

Updating the Beers Criteria for Potentially Inappropriate Medication Use in Older Adults

Results of a US Consensus Panel of Experts

Donna M. Fick, PhD, RN; James W. Cooper, PhD, RPh; William E. Wade, PharmD, FASHP, FCCP; Jennifer L. Waller, PhD; J. Ross Maclean, MD; Mark H. Beers, MD

Background: Medication toxic effects and drug-related problems can have profound medical and safety consequences for older adults and economically affect the health care system. The purpose of this initiative was to revise and update the Beers criteria for potentially inappropriate medication use in adults 65 years and older in the United States.

Methods: This study used a modified Delphi method, a set of procedures and methods for formulating a group judgment for a subject matter in which precise information is lacking. The criteria reviewed covered 2 types of statements: (1) medications or medication classes that *should generally be avoided* in persons 65 years or older because they are either ineffective or they pose unnecessarily high risk for older persons and a safer alternative is available and (2) medications that should not be used in older persons known to have *specific medical conditions*.

Results: This study identified 48 individual medications or classes of medications to avoid in older adults and their potential concerns and 20 diseases/conditions and medications to be avoided in older adults with these conditions. Of these potentially inappropriate drugs, 66 were considered by the panel to have adverse outcomes of high severity.

Conclusions: This study is an important update of previously established criteria that have been widely used and cited. The application of the Beers criteria and other tools for identifying potentially inappropriate medication use will continue to enable providers to plan interventions for decreasing both drug-related costs and overall costs and thus minimize drug-related problems.

Arch Intern Med. 2003;163:2716-2724

From the Department of Medicine, Center for Health Care Improvement (Drs Fick and Maclean); and Office of Biostatistics (Dr Waller), Medical College of Georgia, Augusta; Department of Veterans Affairs Medical Center, Augusta (Dr Fick); Department of Clinical and Administrative Pharmacy, College of Pharmacy, University of Georgia, Athens, (Drs Cooper and Wade); and Merck & Co Inc, West Point, Pa (Dr Beers). The authors have no relevant financial interest in this article.

TOXIC EFFECTS of medications and drug-related problems can have profound medical and safety consequences for older adults and economically affect the health care system. Thirty percent of hospital admissions in elderly patients may be linked to drug-related problems or drug toxic effects.¹ Adverse drug events (ADEs) have been linked to preventable problems in elderly patients such as depression, constipation, falls, immobility, confusion, and hip fractures.^{1,2} A 1997 study of ADEs found that 35% of ambulatory older adults experienced an ADE and 29% required health care services (physician, emergency department, or hospitalization) for the ADE.¹ Some two thirds of nursing facility residents have ADEs over a 4-year period.³ Of these ADEs, 1 in 7 results in hospitalization.⁴

Recent estimates of the overall human and economic consequences of medication-related problems vastly exceed the findings of the Institute of Medicine (IOM) on deaths from medical errors, estimated

to cost the nation \$8 billion annually.⁵ In 2000, it is estimated that medication-related problems caused 106 000 deaths annually at a cost of \$85 billion.⁶ Others have calculated the cost of medication-related problems to be \$76.6 billion to ambulatory care, \$20 billion to hospitals, and \$4 billion to nursing home facilities.^{2,7,8} If medication-related problems were ranked as a disease by cause of death, it would be the fifth leading cause of death in the United States.⁹ The prevention and recognition of drug-related problems in elderly patients and other vulnerable populations is one of the principal health care quality and safety issues for this decade.

**CME course available at
www.archinternmed.com**

The aforementioned IOM report has focused increased attention on finding solutions for unsafe medication practices, polypharmacy, and drug-related problems in the care of older adults. There are many ways to define medication-related prob-

lems in elderly patients, including the use of lists containing specific drugs to avoid in the elderly and appropriateness indexes applied by pharmacists or clinicians.^{1,10,11} Systematic review of the evidence-based literature on medication use in elderly patients is another approach to defining the problem, but the number of controlled studies on medication use in elderly patients is limited.

The use of consensus criteria for safe medication use in elderly patients is one approach to developing reliable and explicit criteria when precise clinical information is lacking. The two most widely used consensus criteria for medication use in older adults are the Beers criteria and the Canadian criteria.¹²⁻¹⁴ The Beers criteria are based on expert consensus developed through an extensive literature review with a bibliography and questionnaire evaluated by nationally recognized experts in geriatric care, clinical pharmacology, and psychopharmacology using a modified Delphi technique to reach consensus. The Beers criteria have been used to survey clinical medication use, analyze computerized administrative data sets, and evaluate intervention studies to decrease medication problems in older adults. The Beers criteria were also adopted by the Centers for Medicare & Medicaid Services (CMS) in July 1999 for nursing home regulation. Previous studies have shown these criteria to be useful in decreasing problems in older adults.¹⁵⁻¹⁹ These criteria, though controversial at times, have been widely used over the past 10 years for studying prescribing patterns within populations, educating clinicians, and evaluating health outcomes, cost, and utilization data.²⁰⁻²³

A recently published study of potentially inappropriate medication (PIM) use with the Beers criteria in a Medicare-managed care population found a PIM prevalence of 23% (541/2336). Those receiving a PIM had significantly higher total, provider, and facility costs and a higher mean number of inpatient, outpatient, and emergency department visits than comparisons after controlling for sex, Charlson Comorbidity Index, and total number of prescriptions.²⁰ Other studies have found that specific PIMs such as nonsteroidal anti-inflammatory drugs (NSAIDs) and benzodiazepines have been associated with adverse outcomes and increased costs.¹⁸ In contrast, a recent study on the relationship between inappropriate drug use, functional status decline, and mortality in 3234 patients from the Duke cohort did not find an association with mortality and inappropriate drug use as determined by the Beers criteria after controlling for covariates.²⁴

In summary, these criteria have been used extensively for evaluating and intervening in medication use in older adults over the past decade. However, with the continuous arrival of new drugs on the market, increased knowledge about older drugs, and removal of older drugs from the market, these criteria must be updated on a regular basis to remain useful. Since the criteria were published in 1997, there has been an increase in the number of scientific studies addressing drug use and appropriateness in older adults, but there is still a lack of controlled studies in the older population and particularly in patients older than 75 years and patients with multiple comorbidities.²³

The purpose of this initiative was to revise and update the Beers criteria for ambulatory and nursing

Below are the Beers criteria published in 1997. In parts 1 and 2, we are first asking you to rate your level of agreement on these 1997 criteria.

Please answer the following questions regarding the use of medications in adults 65 years or older:

Please give one of the following answers:

1=Strongly Agree 2=Agree 3=Unsure 4=Disagree 5=Strongly Disagree
0=Unable to offer an opinion

1) Propoxyphene (Darvon) and combination products (Darvon with ASA, Darvon-N, and Darvocet-N) should be avoided.

1 2 3 4 5 0

Sample survey question.

facility populations older than 65 years in the United States. There were 3 main aims: (1) to reevaluate the 1997 criteria to include new products and incorporate new information available from the scientific literature, (2) to assign or reevaluate a relative rating of severity for each of the medications, and (3) to identify any new conditions or considerations not addressed in the 1997 criteria.

METHODS

There were 5 phases in the data collection for this study: (1) the review of the literature, (2) creation and mailing of the round 1 questionnaire, (3) creation of the second-round questionnaire based on round 1 and expert panel feedback, (4) convening of the expert panel and panel responses to the second-round questionnaire, and (5) completion and analysis of a third and final mailed questionnaire that measured the severity ratings of the PIMs to create the final revised list.

The criteria reviewed covered 2 types of statements: (1) medications or medication classes that *should generally be avoided* in persons 65 years or older because they are either ineffective or they pose unnecessarily high risk for older persons and a safer alternative is available and (2) medications that should not be used in older persons known to have *specific medical conditions*. The 2 statements each used a 5-point Likert scale and ask respondents to rate their agreement or disagreement with the statement from strongly agree (1) to strongly disagree (5), with the midpoint (3) expressing equivocation. The second type of question asked the respondents to evaluate the medication appropriateness given certain conditions or diagnoses (**Figure**). All questions included an option to not answer if the respondent did not feel qualified to answer. This methodology was similar to that used by Beers et al¹³ in the creation of the first 2 iterations of the criteria. The methodology used in the third iteration of the Beers criteria only differed in the number of panelists (13 in 1991; 6 in 1997; and 12 in 2002) and the use of a third-round survey for the severity ratings, which was done (in person) in the 1997 update of the criteria.

RESEARCH DESIGN

The modified Delphi method is a technique to arrive at a group consensus regarding an issue under investigation that was originally developed at the RAND Corporation (Santa Monica, Calif) by Olaf Helmer and Norman Dalkey.²⁵ The Delphi method is a set of procedures and methods for formulating a group judgment for a subject matter in which precise information is lacking (such as medication use in older adults). The Delphi method provides a means to reach consensus within a group of experts. The method relies on soliciting individual (often anonymous) answers to written questions by survey or other type of

communication. A series of iterations provides each individual with feedback on the responses of the others in the group. The final responses are evaluated for variance and means to determine which questions the group has reached consensus about, either affirmatively or negatively.

LITERATURE REVIEW

The selection of articles for formulating the survey involved 3 steps and was phase 1 of the study. First, we identified literature published since January 1994 in English, describing or analyzing medication use in community-living (ambulatory) older adults and older adults living in nursing homes. From that, we created a table and bibliography. We used MEDLINE, searching with the following key terms *adverse drug reactions*, *adverse drug events*, *medication problems*, and *medications and elderly* for all relevant articles published between January 1994 and December 2000. Second, we hand searched and identified additional references from the bibliographies of relevant articles. Third, all the panelists were invited to add references and articles after the first survey to add to the literature review. Each study was systematically reviewed by 2 investigators using a table to outline the following information: type of study design; sample size; medications reviewed; summary of results and key points; quality, type and category of medication addressed; and severity of the drug-related problem.

EXPERT PANEL SELECTION

The panel of members were invited to participate via letter by the 4 investigators and a consultant and represented a variety of experience and judgment including extensive clinical practice, extensive publications in this area, and/or senior academic rank. They were also chosen to represent acute, long-term, and community practice settings with pharmacological, geriatric medicine, and psychiatric expertise. Lastly, they were selected from geographically diverse parts of the United States. We initially invited (via regular mail) 16 potential participants with nationally and/or internationally recognized expertise in psychopharmacology, pharmacoepidemiology, clinical geriatric pharmacology, and clinical geriatric medicine to complete our survey. Our response rate for the initial invitation to participate as a panelist was 75% (12/16). Our final panel thus consisted of 12 experts who completed all rounds of the survey.

DATA COLLECTION AND ANALYSIS

We used the systematic review of the literature to construct the first round questionnaire. The first-round survey contained 4 sections. Parts 1 and 2 reviewed the latest 1997 criteria. Parts 3 and 4 were medications added for the 2002 update for medications alone (part 3) and medications considering diagnoses and conditions. Parts 3 and 4 included 29 new questions about medications or medication classes and conditions. The last question in part 4 asked panel members to add medications to the list. The panel was then surveyed via Delphi technique to determine concordance/consensus with the round 1 survey and invited to add additional medications prior to and during the second-round meeting.

We created the second and third questionnaires (severity ratings) from panel input and the results of the previous round survey. We completed all mailed and face-to-face rounds between October 2001 and February 2002. We constructed the questionnaire statements according to the original Beers criteria published in 1991 and the updated criteria published in 1997. The instructions accompanying the survey asked the respondents to consider the use of medications *only* in adults 65

years and older. The second-round survey included the statements included from round 1 and any statements added by the experts from the first round. In the second round and the face-to-face meeting, the respondents were given information about their answers and the anonymous answers of the other members of the group and were given the opportunity to reconsider their previous response.

After analyzing the responses from the first round of the survey, we examined each question for inclusion or exclusion in the revised criteria or for further consideration in the second round of the survey. We calculated the mean rating and corresponding 95% confidence interval (CI) of each statement or dosing question collected from the first round of the survey. Those statements whose upper limit of the 95% CI was less than 3.0 were included in the updated criteria. Those statements or dosing questions whose lower limit of the 95% CI was greater than 3.0 were excluded from the updated criteria. Statements whose 95% CI included the value of 3.0 were included for further determination in the second-round face-to-face meeting.

The face-to-face meeting was convened on December 10, 2001, in Atlanta, Ga. Each panel member was given the results of the first-round survey and the added medications (from the other panel members) to review approximately 10 days before the meeting. For statements that needed further examination (neither included or excluded during round 1), each rater was given his or her previous rating and the mean rating of the group of experts in the second survey.

Any additional statements or dosing questions that had been made on the open-ended portion of the first round of the survey by any expert was included in the survey for the second round. Forty-four questions were added by expert panelists during round 1 of the survey, and 9 questions were added during the round 2 in-person survey and voted on during the in-person meeting. These questions/medications made up part 5 of the survey. Twenty-four questions from parts 3 and 4 had 95% CIs greater than 3.0 after the round 1 survey. During the second-round face-to-face meeting, the group debated these remaining statements and then rerated them using the same Likert scale. The mean rating and 95% CI were calculated. The technique used for the first round for inclusion or exclusion of the statement or dosing question in the updated criteria was used. Those statements whose 95% CI included 3.0 were excluded from the updated criteria. Lastly, in January 2002, we surveyed panelists on a 5-point scale for the severity of the potential medication problem.

RESULTS

The final criteria are listed in **Table 1** and **Table 2**. Table 1 contains 48 individual medications or classes of medications to avoid in older adults and their potential concerns. Table 2 lists 20 diseases or conditions and medications to be avoided in older adults with these conditions. Sixty-six of these potentially inappropriate drugs were considered by the panel to have adverse outcomes of high severity. New conditions and diagnoses that were addressed this time included depression, cognitive impairment, Parkinson disease, anorexia, and malnutrition, syndrome of inappropriate antidiuretic hormone secretion, and obesity.

A total of 15 medications/medication classes were dropped or modified from the 1997 to the 2002 update from the round 1 survey. Most of the medications dropped since 1997 were those that were associated with diagnoses or conditions. The following medications were voted to be dropped

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 sedating 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
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 benzodiazepines 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 chlorzapatate (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) except with 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
Gastrointestinal antispasmodic drugs: dicyclomine (Bentyl), hyoscyamine (Levsin and Levsinex), propantheline (Pro-Banthine), belladonna alkaloids (Donnatal 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-Trimeton), diphenhydramine (Benadryl), hydroxyzine (Vistaril and Atarax), cyproheptadine (Periactin), promethazine (Phenergan), tripeleennamine, 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

(continued)

Table 1. 2002 Criteria for Potentially Inappropriate Medication Use in Older Adults: Independent of Diagnoses or Conditions (cont)

Drug	Concern	Severity Rating (High or Low)
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
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
Orphenadrine (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
Isosurpine (Vasodilan)	Lack of efficacy.	Low
Nitrofurantoin (Macrochantin)	Potential for renal impairment. Safer alternatives 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
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 alternatives available.	Low
Desiccated thyroid	Concerns about cardiac effects. Safer alternatives 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.

or modified from the criteria by the panelists since the 1997 publication: phenylbutazone, oxybutynin chloride, β -blockers, corticosteroids with persons with diabetes; sedative-hypnotics in persons with chronic obstructive pulmonary disease; β -blockers in persons with asthma; β -blockers in persons with peripheral vascular disorder; β -blockers in persons with syncope and falls; narcotics in persons with bladder outflow obstruction; and theophylline sodium glycinate in persons with insomnia (**Table 3**). Oxybutynin was modified by not including the extended-release formula, which the panel believed had fewer adverse effects. Reserpine was changed to be avoided only at doses greater than 0.25 mg, and disopyramide phosphate avoidance now only refers to the non-extended release formulation. New information about β -blockers in elderly patients led the panel to drop this class of drugs from the list. The other criteria dropped involved use of drugs in the setting of a comorbid condition or drugs

that are off the market. The expert panelists could not reach consensus about adding questions regarding setting maximum dosages for sedative-hypnotics, antipsychotics, selective serotonin reuptake inhibitors, and tricyclic antidepressants that do not have specific recommendations from the manufacturer, though there was agreement that consideration of changes in pharmacokinetics were important in older patients in preventing problems caused by excessive dosages and usage.

This update also includes several medications that have new information or have come to market since the last study of the Beers criteria was published (1997), including selective serotonin reuptake inhibitors, amiodarone, and fluoxetine hydrochloride. The panel also voted to add methyltestosterones, amphetamines, and bupropion hydrochloride to the list of medications to be avoided in older adults. Tables 1 and 2 state why medications were added since 1997, and Table 3 summarizes all the changes to the

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	Phenylpropranolamine 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	May produce polyuria and worsening of incontinence.	High
Arrhythmias	Tricyclic antidepressants (imipramine hydrochloride, doxepin hydrochloride, and amitriptyline 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 (Ritalin), methamphetamine (Desoxyn), and pemolin	Concern due to CNS-altering effects.	High
Depression	Long-term benzodiazepine use. Sympatholytic agents: methyl dopa (Aldomet), reserpine, and guanethidine (Ismelin)	May produce or exacerbate depression.	High
Anorexia and malnutrition	CNS stimulants: DextroAmphetamine (Adderall), methylphenidate (Ritalin), methamphetamine (Desoxyn), pemolin, and fluoxetine (Prozac)	Concern due to appetite-suppressing effects.	High
Syncope or falls	Short- to intermediate-acting benzodiazepine and tricyclic antidepressants (imipramine hydrochloride, doxepin hydrochloride, and amitriptyline hydrochloride)	May produce ataxia, impaired 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
COPD	Long-acting benzodiazepines: chlordiazepoxide (Librium), chlordiazepoxide-amitriptyline (Limbitrol), clidinium-chlordiazepoxide (Librax), diazepam (Valium), quazepam (Doral), halazepam (Paxipam), and chlorzepate (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 systems; COPD, chronic 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.

Beers criteria since 1997, including medications that were added, dropped, or modified.

COMMENT

This study is an important update of previously established criteria that have been widely used and

cited.^{16,20,22,23,26-29} The application of the Beers criteria and other tools for identifying PIM use will continue to enable providers to plan interventions for decreasing both drug-related costs and overall costs and thus minimize drug-related problems.^{9,30} Such tools are also vitally important to managed care organizations, pharmacy benefit plans, and both acute and long-term health care in-

Table 3. Summary of Changes From 1997 Beers Criteria to New 2002 Criteria

Medicines Modified Since 1997 Beers Criteria	
1. Reserpine (Serpasil and Hydropres)*	3. Iron supplements >325 mg†
2. Extended-release oxybutynin (Ditropan XL)‡	4. Short-acting dipyrindamole (Persantine)‡
Medicines Dropped Since 1997 Beers Criteria	
Independent of Diagnoses	
1. Phenylbutazone (Butazolodin)	6. Metoclopramide (Reglan) with seizures or epilepsy
Considering Diagnoses	
2. Recently started corticosteroid therapy with diabetes	7. Narcotics with bladder outflow obstruction and narcotics with constipation
3. β -Blockers with diabetes, COPD or asthma, peripheral vascular disease, and syncope or falls	8. Desipramine (Norpramin) with insomnia
4. Sedative hypnotics with COPD	9. All SSRIs with insomnia
5. Potassium supplements with gastric or duodenal ulcers	10. β -Agonists with insomnia
	11. Bethanechol chloride with bladder outflow obstruction
Medicines Added Since 1997 Beers Criteria	
Independent of Diagnoses	
1. Ketorolac tromethamine (Toradol)	15. Desiccated thyroid
2. Orphenadrine (Norflex)	16. Ferrous sulfate >325 mg
3. Guanethidine (Ismelin)	17. Amphetamines (excluding methylphenidate and anorexics)
4. Guanadrel (Hyloral)	18. Thioridazine (Mellaril)
5. Cyclandelate (Cyclospasmol)	19. Short-acting nifedipine (Procardia and Adalat)
6. Isoxsuprine (Vasodilan)	20. Daily fluoxetine (Prozac)
7. Nitrofurantoin (Macrochantin)	21. Stimulant laxatives may exacerbate bowel dysfunction (except in presence of chronic pain requiring opiate analgesics)
8. Doxazosin (Cardura)	22. Amiodarone (Cordarone)
9. Methyltestosterone (Android, Virilon, and Testrad)	23. Non-COX-selective NSAIDs (naproxen [Naprosyn], oxaprozin, and piroxicam)
10. Mesoridazine (Serentil)	24. Reserpine doses >0.25 mg/d
11. Clonidine (Catapres)	25. Estrogens in older women
12. Mineral oil	
13. Cimetidine (Tagamet)	
14. Ethacrynic acid (Edecrin)	
Considering Diagnoses	
26. Long-acting benzodiazepines: chlordiazepoxide (Librium), chlordiazepoxide-amitriptyline (Limbitrol), clidinium-chlordiazepoxide (Librax), diazepam (Valium), quazepam (Doral), halazepam (Paxipam), and chlorazepate (Tranxene) with COPD, stress incontinence, depression, and falls	33. Decongestants with bladder outflow obstruction
27. Propranolol with COPD/asthma	34. Calcium channel blockers with constipation
28. Anticholinergics with stress incontinence	35. Phenylpropanolamine with hypertension
29. Tricyclic antidepressants (imipramine hydrochloride, doxepine hydrochloride, and amitriptyline hydrochloride) with syncope or falls and stress incontinence	36. Bupropion (Wellbutrin) with seizure disorder
30. Short to intermediate and long-acting benzodiazepines with syncope or falls	37. Olanzapine (Zyprexa) with obesity
31. Clopidogrel (Plavix) with blood-clotting disorders receiving anticoagulant therapy	38. Metoclopramide (Reglan) with Parkinson disease
32. Tolterodine (Detrol) with bladder outflow obstruction	39. Conventional antipsychotics with Parkinson disease
	40. Tacrine (Cognex) with Parkinson disease
	41. Barbiturates with cognitive impairment
	42. Antispasmodics with cognitive impairment
	43. Muscle relaxants with cognitive impairment
	44. CNS stimulants with anorexia, malnutrition, and cognitive impairment

Abbreviations: CNS, central nervous system; COPD, chronic obstructive pulmonary disease; COX, cyclooxygenase; NSAIDs, nonsteroidal anti-inflammatory drugs; SSRIs, selective serotonin reuptake inhibitors.

*Reserpine in doses >0.25 mg was added to the list.

†Ditropan was modified to refer to the immediate-release formulation only and not Ditropan XL and iron supplements was modified to include only ferrous sulfate.

‡Do not consider the long-acting dipyrindamole, which has better properties than the short-acting dipyrindamole in older adults (except with patients with artificial heart valves).

stitutions. However, to remain useful, criteria must be regularly updated and must take into account the ever-increasing, evidence-based literature in the area of medication use in older adults.

The argument in favor of using explicit criteria in prescribing practice is overwhelming: improvements in therapeutic practices and reduction in medication-related ADEs will increase the quality of care and enhance patient outcome at the same time as optimizing resource utilization and promoting fiscal prudence. These criteria, though widely used, have been controversial because of their adoption by nursing home regulators and have been criticized

at times as too simplistic and limiting the freedom of physicians to prescribe.³¹⁻³⁵ However, we believe that thoughtful application of the updated 2002 Beers criteria and other tools for identifying PIM use can enable providers and insurers to plan interventions aimed at decreasing drug-related costs and overall health care costs, while reducing ADE-related admissions in elderly patients^{9,30} and improving care. The updated Beers criteria will enable everyone from individual physicians to health care systems to integrate the new criteria-based prescribing recommendations into their organic, mechanical, and electronic information systems.

The proponents of explicit criteria and evidence-based prescribing are among the biggest players in the health care industry: the IOM, the CMS, the Agency for Healthcare Research and Quality (AHRQ), and the American Association of Health Plans (AAHP), to name but four.^{36,37} Indeed, finding a voice of dissent is challenging. In "Crossing the Quality Chasm" the IOM³⁸ presents a template for the future, when the traditional values of physician integrity, altruism, knowledge, skill, and dedication to lifelong patient care are seamlessly integrated into an information era of point-of-care, computerized decision support that facilitates appropriate care using the available resources. The updated Beers criteria are one component of that movement, enabling all parties, from providers to insurers, to integrate our recommendations into their clinical information systems.

Given the aforementioned, there appears to be a potential niche for the Beers criteria in fulfilling the missions of the IOM, CMS, AHRQ, and AAHP. However, translating research into measurable quality improvement may be more challenging. In the first instance, despite the much-lauded public statements about quality by many (including the above organizations), there is widespread recognition that perhaps cost containment is the principal driver of change in the health care world.³⁹ Individual health care providers and organizations will demand objective evidence that implementation of the updated Beers criteria (or, indeed, other inappropriate medication guides) will result in objective, quantifiable improvements in the clinical effectiveness and cost-effectiveness of health care services. To date, despite extensive literature demonstrating association—based on retrospective studies on administrative data—there is an absence of rigorous, prospective research in this field. We (D.M.F., J.L.W., and J.R.M.) are completing a randomized controlled study among a Medicare managed care population at this time, using the 1997 medication criteria for older adults. Well-controlled studies are needed that show prospectively that using these criteria make a difference in patient outcomes.³¹

These criteria have some limitations, however, and must be regularly updated to remain useful to both clinicians, health care administrators, and researchers. These criteria are meant to apply to the general population of patients 65 years and older, thus some that are not appropriate for significantly older or more frail persons do not appear in this list. These criteria are not meant to regulate practice in a manner to which they supersede the clinical judgment and assessment of the physician or practitioner. In addition, defining inappropriate medications by specific lists of medications rather than other mechanisms may miss some problems such as the underuse and interactions of drugs in older people.^{26,40} A true meta-analysis was not conducted for this study. Lastly, this study has the same limitations previously documented regarding the use of the Delphi technique.^{25,41}

A further challenge to adoption of the Beers criteria will come from the information systems and information technology sector. Despite phenomenal advances in hardware and software, decision support systems continue to have significant limitations, and presenting the right information to the right person at the point of

clinical need remains a challenge for the information systems and information technology engineer, the behavior change specialist, and the medical profession.⁴²

Accepted for publication March 28, 2003.

This research was supported by a grant from the Medical College of Georgia (Augusta) and University of Georgia (Athens) Combined Intramural Grant Program.

We thank Judy Johnson, MAT, R. C. Robinson, BS, and Alison Maclean, BA, for assistance with data management and manuscript preparation. We acknowledge the following individuals for contributing their expertise to this study as panel members: Maude Babington, PharmD (Babington Consulting, LLC, Boulder, Colo); Manju T. Beier, PharmD (The University of Michigan, Ann Arbor); Richard W. Besdine, MD (Brown University, Providence, RI); Jack Fincham, PhD (University of Kansas, Lawrence); F. Michael Gloth III, MD (Johns Hopkins University School of Medicine, Baltimore, Md); Thomas Jackson, MD (Medical College of Georgia, Augusta); John E. Morley, MD (Saint Louis University Health Sciences Center, St Louis, Mo); Becky Nagle, PharmD, BCPC (Medco Health Solutions, Franklin Lakes, NJ); Todd Semla, PharmD, MS (Evanston Northwestern Healthcare, Evanston, Ill); Mark A. Stratton, PharmD (University of Oklahoma, Oklahoma City); Andrew D. Weinberg, MD (Emory University School of Medicine, Atlanta, Ga).

Corresponding author and reprints: Donna M. Fick, PhD, RN, Center for Health Care Improvement, Department of Medicine, Medical College of Georgia, HB 2010, 1467 Harper St, Augusta, GA 30912 (e-mail: dfick@mail.mcg.edu).

REFERENCES

1. Hanlon JT, Schmader KE, Kornkowsky MJ, et al. Adverse drug events in high risk older outpatients. *J Am Geriatr Soc.* 1997;45:945-948.
2. Bootman JL, Harrison DL, Cox E. The health care cost of drug-related morbidity and mortality in nursing facilities. *Arch Intern Med.* 1997;157:2089-2096.
3. Cooper JW. Probable adverse drug reactions in a rural geriatric nursing home population: a four-year study. *J Am Geriatr Soc.* 1996;44:194-197.
4. Cooper JW. Adverse drug reaction-related hospitalizations of nursing facility patients: a 4-year study. *South Med J.* 1999;92:485-490.
5. Kohn L, Corrigan J, Donaldson M, eds. *To Err Is Human: Building a Safer Health System.* Washington, DC: National Academy Press; 1999. Available at: http://books.nap.edu/html/to_err_is_human/. Accessed March 14, 2001.
6. Perry DP. When medicine hurts instead of helps. *Consultant Pharmacist.* 1999;14:1326-1330.
7. Bates DW, Spell N, Cullen DJ, et al, the Adverse Drug Events Prevention Study Group. The costs of adverse drug events in hospitalized patients. *JAMA.* 1997;277:307-311.
8. Johnson JA, Bootman JL. Drug-related morbidity and mortality: a cost-of-illness model. *Arch Intern Med.* 1995;155:1949-1956.
9. Lazarou J, Pomeranz BH, Corey PN. Incidence of adverse drug reactions in hospitalized patients: a meta-analysis of prospective studies. *JAMA.* 1998;279:1200-1205.
10. Hanlon JT, Landsman PB, Cowan K, et al. Physician agreement with pharmacist-suggested drug therapy changes for elderly outpatients. *Am J Health Syst Pharm.* 1996;53:2735-2737.
11. Hanlon JT, Schmader KE, Samsa GP, et al. A method for assessing drug therapy appropriateness. *J Clin Epidemiol.* 1992;45:1045-1051.
12. Beers MH. Explicit criteria for determining potentially inappropriate medication use by the elderly. *Arch Intern Med.* 1997;157:1531-1536.
13. Beers MH, Ouslander JG, Rollinger J, Reuben DB, Beck JC. Explicit criteria for determining inappropriate medication use in nursing home residents. *Arch Intern Med.* 1991;151:1825-1832.
14. McLeod JP, Huang AR, Tamblyn RM. Defining inappropriate practices in prescribing for elderly people: a national consensus panel. *CMAJ.* 1997;156:385-391.

15. Doucet J, Chassagne P, Trivalle C, et al. Drug-drug interactions related to hospital admissions in older adults: a prospective study of 1000 patients. *J Am Geriatr Soc.* 1996;44:944-948.
16. Golden AG, Preston RA, Barnett SD, Liorente M, Hamdan K, Silverman MA. Inappropriate medication prescribing in homebound older adults. *J Am Geriatr Soc.* 1999;47:948-953.
17. Mort JR, Aparasu RR. Prescribing potentially inappropriate psychotropic medications to the ambulatory elderly. *Arch Intern Med.* 2000;160:2825-2831.
18. Smalley WE, Griffin MR. The risks and costs of upper gastrointestinal disease attributable to NSAIDs. *Gastroenterol Clin North Am.* 1996;25:373-396.
19. Thapa PB, Gideon P, Cost TW, Milam AB, Ray WA. Antidepressants and the risk of falls among nursing home residents. *N Engl J Med.* 1998;339:875-882.
20. Fick DM, Waller JL, Maclean JR, et al. Potentially inappropriate medication use in a Medicare managed care population: association with higher costs and utilization. *J Managed Care Pharm.* 2001;7:407-413.
21. Kaufman DW, Kelly JP, Rosenberg L, Anderson TE, Mitchell AA. Recent patterns of medication use in the ambulatory adult population of the United States: the Slone survey. *JAMA.* 2002;287:337-344.
22. Hanlon JT, Schmader KE, Boulton C, et al. Use of inappropriate prescription drugs by older people. *J Am Geriatr Soc.* 2002;50:26-34.
23. Morley JE. Drugs, aging, and the future [editorial]. *J Gerontol A Biol Sci Med Sci.* 2002;57A:M2-M6.
24. Hanlon J, Fillenbaum G, Kuchibhatla M, et al. Impact of inappropriate drug use on mortality and functional status in representative community dwelling elders. *Med Care.* 2002;40:166-176.
25. Dalkey N, Brown B, Cochran S. *The Delphi Method, III: Use of Self Ratings to Improve Group Estimates.* Santa Monica, Calif: Rand Corp; November 1969. Publication RM-6115-PR.
26. Rochon P, Gurwitz J. Prescribing for seniors. *JAMA.* 1999;282:113-115.
27. Aparasu RR, Fliginger SE. Inappropriate medication prescribing for the elderly by office-based physicians. *Ann Pharmacother.* 1997;31:823-829.
28. Dhalla I, Anderson G, Mandani M, Bronskill S, Sykora K, Rochon P. Inappropriate prescribing before and after nursing home admission. *J Am Geriatr Soc.* 2002; 50:995-1000.
29. Sloane P, Zimmerman S, Brown L, Ives T, Walsh J. Inappropriate medication prescribing in residential care/assisted living facilities. *J Am Geriatr Soc.* 2002; 50:1001-1011.
30. Cooper JW, Wade WE. Repeated unnecessary NSAID-associated hospitalizations in an elderly female: a case report. *Geriatr Drug Ther.* 1997;12:95-97.
31. Avorn J. Improving drug use in elderly patients: getting to the next level. *JAMA.* 2001;286:2866-2868.
32. Ruscin JM, Page RL II. Inappropriate prescribing for elderly patients. *JAMA.* 2002; 287:1264-1265.
33. Slater EJ. Polypharmacy in skilled-nursing facilities [letter]. *Ann Intern Med.* 1993; 118:649.
34. Ashburn PE. Polypharmacy in skilled-nursing facilities [letter]. *Ann Intern Med.* 1993;118:649-650.
35. Terplan M. Polypharmacy in skilled-nursing facilities [letter]. *Ann Intern Med.* 1993;118:650.
36. Centers for Medicare and Medicaid Services Web site. Available at: <http://cms.hhs.gov/>. Accessed April 8, 2002.
37. American Association of Health Plans Web site. Available at: <http://www.aahp.org/>. Accessed April 8, 2002.
38. Institute of Medicine. *Crossing the Quality Chasm.* Washington, DC: Institute of Medicine Press; 2001.
39. DesHarnais SI, Fortham MT, Homa-Lowry JM, Wooster LD. Risk-adjusted clinical quality indicators: indices for measuring and monitoring rates of mortality, complications, and readmissions. *Qual Manag Health Care.* 2000;9:14-22.
40. Hanlon JT, Schmader K, Ruby C, Weinberger M. Suboptimal prescribing in older inpatients and outpatients. *J Am Geriatr Soc.* 2001;49:200-209.
41. Hasson F, Keeney S, Mckenna H. Research guidelines for the Delphi survey technique. *J Adv Nurs.* 2000;32:1008-1015.
42. Coiera E. When conversation is better than computation. *J Am Med Inform Assoc.* 2000;7:277-286.