



ORIGINAL ARTICLE

Appropriateness of medication prescribing in nursing homes: A collaboration project between pharmacy and geriatric departments[☆]



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ABSTRACT

Purpose: To evaluate the appropriateness of medication prescribing and to analyze interventions carried out in polymedicated elderly patients in nursing homes (NHs).

Methods: Prospective study of potentially inappropriate medication prescribing in polymedicated older adults living in NHs, implemented via a collaborative project between NHs and the geriatric and pharmacy departments of a university hospital. The pharmacist reviewed patients' active medical prescriptions and prepared an individualized report with proposals aimed at therapeutic optimization that was sent for evaluation to the geriatrician in charge of the NH. The drug-related problems (DRPs) were classified according to the Third Consensus of Granada and the potentially inappropriate prescriptions (PIPs) were identified by explicit criteria (STOPP/START, BEERS, LESS-CHRON), implicit criteria (MAI) and CheckTheMeds[®] software. It was measured the degree of acceptance of the interventions carried out, and the economic impact was calculated from the direct costs of the discontinued drugs.

Results: Of the 210 patients reviewed by the pharmacy department, 105 patients from 10 NHs were analyzed. A total of 510 prescriptions with possible DRPs were identified (38.5% of all prescribed drugs). According to STOPP/START/BEERS or LESS-CHRON criteria, 41.2% were PIPs. The main DRPs identified were: unfavorable risk-benefit ratio, inappropriate dose/regimen, inappropriate treatment duration, probability of adverse events, medication not indicated, and duplicate therapy. Interventions were proposed for 81.5% of the DRPs detected, of which 73.3% were accepted. This resulted in a 23.1% reduction in the number of drugs prescribed per patient and an economic saving of €16,218 per 6-month period.

Conclusion: The appropriateness of medication prescribing in polymedicated older adults living in NHs by the pharmacist has made it possible to reduce DRPs and PIPs and to save costs thanks to the high degree of acceptance by geriatricians.

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Adecuación farmacoterapéutica en centros sociosanitarios: proyecto de coordinación entre servicio de farmacia y geriatría

RESUMEN

Objetivos: Adecuar la farmacoterapia y analizar las intervenciones realizadas en pacientes ancianos institucionalizados en centros sociosanitarios (CSS) con polifarmacia.

Métodos: Estudio prospectivo de un programa de adecuación farmacoterapéutica en pacientes ancianos polimedificados de CSS mediante la puesta en marcha de un proyecto de coordinación de geriatría, farmacia hospitalaria y CSS desde el área de atención especializada. El farmacéutico realizó una revisión farmacoterapéutica de las prescripciones activas de los pacientes, elaborándose un informe individualizado con propuestas dirigidas a la optimización terapéutica. Los problemas relacionados con la medicación

Palabras clave:

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(PRM) encontrados se clasificaron según el Tercer Consenso de Granada, y las prescripciones potencialmente inapropiadas (PPI) se identificaron mediante criterios explícitos (STOPP/START, BEERS, criterios de deprescripción LESS-CHRON), criterios implícitos (MAI) y el programa informático CheckTheMeds®. Se midió el grado de aceptación de las intervenciones realizadas, y la repercusión económica se calculó a partir de los costes directos de los fármacos desprescritos.

Resultados: De los 210 pacientes revisados por el servicio de farmacia se analizaron 105 pacientes evaluados por geriatría pertenecientes a 10 CSS. Se detectaron 510 prescripciones con posibles PRM (38,5% del total de fármacos prescritos). El 41,2% se correspondían a PPI según criterios STOPP/START/BEERS o LESS-CHRON. Los principales PRM identificados fueron: fármacos de beneficio/riesgo desfavorable, dosis o pauta no adecuada, duración no adecuada, mayor probabilidad de efectos adversos, medicamento no indicado y duplicidad. Se intervino en el 81,5% de los PRM detectados, con un grado de aceptación del 73,3% y una reducción del 23,1% en el número de medicamentos prescritos por paciente, con un ahorro económico de 16.218 €/6 meses.

Conclusión: La adecuación farmacoterapéutica en pacientes mayores polimedicados ingresados en CSS por parte del farmacéutico ha permitido disminuir los PRM y las PPI y ahorrar costes gracias al alto grado de aceptación por parte de los geriatras.

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Introduction

In the past, nursing homes for the elderly (NHs) carried out their work in the context of a population aging index of less than 10% and a life expectancy of less than 60–65 years. Nowadays, the aging index is more than 15.5% and life expectancy is around 82 years, and the average age of residents is approximately 84 years.¹ Consequently, many changes have taken place, both in terms of the number of facilities and in the number of places and users, and many NHs serve a heterogeneous patient population.

People who require care in NHs have particular characteristics that make them highly vulnerable, and they often need multi-level care that falls somewhere between the hospital and the home.² They are generally older individuals, with cognitive and/or functional impairment, in a situation of dependence, who present one or more chronic diseases for which they receive multiple medications. The number of drugs prescribed is known to increase with age as the number of comorbidities and chronic diagnoses rises.

Polypharmacy is considered a determining factor for incidents related to the use of drugs in NHs, and leads to increased morbidity and mortality, adverse events (AEs) and hospital admissions, as well as greater use of healthcare resources.³ Avoidable medication-related harm in nursing homes occurs at a rate of 227 events per 1000 person-years. According to a Spanish study on AEs in NHs (EARCAS study),⁴ drug-related problems (DRPs) are among the most common incidents. These include lack of therapeutic compliance or adherence, the prescription of unnecessary medications or administration to the wrong patients, missed doses, and insufficient monitoring of treatments.

Prescriptions must periodically be reviewed in depth and adjusted to the patient's prognosis and changes in their clinical, laboratory, functional and cognitive status, with the aim of improving quality of life, optimizing outcomes, reducing polypharmacy, and achieving rational use of medicines with a minimum associated cost.^{5,6} Multidisciplinary collaborative programs are therefore crucial to improving healthcare.

In 2004, the Castilla-La Mancha Health Service (SESCAM) called on hospital pharmacy departments to implement a pharmaceutical care model in NHs.⁷ In response, our department launched a system⁸ in public NHs by which pharmaceutical needs are managed by the hospital. Several years later, we piloted a coordinated project between the geriatrics department and NHs, with the aim of improving pharmaceutical care in the rest of the NHs in the province.

Incorporating a pharmacist into the healthcare team responsible for the care and management of older patients with multimorbidity

has been shown to reduce drug-related negative outcomes (DNOs) in several studies,^{9,10} while greater benefits can be obtained if the pharmacist joins a multidisciplinary team working in both the health center and hospital and in the NHs.¹¹

The objectives of this study were to determine if highly poly-medicated patients were receiving the appropriate prescription, according to their current clinical, laboratory, functional and cognitive status, in coordination with the specialist geriatric care team, and to analyze the proposals and interventions made to adjust prescriptions after the implementation of this program in NHs.

Materials and methods

Starting in October 2020 to October 2021, the medication use of individual patients in NHs was reviewed and adjusted under the auspices of a program implemented in a secondary care hospital as part of a collaborative care project involving the geriatric department, the hospital pharmacy and NHs. The program was developed in those residential centers for the elderly in the province that were not included in the pharmaceutical benefit program from the hospital pharmacy department. The selection of patients was carried out by the geriatric department together with the NH's medical team, weekly coinciding with the visit of the geriatrician to the NH and based on the following inclusion criteria: elderly patient (65 years or older), highly polymedicated (≥ 10 active substances) and multimorbid. The exclusion criterion was suffering from an acute pathology or destabilization of their underlying pathology in the time of selection.

A patient was defined as multimorbid if they presented chronic diseases listed under two or more clinical categories according to the Integrated Care Process (ICP) classification for patients with multimorbidity (third edition).¹²

Once the patients were selected, the NH's medical team sent a clinical report per patient to the pharmacy department with all the information on: active medication, personal history and baseline situation of the patient.

In each patient, the pharmacist analyzed the clinical, laboratory, functional and cognitive status at the time, and calculated the cumulative anticholinergic burden of the prescribed medication, using the following scales, indices or tools:

- Dependency measured using the Barthel Index and the Red Cross Physical Disability Scale (RCP),¹³
- Cognitive status measured using the Lobo Mini-Mental exam and Red Cross Mental Disability Scale (RCM),¹³

- Comorbidity and frailty measured using the Charlson index¹⁴ and Frailty questionnaire,¹⁵
- Anticholinergic burden of the medication (cumulative effect of taking one or more medications capable of inducing anticholinergic AEs) measured using a web-based tool (ABC Calculator).¹⁶

After reviewing the patient's electronic medical record and applying the scales and indices, the pharmacist carried out a systematic review of chronic pharmacological treatment and drafted a report on medication appropriateness. In this phase, the main objective was to identify potentially inappropriate prescriptions (PIP) and DRPs and to implement the corresponding pharmaceutical interventions.

This pharmaceutical intervention consisted of a series of recommendations issued to the geriatric coordination team according to the pharmacist's best clinical judgment, supported by recommendations published by public bodies, official pharmacotherapy review bulletins, consensus clinical guidelines, best available evidence in the literature, and the following tools: CheckTheMeds® software, the explicit criteria for the detection of PPI in the population elderly (STOPP/START criteria,¹⁷ BEERS criteria,¹⁸ LESS-CHRON deprescription criteria¹⁹), the implicit medication appropriateness index (MAI) criteria,²⁰ and review algorithms (Garfinkel algorithm,²¹ algorithm of the Spanish Society of Primary Care Pharmacy²²).

The review process consisted of an exhaustive analysis by the pharmacist applying polypharmacy review algorithms and the CheckTheMeds® program. This program provided information on possible DRPs: PIP according to explicit criteria, guideline recommendations, information on interactions, duplicities, incorrect doses, AEs, etc. The possible DRPs detected by said tool were analyzed taking into account the characteristics, baseline and functional status of the patients to select the real DRPs on which the intervention was performed.

Once the pharmacotherapeutic review was carried out, the DRPs and DNOs were classified according to the Third Consensus of Granada,²³ identifying the need for treatment, and effectiveness and safety of each drug. In addition of the DRPs detected, those that were also considered PIP according to the explicit criteria were identified.

DRPs taken into account were the following:

- Interaction
- Contraindication
- Inappropriate dose
- Inappropriate regimen
- Inappropriate duration
- Not indicated drug
- Unfavorable benefit/risk
- Diagnosis/symptom insufficiently treated
- Treatment duplication
- Non-compliance
- Drug not effective (therapeutic objective not achieved or lack of efficacy)
- Drug of low therapeutic utility (LTU)
- Prescription errors
- Probability of AEs

DNOs taken into account were the following:

- Necessity (N): effect of non-indicated drug (N1); drug needed not prescribed (N2)
- Effectiveness (E): quantitative effectiveness (QE); non-quantitative effectiveness (NQE)
- Safety (S): quantitative safety (QS); non-quantitative safety (NQS)

Table 1

Characteristics of patients in nursing homes for the elderly.

Age ^a	88 (IQR: 84–92)
Sex	75.3% Female
Level of dependency: Barthel index ^a	50 (IQR: 5–85)
MiniMental ¹⁸	13 (IQR: 2–20)
Age-adjusted Charlson comorbidity index ^a	8 (IQR: 6–10)
Average anticholinergic burden of the medication	1.33 (High risk)
Most frequent chronic diseases (according to defining categories for multimorbidity)	Neurological disease 43% Diabetes mellitus 25% Heart and kidney disease 23% Chronic osteoarticular disease 22%
Number of chronic diseases per patient ^a	8 (IQR: 7–11)
Number of drugs prescribed per patient ^a	13 (IQR: 11–15)
Most prescribed drugs by therapeutic group	Group A: 30% Group N: 24% Group C: 18% Group M: 14%

^a Median (IQR: interquartile range: quartile 1 and 3).

After a clinical review of patient treatment, an individualized report of appropriate/inappropriate medication use was produced by the pharmacist, with proposals aimed at therapeutic optimization. This report was then sent for evaluation by the geriatrician in charge of the NH (Fig. 1). The geriatrician together with the NH's medical team evaluated the pharmacist recommendations and carried out the changes in the treatments. The geriatrician recorded the changes made and the new therapeutic goals established in the patient's electronic medical record. The degree of acceptance of the recommendations was measured by analyzing the clinical history of the patients, where the changes made were reflected.

Finally, the economic impact of the accepted pharmaceutical interventions was calculated on the basis of the direct costs (retail price + value added tax) of discontinued or modified medications. Following the pooling of recommendations and changes in prescriptions, the results were analyzed. The data were recorded through an ad-hoc access database and processed with Excel Microsoft Office 2010®.

Results

Since the start of this program, a total of 210 reports on appropriate medication use have been produced in NH patients; of these, 105 patients from 10 NHs have been evaluated by the geriatric department and residence physician, as of October 2021. The baseline characteristics of these patients are detailed in Table 1. At the beginning of the study of potentially inappropriate medication use, patients had a median of 13 prescribed drugs (IQR: 11–15).

The most frequent multimorbidity profile according to the defining categories for multimorbidity was neurological disease, diabetes mellitus, heart and kidney disease, and chronic osteoarticular disease.

In the 105 patients evaluated, 510 prescriptions with possible DRPs were identified (38.5% of all prescribed drugs), with a prevalence of 4.9 DRPs/patient. The therapeutic groups with the highest incidence of DRPs were: therapeutic group A (alimentary tract and metabolism), N (nervous system), C (cardiovascular system) and M (musculo-skeletal system) according to the ATC classification for medicinal products. The distribution of the types of DRPs detected during the process of determining appropriate prescriptions is shown in Fig. 2, the majority being: drugs with unfavorable benefit/risk keeping in mind the current functional status of the patient, inappropriate dose or regimen, inappropriate duration, and higher probability of AEs.

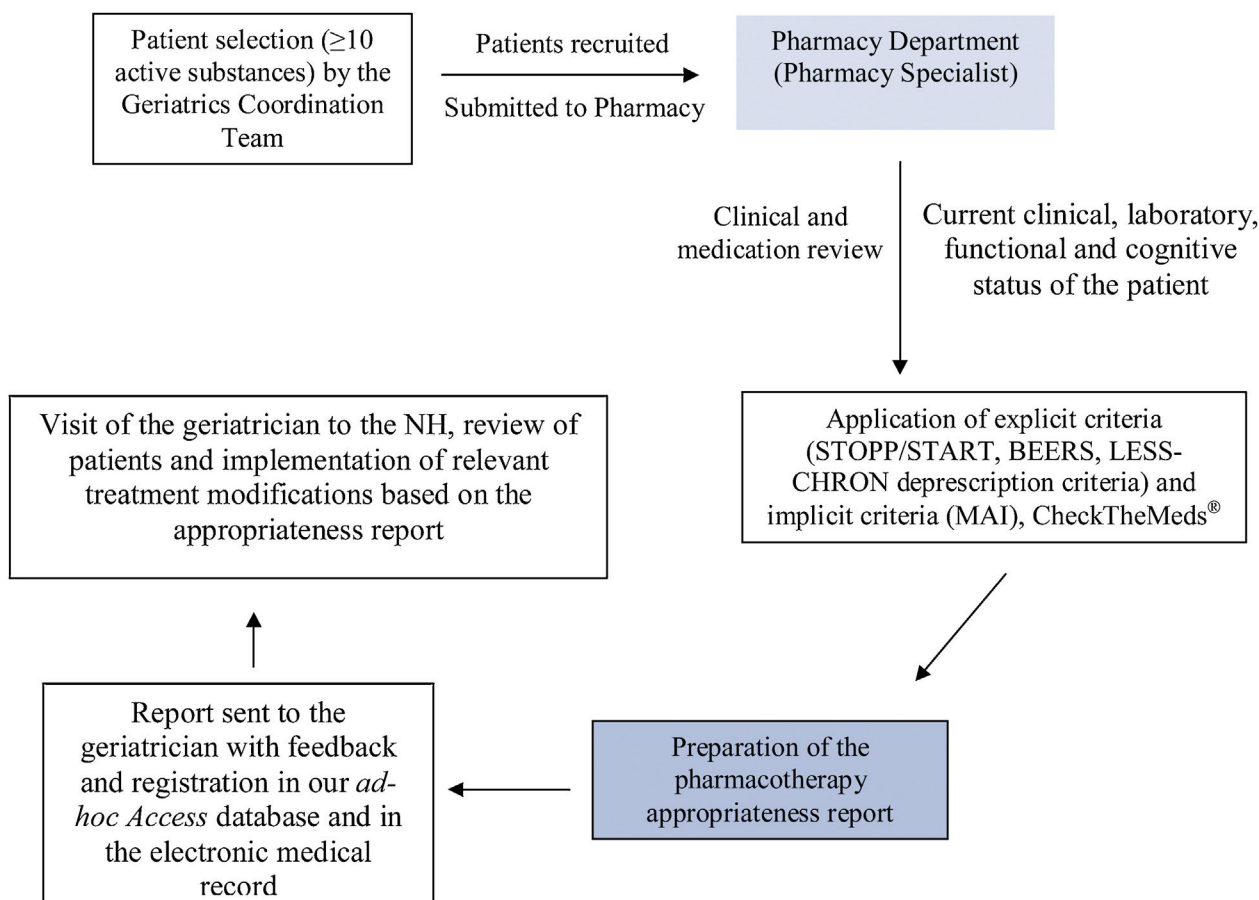


Fig. 1. Work circuit.

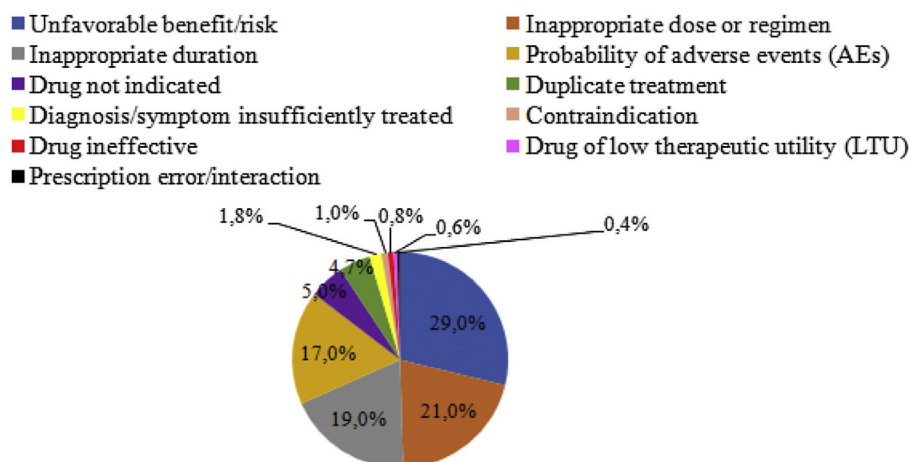


Fig. 2. Drug-related problems detected during the pharmacotherapy appropriateness review.

The most frequent DNOs detected were safety-related (NQS: 46.9% and QS: 35.7%), followed by necessity (N1: 11.4%) and effectiveness (NQE: 2.9%).

The drugs most frequently involved in the detected DRPs (Fig. 3 and Table 2) corresponded to therapeutic groups A (mainly calcium and vitamins B12, folate, and D), group N (mainly antidepressants and benzodiazepines [BZD]), group C (mainly anti-hypertensive and lipid-lowering agents), group M (mainly analgesics), and group B (mainly anti-anemic and anti-thrombotic agents).

PPIs accounted for 41.2% of the DRPs identified according to the explicit criteria used (STOPP/START/BEERS and LESS-CHRON deprescription criteria), the most frequent being those corresponding to the STOPP/START/BEERS (58%) and LESS-CHRON criteria (42%). These criteria include the prolonged use of BZDs and proton pump inhibitors (PPIs) (in most cases without clinical indication for their continued use), inadequate duration of vitamin supplements, prescribed medication without indication based on clinical evidence, acetyl salicylic acid (ASA) and statins in primary prevention,

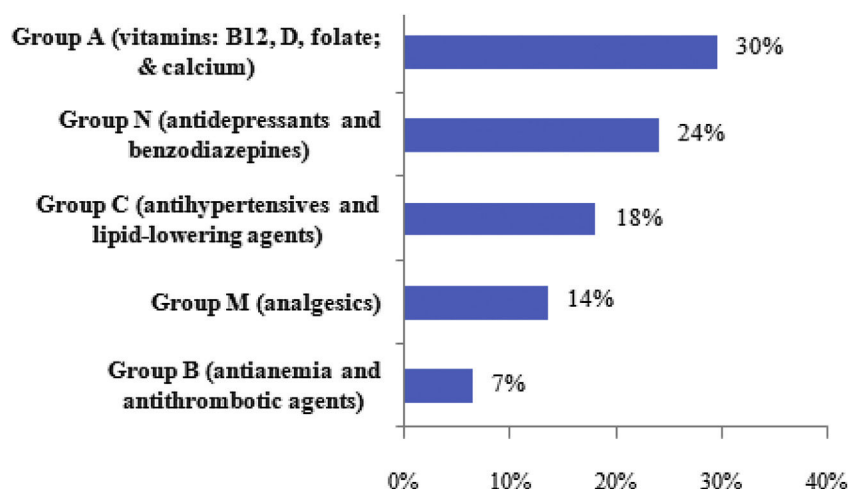


Fig. 3. Main therapeutic groups associated with drug-related problems.

Table 2

Drugs most associated with drug-related problems.

Drug	Total (%)
Antidepressants (trazodone, escitalopram, citalopram, mirtazapine)	9.4%
Calcium/cholecalciferol, calcifediol	8.8%
PPIs (omeprazole, pantoprazole)	7.5%
Analgesics (paracetamol/tramadol, metamizole)	7.4%
Vitamins (cyanocobalamin, folic acid)	6.1%
BZD (lorazepam, alprazolam)	5.5%
Statins (atorvastatin, simvastatin, rosuvastatin)	5.1%
Antihypertensive agents (ACEi: enalapril, ramipril; diuretics)	3.9%
Antiplatelet agents (ASA)	2.4%
Antipsychotics (risperidone, quetiapine)	1.4%

ASA, acetylsalicylic acid; BZD, benzodiazepines; PPIs, proton pump inhibitors; ACEi, angiotensin-converting enzyme inhibitors.

vitamin D ± calcium supplementation in patients with reduced functionality, non-ambulatory or Barthel index < 60 (deprescribing criteria), and loop diuretics as the first line of treatment for hypertension or malleolar edema (not associated with heart, kidney or liver failure).

The pharmacy department made recommendations in 81.5% of all detected DRPs (a total of 415 pharmaceutical interventions performed: Fig. 4).

The median number of interventions or pharmaceutical recommendations per patient was 4 (IQR: 3–6), and the rate of acceptance by the geriatric department was 73.3%.

Analyzing the degree of acceptance of the recommendations according to DRPs: prescription error/interaction (100%), diagnosis/symptom insufficiently treated (89.1%), not indicated drug (81.5%), contraindication (80.1%), inappropriate dose (76.5%), duplicate treatment (75.2%), probability of AEs (73.6%), inappropriate regimen (71.4%), unfavorable benefit/risk (70.1%), inappropriate duration (68.8%), ineffective drug (50.1%). Finally, the groups of drugs in which the recommendation or pharmaceutical intervention (mainly deprescription or dose reduction) were accepted to a greater extent were: statins in primary prevention (degree of acceptance: 85.2%), antihypertensives (80.4%), iron, calcium and vitamin supplementation (folic, B12 and D) (79.8%), antiresorptive and osteoforming drugs (bisphosphonates, denosumab and teriparatide) (76.5%), analgesics (tramadol, metamizol,

paracetamol), antipsychotics, oral antidiabetics and antidementia drugs (66.6%), PPIs (65.8%) and antidepressants (65.7%).

The performance of pharmaceutical interventions and the relevant treatment changes based on the report of appropriate use led to a 23.1% reduction in the number of drugs prescribed per patient. The median number of drugs per patient at the end of the appropriateness study was 10 (IQR: 9–12), which resulted in an economic saving of €16218/6 months.

Discussion

The multidisciplinary coordination between the hospital pharmacy, geriatric department and the NH's medical team has made it possible to improve the appropriateness of pharmacotherapy in the highly polymedicated patients of these centers, with a reduction in polypharmacy and a decrease in associated costs. The systematic review of the pharmacotherapy in these patients has allowed the detection of a high number of DRPs and PIPs. The use of tools to carry out the pharmacotherapeutic review (Checkthemeds software, together with the use of algorithms, explicit criteria or deprescription), are an important aid in the detection of these DRPs and PIPs, but they must always be accompanied by an exhaustive analysis by the pharmacist and in communication with the medical team, who, according to their best criteria and taking into account the current situation of the patient, will select the real or most important DRPs on which to intervene.

PIPs and DRPs in older people lead to increased morbidity and mortality, increased hospital admissions, and higher use of health-care resources, hence the importance and need for a periodic clinical review of prescriptions to adjust pharmacotherapy to the patient's current situation.²⁴

Patients in NHs are mainly characterized by their high clinical complexity and extreme vulnerability, which, together with polypharmacy, makes the risk of AEs higher than in the rest of the population.

The median number of drugs per patient in our NHs at the beginning of the appropriate medication use review was 13, with a prevalence of 4.9 DRPs/patient. If we compare our data with the literature, we can see that there is great variability, although our results are similar to or even greater than those of other authors.^{25,26}

It is essential to implement interventions by multidisciplinary teams and promote geriatric evaluation, training and education of professionals and periodic review of prescriptions to optimize pharmacotherapy, rationalize the use of drugs and improve the

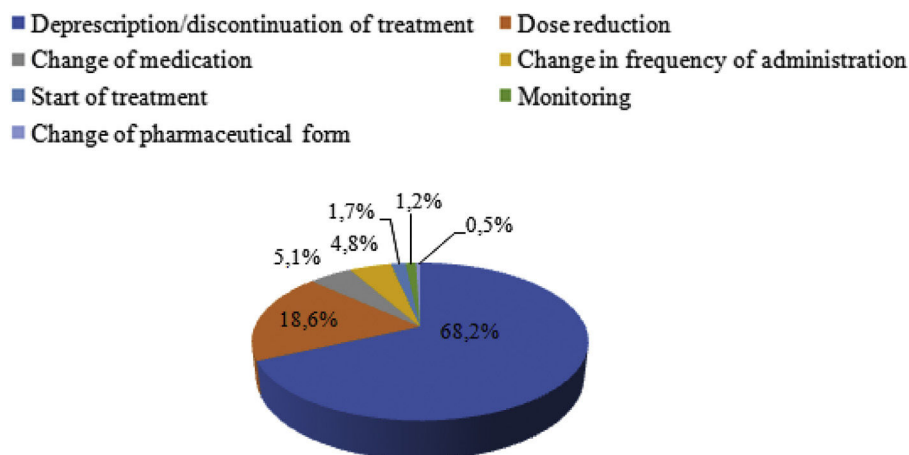


Fig. 4. Summary of pharmaceutical interventions performed by the geriatric coordination team.

therapeutic efficiency, especially in NHs. The incorporation of the pharmacist is paramount in many of these processes.¹¹

Improvements in the quality of prescriptions through pharmaceutical interventions have been demonstrated in numerous studies^{24–28}; multidisciplinary teamwork has also proven effective^{11,29} in significantly resolving DRPs and DNOs. An average of 3.9 interventions/patient were performed in our NHs, higher than that published by other authors,³⁰ probably due to the patient profile and the greater number of drugs prescribed.

The pattern of DRPs and DNOs followed a distribution similar to that described in the literature,²⁷ with the majority of DRPs being related to benefit/risk, dose, indication, duration and probability of AEs, while DNOs were related to safety and necessity. Overall, 41.2% of the PIPs detected were identified mainly through the explicit STOPP, BEERS and LESS-CHRON criteria, a result similar to that reported by other authors.³¹

Using this strategy of reviewing prescribing appropriateness, we not only succeeded in detecting PIP/DRP in our elderly patients and recommending solutions, but we also managed to reduce the number of drugs prescribed per patient by 23.1%, which has resulted in a six-monthly saving of €16,218.

Our pharmaceutical interventions had a degree of acceptance by the multidisciplinary team of 73.3%, similar to that described in the literature.³² The degree of acceptance was analyzed both according to the DRPs and by group of drugs. This may be useful information for selecting target drug groups for intervention: deprescription of statins in primary prevention, deprescription or reduction of antihypertensive dose (therapeutic goal of higher blood pressure based on functional status), deprescription or adjustment of dose or frequency in iron and vitamin supplementation, deprescription of antiresorptive drugs according to baseline situation. It should be noted that the DRPs with a higher than average acceptance are those that could be the most serious for the patient (prescription/interaction error, contraindication, not indicated drug or diagnosis/symptom insufficiently treated).

Among the limitations of this program, it should be noted that when the program is managed from the hospital pharmacy department, it is impossible to guarantee the physical presence of the pharmacist in the NHs of the province, and only digital information entered in the medical records is available. This means that, in many cases, unless the patient has been admitted to hospital or has had a recent laboratory test, it is difficult to precisely determine their current status, in order to be able to adjust their medication (in those cases we rely only on the information received from the NH nurse).

The third global patient safety challenge of the World Health Organization (WHO), “Medication Without Harm”, states that actions should be put in place to reduce inappropriate polymedication in chronic patients. The implementation of multidisciplinary collaborative projects between hospital pharmacy, geriatric medicine and NHs with the aim of systematically reviewing medication in chronic polymedicated patients in order to detect or prevent AEs, ensure appropriateness and improve adherence to treatment, could be an initiative for other hospitals to advance health- and pharmaceutical care in NHs.

Strategies to determine the appropriateness of medical prescriptions provide great support to clinicians, rationalize the use of drugs, improve the quality of prescribing in these patients and enhance safety.

In conclusion, periodic clinical review of the prescriptions of NH residents has proven necessary to adjust pharmacotherapy to the patient's current clinical, laboratory, functional and cognitive status. The incorporation of the pharmacist in the multidisciplinary team is essential to this process.

The appropriateness of medication prescribing in polymedicated older adults living in NHs by the pharmacist has made it possible to reduce DRPs and PIPs and to save costs thanks to the high degree of acceptance by geriatricians.

Contributors

The six authors equally contributed to the work.

Patient consent for publication

Not required.

Data availability statement

All data relevant to the study are included in the article.

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Conflict of interests

None declared.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.regg.2023.01.008.

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