ORIGINAL ARTICLE

Prescribing or deprescribing in older persons: what are the real-life concerns in geriatric practice?

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KEY WORDS

comprehensive geriatric assessment, deprescribing, elderly patients, polypharmacy, STOPP/START criteria

ABSTRACT

INTRODUCTION Multimorbidity in older adults leads to polypharmacy with all its hazardous outcomes and drug-related problems.

OBJECTIVES We aimed to assess the difference in the number of drugs between admission to and discharge from a geriatric ward and identified the patient-related factors associated with changes in the drug regimen.

PATIENTS AND METHODS This retrospective cross-sectional study included 301 geriatric patients who underwent drug optimization in line with the Beers and STOPP/START criteria. The numbers of drugs per individual at hospital admission and discharge were compared using the Wilcoxon signed-rank test. A multiple linear regression model was used to identify patient characteristics that influenced the observed difference in the number of drugs following geriatric hospitalization.

RESULTS A significant reduction of 1.29 in the number of drugs per patient, on average, was observed. The Spearman's correlation coefficient between the number of prescribed medications and the number of coexisting conditions per individual changed from 0.28 to 0.51. The patient-related characteristics that jointly and independently explained ($P < 0.001$) the difference in the number of drugs in the multiple regression model ($R^2 = 0.73$) were the number of drugs on admission, number of coexisting conditions, age, fact of living alone, and the incidence of adverse drug reactions.

CONCLUSIONS Geriatric hospitalization results in deprescribing rather than prescribing medications, especially in individuals who were overtreated, older, undernourished, at risk of an adverse drug reaction, and living alone. Appropriate deprescribing may potentially lead to fewer drug-related problems in the senior population as well as reduce health care costs.

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INTRODUCTION An aging population and a growing proportion of older persons with multiple chronic conditions pose new challenges for clinical practice.[1] Currently, multimorbidity—defined as coexistence of at least 2 chronic conditions in an individual—is the norm and not an exception, especially among older adults. Geriatric clinicians associate this phenomenon with the prevalence of several age-specific physical and mental disorders, and independent treatment of such concurrent diseases may lead to an escalation of unexpected and hazardous interactions among several conditions or medications.[2] Although the number of drug-induced problems in an individual is shown to be linearly dependent on the number of medications used on hospital admission, it is difficult to identify an explicit cut-off for the quantity of drug items leading to drug-related problems.[3] Polypharmacy, a direct consequence of multimorbidity, is the term initially coined to address the use of multiple or an excessive amount of drugs. Today, it refers to the more general phenomenon of unnecessary, duplicated, or potentially inappropriate prescriptions (PIPs).[4,5]

The total number of drugs is demonstrated to be an independent predictor for serious adverse drug reactions (ADRs),[6] or even death.[7] Potentially inappropriate prescriptions are shown to enhance the risk of all-cause hospitalization[8] and rehospitalization.[9] Unplanned hospitalization results in a further increase in the numbers of prescribed drugs[10] and generates more ADRs[11] along with functional decline.[12] This dangerous feedback loop may aggravate polypharmacy in older people, which can also be exacerbated by treatment of disease symptoms rather than dealing with its causes and by poor adherence to complex drug regimens, especially in patients treated by multiple specialists who do not communicate with each other.[13,14] Possible drug–drug or drug–disease interactions, prescription cascades, as well as self-medication induced by high accessibility of over-the-counter drugs can worsen the ADR problem in older and comorbid adults.[15] Moreover, a doctor's unawareness of ADRs in a treated individual, potential prescribing errors, or poor patient–doctor relationships in the face of time pressure during medical visits, as well as barriers in communication such as sensory impairment or cognitive disorders in older persons, can further escalate the drug-related problems.[13,16]

Despite advances in modern pharmacokinetics and pharmacodynamics, there is still limited evidence underpinning unified guidelines for optimal prescribing in older people, especially because the oldest, frailest, and most comorbid patients are underrepresented in clinical trials.[17] Without doubt, polypharmacy in older patients poses not only a quantitative problem, but also a qualitative one. The latter refers to thoughtful modifications of a treatment program, regular in-depth reviews of medications, deprescribing potentially inappropriate medications, or seeking safer alternatives if needed.[8,18,19] A multifaceted and patient-centered approach is required to adjust and tailor treatment plans to individual needs.[20] The rational use of medicines in older adults should be based on expert consensus statements, including the Beers criteria,[21] as well as the STOPP (Screening Tool of Older Persons' potentially inappropriate Prescriptions) and START (Screening Tool to Alert doctors to the right Treatment) criteria.[22]

Considering the prevalence of multimorbidity and the elevated risk of drug-induced problems in geriatric patients, we aimed to analyze the changes in the number of medications before and after hospitalization. We sought to evaluate the quantitative effects of complex geriatric medications by comparing the number of medication items with the number of corresponding morbidities both on admission and at discharge from a geriatric ward. Moreover, we aimed to identify and analyze the independent effect of health-related patient characteristics on the difference in the number of prescribed drugs.

PATIENTS AND METHODS

This retrospective cross-sectional study was conducted from January to June 2017 in the geriatric ward of a medium-sized hospital, serving a population of more than 300 000 inhabitants in northeastern Poland. The analysis included a total of 301 consecutive inpatients (mean [SD] age, 82.3 [6.7] years) without any exclusion criteria. The only exceptions were deaths during hospital stays and one-day treatments. Anonymity of patients was ensured. The retrospective use of patients' data was approved by the Ethics Committee of the Medical University of Bialystok (Białystok, Poland) and conformed to the Declaration of Helsinki.

All patients underwent comprehensive geriatric assessment (CGA), which constitutes a multidimensional and multidisciplinary diagnostic process with the purpose of planning and delivering medical, psychosocial, and rehabilitative care.[23] The geriatric evaluation and management (GEM) standard was applied, which utilizes the results of the CGA to identify high-risk patients, cope with the newly recognized conditions, and formulate a suitably tailored care plan which prevents the iatrogenic complications.

The data on long-term medication use were collected at the time of admission to (time T1) and discharge from (time T2) the geriatric ward. The medication doses were not recorded. Altogether, 71 drug items were defined (Supplementary material, *Table S1*). Any modification or discontinuation of drug therapy during a patient's hospital stay was based on an in-depth analysis and careful decision in line with the Beers[21] and STOPP/START criteria,[22] comorbidity level, and individually agreed-upon treatment goals in patients.

Dependent variable

The difference in the number of drugs (DND) was calculated for each patient as the difference between the number of drugs taken at discharge (NoT2) and the number of drugs taken on admission (NoT1) to the geriatric ward. Accordingly, positive and negative DND values correspond to prescribing and deprescribing in geriatric patients, respectively.

Inpatient characteristics as potential explanatory factors

Numerous inpatient characteristics were examined as potential explanatory variables for DND. These included the following sociodemographic characteristics: age, sex, place of residence (rural / urban), mode of living (alone / with family or others), and number of years of formal education; they also included anthropometric characteristics such as body mass index (BMI). The health-related characteristics encompassed clinical diagnoses, laboratory findings, and components of the CGA: incidence of fall(s) in the previous 12 months (yes / no), episodes of hypoglycemia before or during hospital stay (yes / no); and blood pressure in the supine and vertical positions, along with a battery of tests for the measurement of the multidimensional functional status.

Physical functioning of geriatric inpatients was evaluated using the Barthel index,[24] where the combined score ranges from a minimum of 0 (complete dependence) to a maximum of 100 (complete independence). Instrumental activity of daily living (IADL) was assessed with the Duke-OARS Multidimensional Functional Assessment Questionnaire,[25] where the total score ranges from 0 (lowest function) to 12 (highest function).

Multimorbidity was evaluated based on the 20 most prevalent clinical diagnoses at discharge, defined as follows: depressive disorders, dementia, delirium or confusion during hospital stay, hypertension (treated or newly recognized), osteoarthritis (radiological and clinical presentation), presence of anemia (hemoglobin <12 g/dl in women or <13 g/dl in men), diabetes mellitus (treated or newly recognized), atrial fibrillation (paroxysmal, persistent, or permanent), congestive heart failure, ulcer disease (including erosive gastritis on gastroscopy), chronic kidney disease (glomerular filtration rate <50 ml/min/1.63 m^2), Parkinson disease, cerebrovascular disease (confirmed with brain computed tomography scans or carotid artery Doppler test), liver disorders, thyroid dysfunction, benign prostatic hyperplasia, neoplastic disease, chronic obstructive pulmonary disease, connective tissue disease, and hypovitaminosis D_3 (defined as <30 ng/ml [<74.88 mmol/l]). In line with this categorization, the degree of multimorbidity was assessed as the number of concurrently coexisting conditions (out of the 20 above-defined items). Furthermore, the level of comorbidity was evaluated with the Charlson Comorbidity Index.[26]

ADRs were identified in patients manifesting drug-related episodes of hypoglycemia, postural hypotension, falls, drug-induced Parkinsonism or anemia, and other medical conditions depending on the type of medications used.

Statistical analysis The empirical distributions of the studied variables were evaluated using the Box-and-Whiskers plots, which display their summary descriptive statistics (mean, median, interquartile range, minimum, and maximum). The (dependent) numbers of drugs on admission and at discharge were compared using the Wilcoxon signed-rank test for paired data. Moreover, DND values—the differences in the number of drugs between times T2 and T1—were compared between selected subgroups of patients using the Mann–Whitney test. The monotonic relationship between the number of prescribed medications and the number of coexisting conditions per individual was assessed with the Spearman's rank correlation coefficient.

To identify the sociodemographic or health-related patient characteristics that exert a significant independent effect on DND, a multiple linear regression (LR) model was estimated. The selection of explanatory variables was based on the Akaike information criterion[27] that aims to balance goodness-of-fit against model complexity. The same final model resulted from a stepwise backward elimination procedure with a *P* value of less than 0.1. The LR model was estimated on 297 observations, because 4 of the 301 patients had missing BMI values and were excluded from the sample. The statistical model was checked for homoscedasticity of an error term and the absence of multicollinearity, and the adequacy of specification was validated using the Ramsey RESET test. All statistical analyses were performed with the STATA software version 15.0 (StataCorp LP, College Station, Texas, United States).

RESULTS The sample of geriatric inpatients included 204 women and 97 men (mean [SD] age, 82.4 [6.7] years; range, 62–102 years). The descriptive statistics of the data are presented in TABLES 1 and 2 and in FIGURE 1. The mean number of drugs per patient on admission was 7.53 (SD, 3.4; range, 1–18) and at discharge it was 6.25 (SD, 2.1; range, 2–12). Accordingly, the average DND per patient amounted to –1.29 (SD, 2.89; range, –10 to 7) ($P < 0.001$). The total number of drugs decreased in 57.1% of patients, remained the same in 16.6%, and increased in 26.3%. The 2 latter groups included mostly underdiagnosed and undertreated patients, mainly with depression, dementia, pain syndromes, or taking less than 5 drugs before admission. Significant deprescription was observed for each inpatient profile, irrespective of the age group, sex, BMI, place of residence, severity of depression symptoms, or prevailing disorders (TABLES 1 and 2). Only patients with diagnosed delirium did not show significant reduction in the number of drugs. According to the between-group comparison of the DND, the greatest reduction in the number of drugs was observed in patients with ADR (mean [SD], –2.3 [3.0]). The reduction in the number of medications was also high in inpatients experiencing falls and episodes of hypoglycemia. On the other hand, a significantly lower reduction in the number of medications was observed in patients with hypovitaminosis D_3 because these patients required supplementation of vitamin D_3.

The GEM approach contributed to a considerable improvement in the degree of monotonic dependence between the number of drugs and the number of comorbidities in an individual (FIGURE 2). The Spearman's rank correlation coefficient between the number of diagnoses and the number of drugs on admission was 0.28, and it nearly doubled for the number of drugs at discharge, rising to about 0.51. Moreover, the hospitalization radically changed the distribution of the number of medications taken. The very long right tail of this distribution on admission, which corresponded to patients with a high risk of polypharmacy (25 patients took more than 12 different drugs per person on admission), was notably reduced. Accordingly, deprescribing pertained primarily to severely polymedicated patients.

The estimation results of the multiple LR model with the explanatory variables for DND: the number of drugs on admission, the number

TABLE 1 Characteristics of inpatients and the quantitative effect of geriatric evaluation and management on the number of drugs (n = 301)

Parameter		Number of cases, n (%)	NoT1, mean (SD)	NoT2, mean (SD)	*P* value[a] (NoT1 vs NoT2)	DND, mean (SD)	*P* value[b] (between DNDs for inpatient groups)
Overall		301 (100)	7.53 (3.4)	6.25 (2.1)	<0.001	–1.29 (2.9)	–
Age, y	<84	159 (50)	7.42 (3.3)	6.29 (2.0)	<0.001	–1.13 (2.8)	0.21
	≥85	142 (50)	7.66 (3.4)	6.20 (2.1)	<0.001	–1.45 (3.0)	
Sex	Female	204 (67.8)	7.39 (3.3)	6.25 (2.0)	<0.001	–1.14 (2.8)	0.23
	Male	97 (32.2)	7.82 (3.5)	6.23 (2.2)	<0.001	–1.59 (3.0)	
Place of residence	Urban	212 (70)	7.54 (3.4)	6.22 (2.0)	<0.001	–1.32 (3.0)	0.70
	Rural	89 (30)	7.51 (3.2)	6.31 (2.1)	<0.001	–1.20 (2.7)	
Living alone	Yes	103 (34)	7.47 (3.4)	6.09 (2.1)	0.001	–1.37 (2.8)	0.40
	No	198 (66)	7.65 (3.2)	6.54 (2.0)	<0.001	–1.11 (3.0)	
Years in education	< 10	157 (52)	7.26 (3.3)	6.21 (2.1)	<0.001	–1.04 (2.9)	0.17
	≥ 10	144 (48)	7.83 (3.4)	6.28 (2.1)	<0.001	–1.55 (2.9)	
BMI, m/kg[2][c]	<27.4	150 (51)	7.08 (3.0)	5.89 (2.0)	<0.001	–1.20 (2.8)	0.77
	≥27.4	147 (49)	7.98 (3.6)	6.60 (2.1)	<0.001	–1.37 (3.0)	
Incidence of ADR	No	203 (67.4)	6.86 (3.2)	6.06 (2.0)	0.002	–0.79 (2.7)	<0.001
	Yes	98 (32.6)	8.94 (3.3)	6.63 (2.1)	<0.001	–2.31 (3.0)	
Incidence of falls	No	134 (44.5)	7.11 (3.4)	6.14 (2.0)	0.02	–0.97 (2.9)	0.047
	Yes	167 (55.5)	7.86 (3.3)	6.33 (2.1)	<0.001	–1.53 (2.8)	
Postural hypotension[d]	No	201 (70.0)	7.4 (3.3)	6.29 (2.1)	<0.001	–1.10 (2.7)	0.18
	Yes	86 (30.0)	7.87 (3.4)	6.16 (1.8)	<0.001	–1.70 (3.1)	
Hypoglycemia	No	241 (80.1)	7.09 (3.2)	6.01 (2.0)	<0.001	–1.07 (2.8)	<0.001
	Yes	60 (19.9)	9.32 (3.5)	70.2 (2.0)	<0.001	–2.10 (3.2)	
CCI score	<8	148 (49.2)	6.81 (3.2)	50.5 (1.9)	<0.001	–1.30 (2.7)	0.90
	≥8	153 (50.8)	8.23 (3.3)	6.96 (1.9)	<0.001	–1.27 (3.1)	
Barthel score	0–89	134 (46)	7.67 (3.2)	6.57 (2.0)	<0.001	–1.1 (2.8)	0.69
	90–100	167 (54)	7.42 (3.5)	5.99 (2.0)	<0.001	–1.4 (2.9)	
IADL score	0–7	137 (45)	7.47 (3.2)	6.44 (2.1)	<0.001	–1.04 (2.8)	0.48
	8–12	164 (55)	7.58 (3.5)	6.09 (2.0)	<0.001	–1.5 (2.9)	
Number of conditions out of 20	<7	169 (56)	6.91 (3.3)	5.47 (1.8)	<0.001	–1.43 (2.8)	0.47
	≥7	132 (44)	8.33 (3.3)	7.23 (1.9)	<0.001	–1.10 (3.0)	

a Wilcoxon signed-rank test; b Mann–Whitney test; c number of cases, 297; d number of cases, 287

Abbreviations: ADR, adverse drug reaction; BMI, body mass index; CCI, Charlson Comorbidity Index; DND, difference in the number of drugs between discharge and admission; IADL, instrumental activities of daily living; NoT1, number of drugs on admission; NoT2, number of drugs at discharge

of coexisting conditions, BMI, age, and the incidence of ADR, are presented in TABLE 3. Moreover, due to a nonlinear effect of BMI we enriched the model with the BMI squared (BMI^2), which improved the model's goodness-of-fit. The effect of the first 4 explanatory factors on the DND is presented in FIGURE 3. The number of drugs on admission had the most pronounced quantitative effect on the DND. The downward sloping line ($\hat{\beta}_1 = -0.750$) illustrates the negative relationship between these 2 variables (FIGURE 3A). Accordingly, the greater the number of drugs on admission, the more substantial the reduction in the number of medications. The average cut-off point where deprescribing occurred more frequently than prescribing was about 6 drugs per patient. On the other hand, the level of multimorbidity counteracted deprescribing (FIGURE 3B). The upward sloping line shows that an additional condition in the pool of coexisting diagnoses resulted, on average, in an increase in DND of $\hat{\beta}_2 = 0.447$ per geriatric patient. Deprescribing increased slightly with age ($\hat{\beta}_3 = -0.033$) (FIGURE 3C) and was also dependent on the BMI. The greatest reduction in the number of drugs was observed in underweight individuals (FIGURE 3D). After having controlled for the number of drugs on admission and the multimorbidity level, the fact of living alone and the incidence of ADR increased deprescribing ($\hat{\beta}_6 = -0.384$ and $\hat{\beta}_7 = -0.356$, respectively); however, the latter effect was not significant at $P < 0.05$ ($P = 0.08$).

DISCUSSION

The real-life concerns of geriatric practice allude to an old Latin phrase: *primum non nocere*. To this end, geriatricians seek to maintain

TABLE 2 Top 12 most prevalent conditions and the quantitative effect of geriatric evaluation and management on the number of drugs (n = 301)

Condition		Number of cases, n (%)	NoT1, mean (SD)	NoT2, mean (SD)	*P* value[a] (NoT1 vs NoT2)	DND, mean (SD)	*P* value[b] (between DNDs for inpatient groups)
Hypovitaminosis D_3	No	85 (29.4)	8.16 (3.6)	6.14 (1.8)	<0.001	–2.02 (3.2)	0.01
	Yes	204 (70.6)	7.22 (3.2)	6.27 (2.2)	<0.001	–0.96 (2.7)	
Depression	No	101 (33.6)	7.49 (3.0)	6.00 (2.1)	<0.001	–1.49 (2.5)	0.38
	Yes	200 (66.4)	7.56 (3.5)	6.37 (2.0)	<0.001	–1.19 (3.1)	
Hypertension	No	103 (34.2)	6.71 (3,2)	5.71 (1.6)	0.003	–1.00 (2.9)	0.32
	Yes	198 (65.8)	7.96 (3.3)	6.53 (2.1)	<0.001	–1.43 (2.9)	
Cerebrovascular disease	No	108 (35.9)	7.74 (3.3)	6.20 (2.2)	<0.001	–1.54 (2.9)	0.35
	Yes	193 (64.1)	7.42 (3.6)	6.27 (2.0)	<0.001	–1.15 (2.9)	
Osteoarthritis	No	143 (47.5)	7.16 (3.1)	5.93 (1.8)	<0.001	–1.23 (2.7)	0.91
	Yes	158 (52.5)	7.87 (3.5)	6.64 (2.2)	<0.001	–1.30 (3.1)	
Dementia	No	176 (58.5)	7.82 (3.4)	6.27 (2.1)	<0.001	–1.55 (2.9)	0.12
	Yes	125 (41.5)	7.13 (3.2)	6.22 (1.8)	0.01	–0.91 (2.7)	
Anemia	No	178 (59.1)	7.4 (3.4)	6.03 (2.0)	<0.001	–1.37 (2.7)	0.64
	Yes	123 (40.9)	7.72 (3.3)	6.56 (2.1)	<0.001	–1.16 (3.1)	
Diabetes	No	185 (61.5)	6.78 (3.1)	5.68 (1.9)	<0.001	–1.09 (2.8)	0.11
	Yes	116 (38.5)	8.74 (3.4)	7.14 (2.0)	<0.001	–1.59 (3.0)	
Atrial fibrillation	No	225 (74.8)	7.28 (3.4)	5.94 (2.1)	<0.001	–1.33 (2.9)	0.96
	Yes	76 (25.2)	8.28 (3.0)	7.14 (1.7)	<0.001	–1.13 (2.7)	
Liver diseases	No	227 (75.4)	7.47 (3.4)	6.07 (2.0)	<0.001	–1.39 (2.9)	0.30
	Yes	74 (24.6)	7.71 (3.1)	6.77 (2.0)	0.03	–0.94 (2.9)	
CHF	No	228 (75.7)	7.01 (3.2)	5.79 (1.9)	<0.001	–1.21 (2.9)	0.37
	Yes	73 (24.3)	9.19 (3.5)	7.69 (1.8)	<0.001	–1.50 (2.9)	
Delirium	No	234 (77.7)	7.67 (3.4)	6.21 (2.1)	<0.001	–1.45 (2.9)	0.06
	Yes	87 (22.3)	7.06 (3.2)	6.35 (1.7)	0.28	–0.70 (2.7)	

a Wilcoxon signed-rank test; b Mann–Whitney test

Abbreviations: CHF, congestive heart failure; others, see TABLE 1

TABLE 3 Quantitative impact of explanatory variables on the difference between the number of drugs on admission and at discharge: multiple linear regression model

Explanatory variable	Regression $\hat{\beta}\kappa$ coefficient	SE	95% CI	*P* value
Number of drugs on admission	–0.750	0.029	(–0.807 to –0.693)	<0.001
Number of conditions	0.447	0.047	(0.353–0.540)	<0.001
Age	–0.033	0.014	(–0.059 to –0.006)	0.02
BMI	0.169	0.060	(0.051–0.288)	0.01
BMI^2	–0.002	0.001	(–0.004 to –0.0002)	0.03
Living alone	–0.384	0.042	(–0.754 to –0.014)	0.04
Incidence of ADR	–0.356	0.200	(–0.750 to 0.004)	0.08

R^2 = 0.727; F(7, 289) = 109.80 (P <0.0001)

Abbreviations: see TABLE 1

a continuous balance between rigid standards of treatment and expert opinions, or a sound trade-off between the quantity and quality of medications. Numerous and sometimes conflicting therapeutic goals in comorbid and frail elderly patients require reconciliation of therapeutic priorities to prescribe the smallest number of medications, which allows alleviating as many problems in patients as possible.[28]

This study examined the change in the number of medications between admission to and discharge from the geriatric ward and, hence, it focused on the quantitative and not the qualitative aspect of polypharmacy. Despite the recognition

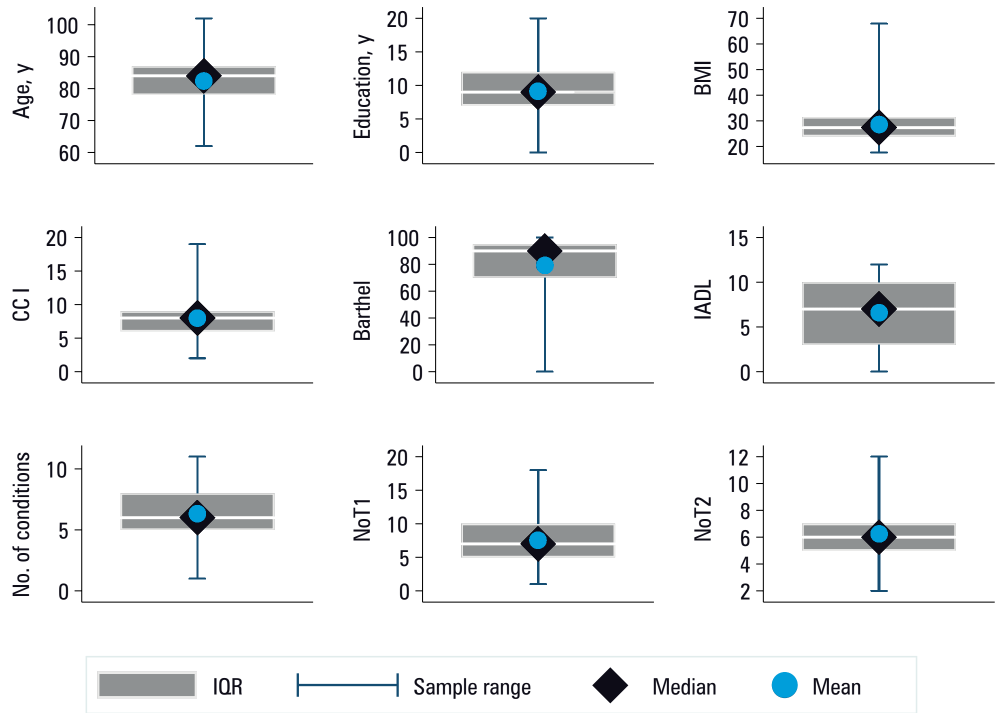


FIGURE 1 Characteristics of geriatric patients. Graphical illustration using box and whiskers plots for continuous and polychotomous variables Abbreviations: see **TABLE 1**

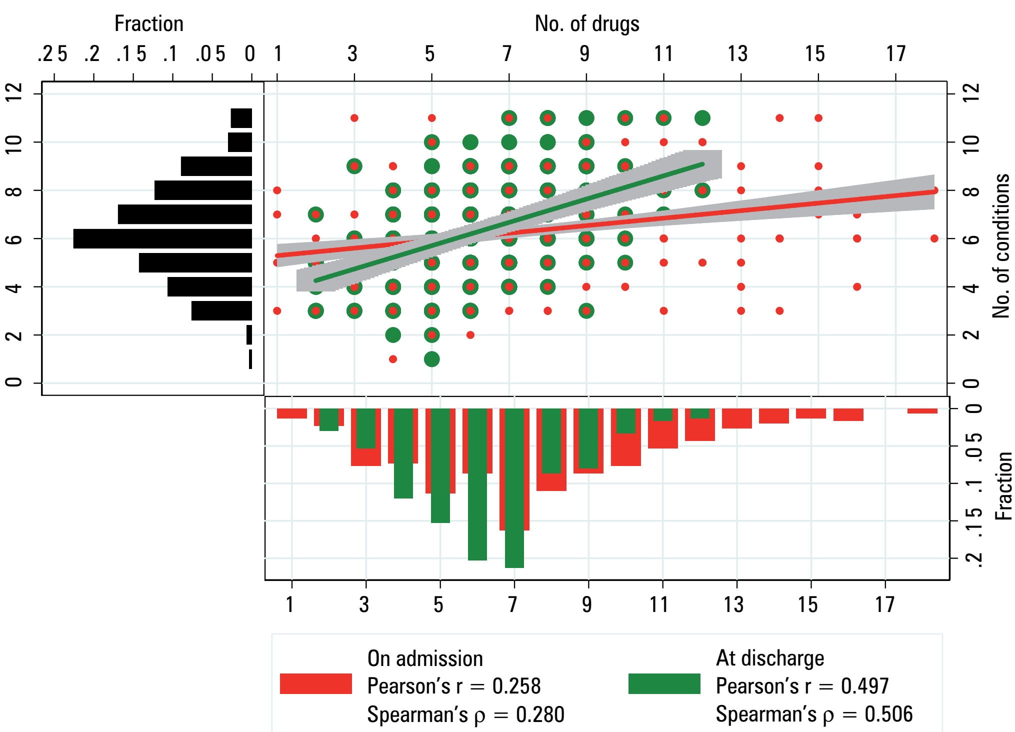
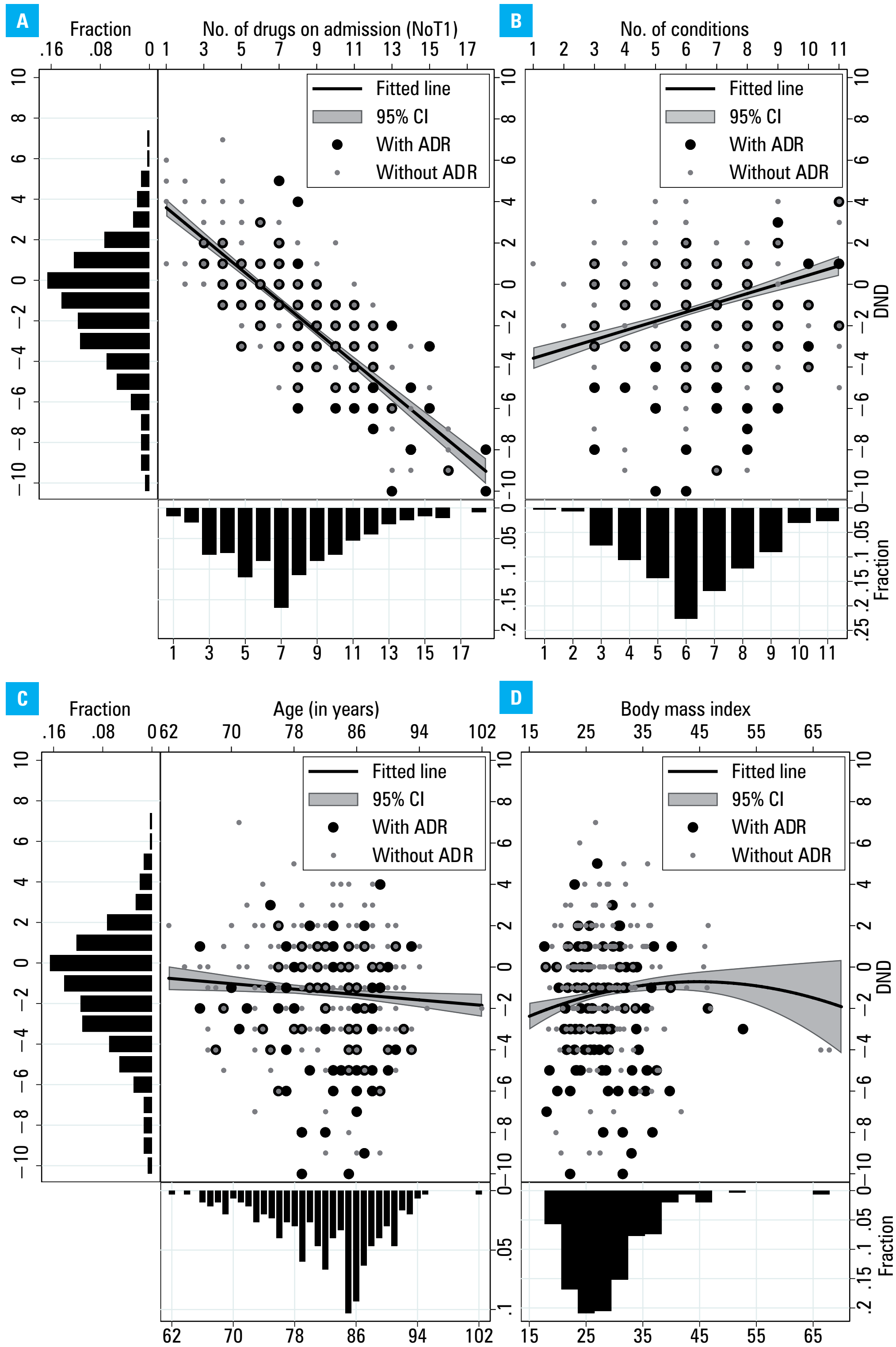


FIGURE 2 Correlation between the number of diseases per geriatric patient and the number of drugs on admission (red) and at discharge (green)

of new disorders in treated patients (eg, hypovitaminosis D_3, hypovitaminosis B_{12}, depression, dementia, pain syndromes), we showed that in real-life practice deprescribing outweighed prescribing. In line with previous studies,[29,30] we documented a significant decline in the number of prescribed drugs, equal to 1.29 drugs per patient: down from an average number of 7.53 drugs on admission to 6.25 at discharge. Notwithstanding the type of a chronic condition, the average number of drugs was significantly reduced in all patient groups. However, the highest deprescribing was seen among patients presenting with ADRs—episodes of hypoglycemia, falls, postural hypotension, or other drug-related symptoms. Our results show that older patients with heart failure or diabetes mellitus (or both) were often overtreated and required deprescribing due to a distorted risk–benefit trade-off, which was confirmed in other studies.[9,31] We showed that the GEM approach doubled the positive correlation between the number of concurrent diseases and the number of prescribed medications. Accordingly, a geriatrician acts as a conciliator between

FIGURE 3 Explanatory factors for the difference in the number of drugs between discharge and admission
Abbreviations: see TABLE 1



different therapeutic goals, prescribing additional medications if they are underused and needed, and deprescribing them if they are overused or misused.[32] The literature shows that the war against polypharmacy has been triggered by clinicians caring for palliative patients.[33] However, nowadays an optimal treatment of older adults is a challenge for many other clinicians.[34,35]

Our study has 2 limitations. First, we did not consider the changes in drug doses and we refrained from qualitative and health-oriented evaluation of alterations in drug regimen, which we leave for further investigations. Second, due to the cross-sectional design of our study, we cannot quantitatively verify the long-term health-related and quality of life–related consequences of drug optimization.

To our knowledge, research on the prerequisites for geriatric deprescribing in a real-life setting is scarce. The results that we obtained using the multivariate statistical model fill this literature gap. The model identified significant factors that independently influence a geriatrician's decision to reduce or extend the palette of drugs. We showed that the effect of deprescribing was intensified by the number of medications on admission, very low BMI as a possible indicator of a patient's frailty, and the presence of ADR. The impact of ADR on deprescribing is significant only at a *P* value of less than 0.1, because the incidence of iatrogenic disorders is also associated with polypharmacy and the multimorbidity level, and its explanatory effect was partially captured by the number of drugs on admission. In addition, deprescribing rose slightly with a patient's age and was slightly higher for persons living alone. On the other hand, the reduction in the number of drugs was significantly limited by the number of coexisting diseases. Accordingly, the identified characteristics of older patients are shown to raise significant concerns in real-life geriatric practice, in line with the principles of the geriatric approach.[20] The literature shows that the number of drugs, rather than the number of diagnoses, constitutes an essential factor for ADRs.[36] Our study revealed that high rates of both polypharmacy and ADRs necessitate pharmacotherapy modification. Additionally, lower BMI (specifically below 25 kg/m^2), together with very advanced old age, might be a surrogate of frailty, which alone seems to decrease the positive risk-to-benefit ratio for most drugs.[37] Moreover, undernutrition can itself be aggravated by polypharmacy or ADRs, and vice versa.[38]

It can be expected that polypharmacy, which is sometimes referred to as a "necessary evil," will be increasingly present in clinical practice.[39] It contributes to serious medical errors[40] and also causes a large economic and social burden for individuals, countries, and insurance companies.[41] The social costs of polypharmacy can be both direct and indirect, arising not only from unnecessary expenditures on inappropriate medications and hospitalizations,[42,43] but also from the impaired quality of life of an older person.[44] Our study showed that the advantages of the GEM in line with the Beers[21] and STOPP/START[22] criteria lie in optimization of the drug regimen, which ultimately results in a significant reduction in the number of medications. In addition, we identified a combination of characteristics that make older patients especially prone to the necessity of quantitative modifications in a drug regimen.

SUPPLEMENTARY MATERIAL Supplementary material is available at www.pamw.pl.

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CONTRIBUTION STATEMENT BB conceived the concept of the study and coordinated funding for the project. KB-B performed and interpreted the statistical analyses. BB and KB-B both contributed to the design of the study, were involved in writing and editing the manuscript, and approved its final version.

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