5,1**	**35,43**	**100**

Legend: v: vial; amp: ampoule; IM: intramuscular, IV: intravenous. * Silver sulfadiazine and collagenase with chloramphenicol. ** analgesic, anti-inflammatory, diuretic, antiemetic, hydroelectrolytic replacement.

Source: The authors (2021).

Of the 41 lesions found in patients, only one was not classified as pressure lesion. Nine types of special coverings were listed used in combination with the already mentioned curatives. Activated charcoal with silver, calcium alginate plate and hydrogel with alginate together represented an average value of R$ 331.22 (71.6% of the total cost of coverings). Calcium Alginate was the most used, followed by the Film. Among the 6 classes of medicines administered, the injectable antibiotics were the most frequent, with Ceftriaxone Sodium and Cefepime Hydrochloride standing out, representing the highest cost among the medications. (Table 2)

Nursing (technical and nurse) concentrated the largest number of visits and time of care, with an average of 36 visits and 2377.37 minutes per patient, corresponding to 18.5% of the cost with personnel. Doctors represented the same proportion of costs, with an average of 12.7 visits and 875 minutes per patient. During the COVID-19 pandemic, telemonitoring was used, mainly by nurses and doctors, with an average of 0.4 treatments per patient (Table 3).

All patients received nutritional support, with 21 (61.8%) on an enteral diet, two (5.9%) on an enteral diet and oral supplements and 11 (32.4%) on oral supplements only. Since the enteral and oral diets are not dispensed by the HCS, they were not counted as supplies. However, the time spent on assessments and guidelines on the diet was considered.

Table 3. Average home visits and telemonitoring, time spent per patient, average value per professional and respective percentage in 2019 and 2020. Juiz de Fora, MG, Brazil, 2021

Professional	Visits Average (±DP)	Telemonitoring Average (±DP)	Time (min) Average (±DP)	Cost In real (R$)	%
Nurse	10.4 (14.5)	0.4 (0.7)	780.4 (1372.6)	429.24	20.0
Tech. ENF.	25.6 (31.8)	0.4 (0.6)	1597.0 (2279.1)	431.08	20.1
Doctor	12.7 (18.9)	0.4 (0.8)	875.0 (1406.3)	857.15	40.0
Physiotherapist	5.5 (8.3)	0.1 (0.3)	340.7 (540.6)	163.40	7.6
Social W	1.4 (1.9)	0.2 (0.9)	100.8 (141.7)	37.23	1.7
Psychologist	2.0 (4.5)	0.03 (0.2)	159.5 (382.9)	66.99	3.1
Speech-language pathologist	3.3 (4.3)	0.1 (0.2)	248.2 (365.2)	79.33	3.7
Nutritionist	4.1 (4.4)	0.1 (0.4)	233.7 (260.2)	79.46	3.7
Total	27.12 (30.3)*	1.2 (1.7)	4335.3 (6316.0)	2143.81	100.0

Legend: Tech. ENF: Nursing Technician; Social W: Social Worker. *Average total number of displacements.
Source: the authors (2021).

Considering all cost components analyzed, it was estimated that the average main expenditure was with professionals R$ 2143.81 (44.7%). The expenses with materials R$ 1382.32 (28.8%), transport R$ 745.47 (15.5%) and equipment R$ 488.89 (10.2%) were similar and far from the cost with professionals. The cost percentage of medicines applied was little significant R$ 34.64 (0.7%) (Figure 2).

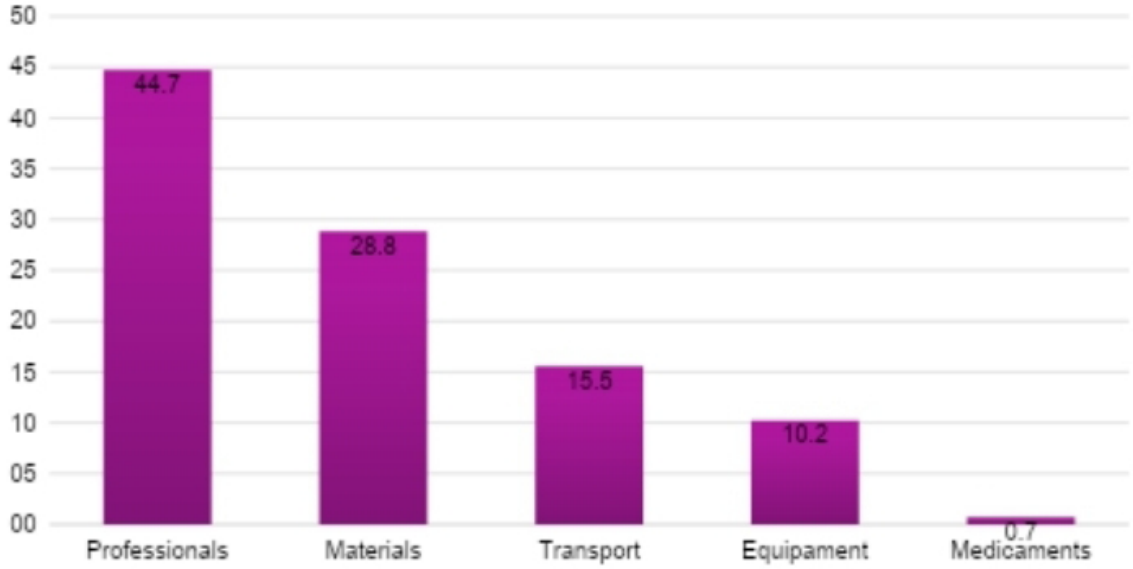

Figure 2. Value percentage of the cost components of the Alzheimer's disease sample in 2019 and 2020. Juiz de Fora, MG, Brazil, 2021

Source: The authors (2021).

The average cost of care for patients with Alzheimer's disease in the two years was R$4,795.20 (±8,412.18). Three patients in the sample accounted for 51.9% of the total expenditure with patients and, although they were disproportionate points in the set, were considered in the sample because they represented the share of patients with the most complex health framework and its impact on costs.

DISCUSSION

Women comprised 76.5% of the sample as found in national and global data that point out that about 65% of cases and deaths occur in the female population [3,13]. Women have longer longevity than men, however, for the elderly population in general care, information, maintenance of cognitive activities and control of risk factors are needed in an attempt to postpone the onset and worsening of Alzheimer's disease. In addition, it is often women who play the role of caregivers and this context can contribute to the increase of family and social costs[14].

Neves et al. (2019) identified that 30.43% of patients admitted to public HCS had a diagnosis of Alzheimer's disease, which significantly contributed to the extension of stay time, becoming a critical stagnation point in the Health Care Network. The average stay time in this sample was 112.2 (±98.8) days, aligned with the findings of other authors on extended stay in dementia frames [5,15-16].

The cascade of disorders triggered after the onset of dementia increases the risk of prolonged hospitalizations, hospital infections and other iatrogenic conditions[1,17-18]. In this sample, the hospital discharge represented 41.2% of the referrals to the HCS and corroborates the results of the authors mentioned. Due to the lack of specific support in the community, the user accesses the healthcare system through the hospital with some acute demand and is discharged in more complex clinical conditions that require specialized care and use of equipment. The predominance of HC3 classification (67.7%) in the sample is due to multimorbidities, which contribute to geriatric syndrome, related

to the high prevalence of immobility syndrome (64.7%) and its complications such as wounds, infections and respiratory diseases[15].

In a U.S. study, the age of patients with dementia such as Alzheimer's was equal to or greater than 75.5 years. In Brazil, the disease is most prevalent in the age group over 80 years, as found in this study (average of 83.7 years)[13]. The primary outcome was death (50.0%), consistent with the *Charlson* Comorbidity Index, which indicated that the patients had a higher estimated relative risk of death (9.23) and a survival rate of 2.25% (10 years), when compared to groups without aggravations[19].

In the cost component "equipment", the largest expenditure was on hospital bed and oxygen concentrator, possibly related to the time of use and the cost of purchasing the products. The type of equipment used and the high average number of days of use are indicative of physical dependence and the severity of the health condition observed in advanced stages of Alzheimer's disease [5-20-21].

In the study sample, 55.9% of patients had one or more pressure lesions associated with Alzheimer's disease and immobility syndrome. The high number of treatments reflected the cost of procedures, which represented 89.8% of this component. A study of profiles of patients treated in an Integral Injury Treatment Unit identified a statistical association between Alzheimer's disease and medical device-related injuries that demanded greater participation from professionals[22].

As for the treatment of injuries, the HCS offers special coverage, as assessed by nursing. The most used coverage was Calcium Alginate with a significant impact on the total cost of coverage. As for the cost component "medication", antibiotics were more used than analgesics and antiemetic drugs and had a greater effect on the total cost of medications administered. This result reaffirms the frequency of infectious complications associated with the disease in question [1,17-18].

Spending with professionals represented 44.7% of all spending in the care cycle. According to other authors, the greatest impact on the cost of care for the dementia patient is attributed to staff charges and salaries, especially of the nursing staff that provides qualified care [4–5,23].

The total amount per patient was R$4,795.20 (±8,412.19). The large variability of costs represents, in some ways, the diversity of clinical profile found and the repercussions on the activities of the HCS, as discussed earlier.

Alzheimer's disease has important social and economic repercussions. In 2015, the World Health Organization estimated that the costs of dementia corresponded to 1.1% of global GDP. In national studies, hospitalized patients with Alzheimer's disease had an average expenditure up to 60% higher than the others, with a growth trend of [4.24-25]. In this context, interprofessional home care modalities have been explored and disseminated to reduce institutionalizations, favor home care and generate savings, better quality of life results and reduction of hospital readmissions[5-6].

One limitation of the study was the regionalized sample that may not reflect the reality of all HCS. The organization and management of public HCS may vary depending on the local specificities of spending sharing within the Health Care Network. In addition, the time cut for the collection of retrospective data included the year 2020, during the COVID-19 pandemic. During this period, admissions and home visits of professionals were restricted and there was greater expenditure of personal protection inputs. The dementia condition may be underreported. Alzheimer's disease may appear as a

secondary condition or comorbidity in patients assessed with some primary condition of care for HC, represented by another code of the ICD-10.

CONCLUSION

In a two-year period, elderly people with Alzheimer's disease admitted to public HCS accumulated up to three other health conditions that demanded nutritional support, intravenous antibiotic therapy and rehabilitation for immobility syndrome. The time spent in service was a defining factor of the high expenditure, because it demanded more time for professional care. Spending on healthcare professionals was the largest cost component of the system.

These findings signal that, within the framework of the planning and management of public health policies for elderly people, more attention should be paid to the prevention of dementia-related multimorbidities. Transitional care between Health Care Network services, especially in the early stages of the disease, can contribute to the prevention of the worsening of Alzheimer's disease, reduce the cost of care and provide benefits to elderly people with dementia and their families.

Considering the importance of home care, dedicated care for the elderly and the cost of health services, this study provides an important contribution to the scientific field, which still needs substantial research in this area. It is also relevant to awaken managers and health policy planners to the need for better interaction between health network services for the management of care of elderly people with dementia.

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