Suboptimal Prescribing in Older Inpatients and Outpatients

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Investigators searched Medline and HealthSTAR databases from January 1, 1985 through June 30, 1999 to identify articles on suboptimal prescribing in those age 65 years and older. A manual search of the reference lists from identified articles and the authors' article files, book chapters, and recent reviews was conducted to identify additional articles. The definitions for various types of suboptimal prescribing (polypharmacy, inappropriate, and underutilization) are numerous, and measurement varies from study to study. The literature suggests that suboptimal prescribing is common in older outpatients and inpatients. Moreover, there is significant morbidity and mortality associated with suboptimal prescribing for these older patients. Evidence from well-controlled studies suggests that multidisciplinary teams and clinical pharmacy interventions can modify suboptimal drug use in older people. Future research is necessary to measure and test other methods for tackling this major public health problem facing older people. **J Am Geriatr Soc 49:200–209, 2001.**

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Prescribing medications is a complex task. While medical schools typically emphasize the mechanistic aspects of pharmacology, there is less exposure to the World Health Organization's recommendation to encourage practitioners to employ a standard pharmacotherapeutic approach that includes a personal formulary of drugs of choice to treat common problems.[1,2] Instead, physicians learn how to prescribe in "real-world" settings beginning with their residency training, and they are influenced by their peers, pharmaceutical company marketing, healthcare systems, and patient demands and expectations.[1]

Optimal medication prescribing is critical to the goal of geriatric medicine of curing disease, eliminating or reducing symptoms, and improving functioning.[3] However, prescribing for older people is especially daunting because they require complex regimens for multiple chronic conditions. Moreover, to minimize adverse drug reactions, practitioners must consider age-related changes in drug pharmacokinetics and pharmacodynamics when selecting from the thousands of chemical entities available.[4]

The magnitude of adverse drug reactions led a panel of geriatric experts to identify them as one of the five most important quality of care problems in older people.[5] While dispensing errors, medication noncompliance, and medication administration errors cannot be ignored, one major contributor to medication-related quality of care issues is suboptimal prescribing. There are three major categories of suboptimal prescribing: (1) overuse or polypharmacy, (2) inappropriate use, and (3) underuse.[4,6,7] Our goal is to provide information regarding the definitions, measurement, and epidemiology of suboptimal prescribing, and evidence from well-controlled studies that suboptimal prescribing can be modified in older people. Because prescribing in nursing homes was recently reviewed, we focus on older people who are hospitalized, community-dwelling, and in outpatient settings.[8–10]

OVERUSE OF MEDICATIONS (POLYPHARMACY)

Polypharmacy is usually defined in two ways. One definition is the concomitant use of multiple drugs, which is measured by a simple count of medications.[11] Although no specific number of medications has been established to define polypharmacy, many use a cutpoint of three to five drugs per patient. [4] Effective July 1, 1999, the Healthcare Finance Administration (HCFA) established a quality indicator that residents taking nine or more medications will

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be used to identify long-term care facilities where medications may potentially be overused and residents may be at increased risk for adverse drug reactions and drug interactions. However, this approach is controversial because many older people require and safely derive benefit from multiple medications. Older patients at discharge from hospital take the highest number of medications (mean = 5).[12–14] Community-dwelling older Americans take an average of 2.7 to 4.2 prescription and nonprescription medications.[15–20] Risk factors for polypharmacy include older age, white race, poorer health, and number of healthcare visits[15,18–22] Other factors that may plausibly increase medication use but have not undergone quantitative investigation in older people include the healthcare beliefs and psychological status of older patient and their families, the characteristics of prescribers, and pharmaceutical industry advertising.

Another definition of polypharmacy is the administration of more medications than are clinically indicated.[23] This definition has the negative connotation of excessive or unnecessary medication use, rather than being an arbitrary number. The measurement of polypharmacy defined in this fashion can involve clinical review using explicit criteria.[24,25] In the ambulatory care setting, Lipton et al. found that 59% of 236 outpatients were taking drugs that had no indication or were less than optimal.[24] Schmader et al. found that 55% of 208 outpatients were taking drugs with no indication, 32.7% were taking ineffective drugs, and 16.8% were taking drugs with therapeutic duplication.[26]

Polypharmacy is problematic for older patients because it may increase the risk of adverse drug reactions, geriatric syndromes, diminished functional status, and healthcare costs.[23,27–30] The risk of adverse drug reactions is strongly associated with increasing number of drugs taken.[4,30] The types of associated geriatric syndromes include cognitive impairment and delirium, falls and hip fractures, and urinary incontinence.[31–36] Diminished physical and instrumental activities of daily living have been shown in controlled analyses to be associated with number of prescription medications in community-dwelling women.[37] These sequelae of multiple drug use may also increase utilization of healthcare resources and concomitant costs.[27,38]

INAPPROPRIATE PRESCRIBING

Inappropriate prescribing has been defined as prescribing of medications that has more potential risk than potential benefit or prescribing that does not agree with accepted medical standards.[6,26,39,40] There are three primary approaches to measure inappropriate prescribing: (1) drugs to avoid, (2) drug utilization reviews, and (3) clinical reviews applying explicit criteria. The following three sections describe these different measures and associated epidemiology.

Drugs to Avoid

Explicit criteria for defining and identifying drugs to avoid using for older people were recently developed by an expert consensus panel from the United States.[41] By refining a list of inappropriate medications for use in nursing home patients, [39] this updated list is intended to apply to older people in all care settings and adds a severity rating reflecting the likelihood of an adverse outcome and the clinical significance of the outcome for each prescribing concern. The expert panel agreed on:

- eighteen medications/medication classes that should generally be avoided because they are either ineffective or pose unnecessarily high risk for older people (Table 1);
- medications that should be avoided by people with one of 14 specific health conditions because of likely drug-disease interactions (Table 2); and
- four drug-drug interactions to be avoided (Table 3).

Effective July 1, 1999, HCFA has now labeled the use of any high-severity drugs for older people in long-term care facilities as unnecessary. They also specify that the use of low-severity drugs and drug-disease combinations should be reviewed by the consultant pharmacist, who should document problems and communicate them to the patient's physician.[42]

Using these U.S. criteria, epidemiological studies have found 14% to 27% of community-dwelling older people used medications that should be avoided in older people.[43–46] Ruscin et al. employed the U.S. criteria and found that 35% of 430 older hospital patients were taking one or more inappropriate medications.[47] Factors associated with inappropriate prescribing include taking multiple prescription drugs, having continuity of care, prior use of inappropriate drugs, and multiple healthcare visits in the previous year.[44,46]

A national expert panel from Canada also developed a list of generally contraindicated drugs and clinically important drug-drug and drug-disease interactions.[48] They included practices that met one of the following three criteria:

- the prescription introduces a substantial and clinically significant increase in the risk of a serious adverse effect;
- equally effective or more effective and less risky alternative therapy is available for most patients; and
- the practice is likely to occur often enough that a change in practice could decrease morbidity in older people.

The expert panel agreed upon 38 situations/cases of problematic/inappropriate prescribing practices: 18 contraindicated drugs/drug classes (Table 1), 16 drug-disease interactions (Table 2) and 4 drug-drug reactions (Table 3). It is notable that only 6 drug-disease interactions, 2 drug-drug interactions, and 13 drugs or drug classes whose use should be avoided in older people appeared on both the U.S. and Canadian lists. To the best of our knowledge, no one has published information about the epidemiology of inappropriate drug use as defined by these Canadian criteria. It is important to note that some clinicians have found the U.S. and Canadian criteria to be controversial and that overreliance on a specific list of medications to identify inappropriate prescribing should not become rote.

Drug Utilization Review

Drug utilization reviews (DURs) use consensus opinion by drug therapy experts to define standards or explicit criteria for a single drug, class of drugs, or group of drugs. DURs typically use retrospective information from large,

Table 1. Inappropriate Drugs/Drug Classes to Avoid Using in the Elderly as Defined by Explicit Criteria by Beers et al.[41] and McLeod et al.[48] Consensus Panels*

Major Therapeutic Class/Subclasses/Individual Agents
ANTIHISTAMINES[41]
Chlorpheniramine (Chlor-Trimeton®), Cyproheptadine (Periactin®), Dexchlorpheniramine maleate (Polaramine®), Diphenhydramine (Benadryl®), Hydroxyzine (Atarax®, Vistaril®), Promethazine hydrochloride (Phenergan®), Tripelennamine hydrochloride (PBZ®)
BLOOD PRODUCTS/MODIFIERS/VOLUME EXPANDERS
Platelet Aggregation Inhibitors
Dipyridamole (Persantine®),[41,48] Ticlopidine (Ticlid®)[41]
CARDIOVASCULAR
Antihypertensive
Methyldopa (Aldomet®),[41] Reserpine (Serpasil®)[41,48]
Peripheral Vasodilators
Cyclandelate (Cyclospasmol®),[41] Ergoloid Mesylate (Hydergine®),[41] Nylidrin,[48] Niacin,[48] Pentoxifylline (Trental®)[48]
Antiarrhythmics
Disopyramide (Norpace®)[41,48]
CNS AGENTS
Narcotics
Meperidine (Demerol®),[41,48] Pentazocine (Talwin®),[41,48] Propoxyphene (in Darvocet®)[41]
Sedative or Hypnotic Agents
Barbiturates (exception Phenobarbital)[41,48]
Butalbital (Butisol®), Pentobarbital (Nembutal®), Secobarbital (Seconal®)
Short and Long Half-Life Benzodiazepines
Chlordiazepoxide (Librium®),[41,48] Diazepam (Valium®),[41,48]
Flurazepam (Dalmane®),[41,48] Triazolam (Halcion®)[48]
Meprobamate[41]
Antidepressants
Amitriptyline (Elavil®),[41,48] Doxepin (Sinequan®),[41] Imipramine (Tofranil®)[48]
Combination Antidepressants/Antipsychotics
Amitriptyline/Perphenazine (Triavil®)[41]
Methylphenidate (Ritalin®)[48]
GASTRIC
Antiemetics
Trimethobenzamide (Tigan®)[41]
Anticholinergic/Antispasmodics[41]
Belladonna (e.g., Donnatal ®), Clidinium (e.g., Librax ®), Dicyclomine (Bentyl®), Hyoscyamine (in Levsin®), Propantheline (Pro-banthine®)
Antidiarrheal
Diphenoxylate (Lomotil®)[48]
GENITOURINARY
Antispasmodics
Oxybutynin (Ditropan®)[41]
HORMONES/SYNTHETICS/MODIFIERS
Hypoglycemic Agents, Oral
Chlorpropamide (Diabinese®)[41]
MUSCULOSKELETAL
Non-Salicylate Non-Steroidal Anti-Inflammatory Drugs
Indomethacin (Indocin®),[41,48] Ketorolac (Toradol®),[48] Mefenamic acid (Ponstel®),[48]
Piroxicam (Feldene®),[48] Phenylbutazone[41,48]
Skeletal Muscle Relaxants[41,48]
Carisoprodol (Soma Compound ®), Chlorzoxazone (Paraflex®), Cyclobenzaprine (Flexeril®), Metaxalone (Skelaxin®), Methocarbamol (Robaxin®), Orphenadrine (Norflex®)

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nonclinical administrative databases to identify problems such as dosage range, duration, therapeutic duplication, and drug-drug interactions.[49–52]

Tamblyn et al. published the results of a DUR study of questionable prescribing of three drug classes (cardiovascular, nonsteroidal anti-inflammatory drugs [NSAIDs], psychotropics) for older Canadians.[53] They developed explicit criteria to identify inappropriate duration (e.g., use of benzodiazepines for >30 days), contraindicated drugs (e.g., long-acting benzodiazepines or phenylbutazone), and drug-

Table 2. Drug-Disease Interactions to Avoid in the Elderly as Defined by Explicit Criteria by Beers et al.[41] and McLeod et al.[48] Consensus Panels*

Drug/Drug Class	Disease
Alpha Blockers	Urinary Incontinence[41]
Anticholinergic Antihistamine	Benign Prostatic Hypertrophy[41]
	Constipation[41]
Anticholinergic Antispasmodics	Benign Prostatic Hypertrophy[41]
	Constipation[41]
Anticholinergic Tricyclic Antidepressant	Benign Prostatic Hypertrophy[41,48]
	Constipation[41]
	Glaucoma[48]
Amphetamines	Hypertension[41]
Aspirin (>325mg/day)	Peptic Ulcer[41]
Benzodiazepines, long half-life	Dementia[48]
	Syncope/Falls[41,48]
Beta Agonists	Insomnia[41]
Beta Blockers	Asthma/Chronic Obstructive Pulmonary Disease[41,48]
	Diabetes[41]
	Heart failure[48,†]
	Peripheral Vascular Disease[41]
	Raynaud Disease[48]
	Syncope/Falls[41]
Bethanechol (Urecholine®)	Benign Prostatic Hypertrophy[41]
Calcium Channel Blocker	Heart Failure[48]
Chlorpromazine (Thorazine®)	Postural hypotension[48]
	Seizures[41]
Clozapine (Clozaril®)	Seizures[41]
Corticosteroids (systemic)	Diabetes[41,48]
Decongestants	Insomnia[41]
Desipramine (Norpramin®)	Insomnia[41]
Disopyramide (Norpace®)	Heart failure[41]
Genitourinary Antispasmodics	*Benign Prostatic Hypertrophy*[41]
	Constipation[41]
Methylphenidate (Ritalin®[48])	Insomnia[41]
Metoclopramide (Reglan®)	Seizures[41]
Monoamine Oxidase Inhibitors	Insomnia[41]
Narcotics	*Benign Prostatic Hypertrophy*[41]
	Constipation[41]
Non-Steroidal Anti-Inflammatory Drugs	Chronic Renal Failure[48]
	Heart failure[48]
	Hypertension[48]
	Peptic Ulcer[41,48]
Phenylpropanolamine (Dexatrim®)	Hypertension[41]
Potassium Supplements	Peptic Ulcer[41]
Sedative/Hypnotics	Chronic Obstructive Pulmonary Disease[41]
Skeletal Muscle Relaxants	Benign Prostatic Hypertrophy[41]
Selective Serotonin Reuptake Inhibitors	Insomnia[41]
Theophylline (Theodur®)	Insomnia[41]
Thiazide Diuretic	Gout[48]
Thioridazine (Mellaril®)	Seizures[41]
Tricyclic Antidepressants	Arrhythmia[41]
	Heart Block[48]
	Postural Hypotension[48]

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†This combination may be beneficial in some patients.

drug interactions (e.g., 130 drug combinations involving cardiovascular, NSAIDs, and psychotropics). They found that 52.6% of patients had one or more high-risk prescribing events and that 45.6% received at least one questionable prescription. The most common problem was the use of benzodiazepines for more than 30 days (30.8 % of patients). Inappropriate use was associated with being female and increased age.

Clinical Review Applying Explicit Criteria

Clinical review of medications using explicit criteria was the subject of a recent comprehensive review and edito-

Table 3. Drug-Drug Interactions to Avoid in Older People as Defined by Explicit Criteria by Beers et al.[41] and McLeod et al.[48] Consensus Panels

Affected Drug	Interacting Drug
Warfarin	Aspirin[41,48]
	Non-Steroidal Anti-Inflammatory Drugs[41,48]
	Dipyridamole[41]
	Ticlopidine[41]
	Cimetidine[48]
Monoamine Oxidase Inhibitors	Selective Serotonin Reuptake Inhibitors[48]

rial.[54,55] Typically the clinical review involves a clinician who utilizes information readily available in a patient's medical record and information from the scientific literature to make judgments regarding the appropriateness of the patient's entire medication regimen.

Investigators from the United Kingdom developed inappropriate prescribing indicators via the consensus of a multidisciplinary healthcare team for older inpatients.[56] Clinical review using these explicit criteria was conducted for 1686 medical inpatients age 65 years or over in 19 hospitals in England and Wales. Little duplication of therapy was seen. Benzodiazepines were prescribed for 22% of patients, but were appropriate in only approximately one-third of these. Of the 2% patients prescribed an angiotensin-converting enzyme (ACE) inhibitor with a potassium-sparing diuretic or potassium supplement, prescription of the combination was appropriate in 84%. Coprescription of corticosteroids with beta 2-adrenoceptor agonists appeared excessive in 67% of patients receiving a beta 2-adrenoceptor agonist, because only 51% had documented evidence of steroid responsiveness or another indication for steroids.

Inappropriate prescribing can also be measured by ratings on the scale developed by Lipton et al. that examines six domains—no indication, improper schedule, inadequate dosage, potential drug interaction, therapeutic duplication, or allergy—and allows for the calculation of a weighted score.[57] The investigators reported good reliability and a positive association with adverse effects resulting from chronic medications.[57] Using this scale they found that 88% of 236 older ambulatory patients had one or more problems with prescription medications.[24] Twenty-two percent were determined to have a serious problem with one or more categories.[24]

Inappropriate prescribing can also be measured using the Medication Appropriateness Index (MAI).[25] For each of 10 criteria (indication, effectiveness, dosage, practical directions, correct directions, drug-drug interactions, drug disease interactions, duration, duplication, and cost), the index has operational definitions and instructions and allows three possible ratings. The ratings generate a weighted score ranging from 0 to 18 (the most prescribing problems) per drug, which serves as a summary measure of prescribing appropriateness.[58] The clinimetric properties of the MAI have demonstrated good intra- and inter-rater reliability and face, content and predictive validity, as well as feasibility in geriatric inpatients and outpatients.[25,26,47,58-60] Schmader et al. found that 74% of 1644 drugs prescribed for 208 older ambulatory patients with polypharmacy had one or more prescribing problems using the MAI.[26] The most prevalent problem areas were incorrect and impractical directions, use of expensive drugs, and incorrect dosage. All patients were taking at least one drug with a prescribing problem. Using a modified MAI, Ruscin et al. demonstrated that 82% of 430 hospitalized older people took one or more inappropriate medications.[47]

Health risks may be associated with inappropriate prescribing. Several studies have documented that hospital admissions and readmissions were due to inappropriate prescribing of drugs with contraindications or interactions.[61-63] Major limitations of these studies are the focus on a single outcome, hospitalization, of which only a small percentage is related to inappropriate drugs, and the absence of multivariate analyses to identify the independence of various risk factors while controlling for health status. There are also limited data that suggest that inappropriate prescribing is linked with higher medical care expenditures.[64] Moreover, a recent General Accounting Office (GAO) report estimated that hospitalization due to inappropriate prescribing in older people by the criteria of Beers et al. costs $20 billion annually.[43]

UNDERUSE OF MEDICATIONS (UNDERUTILIZATION)

Underutilization is an important and increasingly recognized problem in older people.[65] Underutilization has been defined as the omission of drug therapy that is indicated for the treatment or prevention of a disease or condition.[66] Underutilization can be measured by clinical review using explicit criteria. Lipton et al. developed a methodology to assess "omitted-but-necessary drug therapies."[66] If an omission was identified it was rated as either life threatening or not. They found that 55% of 236 ambulatory older patients had one or more necessary drug therapies omitted by lack of physician prescribing.[66] The most common drug therapies that were omitted but determined to be necessary were iron for anemia (19% of all recommendations), cholesterol-lowering drugs (9% of all recommendations), oral hypoglycemics for diabetes (7% of all recommendations), and bronchodilators for chronic obstructive pulmonary disease (COPD) (6% of all recommendations). Pain medications, potassium supplementation, and stool softeners were also frequently considered omissions.

The Assessment of Underutilization of Medication (AOU) extends the Lipton measure by having a health professional match the complete list of chronic medical conditions to the prescribed medications after reviewing the medical record.[67] In this manner, one can determine whether there was an omission of a needed drug for an established disease or condition based on the scientific literature. For each condition, one of three ratings can be made: omission, marginal omission (e.g., used appropriate nonpharmacological approach), or no omission. A study of 20 frail hospitalized older people demonstrated good inter-rater reliability for two clinical pharmacists' AOU evaluations.[67] Moreover, 25% of these patients had evidence of underutilization.[67]

Explicit criteria for certain conditions can also be used to measure underutilization. Some investigators have found that isolated systolic hypertension and depression in older

people may be undertreated.[65,68,69] Several studies have investigated the underutilization of ACE inhibitor medications in patients with congestive heart failure (CHF), with rates of use ranging from 33% to 75%.[70–73] Other investigators have studied the absence of secondary preventive therapy (aspirin, beta blockers, and lipid-lowering agents) in postacute myocardial infarction patients.[74–80] A few investigators have demonstrated the underutilization of anticoagulation in older patients with atrial fibrillation.[81,82]

The underutilization may have a negative relationship with health outcomes but the consequences of undermedication have not been well delineated in older populations. Nonetheless, it is reasonable to expect that undertreated diseases such as hypertension and depression and preventable conditions such as stroke or myocardial infarction will lower quality of life and increase morbidity and mortality in older people.[6,65] One study documented that limiting Medicaid patients' access to medications more than doubled their risk of admission to a nursing home.[83] Similarly, this group found that limiting Medicaid drug reimbursement benefits for the use of psychotropic agents increased the use of mental health services by patients with schizophrenia.[84] Another study found that 19% of drug-associated admissions in older people were related to therapeutic failure likely due to inadequate drug therapy.[27] Underutilization of beta blockers in older survivors of acute myocardial infarctions was associated with higher mortality.[85] Similarly, in a study by Havranek et al., mortality at 1 year was higher in those older people with CHF not treated with an ACE inhibitor.[86]

EVIDENCE THAT SUBOPTIMAL DRUG USE CAN BE MODIFIED IN OLDER PEOPLE

Several authors have summarized the literature regarding methods of improving medication prescribing.[87–89] These include such methods as "academic detailing," computer feedback and drug utilization review, formulary and other restrictions, community education, opinion leader and physician education, pharmacist activities, and multidisciplinary team approaches. While "academic detailing" (i.e., face-to-face educational outreach visits by physicians or pharmacists supplemented by brief graphic print materials) has been shown to be effective in reducing psychoactive drug use in nursing home patients, it has not been formally tested in older outpatients or inpatients.[90] All the remaining approaches have been employed to affect the quality of prescribing in older people in hospital and outpatient settings. The following provides a description and critique of each rigorously designed positive individual study using these approaches.

Computer Feedback/Drug Utilization Review

Using a population-based cohort, design investigators from Merck-Medco, a pharmacy benefit manager, evaluated whether a computerized DUR database linked to a telepharmacy intervention could improve inappropriate medication use defined by Beers criteria in 23,269 community-dwelling older people.[91] They found that the rate of change from baseline to a more appropriate therapeutic agent was 24%, but ranged from 40% for long half-life benzodiazepines to 2% for drugs that theoretically were contraindicated by patients' self-reported history (e.g., beta blocker and chronic obstructive pulmonary disease). No information was provided regarding the impact on health outcomes or cost-effectiveness.

Formulary and Other Restrictions

Investigators from Vanderbilt University studied the impact of prior authorization or mandatory advance approval for the use of one class of expensive medications (NSAIDs) in the Tennessee Medicaid program (approximately 500,000 eligible enrollees) of whom approximately 18% were age 65 years and older.[92] They compared monthly Medicaid expenditures that were potentially affected by the policy change during the year before and the 2 years after its implementation using time-series analysis. They found mean annualized Medicaid expenditures for NSAID prescriptions decreased significantly, with the greatest impact found in those who were older. Moreover, they found that there was no concomitant increase in Medicaid expenditures for other medical care. They concluded that prior authorization requirements may be highly cost effective for NSAIDs, since drugs in this class are similar in efficacy and safety but differ substantially in cost. Whether these findings will generalize to other older people taking other drugs is unknown.

McNutt et al. studied the effect that the requirement that triplicate prescriptions be written for benzodiazepines in New York State had on 20,944 low-income older people.[93] The purpose of the restriction was to reduce diversion and inappropriate prescribing of benzodiazepines. Using a cohort design and time-series analyses, they found a 33% decrease in the prescribing of benzodiazepines in this group of older people. However, a trend suggested an increase in other miscellaneous anxiolytics, some of which may have greater potential for toxicity (e.g., meprobamate). The impact that the intervention had on health-related outcomes was not reported.

Community Education

A novel study by Maclure et al. examined the impact of a national warning letter, a teleconference, small group workshops, and newsletters on first-line prescribing of antihypertensive drugs, with particular emphasis on prescribing of calcium-channel blockers (CCBs).[94] The investigators examined 4403 physicians from British Columbia who prescribed a thiazide diuretic, β-blocker, ACE inhibitor, or CCB as the first antihypertensive agent for 36,507 residents age 66 years and over, with no previous or concurrent sign of underlying cardiovascular disease. A matched cohort design was used for assessment of the teleconference and workshops, a randomized community design for the newsletters, and time-series analysis for the media impacts. They found that the proportion of patients who received a CCB as first-line therapy declined gradually from 22% in early 1994 to 15% in late 1996. Moreover, this proportion was not affected by two waves of adverse news about CCBs in 1995, but fell by 5% for 5 months and by 3% for 1 month after two waves in 1996. The proportion of patients who received either a CCB or an ACE inhibitor as first-line therapy, contrary to guidelines, was still 42% overall in 1996. The workshops and newsletters were followed by shifts from first-line CCB to first-line thiazide prescribing. The investigators concluded that changes in pre-

scribing practices occur gradually, with the accumulation of small impacts from educational interventions and lay media attention. What impact these modest changes in prescribing had on health-related outcomes was not presented.

Opinion Leaders/Physician Education

Soumerai et al. used a randomized, controlled, trial design to study the impact that a guideline-based, multifaceted intervention delivered by a local opinion leader had on the appropriateness of drugs for postacute myocardial infarction patients.[95] The study was conducted in 37 community hospitals in Minnesota, involving 2938 patients, of whom over one-third were greater than 75 years of age. The intervention resulted in a significant increase in aspirin and beta-blocker use in older people in the intervention compared with those in the control hospitals. They concluded that local opinion leaders increased the appropriate use of oral aspirin and beta-blockers in patients hospitalized with acute myocardial infarction. The study was underpowered to detect differences in subsequent health-services utilization or mortality.

Several investigators have looked at the impact of physicians influencing other physicians' prescribing.[96,97] Kroenke et al. conducted a randomized controlled trial of four physician firms, each consisting of nine resident physicians.[96] The patient population consisted of 79 patients ≥65 years of age taking five or more prescription medications and receiving care at a general medicine clinic at an Army medical center. Two firms were randomized to the control group, the other two to the intervention group. The intervention consisted of a physician faculty member making one-time recommendations both verbally and in writing to modify prescribing. The control group received no recommendations. There was a small absolute magnitude of improvement in mean drug use in the intervention group (mean reduction of 0.5 medications per patient). There was no improvement in drug duplications and drug interactions, since there were few events in either group. It is important to note that no data were reported regarding the impact that this intervention had on patient outcomes.

Meyer et al. conducted a randomized controlled trial of 292 outpatients (mean age 61.6 years) taking 10 or more active medications from a Veterans Affairs (VA) medical center.[97] Patients were randomized to one of three groups: (1) control, (2) their physician received a generic letter telling them that they were taking multiple medications and that this was potentially dangerous, or (3) their physician received a specific letter providing information regarding their medications, compliance, and specific recommendations to modify their drug regimen. The active number of medications at 4 months was significantly reduced for both intervention groups compared with the control group. However, there was no difference between the intervention groups. No information was provided regarding the impact at the intervention on health-related outcomes.

Pharmacist Activities

One clinic-based study evaluated the impact of a clinical pharmacist on inappropriate prescribing in ambulatory older patients.[98] That randomized controlled trial evaluated the effect of sustained clinical pharmacist interventions involving 208 older outpatients with polypharmacy (≥5 chronic medications) and their primary physicians. The study was conducted in a general medicine clinic of a VA medical center where a clinical pharmacist met with intervention group patients during all scheduled visits to evaluate their drug regimens and make recommendations to them and their physicians. They found that inappropriate prescribing scores declined significantly more in the intervention group than in the control group after 3 months and was sustained at 12 months.[98] There was no difference between groups at 12 months in health-related quality of life. Fewer intervention than control patients experienced adverse drug events. A cost effectiveness analysis revealed that healthcare use and costs were comparable between groups.[99] This study is limited by the select sample and use of a single, well-trained intervention clinical pharmacist.

A hospital-based randomized controlled trial study evaluated the impact of clinical pharmacists on inappropriate prescribing in 736 older patients.[24,100] For each intervention patient, the pharmacist reviewed the patient chart and drug regimen and consulted with the patient before discharge and at 1, 2 to 4, 8, and 12 weeks postdischarge, either in person or via telephone. The clinical pharmacist also consulted with the patients' physicians regarding drug-related problems. They found that the intervention significantly improved inappropriate prescribing and polypharmacy and improved patient medication knowledge and compliance (measured by a validated questionnaire). There was no difference between groups in health services use and costs. This study is also limited by not measuring patient related outcomes such as functional status or adverse drug reactions.

Multidisciplinary Team Approach

Important components of multidisciplinary geriatric evaluation and management (GEM) are the optimization of medications and its impact, which have been addressed in several studies.[3,101–104] Rubenstein et al. found that the number of medications per patient was reduced in the intervention group of a pivotal VA inpatient geriatric evaluation unit trial.[101] In a non-VA setting, Owens et al. randomized 436 older hospitalized patients to an inpatient geriatric assessment unit or to usual care and found that the intervention group took significantly fewer medications, received more drugs with appropriate indications, and had more optimal medications than the control group.[102] Burns et al. randomized 128 hospitalized veterans to outpatient GEM care or usual care upon discharge and measured multiple outcomes, including number of medications as a secondary outcome.[103] At 1 year after randomization, GEM care patients took significantly fewer medications than the usual care group. Toseland et al. randomized 160 ambulatory veterans to outpatient GEM care or usual care and measured multiple outcomes, including a Quality of Health and Social Care scale that included a Quality Assurance Drug Utilization Review Subscale as a secondary outcome.[104] The Drug Utilization Review Subscale had specific rating criteria for documentation of the medication regimen, complications, extent of patient education and compliance, and monitoring of dosages. At 8 months postrandomization, GEM-care pa-

tients had a lower (better) score on the subscale than usual-care patients. Taken together, these studies suggest that GEM has a beneficial effect on drug-related problems in older people. However, these studies were small, single site investigations that did not include adverse drug reactions or underutilization as outcomes and used limited measures of prescribing appropriateness. Perhaps the current authors' ongoing VA GEM Drug Study, a national, multicenter, randomized, controlled health services trial designed to determine whether inpatient or outpatient GEM care, alone or in combination, is effective in reducing polypharmacy, inappropriate prescribing, medication underutilization, medication non-adherence, and adverse drug reactions will help fill this information gap.

SUMMARY

The definitions for various types of suboptimal prescribing are numerous, and measurement varies from study to study. The literature suggests that suboptimal prescribing, especially inappropriate prescribing, is common in older outpatients and inpatients. Moreover, there is significant morbidity and mortality associated with suboptimal prescribing for these older people. Evidence from well-controlled studies suggests that in particular, clinical pharmacy and multidisciplinary team interventions can modify suboptimal drug use in older people. Future research is necessary to measure and test other methods for tackling this major public health problem facing older people.

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