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Medicine optimization strategy in an acute geriatric unit: The pharmacist in the geriatric team

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Aim: Older patients admitted to acute geriatric units (AGU) frequently use many medications and are particularly vulnerable to adverse drug events, so specific interventions in this setting are required. In the present study, we describe a new medicine optimization strategy in an AGU, and explore its potential in reducing polypharmacy and improving medication appropriateness.

Methods: The present prospective study included patients aged ≥75 years who were admitted to an AGU in a tertiary hospital. An intervention based on a pharmacist clinical interview, medication history and a structured medication review within a comprehensive geriatric assessment was proposed. The differences regarding polypharmacy as the primary outcome (≥5 chronic drugs), hyperpolypharmacy (≥10), number of drugs, drug-related problems and Screening Tool of Older Person's Prescription/Screening Tool to Alert Doctors to Right Treatment criteria between admission and discharge were evaluated.

Results: From October 2016 to April 2017, 234 patients were enrolled, aged 87.6 years (SD 4.6 years); 143 (61.1%) were women. The intervention resulted in a statistically significant improvement in polypharmacy (−10.2%, 95% CI −15.3, −5.2), hyperpolypharmacy (−16.6%, 95% CI −22.3 −11.0), number of medications (−1.4, 95% CI −1.8, −1.0), Screening Tool of Older Person's Prescription criteria (−19.2%, 95% CI −24.9, −13.6), Screening Tool to Alert Doctors to Right Treatment criteria (−6.8%, 95% CI −10.1, −3.5) and drug-related problems (−2.7, 95% CI −2.9, −2.4; $P \leq 0.001$ for all).

Conclusions: A systematic pharmacist-led intervention at hospital admission to an AGU within a comprehensive geriatric assessment was associated to a decrease in polypharmacy, drug-related problems and potentially inappropriate prescribing. **Geriatr Gerontol Int 2019; ••: ••–••.**

Keywords: comprehensive geriatric assessment, elderly, medication review, pharmacists, polypharmacy.

Introduction

Polypharmacy, defined as the use of multiple drugs, is a growing concern for older adults because of its prevalence and potential consequences.[1] Despite the lack of consensus about the definition of polypharmacy,[2] an increasing number of medications are associated with drug–drug and drug–disease interactions, overprescribing, lack of adherence to drug treatment or inappropriate use of medications.[3] Observational studies have suggested a relationship between polypharmacy and negative clinical consequences in older adults, such as falls, adverse drug events, hospitalization, mortality and impairment of function or cognition.[4] Spain is one of the countries with the most aged populations in the world and, in recent years, polypharmacy in this group has become an increasing problem. Hospitalized older adults have shown a high rate of inappropriate prescriptions,[5] and it has been estimated that approximately one in 10 hospital admissions of older patients are a result of adverse drug reactions.[6] High rates of multimorbidity, polypharmacy, potentially inappropriate prescriptions and other medication-related problems, and their cognitive, functional and social situation make drug management especially complicated in these patients.[7] Hospital admission itself is associated with higher morbidity, mortality, and cognitive and functional impairment;[8] additional prescribers and the increase in the number of drugs during hospitalization further contribute to the risk of iatrogenesis and the complexity of drug regimens.[9,10] In contrast, hospitalization (because of the closeness to the patient), strict follow up, access to different specialists and specific resources can be used to optimize the treatments.

However, medication optimization strategies in older people when admitted to the hospital are not widely extended in clinical practice. Some interventions have been proposed, such as the identification of potentially inappropriate prescriptions or medication review strategies, although often they do not adequately meet the needs of complex patients and/or of more advanced age (including octogenarians and nonagenarians).[11] Interventions must be adapted to the settings and patients' needs. The best results in improving important health outcomes, such as readmissions or emergency room visits, have been shown in multifaceted multidisciplinary interventions.[12–15] Pharmacists having extensive knowledge of medications can be valuable for this purpose, and the combination of a specific strategy in acute geriatric specialized care can be the answer to this problem.[16] Acute geriatric units (AGU) were designed for attending to the special needs of older inpatients. They can be defined as hospital units with their own physical location and structure, and are run by a

specialized multidisciplinary team with direct responsibility for the care of older people with acute medical disorders; and they have showed a functional benefit compared with conventional hospital care, and an increased likelihood of living at home after discharge.[17] Comprehensive geriatric assessment (CGA), as the main tool of geriatric medicine, is a multidimensional multidisciplinary diagnostic process focused on assessing an older person's medical, psychological and functional capability in order to develop a coordinated and integrated plan for treatment and long-term follow up focused on the individual's needs.[18] Specific multidisciplinary interventions focused on drug treatment in the context of a CGA in an AGU might improve the use of medications in older inpatients.

In the present study, we aimed to describe a new medicine optimization strategy in an AGU, and explore its effectiveness to reduce polypharmacy as the primary outcome and improve medication appropriateness.

Methods

Study design, setting and population

In the present prospective study, polypharmacy and medication appropriateness between admission and discharge in older adults admitted to an AGU were compared, after implementing a new medicine optimization strategy. The study was carried out at the Department of Geriatrics in a tertiary public hospital (*Complejo Hospitalario de Navarra*, Pamplona, Spain), between October 2016 and April 2017. Study participants were aged ≥75 years. Regular care included attention by a multidisciplinary team of geriatricians, nurses and a social worker.

All patients admitted to the AGU during the study period were eligible for inclusion. Patients were excluded if: (i) they were terminally ill; (ii) the expected hospital stay was <48 h; (iii) they had been previously recruited into the study; or (iv) they were unwilling to participate.

Patients were screened for eligibility within 24 h of admission. The recruitment was limited to working days to a maximum of two patients per day, consecutively selected from the daily AGU admission list. The pharmacist provided the patients or their legal representative oral and written information about the study, and at acceptance, they were asked to give written consent.

Medicine optimization strategy

A pharmacist-led medicine optimization strategy was implemented in the AGU. The pharmacist had a 4-year formal specialization in hospital pharmacy, was funded by the Specialized Healthcare Post-training Program of *Complejo Hospitalario de Navarra* and received 6-month training in two centers attending to geriatric patients before the study. After the inclusion of a participant in the study, the pharmacist carried out the intervention within 24 h, after an initial comprehensive geriatric assessment that was part of the regular management in the AGU and was registered in the patient's electronic medical record. The pharmacist was present in the geriatric unit during the study period, participated in multidisciplinary meetings and had access to the complete medical records (hospital and primary care). The intervention consisted of different steps (Fig. 1 shows the process overview):

A medication history was obtained through different sources (at least medical records and patient interview, and if considered necessary with the pharmacy dispensing record, contacting community pharmacist, general practitioner, nursing home, etc.). The pharmacist carried out a semistructured interview to confirm the detailed up-to-date list of medications, assess treatment adherence and detect drug-related problems (DRP). Patients were asked about their autonomy for and knowledge of the drug treatments, practical handling and other problems interfering with the correct use of the medications, and received open questions about doubts, needs or concerns. The pharmacist provided information and advice (oral or written) when DRP were found at a patient level. Medication reconciliation was also carried out to identify

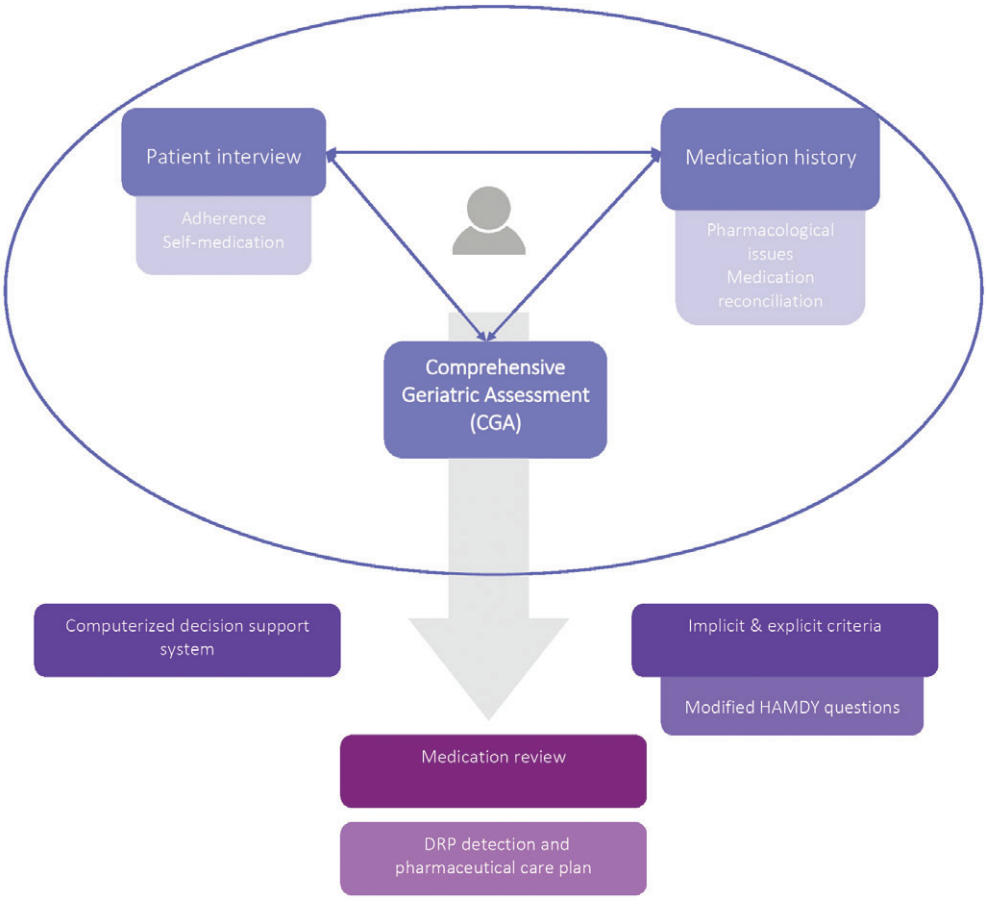

Figure 1 Process overview. DRP, drug-related problems.

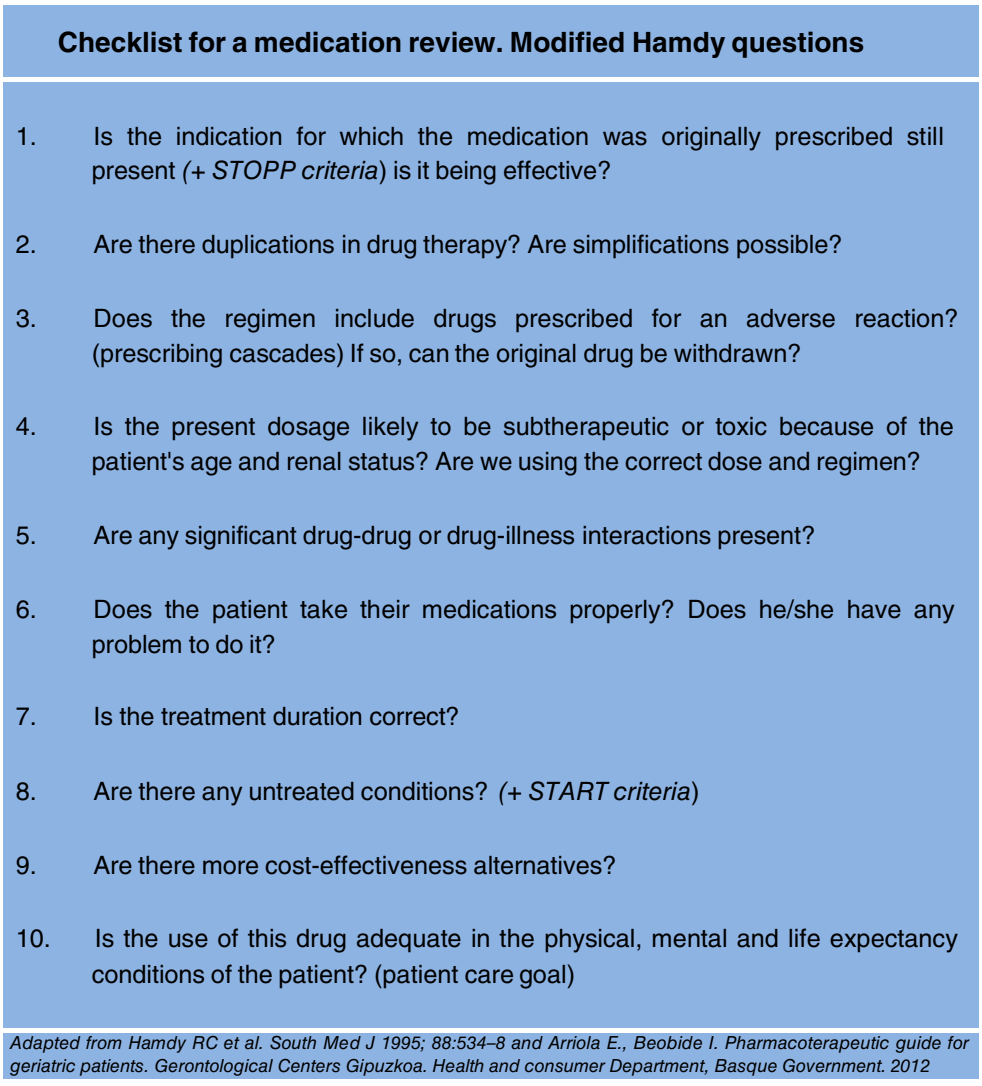

Figure 2 Modified Hamdy questions. START, Screening Tool to Alert Doctors to Right Treatment; STOPP, Screening Tool of Older Person's Prescription.

discrepancies between the prescriptions in the hospital record and the updated list of medications. Considering the information from the CGA and the patient interview, the pharmacist carried out a medication review, combining a questionnaire (Fig. 2) and a computerized decision support system to assist the review process (Checkthemeds).[19] A written report was shared in the electronic patient record, including information about treatment adherence, DRP, and proposed changes and interventions as a pharmaceutical care plan. When deemed necessary, recommendations were also verbally communicated. The research pharmacist was also available to answer queries from patients or healthcare professionals on demand about medications. The time spent in the intervention was approximately 2 h for each patient.

Data collection

Participants were assessed at hospital admission and at discharge. Study researchers registered sociodemographic and clinical characteristics, geriatric syndromes, cognitive and functional status, and blood laboratory data at admission. Medication-related variables were registered at admission and at discharge. Drug treatments were collected from medical records and other sources at admission, and from the discharge summary of the patient at discharge. Chronic medications and those used on demand or for a short time were registered separately. Drugs were classified following the Anatomical Therapeutic and Chemical codes.[20] Medication adherence was measured with the Morisky–Green scale.[21] Comorbidity was quantified using the age-adjusted Charlson Comorbidity Index.[22] The functional independence of the participants was determined with the Barthel Index of basic activities of daily living,[23] and the Global Deterioration Scale was used for cognitive assessment.[24] Malnutrition was detected through the CGA.

Outcome measures

The primary outcome was the difference in the prevalence of polypharmacy between admission and discharge. Polypharmacy was defined as the use by a patient of ≥5 chronic drugs, and hyperpolypharmacy as ≥10. The difference in the prevalence of hyperpolypharmacy and the Screening Tool of Older Person's Prescription (STOPP)/Screening Tool to Alert Doctors to Right Treatment (START) criteria (version 2), as per the mean number of medications, DRP and STOPP or START criteria were also assessed as secondary outcome measures.

DRP detected by the pharmacist in the medication review and Negative Outcomes associated with Medications were classified using the adapted list of the Third Consensus of Granada.[25] The recommendations given to the geriatricians regarding DRP were also recorded, as well as whether they were solved totally, partially or unsolved at discharge. New DRP (not present at admission and present at discharge) were registered. Medications at discharge were labeled as new, modified (same active substance but different dose, regimen etc.) or not modified (same as at admission).

Statistical analysis

For an alpha risk of 0.05 and a beta risk of 0.15 in a two-sided test, 250 participants were necessary to obtain a statistically significant difference, considering an initial rate of polypharmacy of

86.5%[7] and a final rate of 76.5%, and assuming a loss of 15% of patients in the follow up. The GRANMO 7.12 (Institut Municipal d'Investigació Mèdica, Barcelona, Catalonia, Spain) sample size calculation software was used to estimate the sample size with the McNemar test for paired proportions.

Categorical variables were expressed as frequencies and percentages, and quantitative variables as means and standard deviations (SD). The Wilcoxon signed-rank test was used for paired samples of quantitative variables to determine any drug changes between admission and discharge, while the McNemar test was used in the case of categorical variables. Statistical analyses were carried out using the IBM SPSS Statistics v21 statistical software (IBM Corporation, Armonk, NY, USA). Statistical significance was set at $P < 0.05$.

Ethical considerations

The present study was carried out in accordance with the Declaration of Helsinki and the Spanish Organic Law 15/1999 on Protection of Personal Data. The study was approved by the Institutional Research Ethics Committee of Navarra (Pyto 2015/32). Study participants or their legal guardians gave written and signed participation consent before being included in the study.

Results

From the 250 patients who fulfilled inclusion criteria, 16 died during hospitalization, so finally 234 were included in the analyses. The mean age of study participants was 87.6 years (SD 4.6 years), and 61.1% (143) were women. Table 1 lists the characteristics of study participants.

Table 2 shows the differences in the prevalence of polypharmacy and hyperpolypharmacy, mean number of drugs, and the prevalence and mean number of STOPP and START criteria between admission and discharge.

Medication appropriateness of 2469 drugs on admission and 2344 drugs at discharge was evaluated. A total of 802 drugs (32.5%) were discontinued during hospitalization. Among the drugs prescribed at discharge, 1339 (57.1%) were the same as those on admission without any modification, 328 (14%) were the same with modifications and 677 (28.9%) were new drugs. A total of 948 DRP were detected at admission in 228 patients (97%). DRP were associated with different types of Negative Outcomes associated with Medications: 375 (39.5%) were linked to necessity (unnecessary medicines: 33.1%, untreated health problem: 6.4%); 131 (13.8%) with effectiveness (quantitative: 2.7%, non-quantitative: 11.1%) and 442 (46.7%) with safety (quantitative: 12.8%, non-quantitative: 33.9%). Table 3 summarizes the types of DRP detected. The consumption of drugs by Anatomical Therapeutic and Chemical group and associated DRP are detailed in Table S1. At admission, the most common medications were drugs for the nervous system (26.0%), cardiovascular system (25.0%), and alimentary tract and metabolism (19.7%); and at discharge, the percentages were 25.6, 22.0 and 20.1%, respectively. At admission, DRP were particularly linked to the nervous system (30.1%), cardiovascular system (22.0%), and alimentary tract and metabolism drugs (21.6%); at discharge, the proportions were 35.8, 18.1 and 30.5%, respectively. In all cases, recommendations regarding DRP were made to the patient/caregiver or the geriatrician. Table S2 summarizes the various improvement proposals. DRP present at admission were identified as solved at discharge in 604 patients (63.7%), partially solved in 54 patients (5.7%) and unresolved in 249 patients (26.3%). The resolution of the remaining DRP (41, 4.3%), mainly due to non-compliance, was unknown. Unresolved DRP were mainly linked to negative cost-effectiveness (27.3% were solved). At discharge, 320 DRP were found in 160 patients (68.4%); 303 were present at the time of admission and were not fully solved, and 17 were new DRP. The mean number of DRP per patient at admission was 4.0 (SD 1.96) and 1.4 (SD 1.37) at discharge, with a mean difference of −2.7 ($P < 0.001$). Between admission and discharge, a statistically significant reduction was observed for all types of DRP, except inappropriate self-medication.

Discussion

In the present study, it was found that a pharmacist-led intervention in very old and frail inpatients was associated with a reduction in polypharmacy and an improvement in medication appropriateness indicators from admission to discharge. The increase of temporary or on-demand medications was expected due to acute conditions. The decrease of chronic medications at discharge can have important benefits, as polypharmacy has been shown to be the most important medication-related risk factor for readmission and emergency room visits in complex hospitalized older adults.[7] Although the association between the intervention and the reduction of polypharmacy without a control group cannot be shown, previous studies have shown that hospitalization of older patients without specific interventions leads to increased polypharmacy.[26–29]

Over 40% of the prescriptions at discharge were different from those at admission, implying important modifications of drug regimens. A high rate of DRP was detected, especially regarding non-indicated drugs, the likelihood of adverse effects and prescribing/reconciliation errors. A statistically significant reduction was observed for all types of DRP, except inappropriate self-medication, probably because of the low number of cases. The most common recommendation was discontinuation of drug therapy, in line with what was reported in other studies.[13]

The present study population was particularly old (the oldest among similar studies), with a high prevalence of multimorbidity, many different geriatric syndromes, and variable rates of functional and cognitive impairment. This patient profile can benefit from an AGU and CGA, as they have been clearly shown to improve health outcomes.[17,30] Regarding the use of medications, more appropriate prescribing in comparison with general units has been suggested.[31] However, in a previous retrospective study carried out in the same AGU, a reduction in the prevalence of polypharmacy or inappropriate prescriptions between admission and discharge with usual care was not found.[7] This suggests that more specific interventions could enhance the outcomes of the CGA regarding medications.[13,15,32] Interventions have been proposed elsewhere for medicine optimization in hospitalized older people, with different results.[11] Van der Linden *et al.*[15] and Dalleur *et al.*[32] studied interventions in the context of inpatient geriatric consultation teams for older patients not admitted to acute geriatric care wards. The first study found that patients in the intervention group were discharged with fewer drugs, and had more potentially inappropriate medications discontinued compared with admission. Dalleur *et al.* found a reduction in the number of STOPP criteria at discharge, but not in the proportion of patients with STOPP criteria. Spinewine *et al.* proposed a pharmaceutical care intervention provided by a clinical pharmacist in an AGU, and found an improvement in Medication Appropriateness Index scores and Assessing Care Of Vulnerable Elders (ACOVE) criteria of underuse from admission to discharge.[33] However, they did not achieve an improvement of potentially inappropriate prescriptions according to the Beers criteria. The present study found an improvement in both the number and prevalence of explicit criteria for inappropriate prescriptions (overuse and underuse) and DRP as a measure of judgment-based medication appropriateness.

Medicine optimization strategies in older adult populations should be multidimensional and interdisciplinary to meet the needs of hospitalized very old complex patients. Interventions supported in the CGA usually adopt this approach, which allows more individualized interventions.[15,32,33] Consistent with this view, a comprehensive multifaceted intervention was proposed with specific tools to systematically review medications and

Table 1 Baseline patient characteristics

	n (%)
Mean length of hospital stay (*n* = 234), days (SD)	8.1 (4.5)
Comorbidity	
Mean ACCI (SD)	7.5 (1.9)
Living	
With family	132 (56.4%)
Alone	24 (10.3%)
With caregiver	22 (9.4%)
Institutionalized	44 (18.8%)
Others	12 (5.1%)
Reason for admission	
Behavioral disturbances	11 (4.7%)
Dyspnea	73 (31.2%)
Fever	16 (6.8%)
Decompensated heart failure	17 (7.3%)
General deterioration	25 (10.7%)
Vomiting/diarrhea	17 (7.3%)
Others	75 (32.0%)
Dependency (*n* = 221)	
Total dependency (BI 0–20)	63 (26.9%)
Major dependency (BI 21–60)	73 (31.2%)
Moderate dependency (BI 61–90)	58 (24.8%)
Mild dependency (BI 91–99)	7 (3.0%)
Independent (BI 100)	20 (8.5%)
Cognitive status	
Without cognitive deterioration	115 (49.1%)
Minor deterioration	42 (17.9%)
Moderate deterioration	35 (15.0%)
Major deterioration	42 (17.9%)
Behavior disorders	42 (19.7%)
Anxiety	43 (18.4%)
Repeated falls	70 (29.9%)
Inability to walk	83 (35.5%)
Dysphagia	77 (32.9%)
Chronic pain	50 (21.4%)
Sensory deficiency	
Visual deficiency	38 (16.2%)
Hearing deficiency	64 (27.4%)
Urinary incontinence (total or partial)	144 (61.5%)
Bowel incontinence	52 (22.2%)
Mean weight (*n* = 217), kg (SD)	67.2 (13.4)
Mean height (*n* = 213), cm (SD)	157.9 (8.4)
Malnutrition	75 (32.1%)
Transfer	
Home	156 (66.7%)
Nursing home	39 (16.7%)
Other hospital	32 (13.7%)
Other department	1 (0.4%)
Home hospitalization	6 (2.6%)
Renal function, *n* = 232 (GFR: mL/min/1.73 m^2)	
≥60	91 (38.9%)
30–59	89 (38.0%)
15–29	46 (19.7%)
<15	6 (2.6%)
Mean total cholesterol (*n* = 199), mg/dL (SD)	146.9 (40.9)
Mean total proteins (*n* = 203), g/dL (SD)	5.8 (0.9)
Mean albumin (*n* = 198), g/dL (SD)	3.2 (0.5)
Mean hemoglobin (*n* = 231), g/dL (SD)	12.4 (2.1)
Hb <12 g/dL	82 (35.0%)
Mean creatinine (*n* = 232), mg/dL (SD)	1.4 (0.8)
Background	
HT	183 (78.2%)
Heart failure	99 (42.3%)
DLP	94 (40.2%)
AF	91 (38.9%)
CKD	79 (33.8%)
Osteoporosis	67 (28.6%)
DM	65 (27.8%)
Depression	63 (26.9%)
Neoplasia/leukemia/lymphoma	49 (20.9%)
Ischemic heart disease	46 (19.7%)
COPD/asthma	45 (19.2%)
Alzheimer's disease	39 (16.7%)
Chronic anemia	37 (15.8%)
CVA	35 (15.0%)
BPH	33 (14.1%)
Gastric ulcer	28 (12.0%)
Liver disease	11 (4.7%)
Parkinson's disease	6 (2.6%)
Use of medications	
Dependent for taking their medication	156 (66.7%)
Weekly pillbox to organize their medication	44 (18.8%)
Multi-compartment compliance aid	30 (12.8%)

ACCI, age-adjusted Charlson Comorbidity Index; AF, atrial fibrillation; BI, Barthel Index; BPH, benign prostatic hyperplasia; CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease; CVA, cerebrovascular accident; DLP, dyslipidemia; DM, diabetes mellitus; GFR, glomerular filtration rate; HT, hypertension; SD, standard deviation.

measure the appropriateness in hospitalized older adults. The medication history, the clinical interview by the pharmacist and the CGA were the cornerstones of the proposed strategy. Assessing medication appropriateness through DRP also provides more flexibility within this population. They can include reconciliation issues in hospitalized patients, and they are not only focused on the prescription or the traditional concept of medication appropriateness, but also consider other medication processes.

The Lund Integrated Medicines Management model, a systematic intervention based on medication reconciliation and review and post-discharge follow up, has focused on DRP in hospitalized patients, achieving relevant results.[34] However, what makes our clinical pharmacist intervention clinically relevant is its integration in the CGA. Its holistic approach provides information of special value for tailored interventions, which is essential in geriatric profiles.

The present study had certain limitations. Because of the available resources and to prioritize monitoring the implementation of the intervention in actual conditions, a one-arm study was designed. It was carried out in a single hospital and by a single pharmacist, so generalizations might be limited. The time required for the intervention and the expertise of the pharmacist should be taken into account for the extent of the results. The recruitment method and the lack of randomization might pose a risk of selection bias. Furthermore, whether the intervention affected additional clinical outcomes was outside the scope of the present study; thus, information on potential benefits on health outcomes cannot be provided. However, once evidence of effectiveness and feasibility is available, it is the starting point to apply a strategy adapted to our environment in clinical practice and to develop projects to transfer medication appropriateness to yield more robust outcomes. Clinical pharmacist-led interventions in geriatric wards are still uncommon in our setting. The present study could guide and encourage the participation of clinical pharmacists in specialized and interdisciplinary teams in AGU, carrying out systematic strategies to improve the use of medications in frail older inpatients. Future research is required to assess its impact on health outcomes.

In conclusion, there is a need to implement medication optimization strategies in very old and complex patients; a systematic

Table 2 Treatment characteristics at admission and discharge

	Admission *n* (%)	Discharge *n* (%)	Mean difference	*P*-value
No. medications				
Total, mean (SD)	10.5 (4.2)	10.0 (4.1)	−0.5 (2.9)	0.038
Chronic, mean (SD)	9.5 (3.9)	8.1(4.1)	−1.4 (2.8)	<0.001
On demand/temporary, mean (SD)	1.0 (1.2)	1.8 (1.7)	0.8 (1.9)	<0.001
Patients with polypharmacy				
≥5 chronic medications	210 (89.7%)	186 (79.5%)	−24 (−10.2%)	<0.001
≥10 chronic medications	111 (47.4%)	72 (30.8%)	−39 (−16.6%)	<0.001
Potentially inappropriate prescription				
Patients with STOPP criteria, *n* (%)	184 (78.6%)	139 (59.4%)	−45 (−19.2%)	<0.001
No. STOPP criteria, mean (SD)	1.8 (1.4)	1.1 (1.2)	−0,7 (1.0)	<0.001
Patients with START criteria, *n* (%)	151 (64.5%)	135 (57.7%)	−16 (−6.8%)	<0.001
No. START criteria, mean (SD)	1.1 (1.1)	1.0 (1.1)	−0,1 (0.5)	0.001

SD, standard deviation; START, Screening Tool to Alert doctors to Right Treatment; STOPP, Screening Tool of Older Person's Prescription.

Table 3 Detected drug-related problems

	Admission		Discharge				
	n (%)	Mean (SD)	Outcome		*n* (%)	Mean (SD)	*P*-value[†]
			Partially solved *n* (%)	Solved *n* (%)			
Administration problem	13 (1.4)	0.06 (0.3)	1 (7.7)	10 (76.9)	3 (0.9)	0.01 (0.1)	0.002
Inappropriate self-medication	3 (0.3)	0.01 (0.1)	0	3 (100)	0	0.0 (0)	0.083
Low therapeutic utility drug	17 (1.8)	0.07 (0.3)	0	10 (58.8)	7 (2.2)	0.03 (0.2)	0.002
Negative cost-effectiveness	55 (5.8)	0.24 (0.4)	0	15 (27.3)	43 (13.4)	0.18 (0.4)	0.005
Dose/regimen selection	72 (7.6)	0.31 (0.5)	3 (4.2)	52 (72.2)	22 (6.9)	0.09 (0.3)	< 0.001
Duplication	40 (4.2)	0.17 (0.4)	3 (7.5)	21 (52.5)	25 (7.8)	0.11 (0.3)	0.003
Treatment duration	60 (6.3)	0.26 (0.5)	8 (13.3)	28 (46.7)	33 (10.3)	0.14 (0.4)	< 0.001
Dispensing/prescribing/reconciliation error	106 (11.2)	0.45 (0.8)	0	99 (93.4)	7 (2.2)	0.03 (0.2)	< 0.001
Drug form or route	18 (1.9)	0.08 (0.3)	0	13 (72.2)	6 (1.9)	0.03 (0.1)	0.001
Non-compliance	55 (5.8)	0.23 (0.4)	1 (1.8)	13 (23.6)	2 (0.6)	0.01 (0.1)	< 0.001
Non-indicated drug	130 (13.7)	0.56 (0.7)	8 (6.2)	82 (63.1)	51 (15.9)	0.22 (0.5)	< 0.001
Drug-disease/condition interaction or contraindication	48 (5.1)	0.21 (0.5)	2 (4.2)	37 (77.1)	12 (3.7)	0.05 (0.2)	< 0.001
Drug–drug interaction	71 (7.5)	0.3 (0.7)	10 (14.1)	47 (66.2)	24 (7.5)	0.1 (0.4)	< 0.001
Lack of effectiveness	16 (1.7)	0.07 (0.2)	0	12 (75)	5 (1.6)	0.02 (0.1)	0.002
Inappropriate monitoring	6 (0.6)	0.03 (0.1)	0	5 (83.3)	1 (0.3)	0.0 (0.1)	0.025
Drug use/process	5 (0.5)	0.02 (0.1)	0	4 (80)	1 (0.3)	0.0 (0.1)	0.046
Does not fit therapeutic goal	71 (7.5)	0.3 (0.6)	4 (5.6)	49 (69.0)	22 (6.9)	0.09 (0.3)	<0.001
Likelihood of adverse effects	118 (12.4)	0.5 (0.7)	12 (10.2)	75 (63.6)	43 (13.4)	0.18 (0.4)	<0.001
Insufficiently treated symptom or diagnosis	44 (4.6)	0.19 (0.5)	2 (4.5)	29 (65.9)	14 (4.4)	0.06 (0.2)	<0.001
Total	948 (100)	4.05 (2.0)	54 (5.7)	604 (63.7)	320 (100)	1.37 (1.4)	<0.001

[†]Comparison of means. SD, standard deviation.

pharmacist-led intervention within a CGA in the context of an AGU is a great opportunity to reduce polypharmacy and improve medication appropriateness. Here, we showed how a multidisciplinary team can improve the care of older patients.

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Disclosure statement

The authors declare no conflict of interest.

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Supporting information

Additional supporting information may be found in the online version of this article at the publisher's website:

Table S1 Anatomical Therapeutic and Chemical classification index of medications and associated drug-related problems.

Table S2 Proposals for optimization.

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