

DESCRIPTION OF A SYSTEMATIC PHARMACEUTICAL CARE APPROACH INTENDED TO INCREASE THE APPROPRIATENESS OF MEDICATION USE BY ELDERLY PATIENTS

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Abstract

Background & Aims. *The pharmaceutical care practice represents a model of responsible pharmacist involvement in the pharmacotherapy optimization of various population groups, including the elderly, known to be at risk for drug-related problems. Romanian pharmacists could use validated pharmaceutical care experiences to confirm their role as health-care professionals.*

This descriptive research presents the application in two real and different environments of practice of a structured pharmaceutical care approach conceived as the basis for a medication review activity and aiming at the identification and resolution of the drug related problems in the elderly

Patients and methods. *Two patients with similar degree of disease-burden complexity, receiving care in different health-care environments (The Geriatric Ward of the Royal Victoria Hospital from the McGill University Health Centre in Montréal, Québec, Canada, in November 2010, and an urban nursing-home facility in Cluj-Napoca, Romania, in March 2011), were chosen for the analysis. One clinical pharmacist suggested solutions for the management of each of the active drug-related problems identified, using the systematic pharmaceutical care approach and specific published geriatric pharmacotherapy recommendations. The number of the drug-related problems identified and the degree of the care-team acceptance of the pharmacists' solutions were noted for each patient.*

Results. *The pharmacist found 6 active drug-related problems for the hospitalized patient (72 year-old, Chronic Disease Score 9) and 7 potential ones for the nursing-home resident (79 year-old, Chronic Disease Score 8), involving misuse, underuse and overuse of medications. Each patient had 3 geriatric syndromes at baseline. The therapy changes suggested by the pharmacist were implemented for the hospitalized patient, through collaboration with the health-care team. For the nursing home resident, the pharmacist identified the need for additional 6 medications and safety and efficacy arguments to cease 7 initial therapies, simplifying the therapeutic daily schedule (from 24 daily doses to 15).*

Conclusion. *The pharmacist's potential contribution to the optimization of the Romanian elderly patients' pharmacotherapy needs further exploration, as potential drug related problems reported as characteristic for this population were easily identified. The presented structured and validated model of pharmaceutical care approach could be used to this end. Its dissemination and use could be encouraged along with the enhancement of pharmacotherapy information and care team collaboration skills.*

Keywords: Drug-related problems, elderly, pharmaceutical care, medication review, inappropriate medication use

Introduction

The aging process involves multi-level and complex changes that interfere with the pharmacokinetic evolution and with the pharmacodynamic response of the recommended drug regimens; the medication use by the elderly patients has a number of particular features, as they are more exposed to the side effects of medications acting on the central nervous system, while sleep disorders, risk of falls, or urinary incontinence become frequent issues requiring management; their medical care involves the daily administration of multiple medications, many of them insufficiently tested in this population and therefore increasing the risk for drug-related problems (DRP) [1,2].

Inappropriate medication use represents the administration of drugs that involve more risks than benefits to the elderly patients and it constitutes a major and frequent health-related issue in this population, independent of its care environment [3,4]. The reported prevalence of this phenomenon can vary significantly, depending on local availability of the recommended medications and patterns of medication use and elderly care: 64.9% of community-dwelling elderly patients had at least one risk factor for DRP, and 12.2% to 20.3% of the emergency department visits or hospitalizations were attributed to DRP [5-7].

The pharmaceutical care concept of practice includes as a main characteristic the need for an interdisciplinary approach in the choice and monitoring of the patients' pharmacotherapy, with pharmacists taking responsibility for the patients' therapeutic outcomes [8]. As such, pharmacists around the world became involved in the elderly patients therapeutic care, aiming for a safer and more effective medication use, through several types of activities: patient interview, medication review, presentation of drug regimen recommendations to the care team, drug monitoring and recommendation follow-up, drug therapy dosing or management, patient counseling or follow-up after hospital discharge [9-12].

Among these activities, several studies confirmed the potential benefit of a structured medication review process, conducted by trained pharmacists in a variety of settings of patient care, by taking into consideration the elderly health status and medications and by having access to their medical information [13,14]. This process involves the evaluation of the safety and effectiveness of each drug, the identification of viable solutions for the unmet therapeutic objectives, monitoring the progress of the conditions being treated, and discussing specific aspects of the patient's medication with the care team and with the patient [15-17].

Furthermore, the activities embodied in the medication review process became part of the legal requirements for the pharmacists' practice, underlining their relevance for the contemporary pharmacists' activities [18-20]. In Romania, the *Guidelines for Good Pharmaceutical Practice* state that the pharmacists' activity should include appropriate information and advice for patients with the promotion of rational prescribing and appropriate use of medicines [21]. However, although formally trained clinical pharmacists are working in hospitals, their responsibilities are mainly administrative and focused on the delivery of drugs with little interaction with the care team, regardless of the hospital unit considered.

The optimization of the elderly pharmacotherapy could become a targeted intervention for the Romanian pharmacist, in a context where individuals over 65 years old represent 16.1% of the stable population, while the life expectancy for a woman is 77.5 years compared with the European estimate of 83.2 years [22]. Moreover, Romanian elderly patients could be exposed to drug-related problems characteristic for this population, considering that 76.1% of the persons over 75 years old have chronic diseases and there is an annual increase of 17.82% in the rate of hospitalizations in this population [23,24].

The objective of the present study was to present a systematic pharmaceutical care approach implemented in a Canadian hospital geriatric unit (The Geriatric Ward of the Royal Victoria Hospital of the McGill University Health Centre in Montréal) and applied in a Romanian elderly patient, institutionalized in a local nursing-home (Cluj-Napoca) in order to identify the potential DRP and suggest solutions based on the active support of the patient's care team. This experience could be integrated into more complex approaches aiming at consolidating the potential active role of the pharmacist in this context, starting with curriculum changes at an undergraduate level.

Patients and methods

Description of the pharmaceutical care approach

The Geriatric Ward of the Royal Victoria Hospital of the McGill University Health Centre in Montréal (Québec, Canada) comprises 25 beds, attended by an interdisciplinary team including physicians, nurses, a clinical pharmacist, an occupational therapist, a nutritionist, a social worker and a physiotherapist. The hospital pharmacy is responsible for the delivery of the medications to the geriatric patients, as the pharmacist's responsibility in the unit refers only to the provision of pharmaceutical care activities. In this context, after the patients' admission to the unit, the pharmacist undertakes the steps included in the pharmaceutical care approach, being involved in the validation pro-

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cess of the therapy recommended for hospitalized patients and also authorized to give a written professional opinion in the patients charts and to complete a discharge care plan (Table I) [8,25-27].

Table I. The steps involved the medication review process

step: corresponding pharmacist's activity
<p>the first step: establishing a relationship based on trust with the patient</p> <p>The pharmacist personally meets the patient or its caregiver, in the first 24 hours after admission if feasible. This allows the patient to express his views and concerns relating to the therapy he is receiving and to identify the pharmacist as a member of the medical team that cares for him.</p>
<p>the second step: gathering the necessary information</p> <p>The information necessary for the identification and the subsequent resolution of the DRP experienced by the patient includes:</p> <ul style="list-style-type: none"> • personal characteristics and functional profile (age, sex, body mass index, auditory or sight problems, use of a walker, cognition); • social context; • allergies and intolerances; • diagnoses and reasons for admission including information related to medication use prior to admission; • medical history; • medication history and degree of autonomy in the medication administration (use of a pill organizer); • contact information of the community providers of care (pharmacist, general physician, local community service center, permanent or planned caregivers). <p>The information can be obtained from the patient or his caregiver, from the family physician, from the other community providers of care (the Canadian community pharmacy keeps for each patient an updated medication history profile), using the results of the laboratory tests or complementary investigations performed.</p>
<p>the third step: identifying the DRP</p> <p>Using the gathered information, the pharmacist identifies the DRP associated to each of his diagnoses and attempts to prioritize them. The most frequent DRP are:</p> <ul style="list-style-type: none"> • the patient needs a new treatment as he/ she presents a new disease or symptom; • the patient receives a drug that he/ she does not need; • the patient receives a wrong drug (benefit/ risk assessment unfavorable for the geriatric patient, inconvenient dosage form, drug too expensive); • the administered dose is too high or too low; • the patient is non-compliant; • the treatment has side-effects or interactions etc.
<p>the fourth step: elaboration of the care plan</p> <p>Once identified, the pharmacist suggests solutions for each DRP found, using information available in the literature and personal experience and judgment. Therefore, the pharmacist takes responsibility for the patients' therapeutic outcomes. The solutions take into consideration the patients opinions and wishes. The care plan starts with the identification of objectives to be attained through the solution implemented for each DRP and it establishes the monitoring parameters needed to evaluate the solutions' safety and effectiveness.</p>
<p>the fifth step: implementation of the care plan</p> <p>First, all the new information gathered and the recommendations of the pharmacist are mentioned in the medical chart so that they become available to the whole medical team. The pharmacist discusses his recommendations with the physicians, nurses and the other members of the care team: stopping, replacing or introducing medications, modifying schedule of administration to prevent side-effects or interactions, adapting pharmaceutical presentation to the deglutition capacity of the patient etc.</p>
<p>the sixth step: reevaluation of the care plan</p> <p>The reevaluation of the care plan becomes necessary as the patient status evolves. The pharmacist notes the interventions made, the evolution of the patient and his/ her response to treatment. When the patient is being discharged from the hospital, the pharmacist is preparing the discharge care plan, designed to ensure the continuity of care (integrated into the seamless care concept) later on, after the patient returns to the community or is transferred to a long-term care facility. It includes a list of the medications taken before admission, of those indicated before discharge and the reasons for the changes made. A copy of this plan is given to the patient and others are sent to the community pharmacist, to the family physician and (if it is necessary) to the local community center caring for the patient. The pharmacist is also counseling the patient and/ or his/ her caregivers on the new medication plan and offers solutions to commonly encountered problems potentially associated with the suggested therapy.</p>

DRP, drug-related problems

Patients submitted to the comparative medication review process

For the illustration of the pharmaceutical care approach, two patients representative for their environments of care and estimated to have similar disease burdens (assessed with the Chronic Disease Score, CDS [28]) were chosen: a Canadian patient hospitalized at the Geriatric unit of Royal Victoria Hospital of the McGill University Health Centre in Montréal and a Romanian resident of a local nursing home in Cluj-Napoca; both patients were fol-

lowed for 4 weeks (November 2010 and March 2011 respectively), by the same clinical pharmacist, who used for the pharmacotherapy analysis several geriatric pharmacotherapy textbooks and medication appropriateness evaluation tools [29-33].

Main outcome measure

The number of the identified drug-related problems for each patients and the degree of care- team acceptance of the pharmacists' solutions were observed.

Table II. The patients' admission data

Hospitalized patient		Nursing-home resident	
Medical history		Medical history	
diabetes mellitus arterial hypertension postural hypotension ischemic heart disease (old myocardial infarction) dyslipidemia	chronic kidney disease vascular dementia obesity urinary incontinence urinary tract infection ¹	diabetes mellitus arterial hypertension ischemic heart disease central and peripheral circulatory disease dyslipidemia	depressive disorder schizophrenia arthritis osteoporosis hemorrhoidal disease constipation
Chronic Disease Score: 8		Chronic Disease Score: 9	
Medication history before admission to the geriatric unit ²		Medication history compiled from the patients' chart	
clonidine 0.2mg 2x/day acebutolol 100mg 2x/day ³ indapamide 1.25mg 1x/day ramipril 10mg 1x/day amlodipine 10mg 1x/day rosuvastatine 10mg 1x/day aspirin 325mg 1x/day Insulin Novolin 30/70 48 -0-36 (units) Insulin Novorapid 17-17-17 (units) paracetamol 650mg 4x/day as needed		nifedipine 20mg SR 2x/ ay pentaerythritol tetranitrate 20mg 3x/day trimetazidine SR 35mg 2x/ day metoprolol 25mg 2x/day aspirin 75mg 1x/day piracetam 400mg 2x/day Ginkgo biloba 40mg 3x/day simvastatin 20mg 1x/day	tramadol 50mg 2x/day flupentixol 20mg IM monthly Insulin Insuman Basal 26 units daily metformin 850 mg 2x/day diazepam 10 mg IM as needed diclofenac 75mg or ketoprofen 100mg or metamizol 1g IM as needed ⁴ diosmin 500mg 2x/day ⁶ gentamicin ⁵ 80mg IM 2x/ day
Relevant laboratory tests at admission to the geriatric unit:		Available laboratory tests:	
creatinine 2.51 mg/dl (<1.2) Clcr 14.5ml/min (90-140) glucose 100.90 mg/dl (70-115) HbA1C 6.1% (<7%) B12 320 pg/mL(>110) follate 18 nmol/L (4.5-45.3)	albumine 32g/L (35-52) TSH 2.89 µUI/ml (0.27-4.20) CK 640 IU/L (<192) MMSE score 19/30 BMI 39.53	glucose 153 mg/dl (70-115) triglycerides 156 mg/dl (50-200) total cholesterol 219 mg/dl (<200) creatinine 1,18 mg/dl (<1.2) Clcr 42.72ml/min (90-140)	HDL-cholesterol 34.3 mg/dl (>40) LDL-cholesterol 153.5 mg/dl (<130) BMI 27.31

¹ with *Citrobacter freundii* (treated with ciprofloxacin 250mg 2x/day, for 5 days)

² the patient got flu vaccination during hospitalization

³ acebutolol was not available on the hospital formulary and was replaced with atenolol 25mg 1x/day

⁴ used as analgesics

⁵ as empiric treatment for a respiratory tract infection, for 5 days

⁶ for the management of hemorrhoidal disease for 15 days

BMI body mass index, CK creatine phosphokinase, Clcr Creatinine Clearance estimated with the Cockcroft Gault formula using the patients' ideal body weight, MMSE Mini Mental State Examination.

Results

The pharmacists' intervention as a care team member

A 72 year-old Canadian woman was admitted to the Geriatric ward for recurrent falls (6 episodes in the last 3 months), general weakness and accelerated cognitive decline during the last 3 months. On admission, the patient had a urinary tract infection and atrial fibrillation.

According to the first and second steps of the pharmacists' involvement in the medication review process, the pharmacist met the patient, who was unable to give the necessary information. The daughter living with the patient answered the pharmacist's questions, who also contacted the community pharmacist providing the patient's medications (Table II). The patient had an impaired mobility as she was using a walker at home and rarely left the house. The daughter was the one managing the medications at home, using a 'dispill' (personalized pill organizer prepared by the community pharmacy) and the insulin syringes pre-filled in the pharmacy. The test strips for blood glucose monitoring were not used. The community pharmacy confirmed that the insulin syringes were sometimes returned full and that the patient's prescribing physician renewed the prescription at the pharmacy request, without seeing the patient. According to the daughter, the patient did not take other medication or natural products, besides her prescription medication, with the exception of paracetamol used for the pain caused by the recent falls.

The pharmacist assessed the information and identified six active DRP: the patient took multiple antihypertensive medications in the context of severe renal dysfunction, increasing the risk for hypotensive episodes and possibly causing the reported falls (6 episodes the last 3 months); the patient received high insulin doses and was at risk for hypoglycemia, in the context of dementia, severe renal dysfunction and concomitant beta-blocker therapy; the patient presented increased creatine phosphokinase levels, as a possible side-effect of statin treatment; the patient received a high aspirin anti-platelet dose as secondary prevention, in the context of unconfirmed atrial fibrillation; frequent monitoring of the renal function was necessary, as the patient had severe renal dysfunction; the patient was at risk for rebound hypertension after clonidine's abrupt withdrawal. The pharmacist elaborated the care plan (the third and the fourth steps of the approach), her recommendations were transmitted to the care team and the patient's evolution was noted in the care plan (the fifth and the sixth steps) (Table III).

During her stay on the geriatric unit, the patient was also assessed by the other members of the geriatric team: the nurses noted occasional disorientation at time and place, while the nutritionist recommended a diabetic diet with a low potassium intake and a maximum of 60g of proteins per day. The occupational therapist recommended that the patient needed 24 hours of assistance, as she had decreased cognition, was at risk of limitations for activities of

Table III. The hospitalized patient pharmaceutical care plan

	<i>Health related problems</i>					
	<i>Arterial hypertension and postural hypotension</i>	<i>Chronic kidney disease</i>	<i>Increased fall risk</i>	<i>Ischemic heart disease</i>	<i>Dyslipidemia</i>	<i>Diabetes mellitus</i>
<i>therapeutic objectives</i>	Maintain BP <140/90 mmHg without orthostatic hypotension. Prevent rebound hypertension possible after clonidine's abrupt withdrawal at admission (5 days before).	Maintain or improve renal function.	Prevent falls. Reduce fracture risks (postural hypotension, hypoglycemic episodes with concomitant beta-blocker treatment, muscular weakness).	Prevent unnecessary and potentially unsafe high dose of aspirin.	Prevent muscle damage as CK 640 IU/L at admission. Evaluate indication and safety of rosuvastatin.	Maintain glycemic control (preprandial blood glucose 3.9-7.2 mmol/L, postprandial blood glucose <10.0 mmol/L, HbA1C<7%). Avoid hypoglycemia.
<i>possible solutions</i>	Monitor BP daily. Taper clonidine. Stop indapamide. Decrease ramipril to 5mg daily. Reconsider anti-arrhythmic treatment: metoprolol 25mg 2x/day, verapamil 40mg 2x/day or diltiazem 60mg 3x/day.	Reevaluate treatment as Clcr = 14.5 ml/min. Recommend nephrology consult.	Adjust hypertension treatment. Adjust insulin doses. Start calcium and vitamin D (1g/800IU/ day).	Reevaluate indication for 325mg daily aspirin. Adjust aspirin dose to 81 mg.	Temporarily stop rosuvastatin and recheck CK values. Check patients chart for previous CK levels.	Adjust insulin doses. Reevaluate beta-blocker treatment.

	<i>Health related problems</i>					
	<i>Arterial hypertension and postural hypotension</i>	<i>Chronic kidney disease</i>	<i>Increased fall risk</i>	<i>Ischemic heart disease</i>	<i>Dyslipidemia</i>	<i>Diabetes mellitus</i>
chosen solution	BP monitored daily for approximately 2 weeks after clonidine's abrupt withdrawal. Indapamide stopped. Amlodipine stopped. Diltiazem 60mg 3x/day started. Ramipril adjusted to 5mg/day.	Indapamide, ramipril and acebutolol were re-evaluated. Nephrology team delayed dialysis until Clcr <10ml/min.	Acetobutolol, indapamide and amlodipine stopped. BP monitored daily. Insulin dose adjusted to: Regular 18-6-12 units and NPH 0-0-0-9 units. Calcium and vitamin D started (1g/800IU/day).	Cardiology consult did not confirm atrial fibrillation. Aspirin dose adjusted to 81mg daily.	Rosuvastatin stopped for 7 days. Patients chart indicated that CK levels were always higher than reference (265-364 IU/L), under various statins treatment.	Endocrinology team adjusted insulin dose to: Regular 18-6-12 units and NPH 0-0-0-9 units. Acebutolol stopped.
pharmacists intervention	Inform the care team. Inform the patients' daughter. Note in the patients' chart.	Inform the care team. Inform the patients' daughter. Note in the patients' chart.	Inform the care team and the patient's daughter. Note in the patient's chart. Monitor if patient was able to swallow calcium tablet.	Inform the care team. Inform the patients' daughter. Note in the patients chart.	Inform the care team and the patients' daughter. Note in the patients chart: intolerance to statins.	Inform the care team. Inform the patients' daughter. Note in the patients' chart.
necessary monitoring	BP monitored daily for approximately 2 weeks. HR. Compliance.	Creatinine level. Electrolytes. Adjust medications according to CrCl.	BP monitored daily for approximately 2 weeks. Blood glucose 4 times daily for one week, then 2 times weekly Monitor if patient was able to swallow calcium tablet. Signs of constipation ¹ .	Complete blood count every 6 months.	Cholesterol levels every 6 months.	Blood glucose 4 times daily for one week, then 2 times weekly. HbA1C every 6 months.
outcomes	BP variations: 134/70 to 148/88. HR variations: 56 to 66 bpm.	Dialysis delayed until Clcr <10ml/min.	Hypotensive and hypoglycemic episodes were avoided during hospitalization.	Aspirin dose adjusted to 81mg daily.	CK levels dropped from 640 IU/L to 119 IU/L during the 7 days withdrawal of rosuvastatin. Statin treatment was not restarted.	Hypo- and hyperglycemic episodes were avoided during hospitalization.

¹lactulose was added according to local protocol for constipation management.
BP blood pressure, CK creatine phosphokinase, Clcr Creatinine Clearance, HR heart rate.

daily living, had decreased insight and reduced temporal orientation, calculation and balance. The physiotherapist did not confirm the peripheral neuropathy, previously suggested, but found hip flexors weakness. The physician concluded that the patient had no initiative and an increased fall risk with walker. The urinary incontinence was not associated with urinary retention and was assessed as having a mixed etiology with no treatment being initiated.

The patient was evaluated as clinically stable and the medical history was updated to gait apraxia, vascular dementia, diabetes mellitus, hypertension, coronary artery disease, chronic renal failure, urinary incontinence. After approximately 4 weeks of hospitalization and with the daughters' approval, the patient was declared long-term care and the social worker initiated the procedure for placement. The medication list before hospital discharge was: paracetamol 650 mg every 4-6h as needed considering the assessed pain intensity, aspirin 81mg 1x/day, ramipril 5mg 1x/day, diltiazem LA 180mg 1x/day, calcium carbonate and vitamin D 500mg/400IU 2x/day, lactulose 30ml 3x/day, Insulin Novorapid 20-6-12-0 (units), Insulin Novolin NPH 0-0-0-9 (units).

The care plan suggested by the pharmacist

The second patient submitted to the medication review process was a 79 year-old woman, institutionalized in a Romanian nursing-home, 4 years prior to the pharmacist's evaluation. She had a diagnosis of schizophrenia and was considered a difficult resident to attend, as she presented frequent episodes of agitation, claiming she was in pain. The pharmacist could not talk directly to this nursing-home resident and therefore she gathered the information necessary for the analysis, considering available information related to her previous hospitalizations, various prescriptions existing in her chart, the nurse's notes referring to medication administered as needed and from discussions with the facility nurse (Table II). The third and the fourth steps of the pharmaceutical care approach were completed by the pharmacist (Table IV), who identified seven active DRP: the patient needed a reevaluation of the arthritic pain experienced, with the implementation of an efficient and also safer analgesic treatment, as the analysis of the nurses' charts indicated that ketoprofen (100mg IM) or diclofenac (75mg IM) were daily used; the antihypertensive treatment needed to be reevaluated as the blood pressure varied from

Table IV. Pharmaceutical care plan for the nursing home resident

	<i>Health related problems</i>						
	<i>Uncontrolled arthritic pain</i>	<i>Dyslipidemia</i>	<i>Constipation, hemorrhoidal disease</i>	<i>Osteoporosis and fall risk</i>	<i>Uncontrolled arterial hypertension</i>	<i>Depression and anxiety</i>	<i>Use of medications without specific indication or potentially unsafe</i>
<i>therapeutic objectives</i>	Control pain. Avoid NSAIDs side effects.	Reevaluate statin in a psychiatric and poly-medicated patient.	Avoid hemorrhoidal disease. Avoid drug induced constipation (tramadol, simvastatin, flupentixol).	Reduce fall and fracture risk in a patient still able to ambulate.	Maintain BP <140/90 mmHg without orthostatic hypotension.	Prevent depressive and anxious states in a psychiatric patient.	Prevent unnecessary medications use. Prevent potential side effects.
<i>possible solutions</i>	Discontinue regular NSAID treatment (diclofenac or ketoprofen IM). Start regular and safer analgesic treatment.	Discontinue simvastatin.	Start regular use of laxatives. Reevaluate medications causing constipation.	Start oral biphosphonate. Start calcium and vitamin D (1g/ 800IU/day). Stop diazepam.	Start ACEI (perindopril 2 mg 1x/day, fosinopril 10mg 1x/ day or enalapril 2.5mg 2x/day) Stop regular NSAID treatment.	Taper diazepam. Psychiatric reevaluation. Start antidepressant and anxiolytic treatment (escitalopram 10mg daily) and stop tramadol	Discontinue trimetazidine. Discontinue Ginkgo biloba extract. Discontinue piracetam. Discontinue gentamicin as empiric treatment for respiratory tract infections. Discontinue tramadol

	<i>Health related problems</i>						
	<i>Uncontrolled arthritic pain</i>	<i>Dyslipidemia</i>	<i>Constipation, hemorrhoidal disease</i>	<i>Osteoporosis and fall risk</i>	<i>Uncontrolled arterial hypertension</i>	<i>Depression and anxiety</i>	<i>Use of medications without specific indication or potentially unsafe</i>
chosen solution	Stop regular NSAID treatment. Start paracetamol 500mg every 4-6 hours regularly.	Stop simvastatin.	Start lactulose 15-45ml daily, adjusted to stool frequency. Stop simvastatin. Stop tramadol.	Start alendronate 70mg 1x/week. Start calcium and vitamin D (1g/ 800IU/day). Switch to oral form and taper diazepam: a 2.5mg weekly reduction, through a 3 weeks interval.	Start fosinopril 10mg daily. Stop ketoprofen 100mg/day IM and diclofenac 75mg/day IM.	Switch to 10mg diazepam tablet and taper with a 2.5mg weekly reduction, through a 3 weeks interval. Start escitalopram 10mg daily. Stop tramadol.	Stop trimetazidine. Stop Ginkgo biloba extract. Discontinue gentamicin as empiric treatment for respiratory tract infections. Stop tramadol.
pharmacists intervention	Document NSAIDs gastrointestinal, renal and cardiovascular potential side-effects. Evaluate pain intensity using verbal descriptor rating or verbal numerical scale. Consider other analgesic options if paracetamol proves to be insufficient.	Document reason for simvastatin discontinuation.	Document constipation as a risk for hemorrhoids. Document risks of constipation in the elderly. Document use of drugs inducing constipation.	Document administration precautions for alendronate. Document fall and fracture risk associated with diazepam use. Document the taper schedule for diazepam.	Document ACEI benefits in reducing the progression of renal disease in a diabetic patient. Document the possible NSAIDs effects on BP.	Document diazepam use as chemical restraint. Document persistent, uncontrolled pain as a possible cause for agitation. Document risk of serotonin syndrome for tramadol with escitalopram.	Document the debatable benefit of trimetazidine and Ginkgo biloba in this context. Document safer oral antibiotics options. Document risk of serotonin syndrome with concomitant use of tramadol and escitalopram.
necessary monitoring	Pain intensity according to the scale used. Hepatic enzymes one week after the initiation of regular paracetamol treatment. Signs of hepatic injury.	LDL-cholesterol level evaluated after 6 months.	Stool frequency according to nurse's documentation.	Gastrointestinal side-effects of alendronate. Monitor if patient is able to swallow calcium tablet.	BP at least daily during first 2 weeks, then weekly. Serum creatinine. Electrolytes.	Anxiety level. Depression symptoms.	Angina signs and symptoms. Signs and symptoms of infection. Pain intensity using validated rating scales.
outcomes	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown

ACEI angiotensin converting enzyme inhibitors, BP blood pressure, IM intramuscular, NSAIDs nonsteroidal anti-inflammatory drugs.

140/90 mmHg to 180/100 mmHg; the patient had a diagnosis of osteoporosis noted in her chart, but no treatment, although it was not an immobilized patient; the regular use of diazepam (mentioned daily in the nurse's notes) possibly as a chemical restraint, exposed the patient to the risk of falls and fractures, especially in the absence of an osteoporosis medication; the patient needed a treatment for constipation, in the context of repetitive episodes of hemorrhoidal disease and of that of use of several constipation-inducing medications; the patient receiving flupentixol for schizophrenia had episodes of anxiety, that suggested the need for psychiatric reevaluation and adequate treatment; the patient was at risk for polypharmacy, using medications with debatable effectiveness or unsafe in this context.

As the physician attending the facility at the time was not available, the implementation of the pharmacist's solutions was difficult, so the outcomes of her suggestions are unknown. The pharmacist suggested alternative dosage forms to reduce the number of daily-administered doses, while for the diabetes treatment no active DRP were identified. Therefore, the therapeutic plan suggested by the pharmacist was: nifedipine 30mg SR 1x/day, isosorbide mononitrate SR 40mg 1x/day, metoprolol succinate 50mg 1x/day, aspirin 75mg 1x/day, paracetamol 1000mg 3x/day, flupentixol 20mg IM 1x/month, insulin Insuman Basal 26U/day, metformin 850 mg 2x/day, escitalopram 10mg 1x/day, fosinopril 10mg 1x/day, calcium 1000mg and vitamin D 800UI 1x/day, ibandronate 150mg 1x/month, lactulose 66,7% 45ml/day.

Discussion

This study describes a pharmaceutical care approach that can be used in practice. Although the two patients of this study came from different care settings and different health-care systems, and their management might involve different strategies considering the different level of functionality, the pharmaceutical care approach is similar. The pharmacist's contribution to the therapeutic management of the hospitalized patient is real and measurable, while the recommendations made for the therapy optimization of the nursing home resident remained hypothetical, as a true pharmacist care team collaboration was not implemented at the time of the data collection. This dialog would be necessary, as the care plan suggested by the pharmacist identified seven active DRP and indicated several directions that could potentially increase the effectiveness, acceptability and safety of the geriatric patients' therapy.

The DRP identified for the Romanian patient considered in our study, concerning all instances of inappropriate medication use, resembled those identified through other similar studies. A population-based study conducted in a French sample of elderly people aged 75 years and over, found that 53.6% of subjects had at least one potential inappropriate medication administered during the one year collected data. The main inappropriate drugs identified were cerebral vasodilators, estimated to have question-

able efficacy in this population, drugs with anticholinergic properties increasing the risk of cognitive side-effects in the elderly subjects and long half-life benzodiazepines associated with a high risk of sedation, falls, and hip fractures [34]. Almost 60% of prescriptions for all patients included in a prospective investigation conducted in an acute Geriatric Evaluation and Management unit had at least one inappropriate rating at baseline. The pharmacist's medication review at admission, found that approximately 30% of all patients took at least one drug to avoid in the elderly patient, with long-acting benzodiazepines and dipyridamole summing for 65% of cases, while bisphosphonates, calcium with vitamin D, anticoagulant or aspirin were the most frequently underused medications [35]. Australian authors found in a pre-admission prevalence study that 60% of patients received a potentially inappropriate medication, with opiates or benzodiazepines prescribed in patients with a history of recurrent falls as the most frequently encountered ones [36]. On the other hand, underuse of strategies meant to reduce the risk for falls and fractures is another DRP frequent in the elderly population and it was found in both patients evaluated [37]. Unalleviated persistent pain is frequent in the nursing home environment, due to both underuse and underdosing. One of the main DRP of the analyzed Romanian patient was the insufficient pain relief that potentially contributed to several other DRP, like uncontrolled arterial hypertension, restlessness or symptoms of depression. A multi-center evaluation indicated that only 25% of the residents presenting multiple episodes of daily pain have reported that the round-the-clock analgesic treatment has been effective [38]. Depression is common in late life, it is associated with reduced recovery and it has an increasing incidence with age [39]; it is also an undertreated disorder, a finding confirmed for the nursing home resident [40]. The Romanian patient was also exposed to polypharmacy as she received 14 medications daily; polypharmacy was identified as a risk factor for the potentially inappropriate medication use, while the clinical consequences of this practice include hospitalizations, increased costs secondary to increased use of health care resources and increased mortality [41,42].

However, the outcomes of the pharmacists' recommendations for the Romanian patient remain unknown and the magnitude of the identified misuse of medications should not be generalized.

The multidisciplinary approach involving physicians, nurses and pharmacists, proved to be able to resolve DRP in various environments of care and its implementation should be sought as an educational objective, but also a practice-related one. The pharmacist's contribution took the form of medication reviews that reduced the number of DRP and daily medications used in the nursing home or the community environment, through interventions such as drug discontinuation, suggestions for initiation of therapeutic monitoring or for changes in drug therapy or dose

adjustment [43,44]

The Romanian pharmacist's contribution as a member of the care team for the elderly patients is not yet a reality and validated such models of collaboration are useful and welcome, considering the complexity of the medical needs in this population, independently of their care environment. System-related and university education changes need to be implemented to allow for a more active role of the pharmacist in the medication process that could nevertheless benefit from a structured and already validated pharmaceutical care approach. The university curriculum has a traditional orientation, less focused on the acquisition of clinical knowledge and patient-care related competencies, which are considered to be necessary for the contemporary demands of the practicing pharmacist [45,46]. Complex changes seem to be needed at this level: increasing the proportion of pharmacotherapy courses and patients counseling activities, with simultaneous acquisition of care-team collaboration skills.

Conclusion

This study indicates that a proactive and structured intervention of a pharmacist integrated in an interdisciplinary team, can increase the safety and effectiveness of the medication used by an elderly patient. Secondly, it suggested, through a specific example, that such pharmaceutical care intervention taking the form of a comprehensive medication review, could be necessary at a local level. Larger studies are needed to confirm this hypothesis and to reconfirm this approach. They could emphasize the need for a more practice-oriented type of pharmaceutical university education.

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