Cost–Utility Analysis of a Pharmacotherapy Follow-Up for Elderly Nursing Home Residents in Spain

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OBJECTIVES: To compare the cost-effectiveness of a pharmacotherapy follow-up for elderly nursing home (NH) residents with that of usual care.

DESIGN: Prospective observational study with a concurrent control group conducted over 12 months.

SETTING: Fifteen NHs in Andalusia assigned to control (n = 6) or intervention (n = 9).

PARTICIPANTS: Residents aged 65 and older.

INTERVENTION: Pharmacotherapy follow-up.

MEASUREMENTS: Negative outcomes associated with medication, health-related quality of life, cost, quality-adjusted life-year (QALY), and incremental cost-effectiveness ratio (ICER). ICERs were estimated for three scenarios: unadjusted cost per QALY (first scenario), costs adjusted for baseline prescribed medication and QALYs adjusted for baseline utility score (second scenario), and costs and QALYs adjusted for a fuller set of baseline characteristics (third scenario).

RESULTS: Three hundred thirty-two elderly residents were enrolled: 122 in the control group and 210 in the intervention group. The general practitioner accepted 88.7% (274/309) of pharmacist recommendations. Pharmacist interventions reduced the average number of prescribed medication by 0.47 drugs ($P < .001$), whereas the average prescribed medication increased by 0.94 drugs in the control group ($P < .001$). Both groups reported a lower average EuroQol-5D utility score after 12 months (intervention, −0.0576, $P = .002$; control, −0.0999, $P = .003$). For the first scenario, usual care dominated pharmacotherapy follow-up (was less effective and more expensive). Adjusted ICERs were €3,899/QALY ($5,002/QALY) for the second scenario and €6,574/QALY ($8,433/QALY) for the third scenario. For a willingness to pay of €30,000/QALY ($38,487/QALY), the probabilities of the pharmacotherapy follow-up being cost-effective were 35% for the first scenario, 78% for the second, and 76% for the third.

CONCLUSION: Pharmacotherapy follow-up is considered cost-effective for elderly NH residents in Spain. **J Am Geriatr Soc 62:1272–1280, 2014.**

Key words: pharmacotherapy follow-up; nursing home; cost-utility analysis; quality-adjusted life-year; negative outcomes associated with medication

In 2011, there were 270,286 Spaniards living in nursing homes (NHs), with an average age of 83.7 and a female: male ratio of 2.18. This number has tripled over the last 10 years (96,338 people in 2001) and represents 3.3% of the total population aged 65 and older.[1] Because elderly NH residents tend to have many health problems and often take multiple medication,[2] inappropriate medication prescription in NHs is often a problem.[3–6]

Drug-related morbidity and mortality are often preventable, and pharmaceutical services can reduce the number of adverse drug reactions, length of hospital stays, and healthcare costs.[7] Moreover, drug-related morbidity and mortality in NHs is an important economic problem.[8]

A recent systematic review of interventions to optimize prescribing for older care homes residents concluded that the interventions led to the identification and resolution of drug-related problems, improvements in appropriateness of medication, and a reduction in drug costs, although there is no evidence of an intervention's effect on adverse drug events, hospital admissions, mortality, or quality of life.[9] Other systematic reviews have concluded that there is little information available about pharmacist interventions in NHs for the optimization of medication use.[10,11]

Few studies of pharmaceutical care programs for elderly adults have undertaken a rigorous economic evaluation, and a more-standardized approach to data collection is required.[12] This study compared the cost-effectiveness of

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a pharmacotherapy follow-up service for elderly NH residents with that of usual care.

METHODS

The study was designed as a prospective observational study with a concurrent control group conducted over 12 months (2008–09). The target population consisted of elderly NH residents in Andalusia, Spain. Participants were residents aged 65 and older who were cognitively intact and provided informed consent. Nonresident individuals in day care were excluded.

Three hundred sixty institutionalized elderly residents were contacted and asked to participate in the study. Fourteen did not meet inclusion criteria, and 14 declined to participate (Figure 1). Written informed consent was obtained from all participants before inclusion.

Pharmacotherapy Follow-Up

The Pharmaceutical Care Research Group at the University of Granada, Spain, developed the Dader Method of pharmacotherapy follow-up.[13] This method develops and evaluates a pharmacotherapeutic state based on correlating health problems and pharmacotherapy used to treat them. A pharmacist evaluates this pharmacotherapeutic state to determine whether the pharmacotherapeutic goals related to each health problem are being met. If not, any potential or real health outcomes not consistent with the pharmacotherapy objectives (negative outcomes associated with medication)[14] are detected before the pharmacist proceeds to the intervention stag. The intervention objective is to prevent, detect, and solve the negative outcomes associated with medication. The pharmacist interventions were conducted in collaboration with the resident and the general practitioner. The Dader Method was applied in this study in the following phases.

- Resident history review: Data related to medical problems and current pharmacotherapy were obtained from the participant's history.
- First interview: An interview was conducted to complete information about the participant's history.
- Situation state: From the information obtained in the interview and information contained in the participant's history, the pharmacist drew up the "situation state," a document about the participant's current health status and pharmacotherapy.
- Evaluation phase: This stage assessed whether the desired treatment goals were being achieved by evaluating the pharmacotherapy outcomes. International clinical practice guidelines that the clinical team adapted for the particular case of each participant suggested the therapeutic goals for the treatment of each health problem. For example, in the treatment of arterial hypertension without other health problems, the usual treatment goal is to keep blood pressure values below 140/90.
- Intervention phase: For participants found to have negative outcomes associated with medication, the pharmacist drew up a therapeutic plan including interventions to improve each negative outcome associated with medication. The pharmacist proposed an action plan with the participant and general practitioner.
- Successive interviews were conducted to assess situation states and register health problems or new prescribed medication and evaluate the result of the interventions.

Nursing Home

The study was performed in 15 NHs in Andalusia that were assigned to the intervention or control group. Intervention NHs were located in four provinces (one in Córdoba, two in Cádiz, three in Málaga, three in Granada) and control NHs in three provinces (one in Sevilla, one in Cádiz, four in Málaga). Nine NHs were

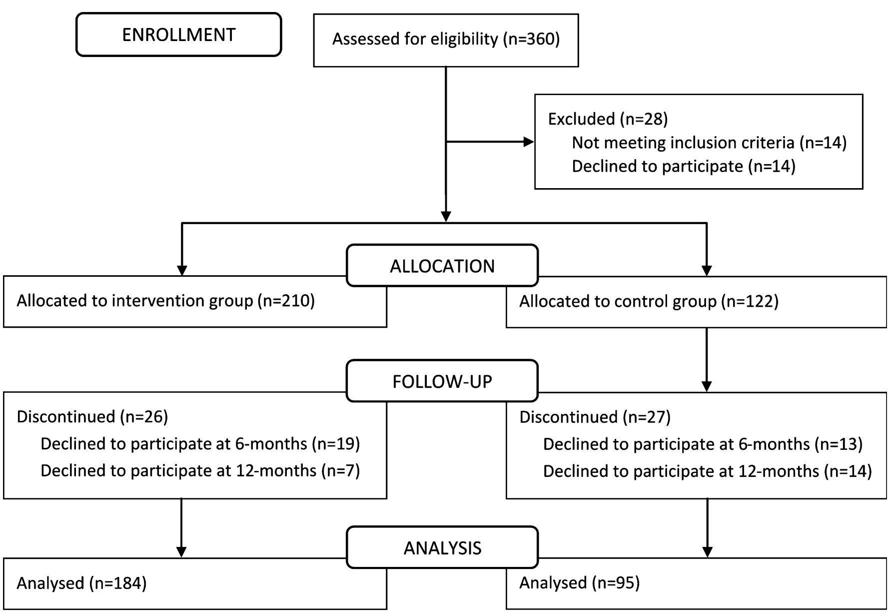

Figure 1. Enrollment, allocation, follow-up, and analysis of institutionalized elderly participants.

assigned to the intervention group if the pharmacist was willing to participate, and the pharmacists selected six NHs as an equivalent control group.

There were no significant differences between the NHs used in the study. They were privately owned, with their own nursing and medical staff, and none restricted access of elderly adults because of their degree of disability.

Control Group

The institutionalized elderly control group received usual care without pharmacist intervention. Health-related quality-of-life questionnaires were administered at baseline and 6 and 12 months. Information on prescribed medication was extracted from NH health information systems.

Negative Outcomes Associated with Medication

The main outcome of the pharmacist intervention was the identification and resolution of negative outcomes associated with medication. According to the Third Consensus of Granada,[14] the negative outcomes associated with medication are health-related outcomes not consistent with pharmacotherapy objectives and are associated with the erroneous use of medicines. Problems related to the medication use process were not recorded in this study (e.g., finding it hard to open a medication bottle).

Pharmacists gave advice about the correct use of medicines to NH residents to prevent or solve negative outcomes associated with medication. There are six kinds of negative outcomes associated (which can be related to necessity, effectiveness, or safety):

- Necessity (untreated health problems): People have a health problem as a consequence of not receiving the medicine they need.
- Necessity (effects from unnecessary medicines): People have a health problem as a consequence of receiving medicine they do not need.
- Effectiveness (nonquantitative ineffectiveness): People have a health problem as a consequence of nonquantitative ineffectiveness of the medication (i.e., not depending on the amount of drug).
- Effectiveness (quantitative ineffectiveness): People have a health problem as a consequence of a quantitative ineffectiveness of the medication (i.e., depending on the amount of drugs).
- Safety (nonquantitative safety problems): People have a health problem as a consequence of a nonquantitative safety problem with the medication (i.e., not depending on the amount of drugs).
- Safety (quantitative safety problems): people suffer from a health problem as a consequence of a quantitative safety problem with the medication (i.e., depending on the amount of drugs).

Health-Related Quality of Life

Health-related quality of life was measured using two questionnaires: the EuroQol-5D[15] and Nottingham Health Profile (NHP).[16,17] Both questionnaires were administered at baseline and 6 and 12 months.

The EuroQol-5D describes health condition using five dimensions (mobility, self-care, usual activities, pain and discomfort, anxiety and depression); each of these is defined using three levels of severity. Scores were used to estimate a utility score—a single index of health-related quality of life ranging from 1 to 0, with 1 being the best possible state of health and 0 being death, although there were also negative utility scores because some states of health are considered to be worse than death. A visual analogue scale was used to measure subject health status with scores of 0 being the worst and 100 the best health state.

The NHP consists of two parts that assess the individual's health condition. In this study, only 38 questions from the first part of this questionnaire were administered. These questions explore six health dimensions: energy, pain, physical mobility, emotional reactions, sleep, and social isolation. The scores are obtained by considering the percentage of affirmative responses (dividing the total positive responses in one dimension by the total number of items in that dimension and multiplying the figure by 100). In both cases, scores range from 0 to 100, with 0 indicating that the individual responded negatively to all the items in the dimension and does not have any health problems and 100 indicating that the person has all of the health problems.

Costs

The analysis took into account only direct costs, including costs for the pharmacist intervention and prescribed medication. Costs are presented in euro and U.S. dollars at 2013 prices (exchange rate on July 7, 2013: 1 euro = US $1.28).

The cost per hour of the pharmacist was obtained from official sources.[18] Each pharmacist recorded time spent conducting each phase, or time was estimated for a group of pharmacists.

- Time for first interview: recorded for each participant.
- Time for situation state and evaluation phase: 45 minutes was estimated per participant.
- Intervention phase: estimate based on the number of negative outcomes associated with medication and pharmacist interventions.
- Successive interviews: estimate based on the number of subsequent interviews in which the pharmacist recorded additional situation states.

The pharmacist recorded prescribed medication for the control group at baseline and 6- and 12-month follow-up. For the intervention group, the pharmacist also recorded prescribed medication after every intervention. Medication cost was obtained from the official drug price.[19]

Statistical Methodology

A cost–utility analysis was used to compare pharmacotherapy follow-up with the usual care. This study followed the recommendations of the proposed guidelines for economic evaluation of health technologies in Spain.[20] The effectiveness of the intervention was estimated as quality-adjusted life-years (QALYs). QALYs were calculated by using an area under the curve analysis, with linear interpolation of utility scores between baseline and 6 and 12 months of follow-up.[21] Deceased residents were assigned a EuroQol-5D utility score of 0 at 6 or 12 months. EuroQol-5D scores were missing for 32 participants at 6 months and for 31 at 12 months. These participants were excluded from the cost–utility analysis.

Cost and QALYs were estimated for each resident. Results of cost–utility analysis were expressed in terms of the incremental cost-effectiveness ratio (ICER), calculated by dividing the difference in total costs between the intervention and control groups by the difference in QALYs between both groups.[22] Participants were not selected randomly. To minimize this limitation, the base case ICERs were estimated for three scenarios.

- First scenario: unadjusted cost per QALY. Second scenario: costs adjusted for baseline drug use and QALYs adjusted for baseline utility score.
- Third scenario: costs and QALYs adjusted for a fuller set of baseline characteristics in which significant differences were detected between the groups.

Because the time horizon of the study did not extend beyond 12 months, discounting of costs and QALYs was not necessary.[20]

To analyze the uncertainty of ICER results, a nonparametric bootstrapping was performed with 1,000 replications. The resulting 1,000 ICER replicates were plotted on the cost-effectiveness plane and used to construct a cost-effectiveness acceptability curve.[23] The plane shows the joint distribution of the difference in costs and effects. The acceptability curve represents the proportion of simulations in which the intervention is considered cost-effective over a range of values of the threshold cost per QALY.[24] Analyses were performed in Stata version 12 (Stata Corp., College Station, TX).

RESULTS

Three hundred thirty-two institutionalized elderly adults were enrolled: 122 control, 210 intervention. Table 1 shows the sociodemographic characteristics of the participants and pharmacists. Sixty-six percent of the participants were female (71% intervention, 57% control); the average age of participants was 81.6 (82.2 intervention, 80.5 control), and they had an average consumption of 6.0 drugs (6.7 intervention, 4.9 control) and an average of 4.5 health problems (4.7 intervention, 4.1 control). Fifty-seven percent had a university education or less (54.9% intervention, 63.4% control), 10.7% were taking nonprescription medicines or herbs (11.6% intervention, 9.2% control), 28.9% kept their medication in their rooms (25.9% intervention, 33.9% control), 10.6% were smokers (12% intervention, 8.2% control), 11.5% had drug allergies (13.5% intervention, 8.2% control), and 38.8% took

Table 1. Baseline Characteristics of Elderly Nursing Home Residents and Pharmacists

Characteristic	Intervention	Control	*P*-Value[a]
Resident	n = 210	n = 122	
Age, average ± SD	82.2 ± 6.9	80.5 ± 7.2	.03
Female, n (%)	149 (71.0)	70 (57.4)	.01
Drugs, average ± SD	6.7 ± 3.0	4.9 ± 3.1	<.001
Health problems, average ± SD	4.7 ± 2.1	4.1 ± 2.2	.02
≥Primary education[b]	112 (54.9)	71 (63.4)	.14
Self-medication, n (%)[b]	24 (11.6)	11 (9.2)	.51
Drugs in room, n (%)[b]	50 (25.9)	38 (33.9)	.14
Smoking habits, n (%)[b]	25 (12.0)	10 (8.2)	.28
Drug allergy, n (%)[b]	28 (13.5)	10 (8.2)	.15
Taking herbal treatments, n (%)[b,c]	89 (43.2)	38 (31.4)	.03
Diabetes mellitus, n (%)	58 (27.6)	26 (21.3)	.20
Hypertension, n (%)	112 (53.3)	65 (53.3)	.99
Heart failure, n (%)	70 (33.3)	34 (27.9)	.30
Arthrosis, n (%)	58 (27.6)	39 (32.0)	.40
Very severe problems, n (%)			
Mobility	12 (6.0)	10 (8.2)	.45
Self-care	42 (21.0)	17 (13.9)	.11
Usual activities	24 (12.0)	12 (9.8)	.55
Pain and discomfort	27 (13.5)	13 (10.7)	.45
Anxiety and depression	13 (6.5)	12 (9.8)	.28
Visual analogue scale (0 = worst, 100 = best), average ± SD[b]	65.5 ± 22.9	62.7 ± 23.5	.34
Pharmacist	n = 10	n = 8	
Age, average ± SD	42.0 ± 8.2	37.7 ± 6.5	.37
Female, n (%)	7 (70.0)	8 (100.0)	.09
Years working, average ± SD	13.7 ± 6.3	8.9 ± 6.5	.08

[a]Student *t*-test or chi-square test.

[b]There are missing values for these variables.

[c]Using lime flower, chamomile, mint tea, for example.

SD = standard deviation.

herbal treatments (e.g., mint tea, chamomile) (43.2% intervention, 31.4% control).

The most prevalent health problems in the sample were diabetes mellitus (25.3%; 27.6% intervention, 21.3% control), hypertension (53.3% of both groups), heart failure (31.3%; 33.3% intervention, 27.9% control), and arthrosis (29.2%; 27.6% intervention, 32% control). The percentage of participants who perceived very severe problems in different dimensions of their state of health was low: 6.8% in mobility (6% intervention, 8.2% control), 18.3% in self-care (21% intervention, 13.9% control), 11.2% in usual activities (12% intervention, 9.8% control), 12.4% in pain or discomfort (13.5 intervention, 10.7% control), and 7.8% in anxiety or depression (6.5% intervention, 9.8% control).

Negative Outcomes Associated with Medication

The general practitioner accepted 88.7% (274/309) of pharmacist recommendations, and 86.2% (218/253) of pharmacists' interventions were implemented, resolving 1.2 average negative outcomes associated with medication per participant during the 12 months of follow-up.

Pharmacotherapy Follow-Up: Time Spent by Pharmacists and Medication Changes

Pharmacists devoted an average of 113.7 ± 26.2 minutes to the stages of pharmacotherapy follow-up: 36.2 ± 9.9 minutes to participant history review and first interview, 45 ± 0 minutes to writing the situation state in the study and evaluation phase (estimated by an expert panel), 20.3 ± 14.2 minutes to the intervention phase, and 12.3 ± 10.8 minutes to the revision phase of intervention results and subsequent interviews.

Pharmacist interventions reduced the average number of prescribed medications by 0.47 drugs ($P < .001$), whereas the average number of prescribed medications increased by 0.94 drugs in the control group ($P < .001$). Figure 2 shows the evolution of average prescribed medications in participants who completed the 12 months of monitoring (excluding those who died). The average number of prescribed medications decreased by 0.52 drugs

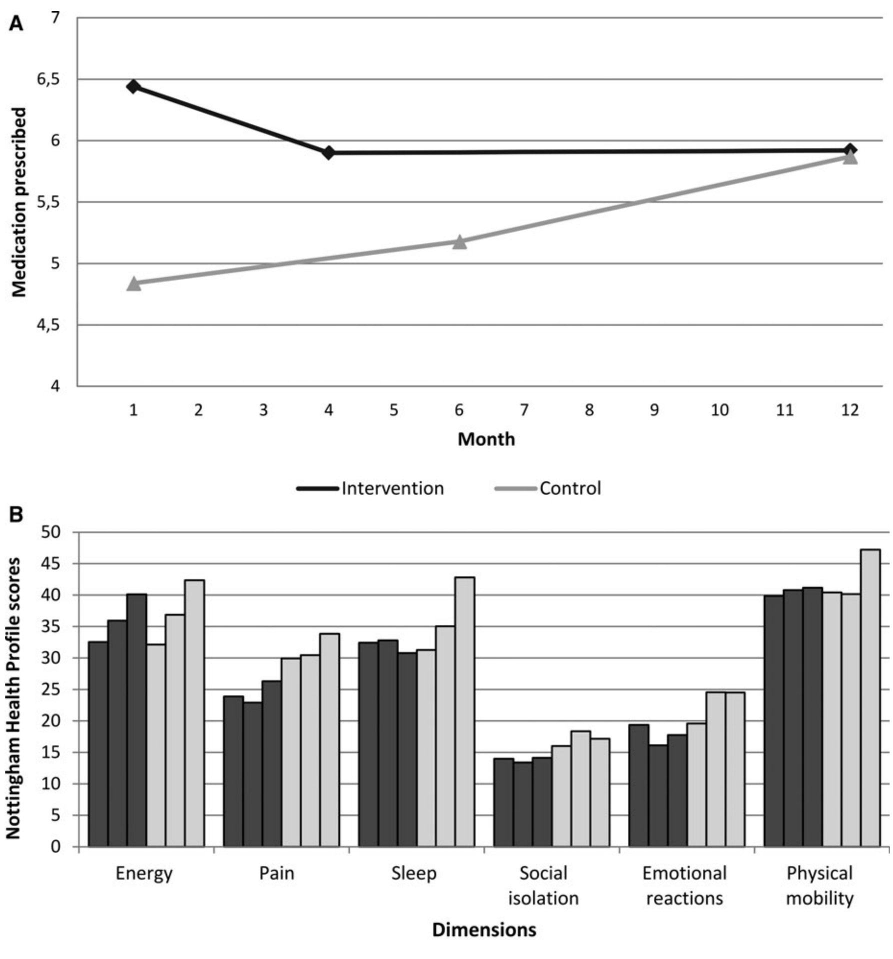

Figure 2. Evolution of average number of prescribed medication of participants who completed 12 months of monitoring (A) and evolution of Nottingham Health Profile scores of six dimensions at baseline (first column), 6 months (second column), and 12 months (third column) for both groups (B).

in the intervention group (*P* < .001), from 6.4 ± 3.1 at baseline to 5.9 ± 2.9 after the first pharmacist intervention (average 125 days) and 5.9 ± 3.0 at 12 months. In the control group, the average number of prescribed medications increased by 1.03 drugs (*P* < .001), from 4.8 ± 2.9 at baseline, 5.2 ± 2.9 at 6 months and 5.9 ± 3.2 at 12 months.

Health-Related Quality of Life and Mortality

Both groups had a lower average EuroQol-5D utility score at 12 months than at baseline. For intervention group participants, the average utility score at the end of the study decreased by 0.058 (*P* = .002), from 0.595 ± 0.30 at baseline to 0.565 ± 0.33 at 6 months and 0.538 ± 0.33 at 12 months. For control group participants, the average utility score at the end of the study decreased by 0.100 (*P* = .003), from a score of 0.621 ± 0.29 at baseline to 0.561 ± 0.32 at 6 months and 0.521 ± 0.32 at 12 months. Participants who died were assigned a EuroQol-5D utility score of 0; 27 participants died during the study (17 (8%) intervention, 10 (8%) control).

Both groups had similar scores on the six dimensions of the NHP at baseline, except for the pain dimension (24.7 intervention, 29.7 control; *P* = .16). The intervention group improved only in the sleep dimension (−1.68 points, *P* = .43) and the emotional reactions dimension (−1.59 points, *P* = .37), whereas control group scores did not improve on any dimension at 12 months. Figure 2 shows the evolution of NHP scores from baseline to 6 and 12 months for both groups.

Costs

The average cost related to time that pharmacists spent in stages of pharmacotherapy follow-up was €74 ($95). The average cost related to prescribed medication for the 12 months of follow-up was €1,151 ($1,476) for the intervention group and €826 ($1,059) for the control group. The average cost in the interventions group fell €0.18/day ($0.23/day) per resident, whereas the average cost in the control group increased by €0.58/day ($0.75/day) per resident (difference in daily average prescribed medication cost between baseline and 12 months).

Cost-Utility Analysis

The average total cost per resident was €1,225 ($1,571) for the intervention and €826 ($1,059) for the control group—an incremental cost difference of €399 ($512; *P* = .002), largely due to the difference in drug prescriptions at baseline. Average QALY scores were 0.565 for the intervention group and 0.566 for the control group—an incremental QALY score difference of −0.001 (*P* = .98), largely due to the difference in utility scores at baseline.

Table 2 shows the results for three scenarios of base case ICERs. For the raw ICER (first scenario), usual care dominated pharmacotherapy follow-up (cost less and

Table 2. Cost, Quality-Adjusted Life Years (QALYs), and Incremental Cost-Effectiveness Ratio (ICER) (€/QALY and $/QALY) for Three Base Case Scenarios

Variable	Intervention	Control	Group Difference (95% Confidence Interval) or ICER
Cost			
Raw, €	1,224.98 (1,062.34–1,387.62)	825.82 (641.32–1,010.32)	399.16 (150.01–648.31)
Raw, $	1,571.53 (1,362.88–1.780.18)	1,059.45 (822.75–1,296.14)	512.08 (192.45–831.71)
Average difference, €[a]	—	—	79.72 (−147.80–307.24)
Average difference, $[a]	—	—	102.27 (−189.61–394.16)
Average difference, €[b]	—	—	141.29 (−91.30–373.89)
Average difference, $[b]	—	—	181.27 (−117.13–479.66)
QALYs			
Raw	0.5655 (0.5212–0.6098)	0.5662 (0.5099–0.6225)	−0.0007 (−0.0697–0.0684)
Average difference[c]	—	—	0.0204 (−0.0247–0.0655)
Average difference[b]	—	—	0.0215 (−0.0234–0.0664)
ICER			
1st scenario, €/QALY[d]	—	—	Dominated
1st scenario, $/QALY[d]	—	—	Dominated
2nd scenario, €/QALY[e]	—	—	3,898.69
2nd scenario, $/QALY[e]	—	—	5,001.63
3rd scenario, €/QALY[f]	—	—	6,573.56
3rd scenario, $/QALY[f]	—	—	8,433.22

Exchange rate: 1 euro = US$1.28.

[a]Adjusted for baseline prescribed medication.

[b]Adjusted for age, sex, drugs, health problems, taking herbs, and utility score.

[c]Adjusted for utility score.

[d]Calculated by dividing difference in total costs by difference in QALYs between both groups.

[e]Calculated by dividing difference in total costs adjusted for drugs between intervention and control group by difference in QALYs adjusted for utility score between both groups.

[f]Calculated by dividing difference in total costs adjusted for age, sex, drugs, health problems, taking herbs, and utility score between intervention and control group by the difference in QALYs adjusted for age, sex, drugs, health problems, taking herbs, and utility score between both groups.

was more effective) because the intervention was more expensive and less effective than usual care. The adjusted ICERs were €3,899/QALY ($5,002/QALY) for the second scenario and €6,574/QALY ($8,433/QALY) for the third scenario. Nonparametric bootstrapping was used to analyze the uncertainty of these results.

For the first scenario, most of the plotted points are located in the upper-left quadrant of the cost-effectiveness plane, characterized by higher-cost, less-effective interventions, and the upper-right quadrant, characterized by higher-cost, more-effective interventions. The acceptability curve shows that, if willingness to pay is €30,000/QALY ($38,487/QALY), the probability of the pharmacotherapy follow-up being more cost-effective than usual care, is 35%.

For the second scenario, most of the plotted points are located in the upper-right quadrant the cost-effectiveness plane. The acceptability curve shows that, if the willingness to pay is €30,000/QALY ($38,487/QALY), the probability of the pharmacotherapy follow-up being more cost-effective than usual care is 78%.

For the third scenario, the cost-effectiveness plane shows that most of the plotted points are located in the upper-right quadrant. The acceptability curve shows that, if the willingness to pay is €30,000/QALY ($38,487/QALY), the probability of the pharmacotherapy follow-up being cost-effective, compared to usual care, is 76%.

The distributions of the 1,000 replicates of the ICER, expressed in euro and US dollars, on the cost-effectiveness plane are similar (higher proportional cost, same effectiveness). For this reason, Figure 3 shows the results expressed only in euro.

DISCUSSION

Elderly NH residents have many health problems and take many medications, which often involves the use of inappropriate drugs[25] and drug-related adverse events.[26] The expected increase in size of this population in Spain,[27] as in other developed countries, makes it important that interventions to improve the quality of life of elderly adults, such as pharmaceutical care services, which aim to optimize the prescription of drugs and avoid negative outcomes associated with medication, be developed.

In this study, general practitioners accepted 88.7% of pharmacist recommendations, and 86.2% of pharmacist interventions were implemented. These results show a higher percentage than pharmacist recommendations accepted by general practitioners (75.6% (565/747)) and accepted recommendations implemented (76.6% (433/565)) in a randomized controlled trial of clinical medication review by a pharmacist for elderly care homes residents in the United Kingdom over 6 months.[28]

Pharmacist interventions resolved an average of 1.2 negative outcomes associated with medication per participant during 12 months of follow-up. The Dader Method is effective for identifying negative outcomes associated

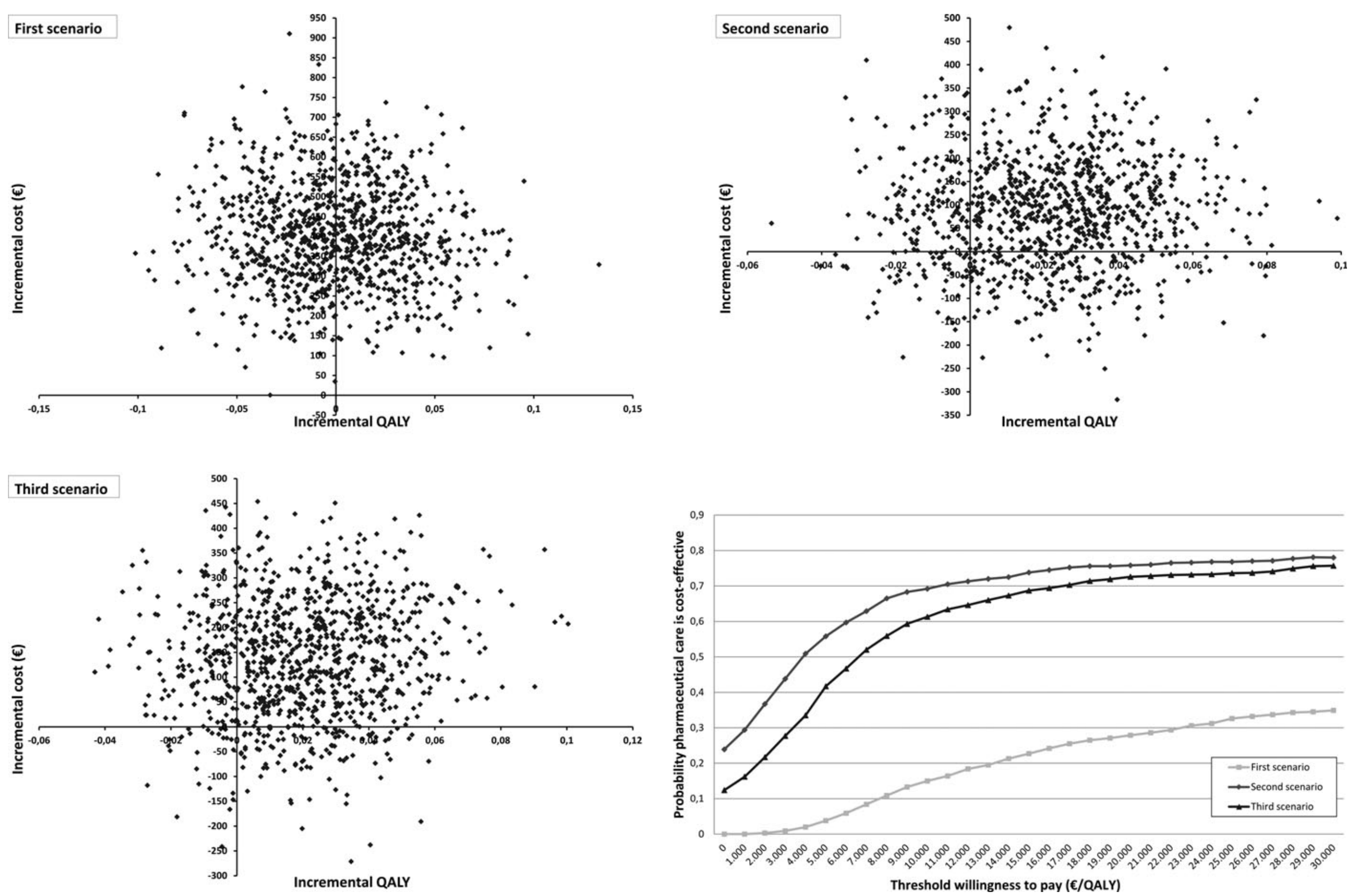

Figure 3. Distribution of bootstrapped incremental cost-effectiveness ratio (n = 1,000) in the cost-effectiveness plane and acceptability curve based on willingness to pay for quality-adjusted life-year QALY for the three scenarios.

with medication (known as drug-related problems in other studies) in NHs, as was shown in a hospital emergency department,[29–32] in a hospital,[33] and in the community.[34]

Pharmacists spent an average of 114 minutes in the pharmacotherapy follow-up, which resulted in a cost of €74 ($95) for the 12 months of the study, less than the $138 obtained in a similar study (2005 prices).[35]

The average number of prescribed medication increased in the control group by 0.94 drugs, increasing the average cost by €0.58/day ($0.75/day) per resident, whereas the average number of prescribed medication decreased in the intervention group by 0.47 drugs, saving an average of €0.18/day ($0.23/day) per resident. Similar pharmacist interventions have obtained higher savings. A previous study estimated an average saving of £0.70 per participant over 28 days of follow-up,[28] and another study estimated an average saving of $30.33 per participant per month.[36]

In a recent review, no intervention was found to optimize prescription for elderly care homes residents that measured quality of life.[9] In the current study, pharmacotherapy follow-up was associated with less impairment in quality of life, although neither group of residents saw an improvement in their quality of life, measured using the EuroQol-5D. QALYs are a valid measure of health outcomes because they take into account morbidity and mortality in one figure that measures health in terms of years of life in good health. A high percentage of participants had several chronic diseases, which may explain the reduction in quality of life (using the EQ5D) in both groups. Using the NHP questionnaire, the intervention group had an improvement in quality of life in two of the six dimensions on the questionnaire, whereas the control group had no improvement in any dimension. These improvements in the dimensions of sleep and emotional reactions may be related to pharmaceutical interventions in anxiolytic medication (a type of medication that is common in elderly adults taking many medications).

With €30,000/QALY being the threshold for determining whether a health technology is cost-effective in Spain,[37] pharmaceutical care for elderly residents in NHs is more cost-effective than usual care. Three base case ICERs were estimated. In the first scenario (raw ICER), pharmaceutical care was a dominated intervention (higher cost and less effective than usual care), and the acceptability curve showed that there was much uncertainty because 35% of the bootstrap simulations were <€30,000/QALY ($38,487/QALY). In the second scenario, the ICER was €3,899/QALY ($5,002/QALY), and the acceptability curve showed that there was little uncertainty because 78% of the bootstrap simulations were <€30,000/QALY ($38,487/QALY). In the third scenario, the ICER was €6,574/QALY ($8,433/QALY), and the acceptability curve showed that there was little uncertainty because 76% of the bootstrap simulations were <€30,000/QALY ($38,487/QALY). A previous study evaluated the cost-effectiveness of a pharmaceutical care intervention to reduce the number of prescriptions of inappropriate psychoactive medication in elderly NH residents in Northern Ireland, and the incremental cost-effectiveness ratio was −130.39/0.309 ($130.39 lower cost per resident and a difference in the proportion of residents receiving one or more inappropriate psychoactive drugs of 30.9 percentage points).[35]

This study has two limitations: nonrandom selection of the sample of elderly adults and noninclusion of certain costs related to the use of health resources, such as emergency visits or hospital admissions. The first limitation has been addressed by adjusting the results for the variables with significant differences. The second limitation concerns not adopting the perspective of the National Health System, recommended by the guidelines,[20,22] but considering a more restrictive perspective focusing on the variation in direct costs of medication and pharmacist time.

Despite these limitations, the study is important for several reasons. It strengthens the limited international evidence of the cost-effectiveness of pharmacotherapy follow-up (or pharmaceutical care, in general) for detecting negative outcomes associated with medication in NHs, and it is the first study of its kind conducted in Spain to suggest that this intervention strategy can be efficient for institutionalized elderly adults.

CONCLUSION

The results of this study suggest that pharmacotherapy follow-up is cost-effective for elderly residents in Andalusian NHs, although there is considerable uncertainty in these results. Pharmacotherapy follow-up is an effective intervention for optimizing prescribed medications and detecting negative outcomes associated with medication but not for improving the quality of life of institutionalized elderly adults, although it reduces spoilage.

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