

## Computerized Indicators of Potential Drug-related Morbidity

### ■ Online Appendix A Drug-Related Morbidity Indicator Definitions

#### 1) Pattern of care:

1. Use of an ACE inhibitor or ARB
2. Electrolytes/serum potassium not tested at least every 6 mo

**Outcome:** ED visit/hospitalization because of hyperkalemia

#### 2) Pattern of care:

1. Use of an ACE inhibitor or ARB
2. BUN/serum Cr not tested at least every 6 mo

**Outcome:** ED visit/hospitalization because of acute renal failure and/or renal insufficiency

#### 3) Pattern of care:

1. Dx/history of CHF
2. Not taking an ACE inhibitor or ARB (eg, captopril, enalapril maleate)

**Outcome:** ED visit/hospitalization because of CHF

#### 4) Pattern of care:

1. History/Dx of CHF
2. Use of an antiarrhythmic agent (eg, disopyramide phosphate, procainamide hydrochloride)

**Outcome:** ED visit/hospitalization because of CHF

#### 5) Pattern of care:

1. Dx of moderate-to-severe asthma
2. Use of a bronchodilator
3. No use of maintenance therapy (eg, beclomethasone dipropionate)

**Outcome:** ED visit/hospitalization because of asthma

#### 6) Pattern of care:

1. Use of thyroid or antithyroid agent (eg, levothyroxine sodium, propylthiouracil)
2. Thyroid tests (eg, thyroxine/thyrotropin) not done at least every 12 mo

**Outcome:** ED visit/hospitalization because of hypothyroidism

#### 7) Pattern of care:

1. History/Dx of depression
2. Use of long-acting benzodiazepine (eg, Librium® [chlordiazepoxide hydrochloride], Valium® [diazepam], Centrax® [prazepam], Paxipam® [halazepam])

**Outcome:** ED visit/hospitalization because of depression

#### 8) Pattern of care:

1. History/Dx of depression
2. Use of a barbiturate (eg, butalbital)

**Outcome:** ED visit/hospitalization because of depression

#### 9) Pattern of care:

1. History/Dx of depression
2. Use of a sympatholytic antihypertensive (eg, reserpine, methyl dopa)

**Outcome:** ED visit/hospitalization because of depression

#### 10) Pattern of care:

1. History/Dx of depression
2. Use of moderate-to-high lipophilic  $\beta$ -adrenergic blocking agent (eg, propranolol hydrochloride, pindolol)

**Outcome:** ED visit/hospitalization because of depression and/or increase in dosage of antidepressant

#### 11) Pattern of care:

1. Use of theophylline salts
2. Drug level testing not done at least every 6 mo

**Outcome:** ED visit/hospitalization because of theophylline toxicity

#### 12) Pattern of care:

1. Use of allopurinol
2. BUN/serum Cr not tested at least every 6 mo

**Outcome:** ED visit/hospitalization because of acute renal failure and/or renal insufficiency

#### 13) Pattern of care:

1. Use of warfarin sodium
2. INR not done at least every month

**Outcome:** ED visit/hospitalization because of major and/or minor hemorrhagic event

#### 14) Pattern of care:

1. History/Dx of MI
2. No use of aspirin and/or  $\beta$ -blocker (eg, metoprolol tartrate)

**Outcome:** ED visit/hospitalization because of secondary MI

#### 15) Pattern of care:

1. History/Dx of bipolar disorder
2. Use of lithium salts
3. Lithium level testing not done at least every 3 mo

**Outcome:** ED visit/hospitalization because of bipolar disorder

#### 16) Pattern of care:

1. Use of lithium
2. Lithium level testing not done every 3 mo

**Outcome:** ED visit/hospitalization because of lithium toxicity

#### 17) Pattern of care:

1. Lithium use for  $\geq 6$  mo
2. Thyroid tests (thyroxine/thyrotropin) not done at least every 6 mo

**Outcome:** ED visit/hospitalization because of hypothyroidism

#### 18) Pattern of care:

1. Use of lithium
2. BUN/serum Cr not tested at least every 3 mo

**Outcome:** ED visit/hospitalization because of acute renal failure and/or renal insufficiency

(continued)

Drug-related Morbidity Indicator Definitions (*Continued*)

**19) Pattern of care:**

1. History/Dx of ulcers and/or GI bleeding
2. NSAID use for  $\geq 1$  mo (not including COX-2)

**Outcome:** ED visit/hospitalization because of gastritis and/or upper GI bleed and/or upper GI perforation and/or GI ulcers and anemia

**20) Pattern of care:**

1. History/Dx of ulcers and/or GI bleeding
2. Use of an oral corticosteroid (eg, prednisone) for  $\geq 3$  mo

**Outcome:** ED visit/hospitalization because of gastritis and/or upper GI bleed and/or GI perforation and/or GI ulcers and anemia

**21) Pattern of care:**

1. Use of anticonvulsant requiring drug level monitoring (eg, phenytoin sodium)
2. Drug level not done at least every 6 mo

**Outcome:** ED visit/hospitalization because of seizure activity

**22) Pattern of care:**

1. Use of an anticonvulsant requiring drug level monitoring (eg, phenytoin, carbamazepine, valproic acid)
2. Drug level testing not done at least every 6 mo

**Outcome:** ED visit/hospitalization because of anticonvulsant drug toxicity

**23) Pattern of care:**

1. Warfarin use
2. NSAID use (eg, diclofenac salts, ibuprofen, ketoprofen)
3. INR not done within 10 d

**Outcome:** ED visit/hospitalization because of a major/minor hemorrhagic event

**24) Pattern of care:**

1. Use of Ticlid<sup>®</sup> (ticlopidine hydrochloride)
2. CBC count/platelets not tested every 2 mo

**Outcome:** ED visit/hospitalization because of blood dyscrasias/thrombocytopenia

**25) Pattern of care:**

1. History/Dx of bladder atony because of diabetes mellitus
2. Use of imipramine hydrochloride

**Outcome:** ED visit/hospitalization because of acute urinary retention

**26) Pattern of care:**

1. History/Dx of BPH
2. Use of an anticholinergic agent

**Outcome:** ED visit/hospitalization because of acute urinary retention

**27) Pattern of care:**

1. History/Dx of high blood pressure ( $>140/90$  mm Hg) and/or CHF
2. NSAID use for  $\geq 3$  months

**Outcome:** ED visit/hospitalization because of CHF and/or fluid overload

**28) Pattern of care:**

1. Use of non-potassium-sparing diuretic (eg, hydrochlorothiazide)
2. No concurrent use of potassium supplement
3. Electrolytes not checked at least every 2 mo initially, then every 6 mo

**Outcome:** ED visit/hospitalization for hypokalemia

**29) Pattern of care:**

1. Use of an aminoglycoside
2. Serum Cr not tested before and after therapy (and if therapy longer than 7 d, not done at least every 7 d)
3.  $\geq 1$  Drug level testing not done

**Outcome:** ED visit/hospitalization because of aminoglycoside toxicity (acute renal failure and/or renal insufficiency and/or vestibular damage and/or auditory damage)

**30) Pattern of care:**

1. History/Dx of COPD
2. Use of a  $\beta$ -blocker (eg, propranolol)

**Outcome:** ED visit/hospitalization because of COPD

**31) Pattern of care:**

1. History/Dx of severe COPD
2. Use of medium-to-long-acting benzodiazepines

**Outcome:** ED visit/hospitalization because of acute respiratory failure

**32) Pattern of care:**

1. History of hypertension
2. Prescription use of sympathomimetic decongestants

**Outcome:** ED visit/hospitalization because of hypertension/tachycardia

**33) Pattern of care:**

1. Use of carbamazepine
2. Electrolytes/CBC count not tested at least every 6 mo

**Outcome:** ED visit/hospitalization because of blood dyscrasias and/or hyponatremia and/or excessive water retention and/or SIADH

**34) Pattern of care:**

1. Use of digoxin
2. BUN/serum Cr not tested at least every 6 mo
3. Digoxin level not tested at least every 6 mo

**Outcome:** ED visit/hospitalization because of digoxin toxicity

**35) Pattern of care:**

1. Warfarin use
2. Antibiotic use (eg, Bactrim<sup>®</sup> [sulfamethoxazole-trimethoprim])
3. PT not tested within 5 d

**Outcome:** ED visit/hospitalization because of a major/minor hemorrhagic event

**36) Pattern of care:**

1. Patient taking  $\alpha$ -blocker
2. Standing blood pressure not checked within 2 mo of initiation of therapy

**Outcome:** ED visit/hospitalization because of fall and hip fracture

## Computerized Indicators of Potential Drug-related Morbidity

### Drug-related Morbidity Indicator Definition (*Continued*)

#### 37) Pattern of care:

1. 65 Years or older
2. Use of long half-life hypnotic/anxiolytic (eg, flurazepam hydrochloride, diazepam)

**Outcome:** ED visit/hospitalization because of fall and/or hip fracture and/or other bone fracture and/or bone break

#### 38) Pattern of care:

1. 65 Years or older
2. Use of tricyclic antidepressant (eg, amitriptyline hydrochloride, doxepin hydrochloride, imipramine)

**Outcome:** ED visit/hospitalization because of fall and/or hip fracture and/or other bone fracture and/or bone break

#### 39) Pattern of care:

1. History/Dx of CHF with heart block or advanced bradycardia
2. Use of digoxin

**Outcome:** ED visit/hospitalization because of CHF and/or heart block

ACE indicates angiotensin-converting enzyme; ARB, angiotensin receptor blocker; ED, emergency department; BUN, blood urea nitrogen; Cr, creatinine; Dx, diagnosis; CHF, congestive heart failure; INR, international normalized ratio; MI, myocardial infarction; GI, gastrointestinal; NSAID, nonsteroidal anti-inflammatory drug; COX-2, cyclo-oxygenase-2; CBC, complete blood count; BPH, benign prostatic hypertrophy; COPD, chronic obstructive pulmonary disease; SIADH, syndrome of inappropriate antidiuretic hormone; and PT, patient.

### ■ Online Appendix B Definitions and References

Drug-related morbidity is defined as “unintended patient injury with a scientifically plausible relationship either to (a) drug therapy or (b) an untreated indication for drug therapy.”<sup>16</sup>

For the US studies<sup>1</sup> in our series, about 8% of hospital admissions were caused by potential drug-related morbidity (calculated median). Based on 1997 hospital utilization data (114 hospital admissions per 1000 population),<sup>18</sup> this would correspond to about 9 potential drug-related admissions per 1000 population. The prevalence of illness-related emergency department visits is about 220 per 1000 population.<sup>17-20</sup> Based on data from Dennehy et al,<sup>19</sup> about 2.6% (33/1260) of emergency department visits are caused by potential drug-related morbidities, so potential drug-related morbidities would cause about 6 emergency department visits per 1000 population, hence the total of 15 per 1000 population.