Prevalence and Predictors of Medication-related Problems

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Introduction

It is estimated that more than 12 million Americans need long-term care (LTC) services.[1] The elderly population (≥65 years of age) comprise an overwhelming majority of these individuals. According to Congressional Budget Office estimates, US expenditures for LTC services will continue to increase each year through 2040, mainly due to the aging of the nation's population.[1]

Florida has a higher proportion of seniors than other states. Although the rate of growth in the state's elderly population has temporarily slowed down, the projected 20-year growth in its population >85 years of age exceeds that of other states by ≥15%.[1] Thus, Florida is home to a greater proportion of the "oldest old."[1] These elderly patients are frail, frequently suffer from multiple physical problems, and often are treated with numerous medications, which may place them at risk for medication-related problems (MRPs) and subsequent LTC facility placement.

The Department of Elder Affairs (DOEA) operates the Long-term Care Community Diversion (LTCD) Program for the elderly.[1] The LTCD Program is intended to shift the emphasis from nursing home care to community-based care in a way that helps elderly patients maintain their independence and quality of life.[1] In addition, it is anticipated that it will defer costs associated with LTC facility admission, as well as defer or prevent iatrogenic issues associated with such living environments. Participation in the LTCD Program is voluntary, but limited to the very frail to ensure that those served are truly at risk of nursing home placement.

One system-level strategy for diverting placement to a LTC facility may be to prospectively identify patients at high risk for MRPs so that physicians can consider the patients' risk level in their decisions about prescribing, delivering, and monitoring subsequent pharmacotherapy.[2-4] If predictive factors can be identified, they might allow the healthcare team to respond promptly and direct care toward amending modifiable factors. Therefore, we performed a cross-sectional study to assess whether patient-level factors are associated with MRPs among Floridians (herein referred to as patients) receiving home and community care services as an alternative to nursing home placement.

Goals and Objectives

The aim of the study was to determine the prevalence and predictors of MRPs among elderly patients enrolled in this Florida LTCD Program. Specifically, the objectives were to:

- determine demographic and clinical characteristics of this group of patients;
- describe the types of MRPs present, and;
- identify risk factors for and correlates of MRPs.

Methods

Literature Search and Evaluation

Prior to our analysis, we conducted a search of the MEDLINE electronic database (1966 to 2004)

with the following key words or phrases: medication-related problem, drug-related problem, undertreatment, underutilization, and polypharmacy. We also searched the National Guideline Clearinghouse for evidence-based clinical practice guidelines for chronic diseases. Additional relevant literature was found by evaluating the reference citations from retrieved articles and hand search.

To summarize the available literature, we created a database that included reviews of MRPs and principles of drug use in the elderly,[5-12] studies of specific drug-related problems[13-41] (including adverse drug events[42-49]), and overviews of evidence-based clinical guidelines and standards of practice. Of the 15 most common chronic diseases observed in the elderly population, we focused on the management of congestive heart failure (CHF),[50-52] stroke,[53-55] coronary heart disease (CHD),[56-59] chronic obstructive pulmonary disease (COPD),[60] and diabetes mellitus (DM).[61-63] The purpose of this exercise was to become familiar with the magnitude of MRPs and assist in the evaluation and identification of such problems. We continued to obtain references after the initial search in order to keep abreast of the literature relevant to this topic.

Sample

The study population consisted of adults enrolled in Florida Medicaid and participating in the LTCD Program with our pharmacy between April 2004 and April 2005. This cross-sectional investigation assessed patients and collected data over a 4-month period from January through April 2005. Patient medication profiles and clinical notations were screened as part of a quality-assurance and performance-improvement effort to identify suboptimal prescribing that might require supplemental pharmaceutical care.

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Classification of MRPs

For the purpose of this study, we used MRPs as a general term for actual or potential MRPs. We classified MRPs into 9 categories:

1. drug use without indication;
2. untreated indication;
3. potentially improper drug selection;
4. potentially low dose;
5. potentially high dose;
6. an actual or potential adverse drug reaction;
7. an actual or potential drug interaction;
8. failure to receive medication; and
9. duplicate therapy.[64]

A tool designed to identify and classify MRPs for medically frail, community-dwelling older adults was empirically developed a priori, using both explicit (eg, Beers criteria[65]) and implicit criteria. For the "untreated indication" category, the investigators reviewed medication profiles for the omission of drug therapy considered to be the standard of care for specific diseases and comorbidities (eg, angiotensin-converting enzyme [ACE] inhibitors for CHF). For "potentially improper drug selection," a list of "watch" medications was utilized, which included therapies with a narrow therapeutic index (eg, warfarin), that required laboratory monitoring (eg, aminoglycosides), were considered to be potentially inappropriate medication (PIM) in older adults (considering diagnoses or conditions using updated 2002 Beers criteria[65]), and had disease- or age-specific contraindications or precautions (eg, thiazolidinediones in patients with CHF, metformin in patients ≥80 years old). Pharmacists evaluated appropriate dosing of medication on the basis of patient-specific characteristics, including age, weight, and medical condition, among other factors. Other drugs, independent of diagnoses or conditions, included in the 2002 Beers criteria[65] were categorized as "an actual or potential adverse drug reaction" (eg, propoxyphene, carisoprodol). The presence of "an actual or potential drug interaction" was determined from clinical notes in the patient's profile, the reason for discontinuation of drug therapy (which was also captured in our database), and a pharmacist-evaluated supplemental electronic drug utilization review computer program (ie, First DataBank®). "Failure to receive medication" could not be assessed by reviewing electronic pharmacy profiles, so this MRP was excluded from the analysis. Similarly, because we required a medical indication for each drug on the patient's profile prior to its entry into the

pharmacy database, "drug use without indication" was not applicable in our review. To evaluate "duplicate therapy," we devised a list of agents and medication classes commonly used in the elderly, and assessed patients' medication profiles for concomitant therapy (eg, 2 different acetaminophen-containing preparations used concurrently).

Identification of MRPs

A 4-step process was utilized to identify MRPs:

1. evaluation of computerized pharmacy-maintained patient profiles for medical diagnoses and comorbidities;
2. analysis of clinical assessments documented in the pharmacy database;
3. screening of past and present medication profiles; and
4. pharmacist review of prescribed drug therapy for appropriateness.

Each potential MRP was identified and classified independently by 4 clinical pharmacists (KTB, DJW, NB, SCN). Panel members tabulated only MRPs that they unanimously accepted during a roundtable discussion.

Statistical Analysis

The initial step in the statistical analysis was exploration of correlative relationships between the dependent variables (MRP/no MRP), number of MRPs, and each of the independent variables (age, gender, primary diagnosis, number of comorbid conditions, cognition, number of medications prescribed, and number of scheduled doses per day). Because an insufficient number of cases was revealed in some categories to ensure the validity of statistical comparisons, variables were grouped into several interval classes (bands)—number of MRPs (0 to 1, 2 to 3, 4+), age class (65 to 69 years, 70 to 74 years, 75 to 79 years, 80 to 84 years, 85+ years), number of comorbid conditions (0 to 2, 3+), number of medications prescribed (0 to 4, 5 to 8, 9+), and number of scheduled doses per day (0 to 2, 3 to 5, 6 to 8, 9 to 11, 12+)—and then further analyzed. Various binary logistic regression models were constructed using the "enter and backward" likelihood ratio methods in the SPSS 13.0 statistical package (SPSS, Chicago, IL). Hypothesized logistic models were constructed to minimize collinearity of model coefficients and correlations among independent regressors. The significance of the overall logistic model was assessed using log-likelihood chi-square tests. Model fit was determined using pseudo r^2 statistics along with predicted versus observed classifications. The statistical significance of logistic model coefficients was tested using the Wald statistic.

Each potential MRP was identified and classified independently by 4 clinical pharmacists.

Results

Characteristics of the Study Population

The clinical and demographic characteristics of patients included in the study are listed in Table 1. A total of 142 patients were included in this evaluation. Of these, 108 (76.1%) were female and 34 (23.9%) were male. The overall average age ± standard deviation was 82.7 ± 7.9 years (range 66 to 97 years), and most patients were white (85.9%). Approximately half (57.7%) of patients had some form of cognitive impairment and 44.4% had ≥3 comorbidities. The median number of medications prescribed was 9.0; the median number of scheduled doses per day was 11.0.

Medication-Related Problems

Altogether, 287 potential MRPs were identified, of which the most prevalent was an actual or potential adverse drug reaction (56.3%) (Table 2). The 3 most frequent MRP categories identified were: an actual or potential adverse drug reaction, potentially improper drug selection, and untreated indication (Table 3). Propoxyphene was prescribed for 18% of all patients evaluated and accounted for nearly one-third (31.3%) of MRPs categorized as an actual or potential adverse drug reaction.

Considering diagnoses or conditions using explicit criteria,[65] PIM accounted for approximately two-thirds of MRPs categorized as potentially improper drug selection. Other therapies with disease- or age-specific contraindications or precautions most frequently identified were the prescribing of warfarin to patients ≥65 years of age (16.4%), metformin use in patients ≥80 years of age (9.0%), and use of thiazolidinediones in patients requiring insulin or who

had CHF (4.5% and 3.0%, respectively).

A potentially untreated indication was found in 62 (43.7%) of patients. In rank order, the most common disease states involved were COPD (30.7%), CHD (29.0%), CHF (24.2%), DM (11.3%), and cerebrovascular disease (4.8%). The most prevalent untreated indications for specific diagnoses included: missing bronchodilator therapy of any kind for patients with COPD (79.2%), no long-acting bronchodilator medication for patients with COPD (58.3%), absence of 3-hydroxy-3-methylglutaryl coenzyme A reductase inhibitor ("statin") therapy for patients with CHD (53.8%), missing an ACE inhibitor or angiotensin II receptor blocker (ARB) for patients with CHF (47.8%), and lack of immediate-release nitrates for patients with CHD (46.2%). Other potentially untreated indications detected were: missing aspirin or beta-blocker therapy in patients with CHD (38.5%), missing aspirin or ACE inhibitor/ARB therapy in patients with DM (22.6%), no short-acting bronchodilator on the medication profile of patients with COPD (20.8%), missing beta-blocker therapy in patients with CHF (17.4%), and missing aspirin therapy in patients with cerebrovascular disease (15.0%).

Figure 1 presents the observed distribution of MRPs present for a given primary diagnosis. Of the 20 patients with hypertension (14.1% of the total patients in this study), an MRP was observed 95% of the time. A similar pattern was observed for patients with cerebrovascular disease, DM, and COPD. The opposite was true for patients with dementia or Alzheimer's disease, where a significant fraction of patients (43.2% and 57.1%, respectively) had no MRP, making it difficult to predict the presence of MRPs in patients with these diagnoses.

Final results of logistic regression analysis, presented in Table 4, show 3 statistically significant factors associated with the presence of MRPs: number of medications, presence/absence of dementia, and age. The factor having the greatest influence on MRPs was the number of medications, with an appreciably higher odds ratio of 4.17. While dementia and age were statistically significant overall (P=0.003 and 0.016, respectively), their contribution to MRPs was small. The effect of the number of medications on MRPs is shown in

Table 1.

Clinical and Demographic Patient Characteristics (N=142)

Characteristic	Corresponding Value
Age (years)	
Mean ± SD	82.7 ± 7.9
Median	82.5
Distribution (n [%])	
65 to 69	6 [4%]
70 to 74	21 [15%]
75 to 79	22 [15%]
80 to 84	33 [23%]
≥85	60 [42%]
Female (n [%])	108 [76.1]
Male (n [%])	34 [23.9]
Race (%)	
White	85.9
Black	4.9
Other	2.8
Unknown	6.4
Primary diagnostic classification (n [%])	
Cardiovascular	35 (25%)
Pulmonary	12 (8%)
Endocrine	8 (6%)
Neurologic	71 (50%)
Other	16 (11%)
Comorbidity	
Mean no. ± SD	2.4 ± 1.4
≥3 comorbidities (n [%])	63 [44.4%]
Cognitive impairment (n [%])	82 [57.7%]
Medications prescribed	
Total no.	1427
Mean ± SD	10.0 ± 5.3
Median	9.0
≥9 medications (n [%])	83 [58.5%]
Scheduled doses of medication/day	
Mean ± SD	11.3 ± 6.3
Median	11.0
≥12 doses/day (n [%])	66 [46.5%]

Table 2.
Description of MRPs

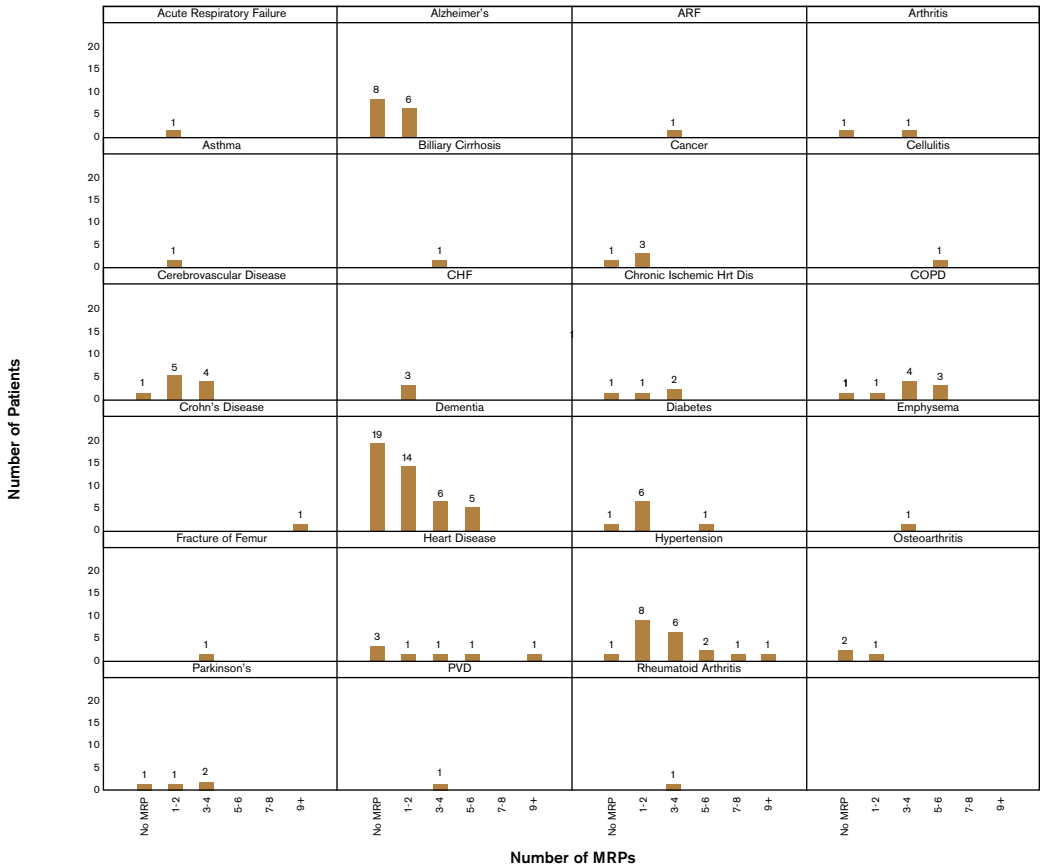
MRP Classification	No. of Occurrences	Proportion/ Sample* (N=142)	Proportion/ Total MRPs (N=287)
1) Drug use without indication	NA	NA	NA
2) Untreated indication	62	43.7%	21.6%
3) Potentially improper drug selection	67	47.2%	23.3%
4) Potentially low dose	10	7.0%	3.5%
5) Potentially high dose	8	5.6%	2.8%
6) An actual or potential ADR	80	56.3%	27.9%
7) An actual or potential drug interaction	12	8.5%	4.2%
8) Failure to receive medication	NA	NA	NA
9) Duplicate therapy	48	33.8%	16.7%

*Total does not add up to 100% as some patients had >1 reported medication-related problem (MRP).
ADR=adverse drug reaction; NA=not applicable.

Figure 2. A slight linear relationship between the number of MRPs and the number of medications was observed. However, the frequencies of MRPs were highly skewed at lower and higher numbers of medications, giving rise to larger prediction errors when single values of prescribed medications were used.

When comparing the difference between full and final logistic models, the final model with only 3 degrees of freedom was not statistically different than a full model with 10 degrees of freedom at

Figure 1.
Relationship Between MRPs and Primary Diagnosis



ARF=acute renal failure; CHF=congestive heart failure; Chr-chronic; Hrt=heart; Dis=disease; COPD=chronic obstructive pulmonary disease; PVD=peripheral vascular disease

the 0.05 level of significance. In addition, the final logistic model adequately fit MRP data with an r^2 value of >0.5. Table 5 demonstrates that the model was good at predicting the presence of an MRP when an MRP was actually observed. However, the model significantly overpredicted the presence of an MRP when no MRP was observed.

The predicted probability of MRPs was 80.7%, 94.5%, and 98.6% for the banded number of medications prescribed (0 to 4, 5 to 8, and 9+, respectively). By increasing the interval class of number of medications from 0 to 4 to 5 to 8, there was a corresponding 17.2% increase in the likelihood of having an MRP. A much smaller gain (4.3%) in the likelihood of having an MRP was predicted by an increase in the number of medications from 5 to 8 to 9+.

Discussion

Drug-related morbidities are a significant healthcare problem, and a great proportion are preventable.[8,49,66,67] Increasingly, there have been numerous reports of the incidence, prevalence, and preventability of medication error-related deaths,[68-70] drug-related hospital admissions,[67,71-74] and adverse drug events in the inpatient and outpatient setting.[42-49,75-77] The intent of this study was to better define patient-level factors associated with MRPs, with the goal of identifying high-risk beneficiaries and supporting interventions that may prevent subsequent LTC facility placement.

A major risk factor for MRPs was the number of medications prescribed. Previous studies[3,4,71,73,74,78-81]

Table 3.

Details Associated with the 3 Most Frequent MRP Categories Identified

MRP Classification	Number (n)	Proportion/Classification
Actual or Potential Adverse Drug Reaction		
Beers medication* + age	79	98.8%
ASA + history of GI bleed	1	1.3%
Total	80	100.1%
Potentially Improper Drug Selection		
Warfarin + age	11	16.4%
Beers medication + cognitive impairment	10	15.0%
Beers medication + depression	10	15.0%
Beers medication + syncope or falls	10	15.0%
Metformin + age	6	9.0%
Beers medication + chronic constipation	5	7.5%
TZD + insulin	3	4.5%
TZD + CHF	2	3.0%
Beers medication + bladder outflow obstruction	2	3.0%
Beers medication + COPD	2	3.0%
Metformin + CHF	1	1.5%
Methadone + age	1	1.5%
Beers medication + CHF	1	1.5%
Beers medication + insomnia	1	1.5%
Beers medication + anorexia and malnutrition	1	1.5%
Beers medication + SIADH/hyponatremia	1	1.5%
Total	67	100.4%
Untreated Indication		
COPD + no long-acting bronchodilator	14	22.6%
CHF + no ACE inhibitor/ARB	11	17.7%
CHD + no statin	7	11.3%
CHD + no IR NTG	6	9.7%
COPD + no short-acting bronchodilator	5	8.1%
DM + no ASA	5	8.1%
CHF + no beta-blocker	4	6.5%
CVA + no ASA	3	4.8%
CHD + no ASA	3	4.8%
CHD + no beta-blocker	2	3.2%
DM + no ACE inhibitor/ARB	2	3.2%
Total	62	100%

*Includes (number, %): propoxyphene (25, 31.3%), oxybutynin IR (10, 12.5%), cyclobenzaprine (5, 6.3%), fluoxetine (5, 6.3%), clonidine (5, 6.3%), hydroxyzine (4, 5.0%), naproxen (4, 5.0%), estrogen (4, 5.0%), diphenhydramine (3, 3.8%), amiodarone (2, 2.5%), nitrofurantoin (2, 2.5%), and trimethobenzamide, methocarbamol, carisoprodol, metaxalone, diazepam, cyproheptadine, promethazine, barbiturates, doxazosin, desiccated thyroid (1, 1.3% each).

ACE=angiotensin-converting enzyme; ARB=angiotensin II receptor blocker; ASA=aspirin; CHD=coronary heart disease; CHF=congestive heart failure; COPD=chronic obstructive pulmonary disease; CVA=cerebrovascular accident; DM=diabetes mellitus; GI=gastrointestinal; IR=immediate-release; NTG=nitroglycerin; SIADH=syndrome of inappropriate antidiuretic hormone; TZD=thiazolidinedione.

Table 4.
Independent Risk Factors for MRPs

Risk Factor	Model Coefficient*	Odds Ratio (95% CI)	*P* Value
No. of medications	1.428	4.17 (2.48 to 7.00)	<0.0001
Dementia	-1.445	0.24 (0.09 to 0.61)	0.003
Age	-0.343	0.71 (0.54 to 0.94)	0.016

*Coefficients are significant at the 0.05 level of significance based on the Wald statistic.
CI=confidence interval.

Table 5.
Classification Table for Logistic Regression Predictions

Observed Presence of an MRP	Predicted Presence of an MRP		
	No	Yes	% Correct
No	20	20	50.0
Yes	7	95	93.1
Overall % correct			81.0

have found the number of drugs prescribed to be a risk factor for several MRPs in older adults, especially adverse drug events, and it has been reported that the use of larger numbers of medications is associated with an increased likelihood of inappropriate prescribing.[12,82] A large national survey of 33,301 nursing facility residents performed by Tobias and Sey[83] found an average of 6.7 medications used per resident, with 27% of residents taking ≥9 medications. The trend of increasing drug use continues through 80 years of age[5] and appears to be highest among older women.[84] The average number of medications prescribed for patients enrolled in the LTCD Program was 10.0, and 59% were prescribed ≥9 medications. These patients were mainly women who were ≥80 years of age.

It is estimated that 20% of Medicare beneficiaries have ≥5 chronic conditions, with 50% receiving ≥5 medications.[85] In our study, 17% and 87% of patients had ≥5 chronic conditions and were prescribed ≥5 medications, respectively. While no specific number of medications has been established to define polypharmacy, some have arbitrarily suggested a cut-point of 3 to 5 drugs per patient.[8] We chose a cut-point of ≥9 medications, as this is a quality indicator that has been established by the Centers for Medicare and Medicaid Services (formerly recognized as the Healthcare Finance Administration) for residents in LTC facilities.[8] Although we did not investigate nursing home patients specifically, a criterion for enrollment in the LTCD Program was a nursing home eligibility determination. Our results appear to confirm this cut-point, demonstrating 98.6% predicted probability of MRPs with ≥9 prescribed medications. In addition, the

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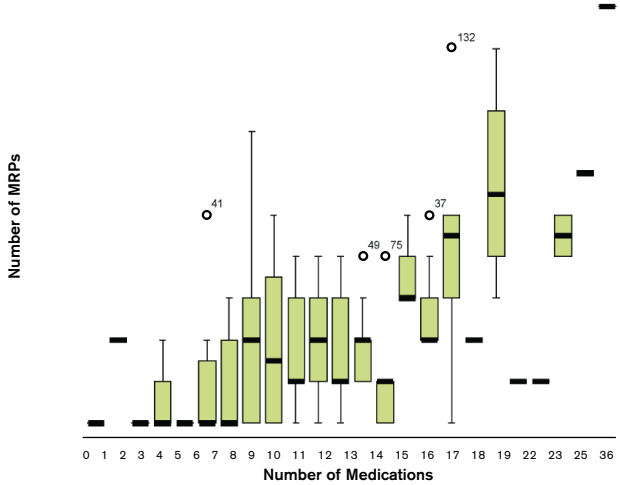
Figure 2.
Box Plot of Number of MRPs Versus Number of Medications



Open circles represent patients with MRPs greater than two standard deviations from the mean.

Prevalence and Predictors of Medication-related Problems

(continued from page 20)

patients included in this investigation had several risk factors for polypharmacy, including older age, white race, and poorer health.[8] Polypharmacy is problematic for the elderly because it may increase the risk of adverse drug reactions, geriatric syndromes (eg, falls and hip fractures, urinary incontinence), and diminished functional status.[8] These sequelae of multiple drug use also may increase the utilization of healthcare resources (including nursing home placement) and concomitant costs.[8]

Although we did not find an association between multiple (≥3) comorbid conditions and MRPs, several larger studies in older adults have demonstrated a correlation between the number of medical diagnoses and adverse drug events.[3,71,79,86,87] This is not surprising, as many older people with chronic conditions require multiple medications. We did find, however, that patients with hypertension (specifically) were at higher risk of having an MRP identified. Previous reports have found that several therapeutic agents and classes of medications commonly used in the elderly have been linked to drug-related problems, of which the most frequently cited includes cardiovascular agents.[48,49] This finding requires further investigation. The likelihood of an MRP was decreased in patients having dementia, which is consistent with findings previously reported by Onder et al.[88] The number of medications does not explain this relationship, as the mean number of medications prescribed for patients with dementia was the same as for those without dementia.

A major risk factor for MRPs was the number of medications prescribed.

In this investigation, we attempted to address the full scope of MRPs proposed by Hepler and Strand.[64] Although adverse drug reactions are among the most common types of MRPs that affect a significant number of individuals and account for increased healthcare expenditures, they represent only 1 of the many types of MRPs. In addition to evaluating the 8 MRP categories outlined by Hepler and Strand,[64] we also included "duplicate therapy" in our criteria, with a reported prevalence of 33.8%. Overall, our assessment of the prevalence of MRPs in patients enrolled in this LTCD Program was approximately 2.0 MRPs per patient.

We included PIM in older adults independent of diagnoses or conditions under the category of an actual or potential adverse drug reaction, whereas PIM that considered diagnoses or conditions was classified as potentially improper drug selection. The use of PIM has been well documented since Beers et al. developed a consensus-based list in 1991.[89] This tool has since been updated,[65,90] and similar tools have been developed for the same purpose.[91,92] Common to all of these tools is the criticism that they are derived from consensus-based rather than evidence-based guidelines. Nonetheless, using updated 2002 Beers criteria,[65] the identification of PIM was performed concurrently in this population of LTCD patients. In addition to using this explicit criterion, we identified additional agents and medication classes that are used frequently in the elderly population and are associated with a significant risk of toxicity, morbidity, and mortality. In some cases, the drug therapy may indeed be appropriate. However, it was decided that some of these agents (eg, warfarin) require a manual drug regimen review despite their potential appropriateness. In this subset of agents, we identified warfarin use to be the most common potentially improper drug selection (16.4%), followed by metformin (9.0%) and thiazolidinedione contraindications or precautions (7.5%). While a drug utilization review computer program detects some of these warnings, others may not be identified, such as age-associated warnings in particular. These findings provide insight into the potentially inappropriate use of the newer anti-diabetic therapies and justify their inclusion in our elderly-specific medication tool.

There is also widespread underuse of beneficial therapies in older adults.[12] Underutilization has been defined as "the omission of drug therapy that is indicated for the treatment or prevention of a disease or condition,"[8,93] the consequences of which may include

decreased quality of life,[7,94] increased morbidity and mortality,[24,95-97] and increased healthcare resource use and cost.[8,98] For instance, Soumerai et al. demonstrated that limiting Medicaid patients' access to medications more than doubled their risk of admission to a nursing home.[99] "Requires therapy but not receiving" has been shown to be among the most common MPRs identified by community pharmacists.[100,101] We found that 43.7% of 142 patients had potentially untreated indications, accounting for 21.6% of the MRPs detected. Similarly, Lipton et al. demonstrated that 55% of 236 ambulatory older patients had ≥1 necessary drug therapy omitted.[93] In the LTC setting, using the Assessment of Underutilization of Medication measure, Jeffery et al. found that 17.4% of 23 residents had evidence of medication underutilization.[102] However, this marked difference in prevalence might have been attributable to sample selection and size.[102]

Several studies focused on medication underutilization have investigated individual drug therapies, such as the underprescribing of ACE inhibitors in patients with CHF, with rates of use ranging from 33% to 75%.[8,19,20,22,103] Our study found a similar rate of underutilization, with 47.8% of patients diagnosed with CHF missing an ACE inhibitor on their pharmacy profile. Particularly surprising was the lack of bronchodilator therapy (either short- or long-acting) in patients with COPD. Although bronchodilators are a key component in the management of COPD, their absence may be due to the presence of comorbidities that are negatively affected by therapy with beta-agonists (eg, CHF, hypokalemia). The absence of statin therapy in patients with CHD may be due to intolerance or abnormal liver function tests, among other reasons. However, we do not have a hypothesis for the reason(s) associated with missing sublingual nitrate therapy in patients with CHD other than these medications not being reported when reviewing the patient's medication profile. Sloan et al. described the prevalence and predictors of nonprescribing of selected medications, whose value for decreasing morbidity has been established in clinical trials in 2014 residents of residential care/assisted living facilities.[41] The authors concluded that undertreatment of older persons is a problem of equivalent magnitude to that of medication overuse.[41] However, despite the validation and support of other methods that have used a combination of explicit criteria and implicit instructions to quantify medication appropriateness,[104-111] medication underuse, which is an important component in the practice of pharmaceutical care, is often not addressed with these instruments.[101]

Underutilization has been defined as "the omission of drug therapy that is indicated for the treatment or prevention of a disease or condition."

Study Limitations

The present study has several limitations. Because it was a cross-sectional study, we were unable to account for patient outcomes and prevalence of admissions to LTC settings. However, as a previous report from the Institute of Medicine suggested[69] and a more recent study confirmed,[67] preventable medication-related morbidity in ambulatory care is at least as significant and prevalent as it is within inpatient care environments. To that end, the prevalence of preventable drug-related hospital admissions in older patients (mean age >70 years) has been estimated to be twice as high as that of their younger counterparts.[67] Future directions at our institution may entail a longitudinal approach to determine whether inappropriate management of drug therapy may be a leading cause of admissions to LTC facilities.

In addition, the investigation evaluated only a single LTCD Program in a specific geographic area. It is possible that prescribing practices and patient characteristics specific to this region could have skewed our results. The approach we used to identify and classify MRPs was based on pharmacy profile record reviews and explicit and implicit criteria carried out by a panel of clinical pharmacists. This limited detection to MRPs with a high probability, based on patient-specific information imported into our database, and undoubtedly excluded many actual, rather than potential, MRPs. For

instance, we were unable to identify patient adherence to prescribed therapy (ie, "failure to receive medication"), we could not validate the presence of a medical condition (eg, depression) or determine whether certain contraindications to therapy were present, we could not account for over-the-counter medications or supplements other than those reported to us, and we had limited ability to detect actual adverse drug events. Likewise, we focused on regularly scheduled medications rather than on as-needed drugs. Previous reports have evaluated the use of as-needed therapy in the LTC setting;[112] however, clinimetric testing was not done to establish reliability.[101] Thus, our findings may be biased toward risk factors for easily identifiable MRPs. Nonetheless, the absence of treatment and detection of other MRPs in such high percentages of patients raises the specter of an important quality problem in the care of older patients.

Lastly, we have not prospectively validated the tool used in this evaluation or tested the inter- and intra-rater reliability of our criteria. We are proposing a larger study that will further examine the demographic-, behavioral-, and pharmacotherapy-related correlates of MRPs and describe valid and reliable clinical decision rules for classifying medically frail, community-dwelling, older adults for the risk of MRPs.

Elderly persons who would likely benefit from evidence-based medical therapies often do not receive them.

Conclusion

Medication-related problems were common among frail elderly people enrolled in a LTCD Program. Although the care of older individuals presents formidable challenges to healthcare professionals, it is possible to identify patients at high risk of experiencing MRPs. Prevention efforts to divert placement of persons into LTC facilities should be targeted toward older adults with multiple medical conditions and those taking multiple medications. Despite strong scientific evidence supporting the effectiveness of certain medications in preventing disease progression, preserving function, and reducing mortality, there is a paucity of data related to the management of older patients, particularly the frailest of the elderly with multiple chronic conditions. This study adds to existing reports from community, hospital, nursing home, and assisted living settings, which demonstrate that elderly persons who would likely benefit from evidence-based medical therapies often do not receive them. Based on our findings, we recommend that future research be directed toward improving the quality of medication use in elderly people at risk for nursing home placement. *MPM*

Take-Away Message

- Medication-related problems (MRPs) place frail elderly patients at risk for injury and loss of independence.
- One of the most common MRPs is "untreated indication."
- MRPs can be addressed through Medication Therapy Management Services (MTMS), which are provided through Medicare prescription drug plans and available to all targeted beneficiaries.

ROI

- MTMS may help prevent or defer nursing home placement through clinician practices that identify MRPs, thus improving outcomes and providing a source of practice revenue.
- Pay for performance systems can provide justification for investment in MTMS and related systems, such as electronic health records and e-Prescribing.

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