

American Geriatrics Society 2019 Updated AGS Beers Criteria[®] for Potentially Inappropriate Medication Use in Older Adults

*By the 2019 American Geriatrics Society Beers Criteria[®] Update Expert Panel**

The American Geriatrics Society (AGS) Beers Criteria[®] (AGS Beers Criteria[®]) for Potentially Inappropriate Medication (PIM) Use in Older Adults are widely used by clinicians, educators, researchers, healthcare administrators, and regulators. Since 2011, the AGS has been the steward of the criteria and has produced updates on a 3-year cycle. The AGS Beers Criteria[®] is an explicit list of PIMs that are typically best avoided by older adults in most circumstances or under specific situations, such as in certain diseases or conditions. For the 2019 update, an interdisciplinary expert panel reviewed the evidence published since the last update (2015) to determine if new criteria should be added or if existing criteria should be removed or undergo changes to their recommendation, rationale, level of evidence, or strength of recommendation. *J Am Geriatr Soc* 00:1–21, 2019.

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For the 2019 update, an interdisciplinary expert panel reviewed the evidence published since the last update (2015) to determine if new criteria should be added or if existing criteria should be removed or undergo changes to their recommendation, rationale, level of evidence, or strength of recommendation. Each of the five types of criteria in the 2015 update were retained in this 2019 update: medications that are potentially inappropriate in most older adults, those that should typically be avoided in older adults with certain conditions, drugs to use with caution, drug-drug interactions, and drug dose adjustment based on kidney function.

OBJECTIVES

The specific aim was to update the 2015 AGS Beers Criteria[®] using a comprehensive, systematic review and grading of the evidence on drug-related problems and adverse events in older adults. The strategies to achieve this aim were to:

- Incorporate new evidence on PIMs included in the 2015 AGS Beers Criteria[®] and evidence regarding new criteria or modifications of existing criteria being considered for the 2019 update.
- Grade the strength and quality of each PIM statement based on the level of evidence and strength of recommendation.
- Convene an interdisciplinary panel of 13 experts in geriatric care and pharmacotherapy who would apply a modified Delphi method, informed by the systematic review and grading, to reach consensus on the 2019 update.
- Incorporate exceptions in the AGS Beers Criteria[®] that the panel deemed clinically appropriate. These exceptions would be designed to make the criteria more individualized to clinical practice and be more relevant across settings of care.

INTENT OF CRITERIA

The primary target audience for the AGS Beers Criteria[®] is practicing clinicians. The criteria are intended for use in adults 65 years and older in all ambulatory, acute, and institutionalized settings of care, except for the hospice and palliative care settings. Consumers, researchers, pharmacy benefits managers, regulators, and policymakers also widely use the AGS Beers Criteria[®]. The intention of the AGS Beers Criteria[®] is to improve medication selection;

educate clinicians and patients; reduce adverse drug events; and serve as a tool for evaluating quality of care, cost, and patterns of drug use of older adults.

As with previously published AGS Beers Criteria®, the goal of the 2019 update continues to be improving the care of older adults by reducing their exposure to PIMs that have an unfavorable balance of benefits and harms compared with alternative treatment options. This is accomplished by using the AGS Beers Criteria® as both an educational tool and a quality measure—two uses that are not always in agreement—and the panel considered and vigorously deliberated both. The AGS Beers Criteria® are not meant to be applied in a punitive manner. Prescribing decisions are not always clear-cut, and clinicians must consider multiple factors, including discontinuation of medications no longer indicated. Quality measures must be clearly defined, easily applied, and measured with limited information and, thus, although useful, cannot perfectly distinguish appropriate from inappropriate care. The panel's review of evidence at times identified subgroups of individuals who should be exempt from a given criterion or to whom a specific criterion should apply. Such a criterion may not be easily applied as a quality measure, particularly when such subgroups cannot be easily identified through structured and readily accessible electronic health data. As an example, the panel thought that a criterion should not be expanded to include all adults 65 years and older when only certain subgroups have an adverse balance of benefits vs harms for the medication, or conversely when a sizable subgroup of older adults may be appropriate candidates for a medication that is otherwise problematic.

Despite past and current efforts to translate the criteria into practice, some controversy and myths about their use in practice and policy continue to prevail. The panel addressed these concerns and myths by writing a companion article to the 2015 update of the AGS Beers Criteria® and an updated 2019 short piece, which remains the best way to advise patients, providers, and health systems on how to use (and not use) the 2019 AGS Beers Criteria®.³

METHODS

Methods used for the 2019 update of the AGS Beers Criteria® were similar to those used in the 2015 update, with additional emphasis on extending the rigor of the evidence review and synthesis process.² These methods were based on the Grading of Recommendations Assessment, Development and Evaluation (GRADE) guidelines for clinical practice guideline development and are consistent with recommendations from the National Academy of Medicine.^{4,5}

Panel Composition

The AGS Beers Criteria® expert update panel comprised 13 clinicians and included physicians, pharmacists, and nurses, each of whom had participated in the 2015 update. Panelists had experience in different practice settings, including ambulatory care, home care, acute hospital care, skilled-nursing facility, and long-term care. In addition, the panel included ex-officio representatives from the Centers for Medicare and Medicaid Services, the National

Committee for Quality Assurance, and the Pharmacy Quality Alliance. Potential conflicts of interest were disclosed at the beginning of the process and before each full panel call and are listed in the disclosures section of this article. Panelists were recused from discussion in areas in which they had a potential conflict of interest.

Literature Review

Literature searches were conducted in PubMed and the Cochrane Library from January 1, 2015, to September 30, 2017. Search terms for each criterion included individual drugs, drug classes, specific conditions, and combinations thereof, each with a focus on “adverse drug events” and “adverse drug reactions.” Medications believed to have low utilizations (eg, meprobamate and central α -agonist antihypertensives other than clonidine) or no longer available in the United States were excluded from the literature search. Searches targeted controlled clinical trials, observational studies, and systematic reviews and meta-analyses, with filters for human participants, 65 years and older, and English language. Clinical reviews and guidelines were also included to provide context. Case reports, case series, letters to the editor, and editorials were excluded.

Searches identified 17,627 references; 5403 abstracts were sent to panelists for review, of which 1422 references were selected for full-text review. Among these, 377 articles were abstracted into evidence tables, including 67 systematic reviews and/or meta-analyses, 29 controlled clinical trials, and 281 observational studies.

Development Process

Between February 2016 and May 2018, the full panel convened for a series of conference calls and 1 full-day, in-person meeting. In addition, the panel divided into four work groups, each assigned a subset of the criteria. Each work group led the review and synthesis of evidence for its subset of the criteria, convening via conference calls and electronically via e-mail.

The development process began by soliciting ideas from the panelists about criteria that should be explored for addition, modification, or removal. Suggestions from others were also welcomed. To guide the evidence selection, review, and synthesis process, each work group then undertook an exercise to identify a priori which clinical outcomes, indications, and comparison groups were most relevant when considering evidence for each criterion (ie, the “desired evidence” for reviewing each criterion). These discussions were not considered binding but provided guidance for keeping the evidence review and synthesis focused on what was most clinically relevant.

Each work group reviewed abstracts from the literature searches for the criteria in its purview and collectively selected a subset for full-text review. This selection process considered the methodologic quality of each study, its relevance to older adults, and its concordance with the desired evidence noted above. After reviewing the full text of each selected article, the work group then decided by consensus which articles represented the best available evidence, based on a balance of these same three key criteria (methodologic quality, relevance to older adults, and concordance with

desired evidence). Special emphasis was placed on selecting systematic reviews and meta-analyses when available, because resource constraints precluded the panel from conducting these types of comprehensive analyses. In general, a study was considered relevant to older adults if the mean or median age of participants was older than 65 years, and especially relevant if most or all participants were older than this age threshold.

Articles comprising the best available evidence were abstracted by AGS staff into evidence tables. These tables summarized the design, population, and findings of each study, and identified markers of methodologic quality highlighted by the GRADE criteria for clinical trials and observational studies and by A MeaSurement Tool to Assess Systematic Reviews (AMSTAR).^{6–8} Each work group then synthesized evidence for each criterion from the 2015 to 2017 literature reviews based on GRADE guidelines and the American College of Physicians' evidence grading framework (Table 1).^{6,9}

Using evidence from the 2015 to 2017 literature review, evidence findings from previous updates in 2012 and 2015, and clinical judgment, each work group presented to the full panel its findings and suggestions for changes (or no change) to the criteria, with ensuing discussion. For most criteria, a consensus emerged, to leave an existing criterion from the 2015 update unchanged, to modify it, to remove it entirely, or to add a new criterion. Potential modifications included the drug(s) included in the criterion, the recommendation, the rationale, the quality of evidence, and the strength of recommendation. As noted in the GRADE guidelines, strength of recommendation ratings incorporate a variety of considerations, including expert opinion and clinical judgment and context, and thus do not always align with quality of evidence ratings.

After discussion of proposed changes, an anonymous Delphi process was used to ascertain panel consensus, using a five-point Likert scale with anchors of “strongly disagree” and “strongly agree.” As a general rule, criteria receiving “agree” or strongly agree ratings from more than 90% of panelists were included. The remainder were brought back for group discussion, with final decisions resolved through consensus.

In addition to changes made on the basis of evidence, the panel decided on several modifications to improve clarity and usability of the AGS Beers Criteria®. These included removing a number of medications that are used only rarely. These removals should not be interpreted as condoning use of these medications but rather are intended to “declutter” the AGS Beers Criteria® and not distract from information on more commonly used medications. In selected cases, the panel changed the wording of certain criteria, recommendations, and rationale statements to improve clarity and avoid potential misinterpretations.

The final set of criteria was reviewed by the AGS Executive Committee and Clinical Practice and Models of Care Committee and subsequently released for public comment. Comments were solicited from the general public and sent to 39 organizations. Comments were accepted over a 3-week period from August 13, 2018, until September 4, 2018. A total of 244 comments were received from 47 individuals (79 comments), 6 pharmaceutical companies (10 comments), and 22 peer organizations (155 comments). All comments were reviewed and discussed by the panel

cochairs. All comments along with proposed changes to the criteria were shared with the entire panel for final approval.

RESULTS

Noteworthy Changes to PIMs for Older Adults

Tables 2 through 6 show the 2019 criteria. Table 7 lists those drugs with strong anticholinergic properties that are sometimes referenced in Tables 2 through 6. Compared with the 2015 criteria, several drugs were removed from Table 2 (medications that are potentially inappropriate in most older adults), Table 3 (medications that are potentially inappropriate in older adults with certain conditions), and Table 4 (medications that should be used with caution). These removals are summarized in Table 8 and include removal of drugs no longer available in the United States (ticlopidine, oral pentazocine). In other cases, the recommendation was removed entirely because the panel decided the drug-related problem was not sufficiently unique to older adults (eg, using stimulating medications in patients with insomnia or avoiding medications that can lower the seizure threshold in patients with a seizure disorder). These removals do not imply that these medications are now considered safe for older adults; rather, they were made to help keep the AGS Beers Criteria® streamlined and focused on medications particularly problematic for older adults.

The H2-receptor antagonists were removed from the “avoid” list in patients with dementia or cognitive impairment. This is because evidence for adverse cognitive effects in these conditions is weak, and because the panel expressed concern that the intersection of this criterion with another criterion that discourages chronic use of proton-pump inhibitors in the absence of strong indications would overly restrict therapeutic options for older adults with dementia who have gastroesophageal reflux or similar issues. However, H2-receptor antagonists remain on the criteria as “avoid” in patients with delirium. In addition, wording of this criterion was modified to affirm that non-benzodiazepine, benzodiazepine receptor agonist hypnotics (ie, the “Z drugs”: zolpidem, eszopiclone, and zaleplon) should be avoided in older adults with delirium.

Two drugs with strong anticholinergic properties, pyrilamine and methscopolamine, were added to the list of anticholinergic drugs to avoid. Changes to criteria on cardiovascular drugs include minor updates to the rationale and a minor change to clarify the recommendation for avoiding digoxin as first-line therapy for atrial fibrillation and heart failure (Table 2). The rationale to avoid sliding-scale insulin has been revised to clarify its meaning and intent (Table 2). Glimepiride has been added to the list of sulfonylureas with a greater risk of severe prolonged hypoglycemia (Table 2). The duration of use of metoclopramide has been added to be consistent with US Food and Drug Administration labeling (Table 2).

The serotonin-norepinephrine reuptake inhibitors (SNRIs) have been added to the list of drugs to avoid in patients with a history of falls or fractures (Table 3). Following a principle that applies to all criteria, the panel recognizes there may be situations when SNRIs, other antidepressants, and other medications listed in this criterion may be appropriate for people with a history of falls

Table 1. Designations of Quality of Evidence and Strength of Recommendations^a**Quality of Evidence**

Quality of evidence ratings for each criterion are based on synthetic assessment of two complementary approaches to evaluating the quality of evidence.

	ACP-based approach ⁹	GRADE-based approach ⁴
High-quality evidence	“Evidence...obtained from 1 or more well-designed and well-executed randomized, controlled trials (RCTs) that yield consistent and directly applicable results. This also means that further research is very unlikely to change our confidence in the estimate of effect.”	Consider the following five factors for the studies that comprise the best-available evidence for a given criterion: 1. <i>Risk of bias</i> : Severity of threats to studies' internal validity (eg, randomized vs observational design, potential for confounding, bias in measurement)
Moderate-quality evidence	“Evidence...obtained from RCTs with important limitations.... In addition, evidence from well-designed controlled trials without randomization, well-designed cohort or case-control analytic studies, and multiple time series with or without intervention are in this category. Moderate-quality evidence also means that further research will probably have an important effect on our confidence in the estimate of effect and may change the estimate.”	2. <i>Inconsistency</i> : Do different studies provide similar or different estimates of effect size 3. <i>Indirectness</i> : How relevant are the studies to the clinical question at hand (eg, nature of study of population, comparison group, type of outcomes measured)
Low-quality evidence	“Evidence obtained from observational studies would typically be rated as low quality because of the risk for bias. Low-quality evidence means that further research is very likely to have an important effect on our confidence in the estimate of effect and will probably change the estimate. However, the quality of evidence may be rated as moderate or even high, depending on circumstances under which evidence is obtained from observational studies.”	4. <i>Imprecision</i> : Precision of estimates of effect 5. <i>Publication bias</i> : Risk of bias due to selective publication of results

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Overall quality of evidence that supports a given criterion: high, moderate, low

Strength of Evidence

Strength of evidence ratings for each criterion are based on synthetic integration of the quality of evidence, the frequency and severity of potential adverse events and relationship to potential benefits, and clinical judgment.

Strong	Harms, adverse events, and risks clearly outweigh benefits.
Weak	Harms, adverse events, and risks may not outweigh benefits.

Abbreviations: ACP, American College of Physicians; GRADE, Grading of Recommendations Assessment, Development and Evaluation.

^aAdapted from: Qaseem A, Snow V, Owens DK, et al. The development of clinical practice guidelines and guidance statements of the American College of Physicians: summary of methods. *Ann Intern Med.* 2010;153:194–199. Guyatt G, Oxman AD, Sultan S, et al. GRADE guidelines. 11.: making an overall rating of confidence in effect estimates for a single outcome and for all outcomes. *J Clin Epidemiol.* 2013;66(2):151–157. Andrews JC, Schünemann HJ, Oxman AD, et al. GRADE guidelines. 15.: going from evidence to recommendation—determinants of a recommendation's direction and strength. *J Clin Epidemiol.* 2013;66(7):726–735.

or fractures, based on potential benefits and the lack of availability of safer alternatives. After reviewing and discussing the evidence on antipsychotics to treat psychosis in patients with Parkinson disease, the panel decided to remove aripiprazole as preferred and add pimavanserin. Thus, the 2019 AGS Beers Criteria® recognize quetiapine, clozapine, and pimavanserin as exceptions to the general recommendation to avoid all antipsychotics in older adults with Parkinson disease (Table 3). However, none of these three excepted drugs is close to ideal in either efficacy or safety, each having its own limitations and concerns.

The criteria on drugs to avoid in older adults with heart failure were reorganized to add clinical nuance based on evidence, other guideline recommendations, and clinical considerations. The updated recommendations are that nondihydropyridine calcium channel blockers should be avoided in older adults who have heart failure with reduced ejection fraction; that nonsteroidal anti-inflammatory drug (NSAIDs), cyclooxygenase-2 inhibitors, thiazolidinediones (“glitazones”), and dronedarone should

be used *with caution* in older adults with heart failure who are asymptomatic (ie, excellent control of heart failure signs and symptoms, with or without use of medications) and *avoided* in older adults who are symptomatic; and that cilostazol should continue to be avoided in older adults with heart failure of any type.

Drugs To Be Used With Caution

Table 4 contains drugs to be used with caution in older adults. The purpose of this table is to identify drugs for which there is some cause for concern, but for which the evidence and/or clinical context is as of yet insufficient to merit inclusion in the main tables. Compared with the previous update, the following changes and additions were made:

- The age threshold beyond which extra caution is advised for using aspirin for primary prevention of cardiovascular disease

Table 2. 2019 American Geriatrics Society Beers Criteria® for Potentially Inappropriate Medication Use in Older Adults^a

Organ System, Therapeutic Category, Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Anticholinergics^b				
First-generation antihistamines	Highly anticholinergic; clearance reduced with advanced age, and tolerance develops when used as hypnotic; risk of confusion, dry mouth, constipation, and other anticholinergic effects or toxicity	Avoid	Moderate	Strong
Brompheniramine				
Carbinoxamine				
Chlorpheniramine				
Clemastine	Use of diphenhydramine in situations such as acute treatment of severe allergic reaction may be appropriate.			
Cyproheptadine				
Dexbrompheniramine				
Dexchlorpheniramine				
Dimenhydrinate				
Diphenhydramine (oral)				
Doxylamine				
Hydroxyzine				
Meclizine				
Promethazine				
Pyrilamine				
Triprolidine				
Antiparkinsonian agents	Not recommended for prevention or treatment of extrapyramidal symptoms with antipsychotics; more effective agents available for treatment of Parkinson disease	Avoid	Moderate	Strong
Benztropine (oral)				
Trihexyphenidyl				
Antispasmodics	Highly anticholinergic, uncertain effectiveness	Avoid	Moderate	Strong
Atropine (excludes ophthalmic)				
Belladonna alkaloids				
Clidinium-chlordiazepoxide				
Dicyclomine				
Homatropine (excludes ophthalmic)				
Hyoscyamine				
Methscopolamine				
Propantheline				
Scopolamine				
Antithrombotics				
Dipyridamole, oral short acting (does not apply to the extended-release combination with aspirin)	May cause orthostatic hypotension; more effective alternatives available; IV form acceptable for use in cardiac stress testing	Avoid	Moderate	Strong
Anti-infective				
Nitrofurantoin	Potential for pulmonary toxicity, hepatotoxicity, and peripheral neuropathy, especially with long-term use; safer alternatives available	Avoid in individuals with creatinine clearance <30 mL/min or for long-term suppression	Low	Strong
Cardiovascular				
Peripheral alpha-1 blockers for treatment of hypertension	High risk of orthostatic hypotension and associated harms, especially in older adults; not recommended as routine treatment for hypertension; alternative agents have superior risk/benefit profile	Avoid use as an antihypertensive	Moderate	Strong
Doxazosin				
Prazosin				
Terazosin				

(Continued)

Table 2 (Contd.)

Organ System, Therapeutic Category, Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Central alpha-agonists Clonidine for first-line treatment of hypertension Other CNS alpha-agonists Guanabenz Guanfacine Methyldopa Reserpine (>0.1 mg/day) Disopyramide	High risk of adverse CNS effects; may cause bradycardia and orthostatic hypotension; not recommended as routine treatment for hypertension	Avoid as first-line antihypertensive Avoid other CNS alpha-agonists as listed	Low Low	Strong Strong
	May induce heart failure in older adults because of potent negative inotropic action; strongly anticholinergic; other antiarrhythmic drugs preferred	Avoid	Low	Strong
Dronedarone	Worse outcomes have been reported in patients taking dronedarone who have permanent atrial fibrillation or severe or recently decompensated heart failure.	Avoid in individuals with permanent atrial fibrillation or severe or recently decompensated heart failure	High	Strong
Digoxin for first-line treatment of atrial fibrillation or of heart failure	Use in atrial fibrillation: should not be used as a first-line agent in atrial fibrillation, because there are safer and more effective alternatives for rate control supported by high-quality evidence. Use in heart failure: evidence for benefits and harms of digoxin is conflicting and of lower quality; most but not all of the evidence concerns use in HF+EF. There is strong evidence for other agents as first-line therapy to reduce hospitalizations and mortality in adults with HF+EF. In heart failure, higher dosages are not associated with additional benefit and may increase risk of toxicity. Decreased renal clearance of digoxin may lead to increased risk of toxic effects; further dose reduction may be necessary in those with stage 4 or 5 chronic kidney disease.	Avoid this rate control agent as first-line therapy for atrial fibrillation Avoid as first-line therapy for heart failure If used for atrial fibrillation or heart failure, avoid dosages >0.125 mg/day	Atrial fibrillation: low Heart failure: low Dosage >0.125 mg/day: moderate	Atrial fibrillation: strong Heart failure: strong Dosage >0.125 mg/day: strong
Nifedipine, immediate release	Potential for hypotension; risk of precipitating myocardial ischemia	Avoid	High	Strong
Amiodarone	Effective for maintaining sinus rhythm but has greater toxicities than other antiarrhythmics used in atrial fibrillation; may be reasonable first-line therapy in patients with concomitant heart failure or substantial left ventricular hypertrophy if rhythm control is preferred over rate control	Avoid as first-line therapy for atrial fibrillation unless patient has heart failure or substantial left ventricular hypertrophy	High	Strong
Central nervous system				
Antidepressants, alone or in combination Amitriptyline Amoxapine Clomipramine Desipramine Doxepin >6 mg/day Imipramine	Highly anticholinergic, sedating, and cause orthostatic hypotension; safety profile of low-dose doxepin (≤6 mg/day) comparable to that of placebo	Avoid	High	Strong

Table 2 (Contd.)

Organ System, Therapeutic Category, Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Nortriptyline Paroxetine Protriptyline Trimipramine				
Antipsychotics, first (conventional) and second (atypical) generation	Increased risk of cerebrovascular accident (stroke) and greater rate of cognitive decline and mortality in persons with dementia Avoid antipsychotics for behavioral problems of dementia or delirium unless nonpharmacological options (eg, behavioral interventions) have failed or are not possible <i>and</i> the older adult is threatening substantial harm to self or others High rate of physical dependence, tolerance to sleep benefits, greater risk of overdose at low dosages	Avoid, except in schizophrenia or bipolar disorder, or for short-term use as antiemetic during chemotherapy	Moderate	Strong
Barbiturates Amobarbital Butabarbital Butalbital Mephobarbital Pentobarbital Phenobarbital Secobarbital		Avoid	High	Strong
Benzodiazepines <i>Short and intermediate acting:</i> Alprazolam Eszazolam Lorazepam Oxazepam Temazepam Triazolam <i>Long acting:</i> Chlordiazepoxide (alone or in combination with amitriptyline or cldinium) Clonazepam Clorazepate Diazepam Flurazepam Quazepam Meprobamate Nonbenzodiazepine, benzodiazepine receptor agonist hypnotics (ie, “Z-drugs”) Eszopiclone Zaleplon Zolpidem	Older adults have increased sensitivity to benzodiazepines and decreased metabolism of long-acting agents; in general, all benzodiazepines increase risk of cognitive impairment, delirium, falls, fractures, and motor vehicle crashes in older adults May be appropriate for seizure disorders, rapid eye movement sleep behavior disorder, benzodiazepine withdrawal, ethanol withdrawal, severe generalized anxiety disorder, and periprocedural anesthesia	Avoid	Moderate	Strong
Ergoloid mesylates (dihydrogenated ergot alkaloids) Isoxsuprine	High rate of physical dependence; sedating Nonbenzodiazepine benzodiazepine receptor agonist hypnotics (ie, Z drugs) have adverse events similar to those of benzodiazepines in older adults (eg, delirium, falls, fractures); increased emergency room visits/hospitalizations; motor vehicle crashes; minimal improvement in sleep latency and duration Lack of efficacy	Avoid Avoid	Moderate Moderate	Strong Strong

(Continued)

Table 2 (Contd.)

Organ System, Therapeutic Category, Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Endocrine				
Androgens Methyltestosterone Testosterone	Potential for cardiac problems; contraindicated in men with prostate cancer	Avoid unless indicated for confirmed hypogonadism with clinical symptoms	Moderate	Weak
Desiccated thyroid	Concerns about cardiac effects; safer alternatives available	Avoid	Low	Strong
Estrogens with or without progestins	Evidence of carcinogenic potential (breast and endometrium); lack of cardioprotective effect and cognitive protection in older women Evidence indicates that vaginal estrogens for the treatment of vaginal dryness are safe and effective; women with a history of breast cancer who do not respond to nonhormonal therapies are advised to discuss the risks and benefits of low-dose vaginal estrogen (dosages of estradiol <25 µg twice weekly) with their healthcare provider Impact on body composition is small and associated with edema, arthralgia, carpal tunnel syndrome, gynecomastia, impaired fasting glucose	Avoid systemic estrogen (eg, oral and topical patch) Vaginal cream or vaginal tablets: acceptable to use low-dose intravaginal estrogen for management of dyspareunia, recurrent lower urinary tract infections, and other vaginal symptoms Avoid, except for patients rigorously diagnosed by evidence-based criteria with growth hormone deficiency due to an established etiology	Oral and patch: high Vaginal cream or vaginal tablets: moderate	Oral and patch: strong Topical vaginal cream or tablets: weak
Growth hormone	Higher risk of hypoglycemia without improvement in hyperglycemia management regardless of care setting. Avoid insulin regimens that include only short- or rapid-acting insulin dosed according to current blood glucose levels without concurrent use of basal or long-acting insulin. This recommendation does not apply to regimens that contain basal insulin or long-acting insulin.	Avoid	High	Strong
Insulin, sliding scale (insulin regimens containing only short- or rapid-acting insulin dosed according to current blood glucose levels without concurrent use of basal or long-acting insulin)	Minimal effect on weight; increases risk of thrombotic events and possibly death in older adults Chlorpropamide: prolonged half-life in older adults; can cause prolonged hypoglycemia; causes SIADH Glimepiride and glyburide: higher risk of severe prolonged hypoglycemia in older adults	Avoid	Moderate	Strong
Megestrol			Moderate	Strong
Sulfonylureas, long acting Chlorpropamide Glimepiride Glyburide (also known as glibenclamide)		Avoid	High	Strong
Gastrointestinal Metoclopramide	Can cause extrapyramidal effects, including tardive dyskinesia; risk may be greater in frail older adults and with prolonged exposure Potential for aspiration and adverse effects; safer alternatives available	Avoid, unless for gastroparesis with duration of use not to exceed 12 weeks except in rare cases Avoid	Moderate	Strong
Mineral oil, given orally			Moderate	Strong
Proton-pump inhibitors	Risk of <i>Clostridium difficile</i> infection and bone loss and fractures	Avoid scheduled use for >8 weeks unless for high-risk patients (eg, oral corticosteroids or chronic NSAID use), erosive esophagitis, Barrett esophagitis, pathological hypersecretory condition, or demonstrated need for maintenance treatment (eg, because of failure of drug discontinuation trial or H2-receptor antagonists)	High	Strong

Table 2 (Contd.)

Organ System, Therapeutic Category, Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Pain medications				
Meperidine	Oral analgesic not effective in dosages commonly used; may have higher risk of neurotoxicity, including delirium, than other opioids; safer alternatives available	Avoid	Moderate	Strong
Non-cyclooxygenase-selective NSAIDs, oral:				
Aspirin >325 mg/day	Increased risk of gastrointestinal bleeding or peptic ulcer disease in high-risk groups, including those >75 years or taking oral or parenteral corticosteroids, anticoagulants, or antiplatelet agents; use of proton-pump inhibitor or misoprostol reduces but does not eliminate risk. Upper gastrointestinal ulcers, gross bleeding, or perforation caused by NSAIDs occur in ~1% of patients treated for 3-6 months and in ~2%-4% of patients treated for 1 year; these trends continue with longer duration of use. Also can increase blood pressure and induce kidney injury. Risks are dose related.	Avoid chronic use, unless other alternatives are not effective and patient can take gastroprotective agent (proton-pump inhibitor or misoprostol)	Moderate	Strong
Diclofenac				
Diflunisal				
Etoricoxib				
Fenoprofen				
Ibuprofen				
Ketoprofen				
Meclofenamate				
Mefenamic acid				
Meloxicam				
Nabumetone				
Naproxen				
Oxaprozin				
Piroxicam				
Sulindac				
Tolmetin				
Indomethacin				
Ketorolac, includes parenteral	Increased risk of gastrointestinal bleeding/peptic ulcer disease and acute kidney injury in older adults Indomethacin is more likely than other NSAIDs to have adverse CNS effects. Of all the NSAIDs, indomethacin has the most adverse effects.	Avoid	Moderate	Strong
Skeletal muscle relaxants				
Carisoprodol	Most muscle relaxants poorly tolerated by older adults because some have anticholinergic adverse effects, sedation, increased risk of fractures; effectiveness at dosages tolerated by older adults questionable	Avoid	Moderate	Strong
Chlorzoxazone				
Cyclobenzaprine				
Metaxalone				
Methocarbamol				
Orphenadrine				
Genitourinary				
Desmopressin	High risk of hyponatremia; safer alternative treatments	Avoid for treatment of nocturia or nocturnal polyuria	Moderate	Strong

Abbreviations: CNS, central nervous system; HFrEF, heart failure with reduced ejection fraction; NSAID, nonsteroidal anti-inflammatory drug; SIADH, syndrome of inappropriate antidiuretic hormone secretion.

^aThe primary target audience is the practicing clinician. The intentions of the criteria include (1) improving the selection of prescription drugs by clinicians and patients; (2) evaluating patterns of drug use within populations; (3) educating clinicians and patients on proper drug usage; and (4) evaluating health-outcome, quality-of-care, cost, and utilization data.

^bSee also criterion on highly anticholinergic antidepressants.

Table 3. 2019 American Geriatrics Society Beers Criteria® for Potentially Inappropriate Medication Use in Older Adults Due to Drug-Disease or Drug-Syndrome Interactions That May Exacerbate the Disease or Syndrome^a

Disease or Syndrome	Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Cardiovascular Heart failure	Avoid: Cilostazol	Potential to promote fluid retention and/or exacerbate heart failure (NSAIDs and COX-2 inhibitors, nondihydropyridine CCBs, thiazolidinediones); potential to increase mortality in older adults with heart failure (cilostazol and dronedarone)	As noted, avoid or use with caution	Cilostazol: low	Cilostazol: strong
	Avoid in heart failure with reduced ejection fraction: Nondihydropyridine CCBs (diltiazem, verapamil)			Nondihydropyridine CCBs: moderate	Nondihydropyridine CCBs: strong
	Use with caution in patients with heart failure who are asymptomatic; avoid in patients with symptomatic heart failure: NSAIDs and COX-2 inhibitors			NSAIDs: moderate	NSAIDs: strong
	Thiazolidinediones (pioglitazone, rosiglitazone)			COX-2 inhibitors: low	COX-2 inhibitors: strong
	Dronedarone			Thiazolidinediones: high	Thiazolidinediones: strong
Syncope	AChEIs	AChEIs cause bradycardia and should be avoided in older adults whose syncope may be due to bradycardia. Nonselective peripheral alpha-1 blockers cause orthostatic blood pressure changes and should be avoided in older adults whose syncope may be due to orthostatic hypotension. Tertiary TCAs and the antipsychotics listed increase the risk of orthostatic hypotension or bradycardia.	Avoid	AChEIs, TCAs, and antipsychotics: high	AChEIs and TCAs: strong
	Nonselective peripheral alpha-1 blockers (ie, doxazosin, prazosin, terazosin)			Nonselective peripheral alpha-1 blockers: high	Nonselective peripheral alpha-1 blockers and antipsychotics: weak
	Tertiary TCAs				
	Antipsychotics: Chlorpromazine Thioridazine Olanzapine				
Central nervous system Delirium	Anticholinergics (see Table 7 and full criteria available on www.geriatriccareonline.org .)	Avoid in older adults with or at high risk of delirium because of potential of inducing or worsening delirium	Avoid	H2-receptor antagonists: low	Strong
	Antipsychotics ^b Benzodiazepines Corticosteroids (oral and parenteral) ^c H2-receptor antagonists	Avoid antipsychotics for behavioral problems of dementia and/or delirium unless nonpharmacological options (eg, behavioral interventions) have failed or are not possible and the older adult is threatening substantial harm to self or others. Antipsychotics are associated with greater risk of cerebrovascular accident (stroke) and mortality in persons with dementia.		All others: moderate	
	Cimetidine Famotidine Nizatidine Ranitidine Meperidine				
	Nonbenzodiazepine, benzodiazepine receptor agonist hypnotics: eszopiclone, zaleplon, zolpidem				
	Anticholinergics (see Table 7 and full criteria available on www.geriatriccareonline.org)	Avoid because of adverse CNS effects	Avoid	Moderate	Strong
Dementia or cognitive impairment	Benzodiazepines	Avoid antipsychotics for behavioral problems of dementia and/or delirium unless nonpharmacological options (eg, behavioral interventions) have failed or are not possible and the older adult is threatening substantial harm to self or			
	Nonbenzodiazepine, benzodiazepine receptor agonist hypnotics				
	Eszopiclone				

Table 3 (Contd.)

Disease or Syndrome	Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
	Zaleplon Zolpidem Antipsychotics, chronic and as-needed use ^b	others. Antipsychotics are associated with greater risk of cerebrovascular accident (stroke) and mortality in persons with dementia.			
History of falls or fractures	Antiepileptics Antipsychotics ^b Benzodiazepines Nonbenzodiazepine, benzodiazepine receptor agonist hypnotics Eszopiclone Zaleplon Zolpidem Antidepressants TCAs SSRIs SNRIs Opioids	May cause ataxia, impaired psychomotor function, syncope, additional falls; shorter-acting benzodiazepines are not safer than long-acting ones. If one of the drugs must be used, consider reducing use of other CNS-active medications that increase risk of falls and fractures (ie, antiepileptics, opioid-receptor agonists, antipsychotics, antidepressants, nonbenzodiazepine and benzodiazepine receptor agonist hypnotics, other sedatives/hypnotics) and implement other strategies to reduce fall risk. Data for antidepressants are mixed but no compelling evidence that certain antidepressants confer less fall risk than others.	Avoid unless safer alternatives are not available; avoid antiepileptics except for seizure and mood disorders Opioids: avoid except for pain management in the setting of severe acute pain (eg, recent fractures or joint replacement)	Opioids: moderate All others: high	Strong
Parkinson disease	Antiemetics Metoclopramide Prochlorperazine Promethazine All antipsychotics (except quetiapine, clozapine, pimavanserin)	Dopamine-receptor antagonists with potential to worsen parkinsonian symptoms Exceptions: Pimavanserin and clozapine appear to be less likely to precipitate worsening of Parkinson disease. Quetiapine has only been studied in low-quality clinical trials with efficacy comparable to that of placebo in five trials and to that of clozapine in two others.	Avoid	Moderate	Strong
Gastrointestinal					
History of gastric or duodenal ulcers	Aspirin >325 mg/day Non-COX-2–selective NSAIDs	May exacerbate existing ulcers or cause new/additional ulcers	Avoid unless other alternatives are not effective and patient can take gastroprotective agent (ie, proton-pump inhibitor or misoprostol)	Moderate	Strong
Kidney/urinary tract					
Chronic kidney disease stage 4 or higher (creatinine clearance <30 mL/min)	NSAIDs (non-COX and COX selective, oral and parenteral, nonacetylated salicylates)	May increase risk of acute kidney injury and further decline of renal function	Avoid	Moderate	Strong

(Continued)

Table 3 (Contd.)

Disease or Syndrome	Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Urinary incontinence (all types) in women	Estrogen oral and transdermal (excludes intravaginal estrogen) Peripheral alpha-1 blockers Doxazosin Prazosin Terazosin	Lack of efficacy (oral estrogen) and aggravation of incontinence (alpha-1 blockers)	Avoid in women	Estrogen: high Peripheral alpha-1 blockers: moderate	Estrogen: strong Peripheral alpha-1 blockers: strong
Lower urinary tract symptoms, benign prostatic hyperplasia	Strongly anticholinergic drugs, except antimuscarinics for urinary incontinence (see Table 7 and full criteria available on www.geriatriccareonline.org)	May decrease urinary flow and cause urinary retention	Avoid in men	Moderate	Strong

Abbreviations: AChEI, acetylcholinesterase inhibitor; CCB, calcium channel blocker; CNS, central nervous system; COX, cyclooxygenase; NSAID, nonsteroidal anti-inflammatory drug; SNRI, serotonin-norepinephrine reuptake inhibitor; SSRI, selective serotonin reuptake inhibitor; TCA, tricyclic antidepressant.

^aThe primary target audience is the practicing clinician. The intentions of the criteria include (1) improving the selection of prescription drugs by clinicians and patients; (2) evaluating patterns of drug use within populations; (3) educating clinicians and patients on proper drug usage; and (4) evaluating health-outcome, quality-of-care, cost, and utilization data.

^bMay be required to treat concurrent schizophrenia, bipolar disorder, and other selected mental health conditions but should be prescribed in the lowest effective dose and shortest possible duration.

^cExcludes inhaled and topical forms. Oral and parenteral corticosteroids may be required for conditions such as exacerbation of chronic obstructive pulmonary disease but should be prescribed in the lowest effective dose and for the shortest possible duration.

was lowered to 70 years or older from 80 years or older. This criterion was also expanded to cover use of aspirin as primary prevention of colorectal cancer. Note that this criterion does not apply to use of aspirin for secondary prevention of either disease.

- In addition to the existing caution about dabigatran, the updated criteria highlight caution about use of rivaroxaban for treatment of venous thromboembolism or atrial fibrillation in adults 75 years or older.
- Tramadol was added to the list of drugs associated with hyponatremia or syndrome of inappropriate antidiuretic hormone secretion. The chemotherapeutic agents carboplatin, cyclophosphamide, cisplatin, and vincristine were removed from this list because the panel thought the prescribing of these highly specialized drugs fell outside the scope of the criteria.
- Vasodilators were removed, because syncope is not unique to older adults.
- The combination dextromethorphan/quinidine was added to the “use with caution” table on the basis of limited efficacy in patients with behavioral symptoms of dementia without pseudobulbar affect while potentially increasing the risk of falls and drug-drug interactions.
- The combination trimethoprim-sulfamethoxazole (TMP-SMX) should be used with caution by patients with reduced kidney function and taking an angiotensin-converting enzyme inhibitor (ACEI) or angiotensin receptor blocker (ARB) because of an increased risk of hyperkalemia.

Drug-Drug Interactions

Table 5 contains potentially clinically important drug-drug interactions to be avoided in older adults. New recommendations include avoiding use of opioids concurrently with benzodiazepines and avoiding use of opioids concurrently with gabapentinoids (except when transitioning from the former to the latter). Other additions to the table are interactions involving TMP-SMX, macrolide antibiotics, and ciprofloxacin. TMP-SMX in combination with phenytoin or warfarin increases the risk of phenytoin toxicity and bleeding, respectively. Macrolides, excluding azithromycin, or ciprofloxacin in combination with warfarin increases bleeding risk. Ciprofloxacin in combination with theophylline increases risk of theophylline toxicity. The concurrent use of a combination of three or more central nervous system (CNS) agents (antidepressants, antipsychotics, benzodiazepines, nonbenzodiazepine benzodiazepine receptor agonist hypnotics, antiepileptics, and opioids) and increased fall risk have been collapsed into one recommendation instead of separate recommendations for each drug class. The recommendation on avoiding concurrent use of medications that increase serum potassium has been expanded to encompass a broader range of these medications.

PIMs Based on Kidney Function

Table 6 contains a list of medications that should be avoided or have their dosage reduced based on kidney function. Two antibiotics have been added, ciprofloxacin and TMP-SMX, over concerns of increased CNS effects and tendon rupture, and worsening renal function and hyperkalemia, respectively. Dofetilide was also added because of concerns of corrected QT interval prolongation and torsade de pointes. The creatinine clearance lower limit at which to avoid edoxaban has been reduced to less than 15 mL/min.

Table 4. 2019 American Geriatrics Society Beers Criteria® for Potentially Inappropriate Medications: Drugs To Be Used With Caution in Older Adults^a

Drug(s)	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Aspirin for primary prevention of cardiovascular disease and colorectal cancer	Risk of major bleeding from aspirin increases markedly in older age. Several studies suggest lack of net benefit when used for primary prevention in older adult with cardiovascular risk factors, but evidence is not conclusive. Aspirin is generally indicated for secondary prevention in older adults with established cardiovascular disease.	Use with caution in adults ≥ 70 years	Moderate	Strong
Dabigatran Rivaroxaban	Increased risk of gastrointestinal bleeding compared with warfarin and reported rates with other direct oral anticoagulants when used for long-term treatment of VTE or atrial fibrillation in adults ≥ 75 years.	Use with caution for treatment of VTE or atrial fibrillation in adults ≥ 75 years	Moderate	Strong
Prasugrel	Increased risk of bleeding in older adults; benefit in highest-risk older adults (eg, those with prior myocardial infarction or diabetes mellitus) may offset risk when used for its approved indication of acute coronary syndrome to be managed with percutaneous coronary intervention.	Use with caution in adults ≥ 75 years	Moderate	Weak
Antipsychotics Carbamazepine Diuretics Mirtazapine Oxcarbazepine SNRIs SSRIs TCAs Tramadol	May exacerbate or cause SIADH or hyponatremia; monitor sodium level closely when starting or changing dosages in older adults	Use with caution	Moderate	Strong
Dextromethorphan/ quinidine	Limited efficacy in patients with behavioral symptoms of dementia (does not apply to treatment of PBA). May increase risk of falls and concerns with clinically significant drug interactions. Does not apply to treatment of pseudobulbar affect.	Use with caution	Moderate	Strong
Trimethoprim- sulfamethoxazole	Increased risk of hyperkalemia when used concurrently with an ACEI or ARB in presence of decreased creatinine clearance	Use with caution in patients on ACEI or ARB and decreased creatinine clearance	Low	Strong

Abbreviations: ACEI, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; PBA, pseudobulbar affect; SIADH, syndrome of inappropriate antidiuretic hormone secretion; SNRI, serotonin-norepinephrine reuptake inhibitor; SSRI, selective serotonin reuptake inhibitor; TCA, tricyclic antidepressant; VTE, venous thromboembolism.

^aThe primary target audience is the practicing clinician. The intentions of the criteria include (1) improving the selection of prescription drugs by clinicians and patients; (2) evaluating patterns of drug use within populations; (3) educating clinicians and patients on proper drug usage; and (4) evaluating health-outcome, quality-of-care, cost, and utilization data.

DISCUSSION

The 2019 AGS Beers Criteria® update contributes to the critically important evidence base and discussion of medications to avoid in older adults and the need to improve medication use in older adults. The 2019 AGS Beers Criteria® include 30 individual criteria of medications or medication classes to be avoided in older adults (Table 2) and 16 criteria specific to more than 40 medications or medication classes that should be used with caution or avoided in certain diseases or conditions (Tables 3 and 4). As in past

updates, there were several changes to the 2019 AGS Beers Criteria®, including criteria that were modified or dropped, a few new criteria, and some changes in the level of evidence grading and clarifications in language and rationale (Tables 8–10).

The 2019 AGS Beers Criteria® is the third such update by the AGS and the fifth update of the AGS Beers Criteria® since their original release.^{1,2,10–12} The criteria was first published almost 30 years ago in 1991, making them the longest running criteria for PIMs in older adults.

Table 5. 2019 American Geriatrics Society Beers Criteria® for Potentially Clinically Important Drug-Drug Interactions That Should Be Avoided in Older Adults

Object Drug and Class	Interacting Drug and Class	Risk Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
RAS inhibitor (ACEIs, ARBs, aliskiren) or potassium-sparing diuretics (amilofide, triamterene)	Another RAS inhibitor (ACEIs, ARBs, aliskiren)	Increased risk of hyperkalemia	Avoid routine use in those with chronic kidney disease stage 3a or higher	Moderate	Strong
Opioids	Benzodiazepines	Increased risk of overdose	Avoid	Moderate	Strong
Opioids	Gabapentin, pregabalin	Increased risk of severe sedation-related adverse events, including respiratory depression and death	Avoid; exceptions are when transitioning from opioid therapy to gabapentin or pregabalin, or when using gabapentinoids to reduce opioid dose, although caution should be used in all circumstances.	Moderate	Strong
Anticholinergic	Anticholinergic	Increased risk of cognitive decline	Avoid; minimize number of anticholinergic drugs (Table 7)	Moderate	Strong
Antidepressants (TCAs, SSRIs, and SNRIs)	Any combination of three or more of these	Increased risk of falls (all) and of fracture (benzodiazepines and nonbenzodiazepine, benzodiazepine receptor agonist hypnotics)	Avoid total of three or more CNS-active drugs ^a ; minimize number of CNS-active drugs	Combinations including benzodiazepines and nonbenzodiazepine, benzodiazepine receptor agonist hypnotics or opioids: high	Strong
Antipsychotics	CNS-active drugs ^a			All other combinations: moderate	Strong
Antiepileptics					
Benzodiazepines and nonbenzodiazepine receptor agonist hypnotics (ie, “Z-drugs”)					
Opioids					
Corticosteroids, oral or parenteral	NSAIDs	Increased risk of peptic ulcer disease or gastrointestinal bleeding	Avoid; if not possible, provide gastrointestinal protection	Moderate	Strong
Lithium	ACEIs	Increased risk of lithium toxicity	Avoid; monitor lithium concentrations	Moderate	Strong
Lithium	Loop diuretics	Increased risk of lithium toxicity	Avoid; monitor lithium concentrations	Moderate	Strong
Peripheral α -1 blockers	Loop diuretics	Increased risk of urinary incontinence in older women	Avoid in older women, unless conditions warrant both drugs	Moderate	Strong
Phenytoin	Trimethoprim-sulfamethoxazole	Increased risk of phenytoin toxicity	Avoid	Moderate	Strong
Theophylline	Cimetidine	Increased risk of theophylline toxicity	Avoid	Moderate	Strong
Theophylline	Ciprofloxacin	Increased risk of theophylline toxicity	Avoid	Moderate	Strong
Warfarin	Amiodarone	Increased risk of bleeding	Avoid when possible; if used together, monitor INR closely	Moderate	Strong
Warfarin	Ciprofloxacin	Increased risk of bleeding	Avoid when possible; if used together, monitor INR closely	Moderate	Strong
Warfarin	Macrolides (excluding azithromycin)	Increased risk of bleeding	Avoid when possible; if used together, monitor INR closely	Moderate	Strong

Table 5 (Contd.)

Object Drug and Class	Interacting Drug and Class	Risk Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Warfarin	Trimethoprim-sulfamethoxazole	Increased risk of bleeding	Avoid when possible; if used together, monitor INR closely	Moderate	Strong
Warfarin	NSAIDs	Increased risk of bleeding	Avoid when possible; if used together, monitor closely for bleeding	High	Strong

Abbreviations: ACEI, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; CNS, central nervous system; INR, international normalized ratio; NSAID, nonsteroidal anti-inflammatory drug; RAS, renin-angiotensin system; SNRI, serotonin-norepinephrine reuptake inhibitor; SSRI, selective serotonin reuptake inhibitor; TCA, tricyclic antidepressant.

^aCNS-active drugs: antiepileptics; antipsychotics; benzodiazepines; nonbenzodiazepine, benzodiazepine receptor agonist hypnotics; TCAs; SSRIs; SNRIs; and opioids.

The 2019 update has a similar number of changes to the 2015 update but fewer changes than the 2012 update. This is likely because, with the support of the AGS and the expert panel, the criteria have been regularly updated about every 3 years since 2012. In 2019, 25 medications or medication classes to be avoided outright or in a disease condition were dropped from the AGS Beers Criteria® (Table 8). A few were also moved to a new table category or modified (Table 10). For medications to be removed from the AGS Beers Criteria®, the panel had to have new evidence or a strong rationale, for reasons such as the literature showed a change in evidence that cast new doubt on their “avoid” status. Finally, some drugs or drug-disease combinations were omitted because they are not disproportionately relevant to the older adult population; this included the criteria on drugs to avoid in adults with chronic seizures or epilepsy and in adults with insomnia.

Four new medications or medication classes were added to the list of drugs to be used with caution (Table 4; additions are also summarized in Table 9). Dextromethorphan/quinidine was added because of its limited efficacy, concerns for clinically significant drug interactions, and potentially increased risk of falls in older adults. TMP-SMX was placed in the “use with caution table” because of increased risk of hyperkalemia when used concurrently with an ACEI or ARB in the presence of decreased creatinine clearance.^{13,14} Rivaroxaban was also added to the use with caution table for adults 75 years or older. Other important changes in the use with caution table included lowering the age threshold in the aspirin for primary prevention recommendation from 80 years or younger to 70 years or younger on the basis of emerging evidence of a major increase in the risk of bleeding at a lower age.¹⁵ The Aspirin in Reducing Events in the Elderly (ASPREE) trial, which was published outside the window of our literature search, found that low-dose aspirin used for primary prevention in older adults did not confer a reduction in mortality, disability-free survival, or cardiovascular events.^{16,17} In a few instances, the level of evidence was revised based on new literature and the improved modified grading method. For instance, H2-receptor antagonists were removed from the list of drugs to avoid in dementia, and the evidence level for H2-receptor antagonists was decreased to low (from moderate in 2015) for drugs to avoid in delirium.¹⁸ Again in 2019, the panel clarified the language for sliding-scale insulin because this continued to be an area of confusion for clinicians.

Importantly, several drugs were added to the drug-disease and drug-drug interactions tables (Tables 3 and 5). Notably, SNRIs were added to the list of antidepressant drug classes to avoid in persons with a history of falls or fractures.^{19,20} For this criterion, the level of evidence for opioids was changed to “moderate”; all other drugs remain at high. Two new drug-drug interactions involving opioids were added, reflecting evidence of substantial harms that can occur when opioids are used concurrently with benzodiazepines or gabapentinoids. Though these drug interactions involving opioids are problematic in all persons, they are growing increasingly common and may lead to greater harm in vulnerable older adults. These concerns need to be balanced with the need to treat chronic pain. A recent review of deaths from opioids concluded that the burden of opioid overdose in older adults requires special attention, noting the largest

Table 6. 2019 American Geriatrics Society Beers Criteria® for Medications That Should Be Avoided or Have Their Dosage Reduced With Varying Levels of Kidney Function in Older Adults

Medication Class and Medication	Creatinine Clearance at Which Action Required, mL/min	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Anti-infective					
Ciprofloxacin	<30	Increased risk of CNS effects (eg, seizures, confusion) and tendon rupture	Doses used to treat common infections typically require reduction when CrCl <30 mL/min	Moderate	Strong
Trimethoprim-sulfamethoxazole	<30	Increased risk of worsening of renal function and hyperkalemia	Reduce dose if CrCl 15-29 mL/min Avoid if CrCl <15 mL/min	Moderate	Strong
Cardiovascular or hemostasis					
Amiloride	<30	Increased potassium and decreased sodium	Avoid	Moderate	Strong
Apixaban	<25	Lack of evidence for efficacy and safety in patients with a CrCl <25 mL/min	Avoid	Moderate	Strong
Dabigatran	<30	Lack of evidence for efficacy and safety in individuals with a CrCl <30 mL/min. Label dose for patients with a CrCl 15-30 mL/min based on pharmacokinetic data.	Avoid; dose adjustment advised when CrCl >30 mL/min in the presence of drug-drug interactions	Moderate	Strong
Dofetilide	<60	QTc prolongation and torsade de pointes	Reduce dose if CrCl 20-59 mL/min Avoid if CrCl <20 mL/min	Moderate	Strong
Edoxaban	15-50 <15 or >95	Lack of evidence of efficacy or safety in patients with a CrCl <30 mL/min	Reduce dose if CrCl 15-50 mL/min Avoid if CrCl <15 or >95 mL/min	Moderate	Strong
Enoxaparin	<30	Increased risk of bleeding	Reduce dose	Moderate	Strong
Fondaparinux	<30	Increased risk of bleeding	Avoid	Moderate	Strong
Rivaroxaban	<50	Lack of efficacy or safety evidence in patients with a CrCl <30 mL/min	Nonvalvular atrial fibrillation: reduce dose if CrCl 15-50 mL/min; avoid if CrCl <15 mL/min Venous thromboembolism treatment and for VTE prophylaxis with hip or knee replacement: avoid if CrCl <30 mL/min	Moderate	Strong
Spironolactone	<30	Increased potassium	Avoid	Moderate	Strong
Triamterene	<30	Increased potassium and decreased sodium	Avoid	Moderate	Strong
Central nervous system and analgesics					
Duloxetine	<30	Increased gastrointestinal adverse effects (nausea, diarrhea)	Avoid	Moderate	Weak
Gabapentin	<60	CNS adverse effects	Reduce dose	Moderate	Strong
Levetiracetam	≤80	CNS adverse effects	Reduce dose	Moderate	Strong
Pregabalin	<60	CNS adverse effects	Reduce dose	Moderate	Strong
Tramadol	<30	CNS adverse effects	Immediate release: reduce dose Extended release: avoid	Low	Weak
Gastrointestinal					
Cimetidine	<50	Mental status changes	Reduce dose	Moderate	Strong
Famotidine	<50	Mental status changes	Reduce dose	Moderate	Strong
Nizatidine	<50	Mental status changes	Reduce dose	Moderate	Strong
Ranitidine	<50	Mental status changes	Reduce dose	Moderate	Strong

Table 6 (Contd.)

Medication Class and Medication	Creatinine Clearance at Which Action Required, mL/min	Rationale	Recommendation	Quality of Evidence	Strength of Recommendation
Hyperuricemia					
Colchicine	<30	Gastrointestinal, neuromuscular, bone marrow toxicity	Reduce dose; monitor for adverse effects	Moderate	Strong
Probenecid	<30	Loss of effectiveness	Avoid	Moderate	Strong

Abbreviations: CNS, central nervous system; CrCl, creatinine clearance; QTc, corrected QT interval; VTE, venous thromboembolism.

Table 7. Drugs With Strong Anticholinergic Properties

Antiarrhythmic	Promethazine
Disopyramide	Pyrilamine
	Triprolidine
Antidepressants	
Amitriptyline	
Amoxapine	
Clomipramine	Antimuscarinics
Desipramine	(urinary incontinence)
Doxepin (>6 mg)	Darifenacin
Imipramine	Fesoterodine
Nortriptyline	Flavoxate
Paroxetine	Oxybutynin
Protriptyline	Solifenacin
Trimipramine	Tolterodine
	Trospium
Antiemetics	
Prochlorperazine	Antiparkinsonian agents
Promethazine	Benzotropine
	Trihexyphenidyl
Antihistamines (first generation)	
Brompheniramine	Antipsychotics
Carbinoxamine	Chlorpromazine
Chlorpheniramine	Clozapine
Clemastine	Loxapine
Cyproheptadine	Olanzapine
Dexbrompheniramine	Perphenazine
Dexchlorpheniramine	Thioridazine
Dimenhydrinate	Trifluoperazine
Diphenhydramine (oral)	
Doxylamine	Antispasmodics
Hydroxyzine	Atropine (excludes ophthalmic)
Meclizine	Belladonna alkaloids
Clidinium-chlordiazepoxide	Scopolamine (excludes ophthalmic)
Dicyclomine	
Homatropine (excludes ophthalmic)	Skeletal muscle relaxants
Hyoscyamine	Cyclobenzaprine
Methscopolamine	Orphenadrine
Propantheline	

relative increase in opioids occurred in persons 55 to 64 (754% increase from 0.2% to 1.7%) and 65 years and older and the absolute number of deaths in this group is moderate.^{21,22}

Several drug-drug interactions involving antimicrobial agents were also added to Table 5, and the recommendation to avoid concurrent use of three or more CNS-active

medications was reformatted to clarify and bring further attention to the increased risk of falls and other harms that can occur when multiple CNS-active medications are combined.²³

PIM use continues to be a serious problem in older adults and especially in vulnerable older adults with multiple chronic conditions. Thus, the AGS Beers Criteria® continue to be useful and necessary as a clinical tool, as an educational tool at the bedside, and as a public health tool to improve medication safety in older adults. The AGS Beers Criteria® can increase awareness of polypharmacy and aid decision making when choosing drugs to avoid in older adults. In a 2017 study using medical expenditure data (n = 16,588) in adults 65 years and older, poor health status was associated with increased PIM use. In another study, the use of PIMs, as measured by the 2015 criteria, in persons with dementia was 11% higher after diagnosis than in the year of diagnosis.^{24,25} Benzodiazepine use remains common in older adults, especially in older women, despite the fact that older adults are highly vulnerable to harms associated with use of these drugs.²⁶ The challenge of decreasing PIM use and improving the overall quality of medication prescribing in older adults remains, and the AGS Beers Criteria® are one part of the solution.

The AGS Beers Criteria® are an essential evidence-based tool that should be used as a guide for drugs to avoid in older adults. However, they are not meant to supplant clinical judgment or an individual patient's preferences, values, care goals, and needs, nor should they be used punitively or to excessively restrict access to medications. These criteria were developed to be used in conjunction with a person-centered team approach (physicians, nurses, pharmacists, other clinicians, the older adult, family, and others) to prescribing and monitoring adverse effects.²⁷ A companion article published to the 2015 updated AGS Beers Criteria®, entitled "How to Use the Beers Criteria: A Guide for Patients, Clinicians, Health Systems, and Payors," remains an important guide for using the AGS Beers Criteria®. It reminds clinicians that medications listed in the Criteria are potentially inappropriate, rather than definitely inappropriate for all older adults, and encourages users to read the rationale and recommendation statements for each medication to avoid because these statements provide important guidance.³ Moreover, the criteria should not be interpreted as giving license to steer patients away from PIMs to even worse choices. For example, the recommendation to avoid chronic, regular use of NSAIDs should not be

Table 8. Medications/Criteria Removed Since 2015 American Geriatrics Society Beers Criteria®

Medication/Criterion	Reason for Removal
Independent of Diagnosis or Condition (Table 2)	
Ticlopidine	No longer on US market; low use
Pentazocine	Oral no longer on US market
Considering Disease and Syndrome Interactions (Table 3)	
Chronic seizures or epilepsy	Not unique to older adults
Bupropion	
Chlorpromazine	
Clozapine	
Maprotiline	
Olanzapine	
Thioridazine	
Thiothixene	
Tramadol	
Dementia	
H2-receptor antagonists	Weak evidence and to avoid overly restricting therapeutic options for older adults with dementia who have gastroesophageal reflux or similar issues (given a coexisting criterion advising against chronic use of PPIs except in specific circumstances)
Insomnia	Not unique to older adults
Oral decongestants	
Phenylephrine	
Pseudoephedrine	
Stimulants	
Amphetamine	
Armodafinil	
Methylphenidate	
Modafinil	
Theobromines	
Theophylline	
Caffeine	
Parkinson disease	
Aripiprazole	Removed as a preferred antipsychotic in older adults with Parkinson disease because of safety and efficacy concerns
Use With Caution (Table 4)	
SIADH/hyponatremia	Highly specialized drugs that fell outside the scope of the criteria
Carboplatin	
Cyclophosphamide	
Cisplatin	
Vincristine	
Syncope	Not unique to older adults
Vasodilators	

Abbreviations: PPI, proton-pump inhibitor; SIADH, syndrome of inappropriate antidiuretic hormone secretion.

interpreted as an invitation to prescribe opioids in their place. For further reference, a 2012 article provides a case example on how nurses can use the criteria to improve medication use in older adults.²⁸

As in previous years, the panel recognizes the need to offer older adults and their clinicians pharmacological and nonpharmacological alternatives to medications included in the AGS Beers Criteria®. Alternatives to some of the most commonly implicated medications listed in the 2015 update

Table 9. Medications/Criteria Added Since 2015 American Geriatrics Society Beers Criteria®

Medication/Criterion	Reason for Addition
Independent of Diagnosis or Condition (Table 2)	
Glimepiride	Severe, prolonged hypoglycemia in older adults
Methscopolamine	Strong anticholinergic
Pyrilamine	
Considering Disease and Syndrome Interactions (Table 3)	
History of falls or fractures	Associated with increased risk in older adults
SNRI	
Parkinson disease	Unlike most other antipsychotics, the revised criteria consider pimavanserin acceptable for treatment of psychosis in Parkinson disease
Pimavanserin	
Use With Caution (Table 4)	
Rivaroxaban	Emerging evidence of increased risk of serious bleeding compared with other anticoagulant options
Tramadol	Risk of SIADH/hyponatremia
Dextromethorphan/quinidine	Limited efficacy in treating patients with dementia symptoms disorder in absence of pseudobulbar affect while potentially increasing risk of falls and drug-drug interactions
TMP-SMX	Increased risk of hyperkalemia in combination with ACEIs and ARBs in patients with reduced kidney function
Clinically Important Drug-Drug Interactions (Table 5)	
Opioids + benzodiazepines	Increased risk of overdose
Opioids + gabapentin/pregabalin	Increased risk of overdose
Phenytoin + TMP-SMX	Increased risk of phenytoin toxicity
Theophylline + ciprofloxacin	Increased risk of theophylline toxicity
Warfarin + ciprofloxacin	Increased risk of bleeding
Warfarin + macrolides (excluding azithromycin)	Increased risk of bleeding
Warfarin + TMP-SMX	Increased risk of bleeding
Medications That Should Be Avoided or Have Their Dosage Reduced With Decreased Kidney Function (Table 6)	
Ciprofloxacin	Increased risk of CNS effects
TMP-SMX	Increased risk of worsening of renal function and hyperkalemia

Abbreviations: ACEI, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; CNS, central nervous system; SIADH, syndrome of inappropriate antidiuretic hormone secretion; SNRI, serotonin-norepinephrine reuptake inhibitor; TMP-SMX, trimethoprim-sulfamethoxazole.

were published in a companion article that accompanied that update. Readers are encouraged to review these suggestions, although we acknowledge that further work needs to be done to keep pace with updates to the criteria and the changing landscape of drug and nondrug therapies. We also encourage readers to research the safety and effectiveness of potential alternatives to drugs included in this document. Deprescribing is a concept to eliminate unsafe or unnecessary drugs from a patient's regimen. One source for online

Table 10. Medications/Criterion Modified Since 2015 American Geriatrics Society Beers Criteria®

Medication/Criterion	Modification
Independent of Diagnosis or Condition (Table 2)	
Peripheral α -1 blockers	For treatment of hypertension
Digoxin for atrial fibrillation and heart failure	Added wording to Drug column; modified rationale; QE for atrial fibrillation changed to Low
Estrogen with or without progestin	Added “recurrent” urinary tract infections
Sliding-scale insulin	Clarified definition of sliding-scale insulin
Metoclopramide	Added duration of use to recommendation
Meperidine	Removed caveat from recommendation
Considering Disease and Syndrome Interactions (Table 3)	
Heart failure	Reorganized recommendations; separated COX-2 inhibitors from other NSAIDs; added QE and SR for COX-2 inhibitors; changed recommendation for NSAIDs, COX-2 inhibitors, and thiazolidinediones to use with caution in asymptomatic heart failure and to avoid in symptomatic heart failure; modified rationale
Syncope	Specified “nonselective peripheral α -1 blockers”; separated rationales, QE, and SR for AChEIs and nonselective peripheral α -1 blockers; modified QE for AChEIs and antipsychotics
Delirium	Changed “Sedative/hypnotics” to Nonbenzodiazepine, benzodiazepine receptor agonist hypnotics; changed QE of H2-receptor antagonists to low
History of fractures and falls	Changed SR of opioids to strong
Parkinson disease	Added rationale for quetiapine, clozapine, and pimavanserin
Chronic kidney disease and NSAIDs	Changed wording (minor) of criterion title
Use With Caution (Table 4)	
Aspirin as primary prevention	Modified age, indication, rationale, and QE
Dabigatran	Modified rationale and recommendation
Prasugrel	Modified rationale
Clinically Important Drug-Drug Interactions (Table 5)	
The table title	Dropped “Non-anti-infective”
ACEIs/ARBs and hyperkalemia	Changed to renin-angiotensin system inhibitors
Combination of three or more CNS agents (antidepressants, antiepileptics, antipsychotics, benzodiazepines, and opioids)	Replaced individual criteria with a single criterion
Medications That Should Be Avoided or Have Their Dosage Reduced With Decreased Kidney Function (Table 6)	
Apixaban, dabigatran, edoxaban, and rivaroxaban	Revised CrCl at which action is required, rationale and recommendations to reflect current labeling, and CrCl exclusion parameters in clinical trials

Abbreviations: ACEI, angiotensin-converting enzyme inhibitor; AChEI, acetylcholinesterase inhibitor; ARB, angiotensin receptor blocker; CNS, central nervous system; COX, cyclooxygenase; CrCl, creatinine clearance; NSAID, nonsteroidal anti-inflammatory drug; QE, quality of evidence; SR, strength of recommendation.

deprescribing resources for many medications included in the 2019 AGS Beers Criteria® is <https://deprescribing.org>.

Of particular note is the potential role for nonpharmacological approaches to manage common conditions in older adults. The evidence base for specific nonpharmacological approaches with a person-centered approach to care is small but growing.^{29–32} One example of the growing evidence for non-drug alternatives is in the area of care for persons with dementia and delirium. Scales and colleagues published a 2019 comprehensive review of evidence-based nonpharmacological approaches for behavioral and psychological symptoms of dementia. They evaluated 197 articles that included sensory practices (eg, massage, light therapy), psychosocial practices (eg, music, pet therapy, reminiscence), and structured care protocols (eg, mouth care, bathing). Though they had recommendations for improving the evidence base, they concluded most practices were acceptable to patients, had no harmful effects, and required minimal to moderate investment.³³ Online resources for some of

these approaches can be found at www.nursinghometoolkit.com and www.hospitalelderlifeprogram.org.

While the AGS Beers Criteria® can be a valuable tool, it should be viewed within the larger context of tools and strategies for improving pharmacological care for older adults. Specifically, the AGS Beers Criteria® is one component of what should be a comprehensive approach to medication use in older adults, and it should be used in conjunction with other tools and management strategies for improving medication safety and effectiveness. Moreover, other explicit criteria for evaluating PIMs in older adults, including the screening tool of older people’s prescriptions and screening tool to alert to right treatment criteria (STOPP/START criteria) can also be valuable resources for improving medication therapy.³⁴

Finally, the 2019 AGS Beers Criteria® have several limitations. Evidence for the benefits and harms of medications in older adults is often limited, particularly from randomized

clinical trials, and so decisions on the composition of the criteria were often made in context of best-available, rather than definitive, evidence. Moreover, evidence assessment frameworks are not perfectly tuned to drug safety evaluation, particularly for observational studies from which much of the relevant evidence derives.^{35,36} The criteria are unable to account for the complexity of all individuals and patient subpopulations, and thus should be taken as guidance to support clinical decision making and not as “the final word” as to whether a specific drug is appropriate or inappropriate for an individual patient. In addition, the criteria are not meant to apply to patients at the end of life or receiving palliative care, when risk-benefit considerations of drug therapy can be different. Medications considered for inclusion in the criteria were generally those available in the United States, and the panel did not seek to include agents available in other countries that may be equally problematic. Finally, the updated literature search was comprehensive but may have missed certain sources of evidence, such as articles written in languages other than English, white papers, technical reports, and other evidence published in the “gray literature.”

Notwithstanding these limitations, the guideline update process had a number of important strengths. The expert panel included members from multiple clinical disciplines, backgrounds, and types of clinical experience. The inclusion of ex-officio members from the Centers for Medicare and Medicaid Services, the Pharmacy Quality Alliance, and the National Committee for Quality Assurance provided a welcome level of expertise when the panel was considering the opportunities and pitfalls of translating recommendations into quality measures. In addition, the panel used a rigorous process for identifying, reviewing, and synthesizing the available evidence to inform the guideline update process, and benefited from the close support of the AGS.

In conclusion, the 2019 update has several important revisions. Important additions among the nearly 70 modifications to the 2015 AGS Beers Criteria® were new medications, clarifications of criteria language and rationale, and the addition of selected drug-drug interactions.

We hope that the criteria will be used thoughtfully and widely. To facilitate this process, we encourage healthcare professionals, patients, payors, and health systems to access resources with information on the criteria, including patient-oriented information on the Health in Aging Foundation website (www.healthinaging.org/medications-older-adults/) and guidance for all on the proper use of the criteria.³ Ongoing support from AGS will facilitate future evidence-based updates, keeping the AGS Beers Criteria® useful, relevant, and a valuable tool for improving the health and well-being of older adults.

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REFERENCES

- American Geriatrics Society 2012 Beers Criteria Update Expert Panel. American Geriatrics Society updated Beers Criteria for potentially inappropriate medication use in older adults. *J Am Geriatr Soc*. 2012;60(4):616-631.
- American Geriatrics Society Beers Criteria Update Expert Panel. American Geriatrics Society 2015 updated Beers Criteria for potentially inappropriate medication use in older adults. *J Am Geriatr Soc*. 2015;63(11):2227-2246.
- Steinman MA, Beizer JL, DuBeau CE, et al. How to use the American Geriatrics Society 2015 Beers Criteria: a guide for patients, clinicians, health systems, and payors. *J Am Geriatr Soc*. 2015;63(12):e1-e7.
- Guyatt G, Oxman AD, Akl EA, et al. GRADE guidelines, 1: introduction-GRADE evidence profiles and summary of findings tables. *J Clin Epidemiol*. 2011;64(4):383-394.
- Institute of Medicine (U.S.). Committee on Standards for Developing Trustworthy Clinical Practice Guidelines. In: Graham R, Mancher M, Wolman DM, et al., eds. *Clinical Practice Guidelines We Can Trust*. Washington, DC: National Academies Press; 2011.
- Balshem H, Helfand M, Schunemann HJ, et al. GRADE guidelines, 3: rating the quality of evidence. *J Clin Epidemiol*. 2011;64(4):401-406.
- Guyatt GH, Oxman AD, Vist G, et al. GRADE guidelines, 4: rating the quality of evidence—study limitations (risk of bias). *J Clin Epidemiol*. 2011;64(4):407-415.
- Shea BJ, Grimshaw JM, Wells GA, et al. Development of AMSTAR: a measurement tool to assess the methodological quality of systematic reviews. *BMC Med Res Methodol*. 2007;7:10.
- Qaseem A, Snow V, Owens DK, Shekelle P, Clinical Guidelines Committee of the American College of Physicians. The development of clinical practice guidelines and guidance statements of the American College of Physicians: summary of methods. *Ann Intern Med*. 2010;153(3):194-199.
- Beers MH, Ouslander JG, Rollingher I, et al. Explicit criteria for determining inappropriate medication use in nursing home residents. *Arch Intern Med*. 1991;151(9):1825-1832.
- Beers MH. Explicit criteria for determining potentially inappropriate medication use by the elderly: an update. *Arch Intern Med*. 1997;157(14):1531-1536.
- 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):2716-2724.
- Chan WY, Clark AB, Wilson AM, et al. The effect of co-trimoxazole on serum potassium concentration: safety evaluation of a randomized controlled trial. *Br J Clin Pharmacol*. 2017;83(8):1808-1814.
- Higashioka K, Niirio H, Yoshida K, et al. Renal insufficiency in concert with renin-angiotensin-aldosterone inhibition is a major risk factor for hyperkalemia associated with low-dose trimethoprim-sulfamethoxazole in adults. *Intern Med*. 2016;55(5):467-471.
- Whitlock EP, Burdu BU, Williams SB, et al. Bleeding risks with aspirin use for primary prevention in adults: a systematic review for the U.S. Preventive Services Task Force. *Ann Intern Med*. 2016;164(12):826-835.
- McNeil JJ, Wolfe R, Woods RL, et al. Effect of aspirin on cardiovascular events and bleeding in the healthy elderly. *N Engl J Med*. 2018;379(16):1509-1518.
- McNeil JJ, Woods RL, Nelson MR, et al. Effect of aspirin on disability-free survival in the healthy elderly. *N Engl J Med*. 2018;379(16):1499-1508.
- Clegg A, Young JB. Which medications to avoid in people at risk of delirium: a systematic review. *Age Ageing*. 2011;40(1):23-29.
- Marcum ZA, Perera S, Thorpe JM, et al. Antidepressant use and recurrent falls in community-dwelling older adults: findings from the health ABC study. *Ann Pharmacother*. 2016;50(7):525-533.
- Torvinen-Kiiskinen S, Tolppanen AM, Koponen M, et al. Antidepressant use and risk of hip fractures among community-dwelling persons with and without Alzheimer's disease. *Int J Geriatr Psychiatry*. 2017;32(12):e107-e115.
- Gomes T, Tadrous M, Muhammad M, et al. The burden of opioid-related mortality in the United States. *JAMA Network Open*. 2018;1(2):1-6.
- Samet JH, Kertesz SG. Suggested paths to fixing the opioid crisis: directions and misdirections. *JAMA Network Open*. 2018;1(2):1-22.
- Hanlon JT, Boudreau RM, Roumani YF, et al. Number and dosage of central nervous system medications on recurrent falls in community elders: the health, aging and body composition study. *J Gerontol A Biol Sci Med Sci*. 2009;64(4):492-498.
- Miller GE, Sarpong EM, Davidoff AJ, et al. Determinants of potentially inappropriate medication use among community-dwelling older adults. *Health Serv Res*. 2017;52(4):1534-1549.
- Gnjidic D, Agogo GO, Ramsey CM, et al. The impact of dementia diagnosis on patterns of potentially inappropriate medication use among older adults. *J Gerontol A Biol Sci Med Sci*. 2018 [Epub ahead of print];73:1410-1417. <https://doi.org/10.1093/gerona/gly078>.
- Olfson M, King M, Schoenbaum M. Benzodiazepine use in the United States. *JAMA Psychiat*. 2015;72(2):136-142.
- The American Geriatrics Society Expert Panel on Person-Centered Care. Person-centered care: a definition and essential elements. *J Am Geriatr Soc*. 2016;64:15-18. Available at <https://onlinelibrary.wiley.com/doi/10.1111/jgs.13866>.
- Fick DM, Resnick B. 2012 Beers criteria update: how should practicing nurses use the criteria? *J Gerontol Nurs*. 2012;38(6):3-5.
- Livingston G, Kelly L, Lewis-Holmes E, et al. Non-pharmacological interventions for agitation in dementia: systematic review of randomised controlled trials. *Br J Psychiatry*. 2014;205:436-442.
- Resnick B, Kolanowski AM, Van Hartsma K. Promoting positive behavioral health: a nonpharmacological toolkit for senior living communities. *J Gerontol Nurs*. 2014;40:2-3.
- Fick DM, DiMeglio B, McDowell JA, et al. Do you know your patient? knowing individuals with dementia combined with evidence-based care promotes function and satisfaction in hospitalized older adults. *J Gerontol Nurs*. 2013;39:2-4.
- Molony SL, Kolanowski A, Van Hartsma K, et al. Person-centered assessment and care planning. *Gerontologist*. 2018;58(suppl_1):S32-S47.
- Scales K, Zimmerman S, Miller SJ. Evidence-based nonpharmacological practices to address behavioral and psychological symptoms of dementia. *Gerontologist*. 2018;58(suppl_1):S88-S102.
- O'Mahony D, O'Sullivan D, Byrne S, et al. STOPP/START criteria for potentially inappropriate prescribing in older people: version 2. *Age Ageing*. 2015;44(2):213-218.
- Neyarapally GA, Hammad TA, Pinheiro SP, et al. Review of quality assessment tools for the evaluation of pharmacoepidemiological safety studies. *BMJ Open*. 2012;2:e001362.
- Hilmer SN, Gnjidic D, Abernethy DR. Pharmacoepidemiology in the post-marketing assessment of the safety and efficacy of drugs in older adults. *J Gerontol Ser A: Biomed Sci Med Sci*. 2012;67A:181-188.