Tools to Reduce Polypharmacy

Murthy Gokula, MD[a,*], Holly M. Holmes, MD[b]

KEYWORDS

- Inappropriate medication • Medication management
- Elderly • Polypharmacy

Approximately one-third of drugs prescribed in the United States may be unnecessary.[1] Older adults use higher numbers of medications compared with younger age groups, primarily because of increased numbers of comorbid conditions and greater numbers of physicians involved in their care, putting them at higher risk of polypharmacy. The use of multiple medications increases the risk for adverse drug events and adverse health outcomes.[2,3] Medication management is of utmost significance in older adults because of changes in body composition, physical function, social environment, and limiting finances with increasing age. Adding or stopping a medication in an older person should focus on improving function or quality of life, a core principle in the management of chronic illnesses in the elderly (**Box 1**).

Older adults are the largest consumers of prescription medications, and over-the-counter (OTC) medications and dietary supplements among older adults are on the rise in the United States. Qato and colleagues[4] conducted a survey in 3500 community-dwelling older adults and found that 29% took 5 or more prescription medications, 42% took at least 1 or more OTC medications, and 49% took at least 1 or more dietary supplements. Approximately 50 new medications enter the market each year, and the use of prescription drugs will continue to increase. Direct-to-consumer marketing and the continued focus on life-saving and life-sustaining therapies increases the reliance on medication therapy in older adults.

Adverse drug reactions (ADRs) are likely with excessive medication use; the risk of an ADR increases with increased medication number.[5] ADRs may be caused by drug-drug or drug-disease interactions and by the use of medications considered inappropriate in the elderly, and ADRs are a major cause of costly hospitalization in

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[a] Geriatric Medicine Fellowship Program, St. Luke's Hospital/University of Toledo, 6005 Monclova Road, Suite 220, Maumee, OH 43537, USA
[b] Department of General Internal Medicine, University of Texas MD Anderson Cancer Center, 1400 Pressler, Unit 1465, Houston, TX 77030, USA
* Corresponding author.
E-mail address: murthy.gokula@utoledo.edu

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Box 1
Definitions

Polypharmacy is defined as the use of multiple medications or duplicative medications that cause increased risk for drug-drug and drug-disease interactions.

Polymedicine or **polytherapy** describes the use of multiple medications prescribed appropriately for treating multiple comorbid conditions.

The prescribing cascade refers to the use of a medication that results in an adverse drug event that is mistaken for a new diagnosis and treated with another medication, thus, increasing the risk for further adverse drug events.

older adults.[5,6] Decreasing medication number and, specifically, decreasing the use of inappropriate medications, may reduce the risk of an ADR.

INTERVENTIONS TO IMPROVE PRESCRIBING

A systematic review by Loganathan and coworkers[7] summarized the effect of interventions to improve prescribing and concluded that staff education in the form of academic detailing has strong evidence for improvement in prescribing in nursing homes and care homes. The successful studies in the review included interactive techniques: (1) academic detailing with face-to-face interaction between a group of experts and prescribing physicians, (2) nursing workshops, and (3) family education. In this review, the use of computerized clinical decision support systems improved appropriate prescribing, and multidisciplinary team meetings including communication among health care professionals increased appropriate prescribing. Pharmacist medication reviews to improve appropriate prescribing were significantly successful in only 1 study.[7] In the United States, a monthly pharmacist medication review is mandatory in long-term care. A systematic review found mixed results for different approaches used to improve appropriate prescribing. However, because of the heterogeneity of study interventions and measures of suboptimal prescribing used in the studies, clear conclusions regarding the most effective interventions were not reached.[8]

Multidisciplinary case conferences involving a geriatrician have been shown to be effective interventions to improve prescribing in both community and hospital settings.[9] It is not clear whether combined strategies undertaken simultaneously have a synergistic effect, but a combination of intervention strategies is likely required to reduce polypharmacy. These combinations could include educational intervention, regular medication review, geriatrics consultation, multidisciplinary team meetings, computerized decision support systems, regulatory policies and procedures, interventions to improve documentation regarding medication indication, and increased vigilance during transitions in care.[9]

Although all of the above strategies may not be routinely available for the busy practicing clinician, a number of tools have been created to aid in medication management. These tools have been developed in various settings and have varying levels of support for their use. Ultimately, to reduce harmful polypharmacy and in settings in which combined interventions are not in use, evidence-based tools need to be incorporated into regular practice to aid in optimizing an older patient's medication regimen. We review a number of such tools that address polypharmacy in the context of their supporting evidence.

THE BEERS CRITERIA

This explicit list of medications (**Tables 1** and **2**) was created by expert consensus in 1991 and originally intended to identify inappropriate medication use in nursing home residents.[10] In 1997, the criteria were revised to apply more generally to persons 65 and older.[11] The criteria were again updated in 2003 with a list of 48 inappropriate medications or drug classes and a list of 20 combinations of medications inappropriate in the setting of specific diagnoses and conditions.[12] The Beers criteria have been updated recently to incorporate the most current evidence according to expert consensus and will be published with the support of the American Geriatrics Society in 2012.

The Beers criteria have been widely adopted in the United States and elsewhere and have been studied in numerous settings.[13] The disadvantages of the criteria are that many of the drugs are older and out of use, and there is insufficient evidence to include some drugs on the list. Further, the harm resulting from the use of some of the inappropriate medications on the list may be minor compared with other inappropriate prescribing, such as under- or overuse of medications, drug-drug interactions, drug-disease interactions, or drug duplication.[14] Finally, the Beers criteria are consensus based, and the reliability of the Delphi process to generate such a list is not definitively established.[15]

Ultimately, the Beers list may be most attractive because it is easy to use, both in clinical and research settings, because lists of drugs to avoid require little individualization or time-consuming decision-making during a busy clinic visit. The list can be easily incorporated into computerized decision support systems to prevent inappropriate use and in reviews of administrative claims databases to determine the prevalence and predictors of use.

IMPROVED PRESCRIBING IN THE ELDERLY TOOL, ALSO KNOWN AS THE CANADIAN CRITERIA

The Improved Prescribing in the Elderly Tool (IPET)[16] was developed by applying criteria for inappropriate medications from McLeod and colleagues[17] to 362 inpatients, resulting in 45 different medications in 14 classes of drugs considered inappropriate. Although the IPET is similar to the Beers criteria, the Beers list identifies more medications that are potentially inappropriate.[18] There is insufficient convincing evidence regarding the use of IPET to reduce the incidence of adverse drug events, health resource utilization, or mortality.[19]

SCREENING TOOL TO ALERT DOCTORS TO RIGHT TREATMENTS AND SCREENING TOOL OF OLDER PERSONS' POTENTIALLY INAPPROPRIATE PRESCRIPTIONS

These tools[20,21] were developed by an interdisciplinary team of geriatricians, primary care physicians, pharmacists, geriatric psychiatrists, and pharmacologists in Ireland. The Screening Tool to Alert Doctors to Right Treatments **(**START) tool consists of 22 evidence-based indicators of drugs commonly omitted by physicians. START is validated, with a high interrater reliability between physicians and pharmacists.[22] The Screening Tool of Older Persons' Potentially Inappropriate Prescriptions (STOPP) includes 65 indicators, mostly focused on drug-drug and drug-disease interactions that influence the risk for falls and duplications of common medication classes. The items are grouped based on human physiologic systems and by drug class. A randomized, controlled trial using START and STOPP in combination with the Medication Appropriateness Index (MAI) and Assessment of Underutilization index to test appropriate prescribing at hospital discharge and 6 months later

Table 1
2002 Criteria for potentially inappropriate medication use in older adults: independent of diagnoses or conditions

Drug	Concern	Severity Rating (High or Low)
Propoxyphene (Darvon) and combination products (Darvon with ASA, Darvon-N, and Darvocet-N)	Offers few analgesic advantages over acetaminophen, yet has the adverse effects of other narcotic drugs.	Low
Indomethacin (Indocin and Indocin SR)	Of all available nonsteroidal anti-inflammatory drugs, this drug produces the most CNS adverse effects.	High
Pentazocine (Talwin)	Narcotic analgesic that causes more CNS adverse effects, including confusion and hallucinations, more commonly than other narcotic drugs. Additionally, it is a mixed agonist and antagonist.	High
Trimethobenzamide (Tigan)	One of the least effective antiemetic drugs, yet it can cause extrapyramidal adverse effects.	High
Muscle relaxants and antispasmodics: methocarbamol (Robaxin), carisoprodol (Soma), chlorzoxazone (Paraflex), metaxalone (Skelaxin), cyclobenzaprine (Flexeril), and oxybutynin (Ditropan). Do not consider the extended-release Ditropan XL	Most muscle relaxants and antispasmodic drugs are poorly tolerated by elderly patients, since these cause anticholinergic adverse effects, sedation, and weakness. Additionally, their effectiveness at doses tolerated by elderly patients is questionable.	High
Flurazepam (Dalmane)	This benzodiazepine hypnotic has an extremely long half-life in elderly patients (often days), producing prolonged sedation and increasing the incidence of falls and fracture. Medium- or short-acting benzodiazepines are preferable.	High
Amitriptyline (Elavil), chlordiazepoxide-amitriptyline (Limbitrol), and perphenazine-amitriptyline (Triavil)	Because of its strong anticholinergic and sedation properties, amitriptyline is rarely the antidepressant of choice for elderly patients.	High
Doxepin (Sinequan)	Because of its strong anticholinergic and sedation properties, doxepin is rarely the antidepressant of choice for elderly patients.	High
Meprobamate (Miltown and Equanil)	This is a highly addictive and sedating anxiolytic. Those using meprobamate for prolonged periods may become addicted and may need to be withdrawn slowly.	High

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Table 1
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Drug	Concern	Severity Rating (High or Low)
Doses of short-acting benzodiazepines: doses greater than lorazepam (Ativan), 3 mg; oxazepam (Serax), 60 mg; alprazolam (Xanax), 2 mg; temazepam (Restoril), 15 mg; and triazolam (Halcion), 0.25 mg	Because of increased sensitivity to benzoadiazepines in elderly patients, smaller doses may be effective as well as safer. Total daily doses should rarely exceed the suggested maximums.	High
Long-acting benzodiazepines: chlordiazepoxide (Librium), chlordiazepoxide-amitriptyline (Limbitrol), clidinium-chlordiazepoxide (Librax), diazepam (Valium), quazepam (Doral), halazepam (Paxipam), and chlorazepate (Tranxene)	These drugs have a long half-life in elderly patients (often several days), producing prolonged sedation and increasing the risk of falls and fractures. Short- and intermediate-acting benzodiazepines are preferred if a benzodiazepine is required.	High
Disopyramide (Norpace and Norpace CR)	Of all antiarrhythmic drugs, this is the most potent negative inotrope and therefore may induce heart failure in elderly patients. It is also strongly anticholinergic. Other antiarrhythmic drugs should be used.	High
Digoxin (Lanoxin) (should not exceed >0.125 mg/d except when treating atrial arrhythmias)	Decreased renal clearance may lead to increased risk of toxic effects.	Low
Short-acting dipyridamole (Persantine). Do not consider the long-acting dipyridamole (which has better properties than the short-acting in older adults) with the patients with artificial heart valves	May cause orthostatic hypotension.	Low
Methyldopa (Aldomet) and methyldopa-hydrochlorothiazide (Aldoril)	May cause bradycardia and exacerbate depression in elderly patients.	High
Reserpine at doses >0.25 mg	May induce depression, impotence, sedation, and orthostatic hypotension.	Low
Chlorpropamide (Diabinese)	It has a prolonged half-life in elderly patients and could cause prolonged hypoglycemia. Additionally, it is the only oral hypoglycemic agent that causes SIADH.	High

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Table 1
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Drug	Concern	Severity Rating (High or Low)
Gastrointestinal antispasmodic drugs: dicyclomine (Bentyl), hyoscyamine (Levsin and Levsinex), propantheline (Pro-Banthine), belladonna alkaloids (Donnafal and others, and clidinium-chlordiazepoxide (Librax)	GI antispasmodic drugs are highly anticholinergic and have uncertain effectiveness, These drugs should be avoided (especially for long-term use).	High
Anticholinergics and antihistamines: chlorpheniramine (Chlor-Trimenton), diphenhydramine (Benadryl), hydroxyzine (Vistaril and Atarax), cyproheptadine (Periactin), promethazine (Phenergan), tripelennamine, dexchlorpheniramine (Polaramine)	All nonprescription and many prescription antihistamines may have potent anticholinergic properties. Nonanticholinergic antihistamines are preferred in elderly patients when treating allergic reactions.	High
Diphenhydramine (Benadryl)	May cause confusion and sedation. Should not be used as a hypnotic, and when used to treat emergency allergic reactions, it should be used in the smallest possible dose.	High
Ergot mesyloids (Hydergine), and cyclandelate (Cyclospasmol)	Have not been shown to be effective in the doses studied.	Low
Ferrous sulfate >325 mg/d	Doses >325 mg/d do not dramatically increase the amount absorbed but greatly increase the incidence of constipation.	Low
All barbiturates (except Phenobarbital) except when used to control seizures	Are highly addictive and cause more adverse effects than most sedative or hypnotic drugs in elderly patients.	High
Meperidine (Demerol)	Not an effective oral analgesic in doses commonly used. May cause confusion and has many disadvantages to other narcotic drugs.	High
Ticlopidine (Ticlid)	Has been shown to be no better than aspirin in preventing clotting and may be considerably more toxic. Safer, more effective alternatives exist.	High
Ketorolac (Toradol)	Immediate and long-term use should be avoided in older persons, since a significant number have asymptomatic GI pathologic conditions.	High

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Drug	Concern	Severity Rating (High or Low)
Amphetamines and anorexic agents	These drugs have potential for causing dependence, hypertension, angina, and myocardial infarction.	High
Long-term use of full-dosage, longer half-life, non–COX-selective NSAIDS: naproxen (Naprosyn, Avaprox, and Aleve), oxaprozin (Daypro), and piroxicam (Feldene)	Have the potential to produce GI bleeding, renal failure, high blood pressure, and heart failure.	High
Daily fluoxetine (Prozac)	Long half-life of drug and risk of producing excessive CNS stimulation, sleep disturbances, and increasing agitation. Safer alternatives exist.	High
Long-term use of stimulant laxatives: bisacodyl (Dulcolax), cascara sagrada, and Neoloid except in the presence of opiate analgesic use	May exacerbate bowel dysfunction.	High
Amiodarone (Cordarone)	Associated with QT interval problems and risk of provoking torsades de pointes. Lack of efficacy in older adults.	High
Orphenadrinie (Norflex)	Causes more sedation and anticholinergic adverse effects than safer alternatives.	High
Guanethidine (Ismelin)	May cause orthostatic hypotension. Safer alternatives exist.	High
Guanadrel (hylorel)	May cause orthostatic hypotension.	High
Cyclandelate (Cyclospasmol)	Lack of efficacy.	Low
Isoxsurpine (Vasodilan)	Lack of efficacy.	Low
Nitrofurantoin (Macrodantin)	Potential for renal impairment. Safer alternative available.	High
Doxazosin (Cardura)	Potential for hypotension, dry mouth, and urinary problems.	Low
Methyltestosterone (Android, Virilon, and Testrad)	Potential for prostatic hypertrophy and cardiac problems.	High
Thioridazine (Mellaril)	Greater potential for CNS and extrapyramidal adverse effects.	High
Mesoridazine (Serentil)	CNS and extrapyramidal adverse effects.	High
Short-acting nifedipine (Procardia and Adalat)	Potential for hypotension and constipation.	High
Clonidine (Catapres)	Potential for orthostatic hypotension and CNS adverse effects.	Low

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Table 1
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Drug	Concern	Severity Rating (High or Low)
Mineral oil	Potential for aspiration and adverse effects. Safer alternatives available.	High
Cimetidine (Tagamet)	CNS adverse effects including confusion.	Low
Ethacrynic acid (Edecrin)	Potential for hypertension and fluid imbalances. Safer alternative available.	Low
Desiccated thyroid	Concerns about cardiac effects. Safer alternative available.	High
Amphetamines (excluding methylphenidate hydrochloride and anorexics)	CNS stimulant adverse effects.	High
Estrogens only (oral)	Evidence of the carcinogenic (breast and endometrial cancer) potential of these agents and lack of cardioprotective effect in older women.	Low

Abbreviations: CNS, central nervous system; COX, cyclooxygenase; GI, gastrointestinal; NSAIDs, nonsteroidal anti-inflammatory drugs; SIADH, syndrome of inappropriate antidiuretic hormone secretion.

From Fick DM, Cooper JW, Wade WE, et al. Updating the Beers criteria for potentially inappropriate medication use in older adults: results of a US consensus panel of experts. Arch Intern Med 2003;163(22):2716–24; with permission.

showed that the use of these criteria, in combination, showed lower rates of polypharmacy, higher rates of correct drug dosing, and reduced drug-drug interactions. The effects were sustained 6 months after discharge.[23] A comparative study of STOPP and the Beers criteria to detect inappropriate prescribing showed the higher sensitivity of the STOPP criteria.[24] The advantages of START and STOPP criteria are (1) good interrater reliability, (2) inclusion of medications used both in the United States and in Europe, (3) logical organization and structure with easy-to-use explicit lists of medication criteria, and (4) short time to complete, usually about 3 minutes.

MEDICATION APPROPRIATENESS INDEX

The MAI uses implicit criteria to measure elements of appropriate prescribing (**Table 3**). It consists of 10 elements considered necessary for appropriate prescribing, including indication, effectiveness, appropriate dose, practical and correct directions, absence of interactions, lack of therapeutic duplication, appropriate duration, and low cost.[25] The MAI involves the use of clinical judgment to assess each criterion, but has operational definitions and explicit instructions to standardize the rating process. The ratings are scored, with different weights for some of the elements considered more important.[26] Of the 10 components in the MAI, 3 (indication, effectiveness, and duplication) can be used without the other 7 to detect polypharmacy and inappropriate prescribing.[27] The main advantages of the MAI are that it can be used in

Table 2
2002 Criteria for potentially inappropriate medication use in older adults: considering diagnoses or conditions

Disease or Condition	Drug	Concern	Severity Rating (High or Low)
Heart failure	Disopyramide (Norpace), and high sodium content drugs (sodium and sodium salts [alginate bicarbonate, biphosphate, citrate, phosphate, salicylate, and sulfate])	Negative inotropic effect. Potential to promote fluid retention and exacerbation of heart failure.	High
Hypertension	Phenylpropanolamine hydrochloride (removed from the market in 2001), pseudoephedrine: diet pills and amphetamines	May produce elevation of blood pressure secondary to sympathomimetic activity.	High
Gastric or duodenal ulcers	NSAIDS and aspirin (>325 mg) (coxibs excluded)	May exacerbate existing ulcers or produce new/ additional ulcers.	High
Seizures or epilepsy	Clozapine (Clozaril), chlorpromazine (Thorazine), thioridazine (Mellaril), and thiothixene (Navane)	May lower seizure thresholds.	High
Blood clotting disorders or receiving anticoagulant therapy	Aspirin, NSAIDs, dipyridamole (Persantin), ticlopidine (Ticlid), and clopidogrel (Plavix)	May prolong clotting time and elevate INR values or inhibit platelet aggregation, resulting in an increased potential for bleeding.	High
Bladder outflow obstruction	Anticholinergics and antihistamines, gastrointestinal antispasmodics, muscle relaxants, oxybutynin (Ditropan), flavoxate (Urispas), anticholinergics, antidepressants, decongestants, and tolterodine (Detrol)	May decrease urinary flow, leading to urinary retention.	High
Stress incontinence	α-Blockers (Doxazosin, Prazosin, and Terazosin), anticholinergics, tricyclic antidepressants (imipramine hydrochloride, doxepin hydrochloride, and amitriptyline hydrochloride), and long-acting benzodiazepines	My produce polyruia and worsening of incontinence.	High

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Disease or Condition	Drug	Concern	Severity Rating (High or Low)
Arrhythmias	Tricyclic antidepressants (imipramine hydrochloride)	Concern due to proarrhythmic effects and ability to produce QT interval changes.	High
Insomnia	Decongestants, theophylline (Theodur), methylphenidate (Ritalin), MAOIs, and amphetamines	Concern due to CNS stimulant effects.	High
Parkinson disease	Metoclopramide (Reglan), conventional antipsychotics, and tacrine (Cognex)	Concern due to their antidopaminergic/ cholinergic effects.	High
Cognitive impairment	Barbiturates, anticholinergics, antispasmodics, and muscle relaxants. CNS stimulants: dextroAmphetamine (Adderall), methylphenidate (Rialin), methamphetamine (Desoxyn), and pemolin	Concern due to CNS-altering effects.	High
Depression	Long-term benzodiazepine use. Sympatholytic agents: methyldopa (Aldomet), reserpine, and guanethidine (Ismelin)	May produce or exacerbate depression.	High
Anorexia and malnutrition	CNS stimulants: DextroAmphetamine (Adderall), methylphenidate (Ritalin), methamphetamine (Desoxyn), permolin, and fluoxetine (Prozac)	Concern due to appetite-suppressing effects.	High
Syncope or falls	Short- to intermediate-acting benzodiazepine and tricyclic antidepressants (imipramine hydrochooride, doxepin hydrochloride, and amitriptyline hydrochloride)	May produce ataxia, imipaired psychomotor function, syncope, and additional falls.	High
SIADH/ hyponatremia	SSRIs: fluoxetine (Prozac), citalopram (Celexa), fluvoxamine (Luvox), paroxetine (Paxil), and sertraline (Zoloft)	May exacerbate or cause SIADH.	Low
Seizure disorder	Bupropion (Wellbutrin)	May lower seizure threshold.	High
Obesity	Olanzapine (Zyprexa)	May stimulate appetite and increase weight gain.	Low

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Table 2
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Disease or Condition	Drug	Concern	Severity Rating (High or Low)
COPD	Long-acting benzodiazepines: chlordiazepoxide (Librium), chlordiazepoxide-amitriptylinie (Limbitrol), clidinium-chlordiazepoxide (Librax), diazepam (Valium), quazepam (Doral), halazepam (Pasipam), and chlorazepate (Tranxene). β-blockers: propranolol	CNS adverse effects. May induce respiratory depression. May exacerbate or cause respiratory depression.	High
Chronic constipation	Calcium channel blockers, anticholinergics, and tricyclic antidepressant (imipramine hydrochloride, doxepin hydrochloride, and amitriptyline hydrochloride)	May exacerbate constipation.	Low

Abbreviations: CNS, central nervous system; COPD, chronie obstructive pulmonary disease; INR, international normalized ratio; MAOIs, monoamine oxidase inhibitors; NSAIDs, nonsteroidal anti-inflammatory drugs; SIADH, syndrome of inappropriate antidiuretic hormone secretion; SSRIs, selective serotonin reuptake inhibitors.

From Fick DM, Cooper JW, Wade WE, et al. Updating the Beers criteria for potentially inappropriate medication use in older adults: results of a US consensus panel of experts. Arch Intern Med 2003;163(22):2716–24; with permission.

inpatient and ambulatory settings, has excellent intra- and interrater reliability, and has face and content validity. The main disadvantages are that it takes at least 10 minutes to complete the entire tool, and it does not address the underuse of appropriate prescribing, like the START tool, for example. The MAI has been linked to adverse outcomes in smaller studies[28] but has not been extensively used in various larger settings.

FIT FOR THE AGED CRITERIA

In this scheme, medications are graded based on Fit for the Aged Criteria (FORTA) class[29]: A, indispensible, with obvious benefit; B, proven efficacy but limited effects or possible safety concerns; C, questionable efficacy or safety; and D, avoid. In a small pilot study in Germany,[30] patients admitted to a geriatric medical ward had medications assessed on admission and at discharge using the criteria, and changes were made according to the criteria and also to reduce drug interactions. There was no significant decrease in the total number of prescribed drugs or in the number of negatively assessed drugs. There was a significant increase in positively assessed drugs as well as appropriate prescribing. These criteria, while presenting a promising approach to medication use in older persons, need further validation in controlled studies before widespread use.

Table 3
Medication appropriateness index

Item	Weight
Is there an indication for the drug?	3
Is the medication effective for the condition?	3
Is the dosage correct?	2
Are the directions correct?	2
Are the directions practical?	1
Are there clinically significant drug-drug interactions?	2
Are there clinically significant drug-disease/condition interactions?	2
Is there unnecessary duplication with other drug(s)?	1
Is the duration of therapy acceptable?	1
Is this drug the least expensive alternative compared to others of equal utility?	1

Data from Hanlon JT, Schmader KE, Samsa GP, et al. A method for assessing drug therapy appropriateness. J Clin Epidemiol 1992;45(10):1045–51 and Samsa GP, Hanlon JT, Schmader KE, et al. A summated score for the medication appropriateness index: development and assessment of clinimetric properties including content validity. J Clin Epidemiol 1994;47(8):891–96.

THE ASSESS, REVIEW, MINIMIZE, OPTIMIZE, REASSESS

The Assess, Review, Minimize, Optimize, Reassess[31] tool (**Table 4**) is a functional and interactive evidence-based practice tool that is designed for use in nursing home residents. The tool takes into account patients' clinical profiles and functional status, including physiologic reserves. It can be used in patients (1) receiving 9 or more medications, (2) seen for initial assessment, (3) with falls or behavioral disturbance,

Table 4
The ARMOR tool

A	Assess	• Beers criteria • β-blockers • Pain medications • Antidepressants • Antipsychotics • Other psychotropics • Vitamins and supplements
R	Review	• Drug–disease interactions • Drug–drug interactions • Adverse drug reactions
M	Minimize	• Number of medications according to functional status rather than evidence-based medicine
O	Optimize	• For renal/hepatic clearance, PT/PTT, β-blockers, pacemaker function, anticonvulsants, pain medications, and hypoglycemics; gradual dose reduction for antidepressants
R	Reassess	• Functional/cognitive status in 1 week and as needed • Clinical status and medication compliance

From Haque R. ARMOR: a tool to evaluate polypharmacy in elderly persons. Annals of Long-Term Care 2009;17(6):26–30; with permission. Available at: http://www.annalsoflongtermcare.com/content/armor-a-tool-evaluate-polypharmacy-elderly-persons. Accessed January 28, 2012.

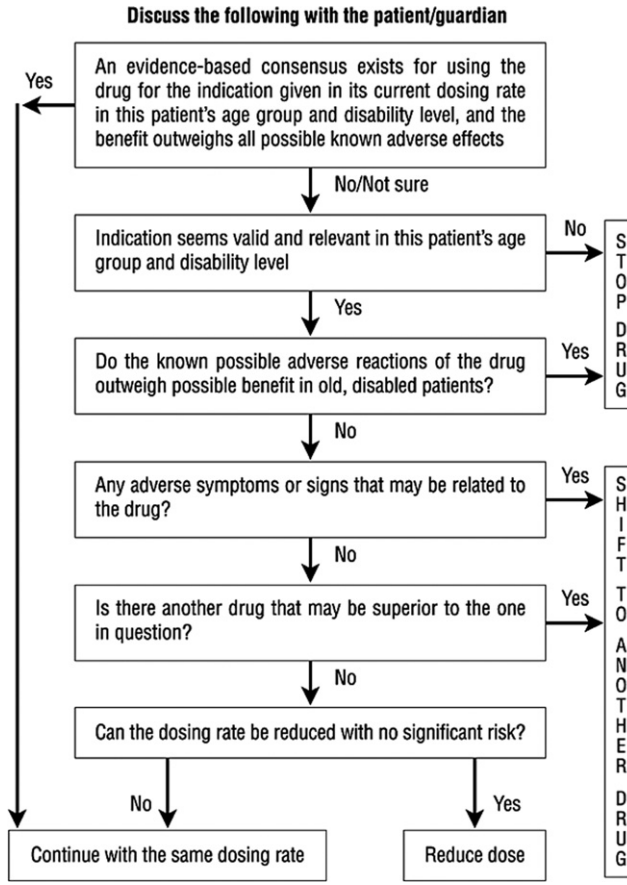

Fig. 1. The Good Palliative-Geriatric Practice algorithm. (*From* Garfinkel D, Zur-Gil S, Ben-Israel J. The war against polypharmacy: a new cost-effective geriatric-palliative approach for improving drug therapy in disabled elderly people. Isr Med Assoc J 2007;9(6):430–34; with permission.)

and/or (4) admitted for rehabilitation. The primary goal of using this systematic approach is to improve functional status. It also incorporates making decisions on changing or discontinuing medications. The overall goal is to improve functional status and mobility, which are the main outcome measures for use of the tool. Its use has been shown to reduce polypharmacy, health care costs, and hospitalizations. However, it was only tested in one nursing facility.

GOOD PALLIATIVE-GERIATRIC PRACTICE ALGORITHM

The Good Palliative-Geriatric Practice algorithm[32] (**Fig. 1**) was a consensus-based flow chart developed in 2004 for nursing homes to reduce polypharmacy. The algorithm was used in 6 nursing homes in Israel, with 119 patients in the intervention group and 71 patients in the control group. There was a significant reduction in mortality, hospitalization, and cost. At the end of 1 year, an average of 2.8 drugs per patient was discontinued, and there were no significant adverse effects caused by

Box 2
Prescribing optimization method

1. Is the patient undertreated and is additional medication indicated?
2. Does the patient adhere to his/her medication schedule?
3. Which drug(s) can be withdrawn or which drug(s) is/are inappropriate for this patient?
4. Which adverse effects are present?
5. Which clinically relevant interactions are to be expected?
6. Should the dose frequency and/or form of the drug be adjusted?

Data from Drenth-van Maanen AC, van Marum RJ, Knol W, et al. Prescribing optimization method for improving prescribing in elderly patients receiving polypharmacy: results of application to case histories by general practitioners. Drugs Aging 2009;26(8):687–701.

discontinuation. The overall rate of drug discontinuation failure (that required resuming the original medication) was 18%, representing 10% of all the drugs. The 1-year mortality rate was 21% in the intervention group and 45% in the control group. Only 11.8% of the intervention group was readmitted to the hospital compared with 30% of the control group. There was a substantial decrease in the cost of drugs ($69 per patient) because of drug discontinuation.[33]

PATIENT-FOCUSED DRUG SURVEILLANCE

Patient-Focused Drug Surveillance[34] was an intervention study for elderly persons in nursing homes in Sweden. The intervention involved a physician-led, patient-focused approach, taking into account the patient's health condition to appropriately optimize medication therapy and reduce polypharmacy. Outcomes studied included mortality, health care utilization, number of medications, health status, and periodic evaluations of quality of drug treatment. The study found improvement in optimum prescribing, improved medication surveillance, and reduction in medication number. The advantage of this approach was the recognition of the need to discuss benefits and risks of drug therapy with frail older persons, accompanied by close monitoring and re-evaluation. The intervention was not described clearly enough to generate a quick reference tool, but the success of this type of intervention was the potential for a sustained change in practice.

GERIATRIC RISK ASSESSMENT MEDGUIDE

Geriatric Risk Assessment Medguide[35] is a clinical informatics tool that generates prospective monitoring plans based on potential risk for falls or for delirium within 24 hours of nursing home admission. Its use was evaluated in 25 nursing homes, assessing not only falls and delirium, but also hospitalizations owing to adverse drug events and mortality. The use of the Geriatric Risk Assessment Medguide tool significantly reduced the rate of delirium. The rates of hospitalization and mortality were lower but not statistically significant. The findings were lessened in residents with a longer length of stay.

PRESCRIBING OPTIMIZATION METHOD

The Prescribing Optimization Method[36] (**Box 2**) was developed to help general practitioners optimize medication use in older adults. POM is based on 6 questions

that address the following: (1) undertreatment, (2) adherence, (3) drugs that can be discontinued or are inappropriate, (4) adverse drug events, (5) interactions, and (6) dosing frequency or formulation. Education of 45 primary care physicians about this approach resulted in improvement in optimum prescribing when applied to a patient case history. The advantage of its use in a clinical setting is that the 6 questions are open and allowed for clinical judgment and, after brief education, could promote better prescribing. Each question from the POM has a number of potential follow-up issues (eg, identification of drugs that are inappropriate) that individually could be time consuming.

ANTICHOLINERGIC RISK SCALE

To create the Anticholinergic Risk Scale (ARS),[37] (**Table 5**) the 500 most commonly prescribed drugs in the Veteran's Administration system were ranked according to anticholinergic potential and assigned a point value, and an individual's score was calculated by added the points for each drug. Increasing ARS score was significantly associated with anticholinergic adverse effects in a retrospective review of 132 geriatric patients and a prospective study of 117 primary care patients. Higher ARS scores have been associated with lower physical function scores[38] but not with mortality.[39] The advantages of the ARS score are the ease of calculating the score using a table given in the manuscript and the potential to reduce anticholinergic side effects; however, it could be time consuming and impractical in clinical settings compared with research settings.

Drug Burden Index

Similarly to the ARS, the drug burden index (DBI)[40] is a formula to describe anticholinergic and sedative burden. Total drug burden was calculated from a combination of data regarding anticholinergic properties, sedative effects, and total medication number, generating a single score for a patient. Applying the results to 3075 persons enrolled in the Health ABC study, increasing drug burden index was significantly correlated with functional and cognitive decline, although increasing medication number was not associated. Further studies have confirmed the association between increasing drug burden index and decreased physical and cognitive function.[41–45] Although the DBI could be incorporated readily into drug utilization review software, it may not be widely available, limiting its usability for most clinicians, unless they have access to a pharmacist or other consultant who may provide DBI scores. Further prospective intervention studies are needed to determine whether improving the DBI score results in better outcomes.

PRISCUS LIST

Developed in Germany, the PRISCUS list[46] is a consensus list of potentially inappropriate medications developed among experts in a process that included a qualitative analysis of inappropriate medication lists from multiple countries, a literature search for medications that cause adverse drug events, development of a preliminary list of inappropriate medications for use in Germany, and generation of the final PRISCUS list using a modified Delphi process. The final outcome was a list of 83 drugs that were rated as inappropriate for the elderly. The final list also contains recommendations for monitoring of laboratory values, dose adaptation, and therapeutic alternatives. The list was developed for use in Germany because of important differences in drugs approved on the market and in prescribing guidelines. Further prospective testing of the use of PRISCUS is needed.

Table 5
Anticholinergic risk scale[a]

3 Points	2 Points	1 Point
Amitriptyline hydrochloride	Amantadine hydrochloride	Carbidopa-levodopa
Atropine products	Baclofen	Entacapone
Benztropine mesylate	Cetirizine hydrochloride	Haloperidol
Carisoprodol	Cimetidine	Methocarbamol
Chlorpheniramine maleate	Clozapine	Metoclopramide hydrochloride
Chlorpromazine hydrochloride	Cyclobenzaprine hydrochloride	Mirtazapine
Dicyclomine hydrochloride	Loperamide hydrochloride	Paroxetine hydrochloride
Diphenhydramine hydrochloride	Loratadine	Pramipexole dihydrochloride
Fluphenazine hydrochloride	Nortriptyline hydrochloride	Quetiapine fumarate
Hydroxyzine hydrochloride and hydroxyzine pamoate	Olanzapine	Ranitidine hydrochloride
Hyoscyamine products	Prochlorperazine maleate	Risperidone
Imipramine hydrochloride	Pseudoephedrine hydrochloride–triprodlidine hydrochloride	Selegiline hydrochloride
Meclizine hydrochloride	Tolterodine tartrate	Trazodone hydrochloride
Oxybutynin chloride		Ziprasidone hydrochloride
Perphenazine		
Promethazine hydrochloride		
Thioridazine hydrochloride		
Thiothixene		
Tizanidine hydrochloride		
Trifluoperazine hydrochloride		

[a] To calculate the Anticholintergic Risk Scale score for a patient, identify medications the patient is taking and add the total points for each medication.

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SUMMARY

The reduction in polypharmacy and avoidance of inappropriate medications is a common goal in the care of older persons, regardless of setting. While multidisciplinary teams and regular medication reconciliation and review can identify and reduce medication-related problems, tools to decrease the use of high-risk/low-benefit medications can help the individual clinician to improve prescribing. Numerous criteria, tools, algorithms, and scoring systems have been developed for use in a wide range of areas from long-term care to the outpatient setting, and some may not be applicable to individual situations. Not all medication review instruments have

been adequately validated, and the tools we have presented have varying levels of evidence to support their use. Clinicians also need to be aware of regulatory, policy, and guideline issues that may impact the use of certain criteria for optimum prescribing. Ultimately, optimizing prescribing by reducing polypharmacy and avoiding inappropriate medications is a highly individualized process for each patient, and clinicians will have to use extensive clinical judgment in using the tools presented here.

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