

# Adverse drug effects in hospitalized elderly: Data from the Healthcare Cost and Utilization Project

Tatyana Shamliyan

Division of Health Policy and Management, University of Minnesota School of Public Health and Minnesota Evidence-based Practice Center, Minneapolis, MN, USA

**Abstract:** We aimed to analyze trends in hospital admissions due to adverse drug effects between the years 2000 to 2007 among the elderly using the National Inpatient Sample (NIS) of the Healthcare Cost and Utilization Project. We identified the discharges with the principal and all listed diagnoses related to adverse drug effects and associated hospital charges using the *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9) codes. Between 2000 and 2007, 321,057 patients over 65 years were discharged with a principal diagnosis related to an adverse drug effect. Hospital charges were \$5,329,276,300 or \$666,159,537 annual cost. The number of discharges and total hospital charges did not change over the examined years, while mean charge per discharge increased on average by \$1064 ± 384 per year. Total hospital charges for drug-induced gastritis with hemorrhage increased the most by \$11,206,555 per year among those 66–84 years old and by \$8,646,456 per year among those older than 85 years. During 2007, 791,931 elderly had adverse treatment effects among all listed diagnoses with hospital charges of \$937,795,690. Effective drug management interventions are needed to improve safety of treatments in the elderly.

**Keywords:** adverse drug reaction reporting systems, aged, hospitalization, international classification of diseases

## Introduction

Adverse drug events result in hospital admissions, increased costs, and poor quality of health care.<sup>1</sup> Prevention of adverse treatment effects is essential for improving patient safety and quality of care.<sup>2</sup> With \$2.5 trillion in annual spending for healthcare in the US, adverse treatment effects contribute to unnecessary and preventable cost.<sup>2</sup> Hospital admissions due to adverse drug effects can be prevented with high quality care.<sup>3</sup> Aging patients are most vulnerable to multimorbid conditions and polypharmacy.<sup>4</sup> However, hospital admissions for adverse drug events among elderly have not been evaluated in relation to quality of care. We aimed to examine frequency and hospital charges of adverse treatment effects among elderly using the National Inpatient Sample (NIS) of the Healthcare Cost and Utilization Project.<sup>5</sup>

## Methods

We analyzed total number of discharges with a principal diagnosis of adverse drug events in 2000–2007. We defined elderly inpatients in two age categories: 65–84 and ≥85 years of age. Principal diagnoses as the reasons for admission were identified using codes of the *International Classification of Diseases, ninth Revision, Clinical Modification* (ICD-9-CM), see Appendix Table 1).<sup>6,7</sup> We defined adverse drug effects as

Correspondence: Tatyana Shamliyan  
Division of Health Policy and Management, University of Minnesota School of Public Health, D330-5 Mayo (MMC 729), 420 Delaware Street SE, Minneapolis, MN 55455, USA  
Tel +1 612 626 5893  
Fax +1 612 624 8448  
Email shaml005@umn.edu

**Table 1** Total number of discharges with ICD-9-CM principal diagnosis of adverse drug effects in elderly in the US in 2000–2007\*

ICD-9-CM	Principal diagnosis	Discharges	Total cost (\$)
535.40	Specified gastritis without mention of hemorrhage	57786	860,998,714
535.41	Specified gastritis with hemorrhage	87807	1,572,983,700
962.3	Poisoning by insulins and antidiabetic agents, acetohexamide, biguanide derivatives, oral, chlorpropamide, glucagon, insulin, phenformin	15319	188,311,752
962.7	Poisoning by thyroid and thyroid derivatives, dextrothyroxine, levothyroxine sodium, liothyronine, thyroglobulin	255	2,413,273
963.0	Poisoning by antiallergic and antiemetic drugs, antihistamines, chlorpheniramine, diphenhydramine, diphenylpyraline, thonzylamine, tripeleennamine	803	8,633,615
963.1	Poisoning by antineoplastic and immunosuppressive drugs, azathioprine, busulfan, chlorambucil, cyclophosphamide, cytarabine, fluorouracil	209	4,110,450
964.2	Poisoning by anticoagulants, coumarin, heparin, phenindione, warfarin sodium	12358	177,192,573
965.00	Poisoning by opium (alkaloids), unspecified	2888	56,110,222
965.02	Poisoning by methadone	1323	26,343,332
965.09	Poisoning by opiates and related narcotics other, meperidine (pethidine), morphine	12583	217,660,115
965.1	Poisoning by salicylates, acetylsalicylic acid (aspirin), salicylic acid salts	2950	49,525,273
965.4	Poisoning by aromatic analgesics, not elsewhere classified, acetanilid, paracetamol (acetaminophen), phenacetin (acetophenetidin)	5469	109,796,708
965.61	Poisoning by propionic acid derivatives, fenoprofen, flurbiprofen, ibuprofen, ketoprofen, naproxen, oxaprozin	229	2,148,674
965.8	Poisoning by other specified analgesics and antipyretics, pentazocine	3443	59,098,750
965.9	Poisoning by unspecified analgesic and antipyretic	586	6,430,193
966.1	Poisoning by hydantoin derivatives, phenytoin	3778	47,403,049
966.3	Poisoning by other and unspecified anticonvulsants	1969	22,563,220
966.4	Poisoning by anti-Parkinsonism drugs, amantadine, ethopropazine (profenamine), levodopa (L-dopa)	522	4,671,189
967.0	Poisoning by barbiturates, amobarbital (amylobarbitone), barbital (barbitone), butobarbital (butabarbitone), pentobarbital (pentobarbitone), phenobarbital (phenobarbitone)	870	14,641,286
967.8	Poisoning by other sedatives and hypnotics	6162	87,972,831
967.9	Poisoning by unspecified sedative or hypnotic, sleeping, drug NOS, pill NOS, tablet NOS	2191	33,068,947
968.0	Poisoning by central nervous system muscle-tone depressants, chlorphenesin (carbamate), mephensin, methocarbamol	552	5,517,789
968.5	Poisoning by surface (topical) and infiltration anesthetics, cocaine, lidocaine (lignocaine), procaine, tetracaine	78	946,598
969.0	Poisoning by antidepressants, amitriptyline, imipramine, monoamine oxidase (MAO) inhibitors	5962	93,815,748
969.1	Poisoning by phenothiazine-based tranquilizers, chlorpromazine, fluphenazine, prochlorperazine, promazine	53	235,756
969.3	Poisoning by other antipsychotics, neuroleptics, and major tranquilizers	1482	22,016,443
969.4	Poisoning by benzodiazepine-based tranquilizers, chlordiazepoxide, diazepam, flurazepam, lorazepam, medazepam, nitrazepam	19446	328,528,129
969.5	Poisoning by other tranquilizers, hydroxyzine, meprobamate	301	1,910,136
969.8	Poisoning by other specified psychotropic agents	1511	22,890,849
970.8	Poisoning by other specified central nervous system stimulants	660	12,158,791
971.3	Poisoning by sympatholytics (antiadrenergics), phenoxybenzamine, tolazoline hydrochloride	864	10,867,698
972.0	Poisoning by cardiac rhythm regulators, practolol, procainamide, propranolol, quinidine	1250	14,339,989

(Continued)

**Table 1** (Continued)

ICD-9-CM	Principal diagnosis	Discharges	Total cost (\$)
972.1	Poisoning by cardiotonic glycosides and drugs of similar action, digitalis glycosides, digoxin, strophanthins	8534	119,955,030
972.4	Poisoning by coronary vasodilators, dipyridamole, nitrates (nitroglycerin), nitrites	2313	33,649,395
972.6	Poisoning by other antihypertensive agents, guanethidine, rauwolfia alkaloids, reserpine	5705	69,053,555
972.9	Poisoning by other and unspecified agents primarily affecting the cardiovascular system	2138	27,653,973
974.3	Poisoning by saluretics, benzothiadiazides, chlorothiazide group	96	1,484,756
974.4	Poisoning by other diuretics, ethacrynic acid, furosemide	1922	18,037,222
975.2	Poisoning by skeletal muscle relaxants	269	3,640,433
977.8	Poisoning by other specified drugs and medicinal substances, diagnostic agents and kits	3825	54,184,255
Total	All diagnoses	321,057	5,329,276,300

**Notes:** \*HCUPnet, Healthcare Cost and Utilization Project. Agency for Healthcare Research and Quality, Rockville, MD. (<http://hcupnet.ahrq.gov/>)

**Abbreviation:** NOS, not otherwise specified.

poisoning due to inappropriate uses or medication errors (eg, wrong medication, wrong patient, overdose) and as an adverse drug reaction.<sup>8</sup> We did not analyze clinical side effects including drug-induced psychoses (ICD codes 10 292.0–292.9) or dermatitis (ICD codes 5 692.3, 692.9, 693.0, 693.8, 693.9).<sup>8</sup> We identified all listed diagnoses of adverse treatment effects that coexisted at the time of admission, or that developed during the stay in 2007 using ICD-9-CM codes<sup>6</sup> (Appendix Table 2). We analyzed mean hospital charges<sup>5</sup> as the amount the hospital charged for the entire hospital stay for each ICD code. We multiplied the number of discharges by the mean hospital charge to calculate total hospital charges for each ICD code for each year and for the total time period from 2000 to 2007. We analyzed time trend in discharges and hospital charges with years as a continuous variable. We used restricted maximum likelihood (REML) estimation methods and –2 Res Log Likelihood Fit Statistics with mixed procedure<sup>9</sup> in SAS. All calculations were performed at 95% confidence levels using a two-sided *P* value with SAS software.<sup>10</sup>

## Results

During the period between 2000 and 2007, 321,057 hospital admissions among the elderly had principal diagnoses of adverse drug effects (Table 1). Total hospital charges were \$5,329,276,300 or \$666,159,537 per year.

Drug-induced gastritis with hemorrhage (87,807 discharges) and without mention of hemorrhage (57,786 discharges) constituted 31% and 21% of all drug-induced hospitalizations, respectively. Poisoning by benzodiazepine-based

tranquilizers, insulins, antidiabetic agents, and anticoagulants contributed to 5% or more of drug-induced hospitalizations in the elderly.

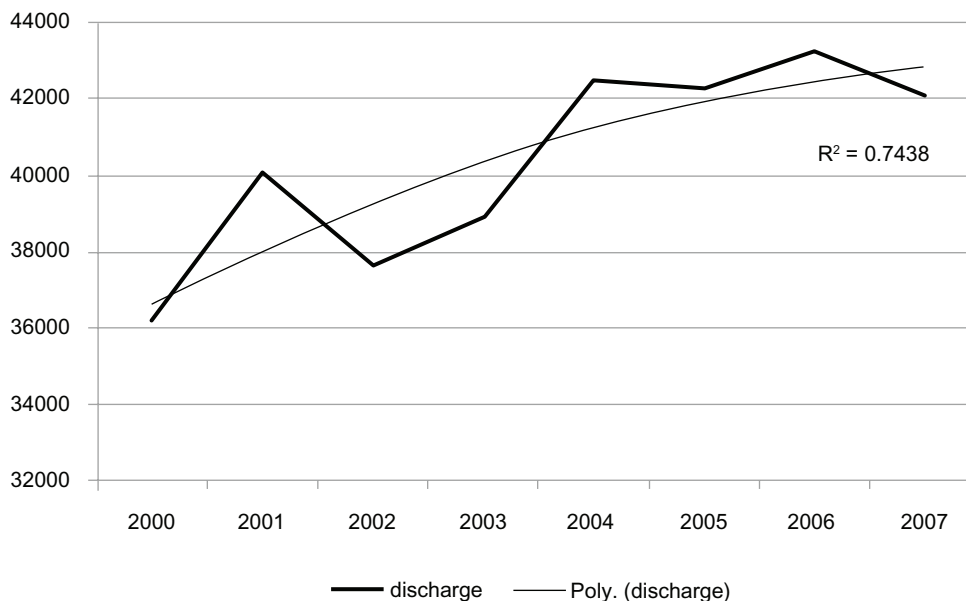
Hospital charges for gastritis with hemorrhage (\$1,572,983,700 or 36% of all hospital charges), gastritis without mention of hemorrhage (\$860,998,714 or 20% of all hospital charges), for poisoning by benzodiazepine-based tranquilizers (\$328,528,129 or 8% of all hospital charges), and for poisoning by opiates (\$217,660,115 or 5% of all hospital charges) were the largest drug-induced charges among elderly patients.

Total number of hospital admissions due to adverse drug effects increased from 36,199 in 2000 to 42,057 in 2007 (Figure 1). Total hospital charges increased from \$393,618,776 in 2000 to \$905,776,719 in 2007 (Figure 2).

Elderly patients constituted more than 50% of all admissions due to poisoning by anticoagulants and cardiotonics. Half of all hospital admissions with a principal diagnosis of poisoning by an anti-Parkinsonism drug or drug-induced gastritis with hemorrhage occurred in elderly patients.

The number of discharges and total hospital charges did not change over the examined years (*P* values for trend 0.61 and 0.11, respectively) while the mean charge per discharge increased on average by \$1064 ± 384 per year (*P* value for trend 0.006).

Hospital admissions due to drug-induced gastritis and due to poisoning by glycosides decreased during 2000–2007 (Table 2). Hospital admissions due to poisoning by opiates



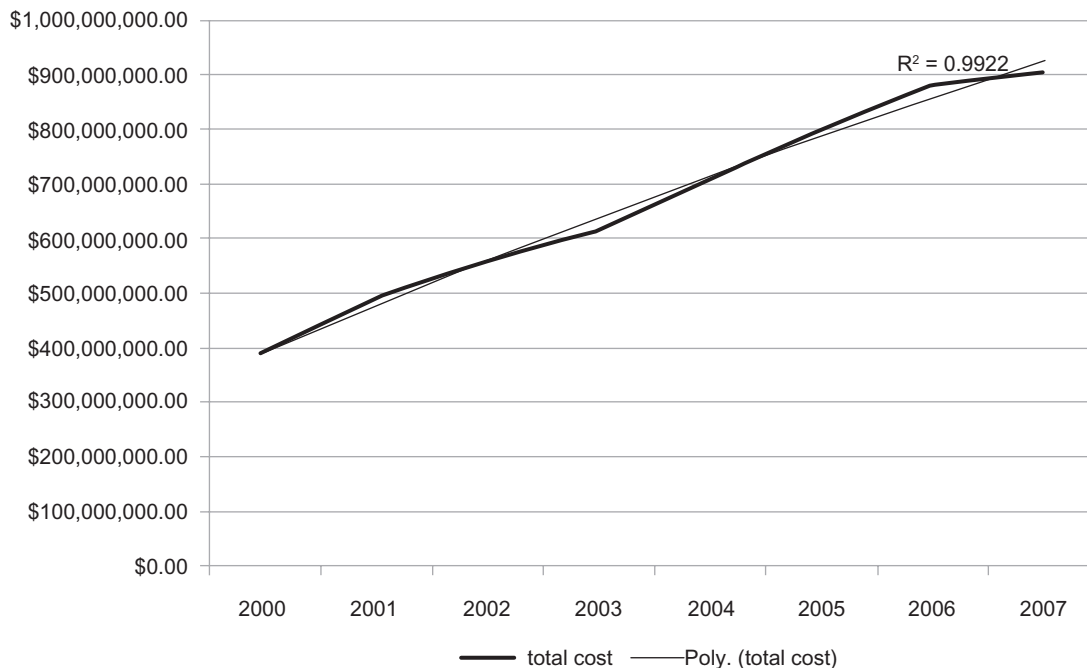
**Figure 1** Trend in total number of elderly discharged with ICD-9-CM principal diagnosis of adverse drug effect in the US for 2000-2007.\*  
 \*HCUPnet, Healthcare Cost and Utilization Project. Agency for Healthcare Research and Quality, Rockville, MD. (<http://hcupnet.ahrq.gov/>)

or insulin and antidiabetic agents increased in the examined time period (Table 2).

Mean hospital charges increased significantly for poisoning by methadone and salicylates. Hospital charges in elderly who were hospitalized for drug-induced gastritis with hemorrhage increased by \$19,853,011 per year.

Hospital charges for patients aged 65-84 who were hospitalized for insulin poisoning and antidiabetic agents increased by \$4,600,443 per year (Table 2).

All listed diagnoses related to adverse treatment effects in elderly in 2007 constituted 791,931 discharges and \$937,795,690 hospital charges (Table 3). Adverse effects



**Figure 2** Trend in total cost for discharged elderly with a ICD-9-CM principal diagnosis of adverse drug effects in the US for 2000-2007.\*  
 \*HCUPnet, Healthcare Cost and Utilization Project. Agency for Healthcare Research and Quality, Rockville, MD. (<http://hcupnet.ahrq.gov/>)

**Table 2** Significant time trend in discharges with a ICD-9-CM principal diagnosis of adverse drug effects in elderly in the US in 2000–2007\*

Code	Age	Change per year	Lower 95% CI	Upper 95% CI
<b>Total number of discharges</b>				
Poisoning by opiates and related narcotics other, meperidine (pethidine), morphine	65–84	131	55	207
	85+	109	38	181
Specified gastritis with hemorrhage	85+	–91	–162	–20
Specified gastritis without mention of hemorrhage	85+	–89	–161	–18
Poisoning by cardiotoxic glycosides and drugs of similar action, digitalis glycosides, digoxin, strophanthins	85+	–86	–157	–15
Poisoning by insulins and antidiabetic agents, acetohexamide, biguanide derivatives, oral, chlorpropamide, glucagon, insulin, phenformin	65–84	88	12	164
<b>Mean hospital charges, \$</b>				
Poisoning by methadone	65–84	\$1,583	\$465	\$2,701
Poisoning by salicylates, acetylsalicylic acid (aspirin), salicylic acid salts	65–84	\$1,229	\$225	\$2,233
	85+	\$1,006	\$63	\$1,948
Poisoning by opium (alkaloids), unspecified	65–84	\$1,291	\$36	\$2,546
<b>Total hospital charges, \$</b>				
Specified gastritis without mention of hemorrhage	65–84	\$7,646,061	\$5,589,408	\$9,702,715
	85+	\$5,105,871	\$3,183,223	\$7,028,519
Specified gastritis with hemorrhage	65–84	\$11,206,555	\$9,149,902	\$13,263,209
	85+	\$8,646,456	\$6,723,808	\$10,569,104
Poisoning by insulins and antidiabetic agents, acetohexamide, biguanide derivatives, oral, chlorpropamide, glucagon, insulin, phenformin	65–84	\$4,600,443	\$2,543,790	\$6,657,096
Poisoning by opiates and related narcotics other, meperidine (pethidine), morphine	65–84	\$6,502,314	\$4,422,840	\$8,581,789
	85+	\$3,990,380	\$2,035,223	\$5,945,538
Poisoning by benzodiazepine-based tranquilizers, chlordiazepoxide, diazepam, flurazepam, lorazepam, medazepam, nitrazepam	65–84	\$5,551,531	\$3,494,877	\$7,608,184
Poisoning by medicinal agents, not specified	65–84	\$2,498,657	\$1,910,589	\$3,086,724
Poisoning by other sedatives and hypnotics	65–84	\$3,890,757	\$1,834,103	\$5,947,410
Poisoning by aromatic analgesics, not elsewhere classified, acetanilid, paracetamol (acetaminophen), phenacetin (acetophenetidin)	65–84	\$3,912,772	\$1,807,026	\$6,018,518
Poisoning by anticoagulants, coumarin, heparin, phenindione, warfarin sodium	65–84	\$3,564,249	\$1,507,595	\$5,620,902
Poisoning by other antihypertensive agents, guanethidine, rauwolfia alkaloids, reserpine	65–84	\$3,354,306	\$1,297,653	\$5,410,959
Poisoning by benzodiazepine-based tranquilizers, chlordiazepoxide, diazepam, flurazepam, lorazepam, medazepam, nitrazepam	85+	\$3,035,785	\$1,113,137	\$4,958,433
Poisoning by opium (alkaloids), unspecified	65–84	\$4,019,466	\$1,430,863	\$6,608,070
Poisoning by unspecified sedative or hypnotic, sleeping drug NOS, pill NOS, tablet NOS	65–84	\$2,824,729	\$680,482	\$4,968,976
Poisoning by salicylates, acetylsalicylic acid (aspirin), salicylic acid salts	65–84	\$2,619,376	\$547,870	\$4,690,883
Poisoning by other specified analgesics and antipyretics, pentazocine	65–84	\$2,753,695	\$553,314	\$4,954,075
Poisoning by antidepressants, amitriptyline, imipramine, monoamine oxidase (MAO) inhibitors	65–84	\$2,649,658	\$522,619	\$4,776,698
Poisoning by hydantoin derivatives, phenytoin	65–84	\$2,531,952	\$465,643	\$4,598,262
Poisoning by other specified drugs and medicinal substances, diagnostic agents and kits	65–84	\$2,632,369	\$473,890	\$4,790,848

(Continued)

**Table 2** (Continued)

Code	Age	Change per year	Lower 95% CI	Upper 95% CI
Poisoning by other diuretics, ethacrynic acid, furosemide	65–84	\$2,604,287	\$432,360	\$4,776,214
Poisoning by other and unspecified agents primarily affecting the cardiovascular system	65–84	\$2,615,983	\$426,308	\$4,805,659
Poisoning by cardiotonic glycosides and drugs of similar action, digitalis glycosides, digoxin, strophanthins	65–84	\$2,372,342	\$315,689	\$4,428,996
Poisoning by insulins and antidiabetic agents, acetohexamide, biguanide derivatives, oral, chlorpropamide, glucagon, insulin, phenformin	85+	\$2,093,655	\$171,007	\$4,016,303
Poisoning by coronary vasodilators, dipyridamole, nitrates (nitroglycerin), nitrites	65–84	\$2,282,972	\$177,226	\$4,388,718

**Abbreviation:** NOS, not otherwise specified.

\*HCUPnet, Healthcare Cost and Utilization Project. Agency for Healthcare Research and Quality, Rockville, MD. (<http://hcupnet.ahrq.gov/>)

of anticoagulants were experienced by 94,793 patients 65–84 years (55.65% of all discharged with this diagnosis) and 31,807 inpatients older than 85 years (19% of all discharged with this diagnosis). Total hospital charges for adverse effects of anticoagulants in 2007 in elderly were \$404,165,145 and \$47,642,222 in the two age categories, respectively. Adverse effects of diuretics in 2007 afflicted 29,655 elderly patients, with total hospital charges of \$46,906,127. Adverse effects of corticosteroids afflicted 87,454 adults 65–84 years of age (41% of all discharged with this diagnosis) with a total hospital charge of \$317,339,123. Much less expected was a large number of elderly with unspecified adverse drug effects. In 2007, 27,976 elderly experienced adverse drug effects with unknown definitive cause. Total hospital charges for such unspecified adverse drug effects were \$35,520,572.

## Discussion

Hospital admissions due to adverse drug effects are common. While the rate of admissions remained the same during the study period, costs continued to increase. Several pharmacologic groups including antidiabetic drugs, anticoagulants,

cardiotonics, saluretics, and anti-inflammatory medications are responsible for the most common adverse events in the elderly. Hospital charges are substantial when all listed diagnoses related to adverse drug effects in the elderly are analyzed.

We did not analyze probable variability of adverse drug effects among geographical regions, types of hospitals, or patient income. Such variability may be associated with differences in hospital admission and charges but does not decrease the significance of the problem of very common and costly adverse drug events in the elderly. We could not judge the validity of hospital discharge codes in identifying drug-specific adverse effects.<sup>11</sup> Previous studies have demonstrated poor predictive value of hospital discharge codes in identifying drug adverse effects.<sup>11,12</sup>

Hospital admissions due to adverse drug effects may reflect inadequate drug management in outpatient settings that cannot be analyzed using the National Inpatient Sample. Outpatient clinical pharmacology services may reduce adverse drug events in elderly,<sup>13–15</sup> but preventive effects on hospital admissions are not clear. Effective drug management interventions are needed to improve safety of treatments in elderly.

**Table 3** Hospitalization with ICD9-CM all-listed diagnosis codes of adverse treatment effects in elderly, 2007\*

Principal diagnosis	Year of age	Total number of discharges	% of all discharges with ICD code	Charges, \$ (mean)	Total cost
Accidental poisoning by methadone	65–84	271	6.30%	37	10,063
Accidental poisoning by other opiates and related narcotics, morphine, opium (alkaloids)	65–84	3,984	21.80	196	781,447
	85+	546	2.99	56	30,546
Accidental poisoning by salicylates, acetylsalicylic acid (aspirin), salicylic acid salts, amino derivatives of salicylic acid	65–84	248	13.72	37	9,149
	85+	80	4.43	21	1,698

(Continued)

**Table 3** (Continued)

Principal diagnosis	Year of age	Total number of discharges	% of all discharges with ICD code	Charges, \$ (mean)	Total cost
Accidental poisoning by aromatic analgesics, not elsewhere classified, acetanilid, paracetamol (acetaminophen), phenacetin (acetophenetidin)	65–84	631	8.67	60	38,183
	85+	78	1.08	20	1,531
Accidental poisoning by antirheumatics (antiphlogistics), gold salts, indomethacin,	65–84	93	10.08	22	1,998
Accidental poisoning by other specified analgesics and antipyretics, pentazocine	65–84	747	26.65	62	46,351
	85+	148	5.27	28	4,109
Accidental poisoning by unspecified analgesic or antipyretic	65–84	127	25.19	25	3,185
Accidental poisoning by barbiturates	65–84	117	11.22	24	2,821
Accidental poisoning by other specified sedatives and hypnotics	65–84	810	25.87	69	55,549
	85+	174	5.55	31	5,316
Accidental poisoning by unspecified sedative or hypnotic, sleeping drug NOS, pill NOS, tablet NOS	65–84	853	27.79	70	59,915
	85+	121	3.94	26	3,103
Accidental poisoning by benzodiazepine-based tranquilizers, chlordiazepoxide, diazepam, flurazepam, lorazepam, medazepam, nitrazepam	65–84	2,378	15.08	123	293,373
	85+	336	2.13	40	13,516
Accidental poisoning by other specified tranquilizers, hydroxyzine, meprobamate	65–84	308	8.91	42	12,890
	85+	68	1.96	19	1,253
Accidental poisoning by antidepressants, amitriptyline, imipramine, monoamine oxidase (MAO) inhibitors	65–84	542	11.61	55	29,870
	85+	113	2.42	23	2,639
Accidental poisoning by psychostimulants, amphetamine, caffeine	65–84	58	2.21	17	992
Accidental poisoning by central nervous system stimulants, analeptics, opiate antagonists	65–84	307	2.75	54	16,439
Accidental poisoning by other psychotropic agents	65–84	145	17.50	30	4,278
Accidental poisoning by anticonvulsant and anti-Parkinsonism drugs, amantadine, hydantoin derivatives, oxazolidine derivatives (paramethadione, trimethadione)	65–84	998	20.90	84	83,967
	85+	216	4.52	33	7,043
Accidental poisoning by other central nervous system depressants, ether, gaseous anesthetics, halogenated hydrocarbon derivatives, intravenous anesthetics, thiobarbiturates	65–84	188	6.59	33	6,120
Accidental poisoning by parasympathomimetics (cholinergics), acetylcholine, pilocarpine, anticholinesterase: organophosphorus, reversible	65–84	94	60.57	22	2,067
Accidental poisoning by sympatholytics (antiadrenergics), phenoxybenzamine, tolazoline hydrochloride	65–84	250	45.94	37	9,184
	85+	70	12.95	19	1,317
Accidental poisoning by antibiotics	65–84	158	28.60	28	4,458
Accidental poisoning by other anti-infectives	65–84	79	28.19	20	1,557
Accidental poisoning by hormones and synthetic substitutes	65–84	2,748	39.98	171	468,595
	85+	677	9.86	70	47,416
Accidental poisoning by primarily systemic agents	65–84	403	18.92	52	20,871
Accidental poisoning by agents primarily affecting blood constituents	65–84	1,656	49.74	110	182,285
	85+	509	15.28	56	28,301
Accidental poisoning by agents primarily affecting cardiovascular system	65–84	2,658	41.14	139	370,247
	85+	874	13.52	76	66,654
	65–84	203	35.52	33	6,784

(Continued)

**Table 3** (Continued)

Principal diagnosis	Year of age	Total number of discharges	% of all discharges with ICD code	Charges, \$ (mean)	Total cost
Accidental poisoning by agents primarily affecting gastrointestinal system	85+	63	10.94	17	1,086
Accidental poisoning by water, mineral, and uric acid metabolism drugs	65–84	841	44.72	70	59,154
	85+	246	13.08	37	9,144
Accidental poisoning by agents primarily acting on the smooth and skeletal muscles and respiratory system	65–84	348	16.68	45	15,792
Accidental poisoning by agents primarily affecting skin and mucous membrane, ophthalmologic, otorhinolaryngologic, and dental drugs	65–84	86	21.86	24	2,013
Accidental poisoning by other specified drugs, central appetite depressants	65–84	566	20.85	59	33,256
	85+	152	5.61	26	4,033
Accidental poisoning by unspecified drug	65–84	697	25.78	66	46,298
	85+	131	4.84	26	3,377
Accidental cut, puncture, perforation, or hemorrhage during surgical operation	65–84	11,833	33.28	890	10,531,148
	85+	1,318	3.71	111	146,408
Accidental cut, puncture, perforation, or hemorrhage during endoscopic examination	65–84	1,551	49.30	132	203,951
	85+	354	11.24	46	16,191
Accidental cut, puncture, perforation, or hemorrhage during aspiration of fluid or tissue, puncture, and catheterization, abdominal paracentesis, aspirating needle biopsy, blood sampling	65–84	334	45.94	57	18,917
	85+	1,833	51.78	111	92,489
Accidental cut, puncture, perforation, or hemorrhage during heart catheterization	65–84	830	51.78	111	92,489
	85+	103	6.41	25	2,555
Accidental cut, puncture, perforation, or hemorrhage during other specified medical care	65–84	2,840	39.14	238	675,262
	85+	602	8.30	65	39,207
Accidental cut, puncture, perforation, or hemorrhage during unspecified medical care	65–84	155	30.32	39	6,053
Foreign object left in body during surgical operation	65–84	268	30.35	38	10,139
Foreign object left in body during other specified procedures	65–84	102	29.11	23	2,378
Mechanical failure of instrument or apparatus during surgical operation	65–84	93	34.75	23	2,145
Mechanical failure of instrument or apparatus during other specified procedures	65–84	59	34.92	17	1,037
Other specified misadventures during medical care, performance of inappropriate treatment	65–84	1,845	42.30	184	340,133
	85+	348	7.99	54	18,783
Unspecified misadventure during medical care	65–84	439	36.56	84	36,855
	85+	98	8.17	27	2,624
Causing adverse effects, penicillins, natural, synthetic, semisynthetic, such as ampicillin, cloxacillin, nafcillin, oxacillin	65–84	4,670	30.60	252	1,175,580
	85+	1,316	8.62	104	136,598
Causing adverse effects, antifungal antibiotics	65–84	459	20.23	53	24,351
	85+	86	3.79	20	1,722
Causing adverse effects, erythromycin and other macrolides, oleandomycin, spiramycin	65–84	1,340	35.88	100	134,634
	85+	349	9.35	44	15,323
Causing adverse effects, tetracycline group, doxycycline, minocycline, oxytetracycline	65–84	590	30.71	61	35,785
	85+	176	9.16	29	5,112

(Continued)

**Table 3** (Continued)

Principal diagnosis	Year of age	Total number of discharges	% of all discharges with ICD code	Charges, \$ (mean)	Total cost
Causing adverse effects, cephalosporin group, cepha-lexin, cephaloglycin, cephaloridine, cephalothin	65–84	4,062	32.11	221	895,948
	85+	1,168	9.23	98	114,012
Causing adverse effects, antimycobacterial antibiotics, cycloserine, kanamycin, rifampin, streptomycin	65–84	604	34.18	76	46,021
	85+	124	7.04	26	3,206
Causing adverse effects, antineoplastic antibiotics, actinomycins, such as bleomycin, cactinomycin, dactinomycin, daunorubicin, mitomycin	65–84	679	33.76	74	49,951
Causing adverse effects, other specified antibiotics	65–84	16,502	34.28	733	12,102,073
	85+	5,191	10.78	282	1,462,584
Causing adverse effects, unspecified antibiotic	65–84	8,151	40.87	429	3,499,517
	85+	2,571	12.89	174	446,829
Causing adverse effects, sulfonamides, sulfadiazine, sulfafurazole, sulfamethoxazole	65–84	3,406	31.48	196	669,035
	85+	1,218	11.26	98	118,907
Causing adverse effects, quinoline and hydroxyquinoline derivatives, chiniofon, diiodohydroxyquinoline,	65–84	287	44.00	49	14,166
	85+	80	12.30	20	15,71
Causing adverse effects, antimalarials and drugs acting on other blood protozoa, chloroquine phosphate, cycloguanil, primaquine, proguanil (chloroguanide), pyrimethamine	65–84	323	39.45	45	14,522
	85+	59	7.22	17	1,017
Causing adverse effects, other antiprotozoal drugs, emetine	65–84	1,287	35.82	101	130,356
	85+	345	9.61	45	15,444
Causing adverse effects, antiviral drugs, methisazone	65–84	868	15.51	77	66,967
	85+	218	3.89	33	7,174
Causing adverse effects, other antimycobacterial drugs, ethambutol, ethionamide, isoniazid, sulfones, para-aminosalicylic acid derivatives	65–84	311	25.84	43	13,446
Causing adverse effects, other and unspecified anti-infectives, flucytosine, nitrofurantoin derivatives	65–84	2,169	41.97	143	310,964
	85+	824	15.95	83	68,199
Causing adverse effects, adrenal cortical steroids, cortisone derivatives, desoxycorticosterone derivatives, fluorinated corticosteroids	65–84	87,454	40.86	3,629	317,339,123
	85+	15,052	7.03	756	11,379,733
Causing adverse effects, androgens and anabolic congeners, nandrolone phenpropionate, oxymetholone, testosterone and preparations	65–84	78	43.28	20	1,537
Causing adverse effects, ovarian hormones and synthetic substitutes, contraceptives, oral, estrogens, estrogens and progestogens combined, progestogens	65–84	364	14.80	42	15,214
	85+	98	3.98	24	2,361
Causing adverse effects, insulin and antidiabetic agents, acetohexamide, biguanide derivatives, oral, chlorpropamide, glucagon, insulin, phenformin	65–84	17,195	53.12	752	12,930,202
	85+	4,006	12.37	234	936,802
Causing adverse effects, anterior pituitary hormones, corticotropin, gonadotropin, somatotropin (growth hormone)	65–84	63	17.15	19	1,171
Causing adverse effects, posterior pituitary hormones, vasopressin	65–84	304	47.79	40	12,185
	85+	76	11.92	22	1,668
Causing adverse effects, parathyroid and parathyroid derivatives	65–84	78	48.15	19	1,515
Causing adverse effects, thyroid and thyroid derivatives, dextrothyroxine, levothyroxine sodium, liothyronine, thyroglobulin	65–84	1,251	47.64	97	121,241
	85+	472	17.97	54	25,494

(Continued)

**Table 3** (Continued)

Principal diagnosis	Year of age	Total number of discharges	% of all discharges with ICD code	Charges, \$ (mean)	Total cost
Causing adverse effects, antithyroid agents, iodides, thiouracil, thiourea	65–84	258	29.95	40	10,356
Causing adverse effects, other and unspecified hormones and synthetic substitutes	65–84	67	29.93	18	1,205
Causing adverse effects, antiallergic and antiemetic drugs, antihistamines, chlorpheniramine, diphenhydramine, diphenylpyraline, thonzylamine, tripeleminamine	65–84 85+	3,152 784	39.07 9.72	190 72	600,190 56,309
Causing adverse effects, antineoplastic and immunosuppressive drugs, azathioprine, busulfan, chlorambucil, cyclophosphamide, cytarabine, fluorouracil, mercaptopurine	65–84 85+	66,481 4,265	39.53 2.54	3,155 250	209,744,458 1,066,938
Causing adverse effects, vitamins, not elsewhere classified, vitamin A, vitamin D,	65–84 85+	273 69	41.89 10.57	40 18	10,804 1,253
Causing adverse effects, iron and its compounds, ferric salts, ferrous sulphate, and other ferrous salts	65–84 85+	591 178	42.25 12.71	61 30	36,204 5,321
Causing adverse effects, liver preparations and other antianemic agents, folic acid	65–84	131	44.62	34	4,392
Causing adverse effects, anticoagulants, coumarin, heparin, phenindione, prothrombin synthesis inhibitor, warfarin sodium	65–84 85+	94,793 31,807	55.65 18.67	4,264 1,498	404,165,145 47,642,222
Causing adverse effects, fibrinolysis-affecting drugs, aminocaproic acid, streptodornase, streptokinase, urokinase	65–84 85+	557 122	49.39 10.84	65 25	36,211 3,102
Causing adverse effects, anticoagulant antagonists and other coagulants, hexadimethrine bromide, protamine sulfate	65–84 85+	337 79	48.37 11.38	44 19	14,978 1,523
Causing adverse effects, gamma globulin	65–84	257	21.86	42	10,677
Causing adverse effects, natural blood and blood products, blood plasma, human fibrinogen	65–84 85+	1,169 247	33.15 7.02	93 39	108,702 9,713
Causing adverse effects, other agents affecting blood constituents, macromolecular blood substitutes	65–84 85+	6,532 1,442	52.09 11.50	343 103	2,238,266 149,039
Causing adverse effects, methadone	65–84 85+	654 95	26.60 3.86	63 23	40,926 2,157
Causing adverse effects, other opiates and related narcotics	65–84 85+	31,794 8,214	38.12 9.85	1,619 481	51,469,617 3,947,291
Causing adverse effects, salicylates, acetylsalicylic acid (aspirin), amino derivatives of salicylic acid, salicylic acid salts	65–84 85+	8,014 2,560	49.30 15.75	406 164	3,249,970 418,634
Causing adverse effects, aromatic analgesics, not elsewhere classified, acetanilid, paracetamol (acetaminophen), phenacetin (acetophenetidin)	65–84 85+	2,970 959	34.78 11.24	177 80	525,204 76,953
Causing adverse effects, antirheumatics (antiphlogistics), gold salts, indomethacin	65–84 85+	5,638 1,671	36.43 10.80	325 113	1,833,789 188,112
Causing adverse effects, other non-narcotic analgesics, pyrabital	65–84 85+	992 245	38.49 9.49	87 38	85,998 9,182
Causing adverse effects, other specified analgesics and antipyretics, pentazocine	65–84 85+	10,507 2,971	42.20 11.93	588 200	6,177,953 595,413

(Continued)

**Table 3** (Continued)

Principal diagnosis	Year of age	Total number of discharges	% of all discharges with ICD code	Charges, \$ (mean)	Total cost
Causing adverse effects, unspecified analgesic and antipyretic	65–84	13,539	41.33	645	8,728,366
	85+	3,513	10.72	206	725,273
Causing adverse effects, hydantoin derivatives, phenytoin	65–84	8,344	35.40	372	3,108,179
	85+	1,909	8.10	119	227,128
Causing adverse effects, other and unspecified anticonvulsants, beclamide, primidone	65–84	5,435	29.28	260	1,413,490
	85+	1,164	6.27	92	107,227
Causing adverse effects, anti-Parkinsonism drugs, amantadine, ethopropazine (profenamine), Levodopa (L-dopa)	65–84	2,458	65.31	149	365,998
	85+	632	16.80	71	44,735
Causing adverse effects, barbiturates	65–84	202	16.94	30	6,161
	85+	57	4.76	16	933
Causing adverse effects, other sedatives and hypnotics	65–84	6,696	47.87	358	2,399,603
	85+	1,859	13.29	126	234,199
Causing adverse effects, sedatives and hypnotics unspecified, sleeping drug NOS, pill NOS, tablet NOS	65–84	11,534	41.84	600	6,924,117
	85+	2,893	10.49	200	577,368
Causing adverse effects, central nervous system muscle-tone depressants, chlorphenesin (carbamate), mephensin, methocarbamol	65–84	336	39.60	48	16,070
	85+	53	6.24	16	838
Causing adverse effects, other gaseous anesthetics, ether, nitrous oxide, halogenated hydrocarbon derivatives, except halothane	65–84	322	37.25	48	15,465
	85+	72	8.37	18	1,336
Causing adverse effects, intravenous anesthetics, ketamine, methohexital (methohexitone), thiobarbiturates, such as thiopental sodium	65–84	905	39.12	86	78,077
	85+	138	5.96	27	3,735
Causing adverse effects, other and unspecified general anesthetics	65–84	2,947	42.54	202	594,890
	85+	509	7.35	60	30,586
Causing adverse effects, surface and infiltration anesthetics, cocaine, lidocaine (lignocaine), procaine, tetracaine	65–84	319	31.19	43	13,717
	85+	114	11.15	25	2,904
Causing adverse effects, peripheral nerve- and plexus-blocking anesthetics	65–84	341	37.40	46	15,595
	85+	85	3.31	21	1,734
Causing adverse effects, spinal anesthetics	65–84	662	25.95	84	55,451
	85+	85	3.31	21	1,734
Causing adverse effects, antidepressants, amitriptyline, imipramine, monoamine oxidase (MAO) inhibitors	65–84	5,471	38.92	281	1,538,923
	85+	1,985	14.12	132	261,560
Causing adverse effects, phenothiazine-based tranquilizers, chlorpromazine, fluphenazine, phenothiazine, prochlorperazine, promazine	65–84	757	34.31	73	55,158
	85+	133	6.04	27	3,632
Causing adverse effects, butyrophenone-based tranquilizers, haloperidol, spiperone, trifluoperidol	65–84	1,142	35.43	87	99,298
	85+	509	15.81	57	29,253
Causing adverse effects, other antipsychotics, neuroleptics, and major tranquilizers	65–84	4,745	31.01	243	1,154,744
	85+	1,666	10.89	122	203,698
Causing adverse effects, benzodiazepine-based tranquilizers, chlordiazepoxide, diazepam, flurazepam, lorazepam, medazepam, nitrazepam	65–84	7,887	43.37	411	3,239,868
	85+	2,624	14.43	170	445,823
Causing adverse effects, other tranquilizers, hydroxyzine, meprobamate	65–84	275	38.39	40	10,973
	85+	96	13.37	22	2,120
Causing adverse effects, psychostimulants, amphetamine, caffeine	65–84	286	20.50	40	11,507

(Continued)

**Table 3** (Continued)

Principal diagnosis	Year of age	Total number of discharges	% of all discharges with ICD code	Charges, \$ (mean)	Total cost
Causing adverse effects, other psychotropic agents	65–84	2,134	25.49	138	293,880
	85+	261	3.11	39	10,134
Causing adverse effects, unspecified psychotropic agent	65–84	398	34.60	47	18,666
	85+	84	7.32	23	1,918
Causing adverse effects, opiate antagonists, levallorphan, nalorphine, naloxone	65–84	688	38.88	91	62,649
	85+	151	8.55	32	4,836
Causing adverse effects, parasympathomimetics (cholinergics), acetylcholine, pilocarpine, anticholinesterase: organophosphorus, reversible	65–84	1,185	56.06	89	105,341
	85+	671	31.74	66	44,481
Causing adverse effects, parasympatholytics (anticholinergics and antimuscarinics) and spasmolytics, atropine, homatropine, hyoscine (scopolamine), quaternary ammonium derivatives	65–84	903	38.06	79	71,380
	85+	416	17.55	48	19,959
Causing adverse effects, sympathomimetics (adrenergics), epinephrine (adrenalin), levarterenol (noradrenalin)	65–84	2,985	43.47	201	599,321
	85+	799	11.63	74	59,397
Causing adverse effects, sympatholytics (antiadrenergics), phenoxybenzamine, tolazoline hydrochloride	65–84	6,924	57.95	366	2,532,698
	85+	2,307	19.31	161	372,178
Causing adverse effects, unspecified drug primarily affecting the autonomic nervous system	65–84	63	37.75	17	1,070
Causing adverse effects, cardiac rhythm regulators, practolol, procainamide, propranolol, quinidine	65–84	10,267	60.63	524	5,378,051
	85+	2,634	15.55	160	422,553
Causing adverse effects, cardiotonic glycosides and drugs of similar action, digitalis glycosides, digoxin, strophanthins	65–84	19,375	56.72	723	14,004,365
	85+	11,179	32.73	467	5,217,237
Causing adverse effects, antilipemic and antiarteriosclerotic drugs, cholestyramine, clofibrate	65–84	5,398	51.21	284	1,534,558
	85+	899	8.52	83	74,858
Causing adverse effects, coronary vasodilators, dipyridamole, nitrates (nitroglycerin), nitrites, prenylamine	65–84	6,480	44.93	337	2,183,971
	85+	2,136	14.81	140	298,336
Causing adverse effects, other vasodilators, cyclandelate, diazoxide, hydralazine, papaverine	65–84	494	39.18	61	29,933
	85+	111	8.77	23	2,592
Causing adverse effects, other antihypertensive agents, clonidine, guanethidine, rauwolfia alkaloids, reserpine	65–84	20,725	49.78	1,036	21,467,546
	85+	7,486	17.98	406	3,041,078
Causing adverse effects, other and unspecified agents primarily affecting the cardiovascular system	65–84	17,374	50.10	836	14,524,755
	85+	5,989	17.27	348	2,086,797
Causing adverse effects, antacids and antigastric secretion drugs, aluminum hydroxide, magnesium trisilicate	65–84	1,079	39.79	91	98,075
	85+	338	12.46	49	16,579
Causing adverse effects, irritant cathartics, bisacodyl, castor oil, phenolphthalein	65–84	168	47.51	31	5,242
	85+	80	22.62	21	1,678
Causing adverse effects, emollient cathartics, sodium dioctyl sulfosuccinate	65–84	150	42.17	28	4,259
	85+	86	24.20	21	1,788
Causing adverse effects, other cathartics, including intestinal atonia drugs, magnesium sulfate	65–84	1,016	43.38	92	93,400
	85+	403	17.22	46	18,356
Causing adverse effects, antidiarrheal drugs, bismuth subcarbonate, kaolin, pectin	65–84	332	49.75	40	13,180
	85+	100	14.92	23	2,320

(Continued)

**Table 3** (Continued)

Principal diagnosis	Year of age	Total number of discharges	% of all discharges with ICD code	Charges, \$ (mean)	Total cost
Causing adverse effects, other specified agents primarily affecting the gastrointestinal system	65–84	406	39.70	52	21,122
	85+	101	9.84	24	2,366
Causing adverse effects, purine derivative diuretics, theobromine, theophylline	65–84	915	62.67	82	74,956
	85+	116	7.96	24	2,732
Causing adverse effects, carbonic acid anhydrase inhibitors, acetazolamide	65–84	188	37.90	34	6,432
	85+	77	15.58	20	1,571
Causing adverse effects, saluretics, benzothiadiazides, chlorothiazide group	65–84	11,695	52.12	639	7,473,166
	85+	4,086	18.21	258	1,053,977
Causing adverse effects, other diuretics, ethacrynic acid, furosemide	65–84	29,655	50.65	1,582	46,906,127
	85+	12,883	22.00	763	9,836,264
Causing adverse effects, electrolytic, caloric, and water-balance agents	65–84	1,482	39.99	110	162,501
	85+	500	13.49	63	31,367
Causing adverse effects, uric acid metabolism drugs, phenoquin, probenecid	65–84	1,793	53.53	122	218,118
	85+	493	14.70	53	25,978
Causing adverse effects, smooth muscle relaxants, adiphenine, metaproterenol (orciprenaline)	65–84	647	53.92	63	41,025
	85+	274	22.83	39	10,634
Causing adverse effects, skeletal muscle relaxants, alcuronium chloride, uxamethonium chloride	65–84	1,041	38.85	78	81,130
	85+	261	9.74	37	9,721
Causing adverse effects, other and unspecified drugs acting on muscles	65–84	162	46.82	29	4,779
Causing adverse effects, antitussives, dextromethorphan, pipazethate hydrochloride	65–84	167	45.58	30	5,019
Causing adverse effects, expectorants, acetylcysteine, cocillana, terpin hydrate	65–84	149	39.05	26	3,908
Causing adverse effects, antiasthmatics, aminophylline (theophylline ethylenediamine)	65–84	1,478	31.33	110	162,174
	85+	327	6.94	40	13,112
Causing adverse effects, other and unspecified respiratory drugs	65–84	146	62.06	30	4,350
Causing adverse effects, local anti-infectives and anti-inflammatory drugs	65–84	1,237	35.48	110	136,261
	85+	243	6.98	44	10,786
Causing adverse effects, antipruritics	65–84	71	46.11	19	1,347
Causing adverse effects, emollients, demulcents, and protectants	65–84	96	37.12	21	2,053
Causing adverse effects, eye anti-infectives and other eye drugs, idoxuridine	65–84	129	33.84	27	3,481
	85+	108	28.15	22	2,411
Causing adverse effects, anti-infectives and other drugs and preparations for ear, nose, and throat	65–84	346	36.83	75	25,972
Causing adverse effects, other drugs and medicinal substances, contrast media used for diagnostic x-ray procedures, diagnostic agents and kits	65–84	27,976	44.77	1,270	35,520,572
	85+	6,268	10.03	345	2,160,531
Causing adverse effects, unspecified drug or medicinal substance	65–84	18,682	41.54	810	15,133,675
	85+	4,891	10.88	282	1,379,955
Causing adverse effects, BCG vaccine	65–84	96	63.05	24	2,319
Causing adverse effects, other and unspecified bacterial vaccines	65–84	156	39.47	31	4,803
Causing adverse effects, other and unspecified viral and rickettsial vaccines, mumps vaccine	65–84	194	38.33	33	6,300
Causing adverse effects, other and unspecified vaccines and biologic substances	65–84	138	22.62	27	3,729
Total		791,931			937,795,690

**Abbreviations:** NOS, not otherwise specified; BCG, Bacillus Calmette-Guérin.

## Acknowledgments

The authors report no conflicts of interest in this work. Dr Shamliyan thanks Nancy Russel, MLS, for assistance in writing this paper.

## References

- Patel H, Bell D, Molokhia M, et al. Trends in hospital admissions for adverse drug reactions in England: Analysis of national hospital episode statistics 1998–2005. *BMC Clin Pharmacol*. 2007;7:9.
- Young PL, Olsen LA, McGinnis JM. Value in health care: Accounting for cost, quality, safety, outcomes, and innovation. *Roundtable on Evidence-Based Medicine*: Institute of Medicine; 2009. <http://www.nap.edu/catalog/12566.html>. Accessed March 10, 2009.
- Kruzikas DT, Jiang HJ, Remus D, Barrett ML, Coffey RM, Andrews R. Preventable Hospitalizations: A Window Into Primary and Preventive Care, 2000. HCUP Fact Book No. 5; AHRQ Publication No. 04-0056. ISBN 1-58763-154-7;2004. Available from: <http://www.ahrq.gov/data/hcup/factbk5/factbk5.pdf>. Accessed March 10, 2010.
- Levit KTR, Wier LTR, Stranges ETR, Ryan KTR, Elixhauser AA. HCUP facts and figures: Statistics on hospital-based care in the United States. Rockville, MD: Agency for Healthcare Research and Quality; 2007. Available from: <http://www.hcup-us.ahrq.gov/reports.jsp>. Accessed March 10, 2010.
- HCUPnet. Healthcare Cost and Utilization Project. Agency for Healthcare Research and Quality, Rockville, MD. <http://hcupnet.ahrq.gov>. Accessed March 10, 2010.
- ICD-9-CM : The International Classification Of Diseases, Ninth Revision, Clinical Modification. 4th ed. New York, NY: McGraw-Hill; 1994.
- Gurwitz JH, Field TS, Harrold LR, et al. Incidence and preventability of adverse drug events among older persons in the ambulatory setting. *JAMA*. 2003;289(9):1107–1116.
- Houglund P, Xu W, Pickard S, Masheter C, Williams SD. Performance of International Classification Of Diseases, 9th Revision, Clinical Modification codes as an adverse drug event surveillance system. *Med Care*. 2006;44(7):629–636.
- Littell RC. *SAS System for mixed models*. 4th ed. Cary, NC; SAS Institute: 2000.
- SAS Institute. *SAS/AF 9.1 procedure guide*. Cary, NC; SAS Institute: 2004. Available from: <http://0-www.books24x7.com.catalog.kcls.org/marc.asp?isbn=159047225x>. Accessed.
- Leonard CE, Haynes K, Localio AR, et al. Diagnostic E-codes for commonly used, narrow therapeutic index medications poorly predict adverse drug events. *J Clin Epidemiol*. 2008;61(6):561–571.
- Naessens JM, Campbell CR, Huddleston JM, et al. A comparison of hospital adverse events identified by three widely used detection methods. *Int J Qual Health Care*. 2009;21(4):301–307.
- Hanlon JT, Maher RL, Lindblad CI, et al. Comparison of methods for detecting potential adverse drug events in frail elderly inpatients and outpatients. *Am J Health Syst Pharm*. 2001;58(17):1622–1626.
- Ellis SL, Carter BL, Malone DC, et al. Clinical and economic impact of ambulatory care clinical pharmacists in management of dyslipidemia in older adults: The IMPROVE study. Impact of managed pharmaceutical care on resource utilization and outcomes in Veterans Affairs Medical Centers. *Pharmacotherapy*. 2000;20(12):1508–1516.
- Lim WS, Low HN, Chan SP, Chen HN, Ding YY, Tan TL. Impact of a pharmacist consult clinic on a hospital-based geriatric outpatient clinic in Singapore. *Ann Acad Med Singapore*. 2004;33(2):220–227.

## Appendix

**Table 1** The *International Classification of Diseases, 9 Revision, Clinical Modification (ICD-9-CM)* codes related to adverse drug effects, principal diagnosis

ICD code	Principal diagnosis
535.40 Oth Spf Gstrt W/O Hmrhg	specified gastritis; without mention of hemorrhage
535.41 Oth Spf Gastrt W Hmrhg	specified gastritis; with hemorrhage
962.3 Poison-Insulin/Antidiab	Poisoning by; insulins and antidiabetic agents, Acetohexamide, Biguanide derivatives, oral, Chlorpropamide, Glucagon, Insulin, Phenformin
962.7 Poisoning-Thyroid/Deriv	Poisoning by; thyroid and thyroid derivatives, Dextrothyroxin, Levothyroxine sodium, Liothyronine, Thyroglobulin
963.0 Pois-Antiallrg/Antiemet	Poisoning by; antiallergic and antiemetic drugs, Antihistamines, Chlorpheniramine, Diphenhydramine, Diphenylpyraline, Thonzylamine, Tripeleminamine
963.1 Pois-Antineopl/Immunosup	Poisoning by; antineoplastic and immunosuppressive drugs, Azathioprine, Busulfan, Chlorambucil, Cyclophosphamide, Cytarabine, Fluorouracil
964.2 Poisoning-Anticoagulants	Poisoning by; anticoagulants, Coumarin, Heparin, Phenindione, Warfarin sodium
965.00 Poisoning-Opium Nos	Poisoning by; opium (alkaloids), unspecified
965.02 Poisoning-Methadone	Poisoning by; methadone
965.09 Poisoning-Opiates Nec	Poisoning by opiates and related narcotics; other, Meperidine [pethidine], Morphine
965.1 Poisoning-Salicylates	Poisoning by; salicylates, Acetylsalicylic acid [aspirin], Salicylic acid salts
965.4 Pois-Arom Analgesics Nec	Poisoning by; aromatic analgesics, not elsewhere classified, Acetanilid, Paracetamol [acetaminophen], Phenacetin [acetophenetidin]
965.61 Pois-Propionic Acid Derv	Poisoning by; propionic acid derivatives, Fenoprofen, Flurbiprofen, Ibuprofen, Ketoprofen, Naproxen, Oxaprozin
965.8 Pois-Analges/Antipyr Nec	Poisoning by; other specified analgesics and antipyretics; Pentazocine
965.9 Pois-Analges/Antipyr Nos	Poisoning by; unspecified analgesic and antipyretic
966.1 Poison-Hydantoin Derivat	Poisoning by; hydantoin derivatives, Phenytoin
966.3 Pois-Anticonvul Nec/Nos	Poisoning by; other and unspecified anticonvulsants
966.4 Pois-Anti-Parkinson Drug	Poisoning by; anti-Parkinsonism drugs, Amantadine, Ethopropazine [profenamine], Levodopa [L-dopa]
967.0 Poisoning-Barbiturates	Poisoning by; barbiturates, Amobarbital [amylobarbitone], Barbital [barbitone], Butobarbital [butabarbitone], Pentobarbital [pentobarbitone], Phenobarbital [phenobarbitone]
967.8 Pois-Sedative/Hypnot Nec	Poisoning by; other sedatives and hypnotics
967.9 Pois-Sedative/Hypnot Nos	Poisoning by; unspecified sedative or hypnotic, Sleeping: drug NOS, pill NOS, tablet NOS
968.0 Pois-Cns Muscle Depress	Poisoning by; central nervous system muscle-tone depressants, Chlorphenesin (carbamate), Mephesisin, Methocarbamol
968.5 Pois-Topic/Infilt Anesth	Poisoning by; surface [topical] and infiltration anesthetics, Cocaine, Lidocaine [lignocaine], Procaine, Tetracaine
969.0 Poisoning-Antidepressant	Poisoning by; antidepressants, Amitriptyline, Imipramine, Monoamine oxidase [MAO] inhibitors
969.1 Pois-Phenothiazine Tranq	Poisoning by; phenothiazine-based tranquilizers, Chlorpromazine, Fluphenazine, Prochlorperazine, Promazine
969.3 Poison-Antipsychotic Nec	Poisoning by; other antipsychotics, neuroleptics, and major tranquilizers
969.4 Pois-Benzodiazepine Tran	Poisoning by; benzodiazepine-based tranquilizers, Chlordiazepoxide, Diazepam, Flurazepam, Lorazepam, Medazepam, Nitrazepam
969.5 Poison-Tranquilizer Nec	Poisoning by; other tranquilizers, Hydroxyzine, Meprobamate
969.8 Poison-Psychotropic Nec	Poisoning by; other specified psychotropic agents
970.8 Pois-Cns Stimulants Nec	Poisoning by; other specified central nervous system stimulants
971.3 Poisoning-Sympatholytics	Poisoning by; sympatholytics [antiadrenergics], Phenoxybenzamine, Tolazoline hydrochloride
972.0 Pois-Card Rhythm Regulat	Poisoning by; cardiac rhythm regulators, Practolol, Procainamide, Propranolol, Quinidine
972.1 Poisoning-Cardiotonics	Poisoning by; cardiotonic glycosides and drugs of similar action, Digitalis glycosides, Digoxin, Strophanthins

(Continued)

**Table 1** (Continued)

ICD code	Principal diagnosis
972.4 Pois-Coronary Vasodilat	Poisoning by; coronary vasodilators, Dipyridamole, Nitrates [nitroglycerin], Nitrites
972.6 Pois-Antihyperten Agent	Poisoning by; other antihypertensive agents, Guanethidine, Rauwolfia alkaloids, Reserpine
972.9 Pois-Cardiovasc Agt Nec	Poisoning by; other and unspecified agents primarily affecting the cardiovascular system
974.3 Poisoning-Saluretics	Poisoning by; saluretics, Benzothiadiazides, Chlorothiazide group
974.4 Poisoning-Diuretics Nec	Poisoning by; other diuretics, Ethacrynic acid, Furosemide
975.2 Pois-Skelet Muscle Relax	Poisoning by; skeletal muscle relaxants
977.8 Poison-Medicinal Agt Nec	Poisoning by; other specified drugs and medicinal substances, Diagnostic agents and kits

**Table 2** The *International Classification of Diseases, 9 Revision, Clinical Modification (ICD-9-CM)* codes related to adverse treatment effects, all listed diagnoses

ICD code	Diagnoses
E850.1 Acc Poison-Methadone	Accidental poisoning by; methadone
E850.2 Acc Poison-Opiates Nec	Accidental poisoning by; other opiates and related narcotics, Morphine, Opium (alkaloids)
E850.2 Acc Poison-Opiates Nec	Accidental poisoning by; other opiates and related narcotics, Morphine, Opium (alkaloids)
E850.3 Acc Poison-Salicylates	Accidental poisoning by; salicylates, Acetylsalicylic acid [aspirin], Salicylic acid salts, Amino derivatives of salicylic acid
E850.3 Acc Poison-Salicylates	Accidental poisoning by; salicylates, Acetylsalicylic acid [aspirin], Salicylic acid salts, Amino derivatives of salicylic acid
E850.4 Acc Poison-Arom Analgesc	Accidental poisoning by; aromatic analgesics, not elsewhere classified, Acetanilid, Paracetamol [acetaminophen], Phenacetin [acetophenetidin]
E850.4 Acc Poison-Arom Analgesc	Accidental poisoning by; aromatic analgesics, not elsewhere classified, Acetanilid, Paracetamol [acetaminophen], Phenacetin [acetophenetidin]
E850.6 Acc Poison-Antirheumatic	Accidental poisoning by; antirheumatics [antiphlogistics], Gold salts, Indomethacin
E850.8 Acc Poison-Analgesic Nec	Accidental poisoning by; other specified analgesics and antipyretics, Pentazocine
E850.8 Acc Poison-Analgesic Nec	Accidental poisoning by; other specified analgesics and antipyretics, Pentazocine
E850.9 Acc Poison-Analgesic Nos	Accidental poisoning by; unspecified analgesic or antipyretic
E851 Acc Poison-Barbiturates	Accidental poisoning by barbiturates
E852.8 Acc Poison-Sedatives Nec	Accidental poisoning by; other specified sedatives and hypnotics
E852.8 Acc Poison-Sedatives Nec	Accidental poisoning by; other specified sedatives and hypnotics
E852.9 Acc Poison-Sedatives Nos	Accidental poisoning by; unspecified sedative or hypnotic, Sleeping: drug NOS, pill NOS, tablet NOS
E852.9 Acc Poison-Sedatives Nos	Accidental poisoning by; unspecified sedative or hypnotic, Sleeping: drug NOS, pill NOS, tablet NOS
E853.2 Acc Poisn-Benz Diaz Tranq	Accidental poisoning by; benzodiazepine-based tranquilizers, Chlordiazepoxide, Diazepam, Flurazepam, Lorazepam, Medazepam, Nitrazepam
E853.2 Acc Poisn-Benz Diaz Tranq	Accidental poisoning by; benzodiazepine-based tranquilizers, Chlordiazepoxide, Diazepam, Flurazepam, Lorazepam, Medazepam, Nitrazepam
E853.8 Acc Poisn-Tranquilizr Nec	Accidental poisoning by; other specified tranquilizers, Hydroxyzine, Meprobamate
E853.8 Acc Poisn-Tranquilizr Nec	Accidental poisoning by; other specified tranquilizers, Hydroxyzine, Meprobamate
E854.0 Acc Poison-Antidepressnt	Accidental poisoning by; antidepressants, Amitriptyline, Imipramine, Monoamine oxidase [MAO] inhibitors
E854.0 Acc Poison-Antidepressnt	Accidental poisoning by; antidepressants, Amitriptyline, Imipramine, Monoamine oxidase [MAO] inhibitors
E854.2 Acc Poisn-Psychstimulant	Accidental poisoning by; psychostimulants, Amphetamine, Caffeine
E854.3 Acc Poison-Cns Stimulant	Accidental poisoning by; central nervous system stimulants, Analeptics, Opiate antagonists
E854.8 Acc Poisn Psychotrop Nec	Accidental poisoning by; other psychotropic agents
E855.0 Acc Poisn-Anticonvulsant	Accidental poisoning by; anticonvulsant and anti-Parkinsonism drugs, Amantadine, Hydantoin derivatives, Oxazolidine derivatives [paramethadione] [trimethadione]
E855.0 Acc Poisn-Anticonvulsant	Accidental poisoning by; anticonvulsant and anti-Parkinsonism drugs, Amantadine, Hydantoin derivatives, Oxazolidine derivatives [paramethadione] [trimethadione]
E855.1 Acc Poisn-Cns Depres Nec	Accidental poisoning by; other central nervous system depressants, Ether, Gaseous anesthetics, Halogenated hydrocarbon derivatives, Intravenous anesthetics, Thiobarbiturates

(Continued)

**Table 2** (Continued)

ICD code	Diagnoses
E855.3 Acc Poison-Cholinergics	Accidental poisoning by; parasympathomimetics [cholinergics], Acetylcholine, Pilocarpine, Anticholinesterase: organophosphorus, reversible
E855.6 Acc Poiso-Sympatholytics	Accidental poisoning by; sympatholytics [antiadrenergics], Phenoxybenzamine, Tolazoline hydrochloride
E855.6 Acc Poiso-Sympatholytics	Accidental poisoning by; sympatholytics [antiadrenergics], Phenoxybenzamine, Tolazoline hydrochloride
E856 Acc Poison-Antibiotics	Accidental poisoning by antibiotics
E857 Acc Poiso-Oth Anti-Infect	Accidental poisoning by other anti-infectives
E858.0 Acc Poison-Hormones	Accidental poisoning by; hormones and synthetic substitutes
E858.0 Acc Poison-Hormones	Accidental poisoning by; hormones and synthetic substitutes
E858.1 Acc Poiso-Systemic Agent	Accidental poisoning by; primarily systemic agents
E858.2 Acc Poison-Blood Agent	Accidental poisoning by; agents primarily affecting blood constituents
E858.2 Acc Poison-Blood Agent	Accidental poisoning by; agents primarily affecting blood constituents
E858.3 Acc Poiso-Cardiovasc Agt	Accidental poisoning by; agents primarily affecting cardiovascular system
E858.3 Acc Poiso-Cardiovasc Agt	Accidental poisoning by; agents primarily affecting cardiovascular system
E858.4 Acc Poison-Gi Agent	Accidental poisoning by; agents primarily affecting gastrointestinal system
E858.4 Acc Poison-Gi Agent	Accidental poisoning by; agents primarily affecting gastrointestinal system
E858.5 Acc Poiso-Metabol Agnt	Accidental poisoning by; water, mineral, and uric acid metabolism drugs
E858.5 Acc Poiso-Metabol Agnt	Accidental poisoning by; water, mineral, and uric acid metabolism drugs
E858.6 Acc Poiso-Muscl/Resp Agt	Accidental poisoning by; agents primarily acting on the smooth and skeletal muscles and respiratory system
E858.7 Acc Poiso-Skin/Eent Agnt	Accidental poisoning by; agents primarily affecting skin and mucous membrane, ophthalmological, otorhinolaryngological, and dental drugs
E858.8 Acc Poisoning-Drug Nec	Accidental poisoning by; other specified drugs, Central appetite depressants
E858.8 Acc Poisoning-Drug Nec	Accidental poisoning by; other specified drugs, Central appetite depressants
E858.9 Acc Poisoning-Drug Nos	Accidental poisoning by; unspecified drug
E858.9 Acc Poisoning-Drug Nos	Accidental poisoning by; unspecified drug
E870.0 Acc Cut/Hem In Surgery	Accidental cut, puncture, perforation, or hemorrhage during; surgical operation
E870.0 Acc Cut/Hem In Surgery	Accidental cut, puncture, perforation, or hemorrhage during; surgical operation
E870.4 Acc Cut/Hem W Scope Exam	Accidental cut, puncture, perforation, or hemorrhage during; endoscopic examination
E870.4 Acc Cut/Hem W Scope Exam	Accidental cut, puncture, perforation, or hemorrhage during; endoscopic examination
E870.5 Acc Cut/Hem W Catheteriz	Accidental cut, puncture, perforation, or hemorrhage during; aspiration of fluid or tissue, puncture, and catheterization, Abdominal paracentesis, Aspirating needle biopsy, Blood sampli
E870.6 Acc Cut/Hem W Heart Cath	Accidental cut, puncture, perforation, or hemorrhage during; heart catheterization
E870.6 Acc Cut/Hem W Heart Cath	Accidental cut, puncture, perforation, or hemorrhage during; heart catheterization
E870.8 Acc Cut In Med Care Nec	Accidental cut, puncture, perforation, or hemorrhage during; other specified medical care
E870.8 Acc Cut In Med Care Nec	Accidental cut, puncture, perforation, or hemorrhage during; other specified medical care
E870.9 Acc Cut In Med Care Nos	Accidental cut, puncture, perforation, or hemorrhage during; unspecified medical care
E871.0 Post-Surgical Forgn Body	Foreign object left in body during; surgical operation
E871.8 Post-Op Foreign Body Nec	Foreign object left in body during; other specified procedures
E874.0 Instrmnt Fail In Surgery	Mechanical failure of instrument or apparatus during; surgical operation
E874.8 Instrmnt Fail-Proced Nec	Mechanical failure of instrument or apparatus during; other specified procedures
E876.8 Medical Misadventure Nec	Other specified misadventures during medical care, Performance of inappropriate treatment NEC
E876.8 Medical Misadventure Nec	Other specified misadventures during medical care, Performance of inappropriate treatment NEC
E876.9 Medical Misadventure Nos	Unspecified misadventure during medical care
E876.9 Medical Misadventure Nos	Unspecified misadventure during medical care
E930.0 Adv Eff Penicillins	Causing adverse effects; penicillins, Natural, Synthetic, Semisynthetic, such as: ampicillin, cloxacillin, nafcillin, oxacillin
E930.0 Adv Eff Penicillins	Causing adverse effects; penicillins, Natural, Synthetic, Semisynthetic, such as: ampicillin, cloxacillin, nafcillin, oxacillin

(Continued)

**Table 2** (Continued)

ICD code	Diagnoses
E930.1 Adv Eff Antifung Antibiot	Causing adverse effects; antifungal antibiotics
E930.1 Adv Eff Antifung Antibiot	Causing adverse effects; antifungal antibiotics
E930.3 Adv Eff Erythromycin	Causing adverse effects; erythromycin and other macrolides, Oleandomycin, Spiramycin
E930.3 Adv Eff Erythromycin	Causing adverse effects; erythromycin and other macrolides, Oleandomycin, Spiramycin
E930.4 Adv Eff Tetracycline	Causing adverse effects; tetracycline group, Doxycycline, Minocycline, Oxytetracycline
E930.4 Adv Eff Tetracycline	Causing adverse effects; tetracycline group, Doxycycline, Minocycline, Oxytetracycline
E930.5 Adv Eff Cephalosporin	Causing adverse effects; cephalosporin group, Cephalexin, Cephaloglycin, Cephaloridine, Cephalothin
E930.5 Adv Eff Cephalosporin	Causing adverse effects; cephalosporin group, Cephalexin, Cephaloglycin, Cephaloridine, Cephalothin
E930.6 Adv Eff Antmycob Antibiot	Causing adverse effects; antimycobacterial antibiotics, Cycloserine, Kanamycin, Rifampin, Streptomycin
E930.6 Adv Eff Antmycob Antibiot	Causing adverse effects; antimycobacterial antibiotics, Cycloserine, Kanamycin, Rifampin, Streptomycin
E930.7 Adv Eff Antineop Antibiot	Causing adverse effects; antineoplastic antibiotics, Actinomycins, such as: Bleomycin, Cactinomycin, Dactinomycin, Daunorubicin, Mitomycin
E930.8 Adv Eff Antibiotics Nec	Causing adverse effects; other specified antibiotics
E930.8 Adv Eff Antibiotics Nec	Causing adverse effects; other specified antibiotics
E930.9 Adv Eff Antibiotic Nos	Causing adverse effects; unspecified antibiotic
E930.9 Adv Eff Antibiotic Nos	Causing adverse effects; unspecified antibiotic
E931.0 Adv Eff Sulfonamides	Causing adverse effects; sulfonamides, Sulfadiazine, Sulfafurazole, Sulfamethoxazole
E931.0 Adv Eff Sulfonamides	Causing adverse effects; sulfonamides, Sulfadiazine, Sulfafurazole, Sulfamethoxazole
E931.3 Adv Eff Quinoline	Causing adverse effects; quinoline and hydroxyquinoline derivatives, Chiniofon, Diiodohydroxyquin
E931.3 Adv Eff Quinoline	Causing adverse effects; quinoline and hydroxyquinoline derivatives, Chiniofon, Diiodohydroxyquin
E931.4 Adv Eff Antimalarials	Causing adverse effects; antimalarials and drugs acting on other blood protozoa, Chloroquine phosphate, Cycloguanil, Primaquine, Proguanil [chloroguanide], Pyrimethamine
E931.4 Adv Eff Antimalarials	Causing adverse effects; antimalarials and drugs acting on other blood protozoa, Chloroquine phosphate, Cycloguanil, Primaquine, Proguanil [chloroguanide], Pyrimethamine
E931.5 Adv Eff Antiprotozoal Nec	Causing adverse effects; other antiprotozoal drugs, Emetine
E931.5 Adv Eff Antiprotozoal Nec	Causing adverse effects; other antiprotozoal drugs, Emetine
E931.7 Adv Eff Antiviral Drugs	Causing adverse effects; antiviral drugs, Methisazone
E931.7 Adv Eff Antiviral Drugs	Causing adverse effects; antiviral drugs, Methisazone
E931.8 Adv Eff Antimycobac Nec	Causing adverse effects; other antimycobacterial drugs, Ethambutol, Ethionamide, Isoniazid, Sulfones, Para-aminosalicylic acid derivatives
E931.9 Adv Eff Antinfct Nec/Nos	Causing adverse effects; other and unspecified anti-infectives, Flucytosine, Nitrofurantoin derivatives
E931.9 Adv Eff Antinfct Nec/Nos	Causing adverse effects; other and unspecified anti-infectives, Flucytosine, Nitrofurantoin derivatives
E932.0 Adv Eff Corticosteroids	Causing adverse effects; adrenal cortical steroids, Cortisone derivatives, Desoxycorticosterone derivatives, Fluorinated corticosteroids
E932.0 Adv Eff Corticosteroids	Causing adverse effects; adrenal cortical steroids, Cortisone derivatives, Desoxycorticosterone derivatives, Fluorinated corticosteroids
E932.1 Adv Eff Androgens	Causing adverse effects; androgens and anabolic congeners, Nandrolone phenpropionate, Oxymetholone, Testosterone and preparations
E932.2 Adv Eff Ovarian Hormones	Causing adverse effects; ovarian hormones and synthetic substitutes, Contraceptives, oral, Estrogens, Estrogens and progestogens combined, Progestogens
E932.2 Adv Eff Ovarian Hormones	Causing adverse effects; ovarian hormones and synthetic substitutes, Contraceptives, oral, Estrogens, Estrogens and progestogens combined, Progestogens
E932.3 Adv Eff Insulin/Antidiab	Causing adverse effects; insulins and antidiabetic agents, Acetohexamide, Biguanide derivatives, oral, Chlorpropamide, Glucagon, Insulin, Phenformin
E932.3 Adv Eff Insulin/Antidiab	Causing adverse effects; insulins and antidiabetic agents, Acetohexamide, Biguanide derivatives, oral, Chlorpropamide, Glucagon, Insulin, Phenformin
E932.4 Adv Eff Ant Pituitary	Causing adverse effects; anterior pituitary hormones, Corticotropin, Gonadotropin, Somatotropin [growth hormone]
E932.5 Adv Eff Post Pituitary	Causing adverse effects; posterior pituitary hormones, Vasopressin

(Continued)

**Table 2** (Continued)

ICD code	Diagnoses
E932.5 Adv Eff Post Pituitary	Causing adverse effects; posterior pituitary hormones, Vasopressin
E932.6 Adv Eff Parathyroid	Causing adverse effects; parathyroid and parathyroid derivatives
E932.7 Adv Eff Thyroid Deriv	Causing adverse effects; thyroid and thyroid derivatives, Dextrothyroxine, Levothyroxine sodium, Liothyronine, Thyroglobulin
E932.7 Adv Eff Thyroid Deriv	Causing adverse effects; thyroid and thyroid derivatives, Dextrothyroxine, Levothyroxine sodium, Liothyronine, Thyroglobulin
E932.8 Adv Eff Antithyroid Agnt	Causing adverse effects; antithyroid agents, Iodides, Thiouracil, Thiourea
E932.9 Adv Eff Hormones Nec/Nos	Causing adverse effects; other and unspecified hormones and synthetic substitutes
E933.0 Adv Eff Anallrg/Antemet	Causing adverse effects; antiallergic and antiemetic drugs, Antihistamines, Chlorpheniramine, Diphenhydramine, Diphenylpyraline, Thonzylamine, Tripeleennami
E933.0 Adv Eff Anallrg/Antemet	Causing adverse effects; antiallergic and antiemetic drugs, Antihistamines, Chlorpheniramine, Diphenhydramine, Diphenylpyraline, Thonzylamine, Tripeleennami
E933.1 Adv Eff Antineoplastic	Causing adverse effects; antineoplastic and immunosuppressive drugs, Azathioprine, Busulfan, Chlorambucil, Cyclophosphamide, Cytarabine, Fluorouracil, Mercaptopurine
E933.1 Adv Eff Antineoplastic	Causing adverse effects; antineoplastic and immunosuppressive drugs, Azathioprine, Busulfan, Chlorambucil, Cyclophosphamide, Cytarabine, Fluorouracil, Mercaptopurine
E933.5 Adv Eff Vitamins Nec	Causing adverse effects; vitamins, not elsewhere classified, Vitamin A, Vitamin D
E933.5 Adv Eff Vitamins Nec	Causing adverse effects; vitamins, not elsewhere classified, Vitamin A, Vitamin D
E934.0 Adv Eff Iron Compounds	Causing adverse effects; iron and its compounds, Ferric salts, Ferrous sulphate and other ferrous salts
E934.0 Adv Eff Iron Compounds	Causing adverse effects; iron and its compounds, Ferric salts, Ferrous sulphate and other ferrous salts
E934.1 Adv Eff Liver/Antianemic	Causing adverse effects; liver preparations and other antianemic agents, Folic acid
E934.2 Adv Eff Anticoagulants	Causing adverse effects; anticoagulants, Coumarin, Heparin, Phenindione, Prothrombin synthesis inhibitor, Warfarin sodium
E934.2 Adv Eff Anticoagulants	Causing adverse effects; anticoagulants, Coumarin, Heparin, Phenindione, Prothrombin synthesis inhibitor, Warfarin sodium
E934.4 Adv Eff Fibrinolysis Agt	Causing adverse effects; fibrinolysis-affecting drugs, Aminocaproic acid, Streptodornase, Streptokinase, Urokinase
E934.4 Adv Eff Fibrinolysis Agt	Causing adverse effects; fibrinolysis-affecting drugs, Aminocaproic acid, Streptodornase, Streptokinase, Urokinase
E934.5 Adv Eff Coagulants	Causing adverse effects; anticoagulant antagonists and other coagulants, Hexadimethrine bromide, Protamine sulfate
E934.5 Adv Eff Coagulants	Causing adverse effects; anticoagulant antagonists and other coagulants, Hexadimethrine bromide, Protamine sulfate
E934.6 Adv Eff Gamma Globulin	Causing adverse effects; gamma globulin
E934.7 Adv Eff Blood Products	Causing adverse effects; natural blood and blood products, Blood plasma, Human fibrinogen
E934.7 Adv Eff Blood Products	Causing adverse effects; natural blood and blood products, Blood plasma, Human fibrinogen
E934.8 Adv Eff Blood Agent Nec	Causing adverse effects; other agents affecting blood constituents, Macromolecular blood substitutes
E934.8 Adv Eff Blood Agent Nec	Causing adverse effects; other agents affecting blood constituents, Macromolecular blood substitutes
E935.1 Adv Eff Methadone	Causing adverse effects; methadone
E935.1 Adv Eff Methadone	Causing adverse effects; methadone
E935.2 Adv Eff Opiates	Causing adverse effects; other opiates and related narcotics
E935.2 Adv Eff Opiates	Causing adverse effects; other opiates and related narcotics
E935.3 Adv Eff Salicylates	Causing adverse effects; salicylates, Acetylsalicylic acid [aspirin], Amino derivatives of salicylic acid, Salicylic acid salts
E935.3 Adv Eff Salicylates	Causing adverse effects; salicylates, Acetylsalicylic acid [aspirin], Amino derivatives of salicylic acid, Salicylic acid salts
E935.4 Adv Eff Arom Analgsc Nec	Causing adverse effects; aromatic analgesics, not elsewhere classified, Acetanilid, Paracetamol [acetaminophen], Phenacetin [acetophenetidin]
E935.4 Adv Eff Arom Analgsc Nec	Causing adverse effects; aromatic analgesics, not elsewhere classified, Acetanilid, Paracetamol [acetaminophen], Phenacetin [acetophenetidin]

(Continued)

**Table 2** (Continued)

ICD code	Diagnoses
E935.6 Adv Eff Antirheumatics	Causing adverse effects; antirheumatics [antiphlogistics], Gold salts, Indomethacin
E935.6 Adv Eff Antirheumatics	Causing adverse effects; antirheumatics [antiphlogistics], Gold salts, Indomethacin
E935.7 Adv Eff Non-Narc Analgsc	Causing adverse effects; other non-narcotic analgesics, Pyrabital
E935.7 Adv Eff Non-Narc Analgsc	Causing adverse effects; other non-narcotic analgesics, Pyrabital
E935.8 Adv Eff Analgesics Nec	Causing adverse effects; other specified analgesics and antipyretics, Pentazocine
E935.8 Adv Eff Analgesics Nec	Causing adverse effects; other specified analgesics and antipyretics, Pentazocine
E935.9 Adv Eff Analgesic Nos	Causing adverse effects; unspecified analgesic and antipyretic
E935.9 Adv Eff Analgesic Nos	Causing adverse effects; unspecified analgesic and antipyretic
E936.1 Adv Eff Hydantoin Deriv	Causing adverse effects; hydantoin derivatives, Phenytoin
E936.1 Adv Eff Hydantoin Deriv	Causing adverse effects; hydantoin derivatives, Phenytoin
E936.3 Adv Eff Antconvl Nec/Nos	Causing adverse effects; other and unspecified anticonvulsants, Beclamide, Primidone
E936.3 Adv Eff Antconvl Nec/Nos	Causing adverse effects; other and unspecified anticonvulsants, Beclamide, Primidone
E936.4 Adv Eff Anti-Parkinson	Causing adverse effects; anti-Parkinsonism drugs, Amantadine, Ethopropazine [profenamine], Levodopa [L-dopa]
E936.4 Adv Eff Anti-Parkinson	Causing adverse effects; anti-Parkinsonism drugs, Amantadine, Ethopropazine [profenamine], Levodopa [L-dopa]
E937.0 Adv Eff Barbiturates	Causing adverse effects; barbiturates
E937.0 Adv Eff Barbiturates	Causing adverse effects; barbiturates
E937.8 Adv Eff Sedat/Hypnot Nec	Causing adverse effects; other sedatives and hypnotics
E937.8 Adv Eff Sedat/Hypnot Nec	Causing adverse effects; other sedatives and hypnotics
E937.9 Adv Eff Sedat/Hypnot Nos	Causing adverse effects; sedatives and hypnotics; unspecified, Sleeping: drug NOS, pill NOS, tablet NOS
E937.9 Adv Eff Sedat/Hypnot Nos	Causing adverse effects; sedatives and hypnotics; unspecified, Sleeping: drug NOS, pill NOS, tablet NOS
E938.0 Adv Eff Cns Muscl Depres	Causing adverse effects; central nervous system muscle-tone depressants, Chlorphenesin (carbamate), Mephesisin, Methocarbamol
E938.0 Adv Eff Cns Muscl Depres	Causing adverse effects; central nervous system muscle-tone depressants, Chlorphenesin (carbamate), Mephesisin, Methocarbamol
E938.2 Adv Eff Gas Anesthet Nec	Causing adverse effects; other gaseous anesthetics, Ether, Nitrous oxide, Halogenated hydrocarbon derivatives, except halothane
E938.2 Adv Eff Gas Anesthet Nec	Causing adverse effects; other gaseous anesthetics, Ether, Nitrous oxide, Halogenated hydrocarbon derivatives, except halothane
E938.3 Adv Eff Intraven Anesth	Causing adverse effects; intravenous anesthetics, Ketamine, Methohexital [methohexitone], Thiobarbiturates, such as thiopental sodium
E938.3 Adv Eff Intraven Anesth	Causing adverse effects; intravenous anesthetics, Ketamine, Methohexital [methohexitone], Thiobarbiturates, such as thiopental sodium
E938.4 Adv Eff Gen Anes Nec/Nos	Causing adverse effects; other and unspecified general anesthetics
E938.4 Adv Eff Gen Anes Nec/Nos	Causing adverse effects; other and unspecified general anesthetics
E938.5 Adv Eff Topic/Infil Anes	Causing adverse effects; surface and infiltration anesthetics, Cocaine, Lidocaine [lignocaine], Procaine, Tetracaine
E938.5 Adv Eff Topic/Infil Anes	Causing adverse effects; surface and infiltration anesthetics, Cocaine, Lidocaine [lignocaine], Procaine, Tetracaine
E938.6 Adv Eff Nerve-Block Anes	Causing adverse effects; peripheral nerve- and plexus-blocking anesthetics
E938.7 Adv Eff Spinal Anesthet	Causing adverse effects; spinal anesthetics
E938.7 Adv Eff Spinal Anesthet	Causing adverse effects; spinal anesthetics
E939.0 Adv Eff Antidepressants	Causing adverse effects; antidepressants, Amitriptyline, Imipramine, Monoamine oxidase [MAO] inhibitors
E939.0 Adv Eff Antidepressants	Causing adverse effects; antidepressants, Amitriptyline, Imipramine, Monoamine oxidase [MAO] inhibitors
E939.1 Adv Eff Phenothiaz Tranq	Causing adverse effects; phenothiazine-based tranquilizers, Chlorpromazine, Fluphenazine, Phenothiazine, Prochlorperazine, Promazine
E939.1 Adv Eff Phenothiaz Tranq	Causing adverse effects; phenothiazine-based tranquilizers, Chlorpromazine, Fluphenazine, Phenothiazine, Prochlorperazine, Promazine

(Continued)

**Table 2** (Continued)

ICD code	Diagnoses
E939.2 Adv Eff Butyrophen Tranq	Causing adverse effects; butyrophenone-based tranquilizers, Haloperidol, Spiperone, Trifluoperidol
E939.2 Adv Eff Butyrophen Tranq	Causing adverse effects; butyrophenone-based tranquilizers, Haloperidol, Spiperone, Trifluoperidol
E939.3 Adv Eff Antipsychotc Nec	Causing adverse effects; other antipsychotics, neuroleptics, and major tranquilizers
E939.3 Adv Eff Antipsychotc Nec	Causing adverse effects; other antipsychotics, neuroleptics, and major tranquilizers
E939.4 Adv Eff Benzodiaz Tranq	Causing adverse effects; benzodiazepine-based tranquilizers, Chlordiazepoxide, Diazepam, Flurazepam, Lorazepam, Medazepam, Nitrazepam
E939.4 Adv Eff Benzodiaz Tranq	Causing adverse effects; benzodiazepine-based tranquilizers, Chlordiazepoxide, Diazepam, Flurazepam, Lorazepam, Medazepam, Nitrazepam
E939.5 Adv Eff Tranquilizer Nec	Causing adverse effects; other tranquilizers, Hydroxyzine, Meprobamate
E939.5 Adv Eff Tranquilizer Nec	Causing adverse effects; other tranquilizers, Hydroxyzine, Meprobamate
E939.7 Adv Eff Psychostimulants	Causing adverse effects; psychostimulants, Amphetamine, Caffeine
E939.8 Adv Eff Psychotropic Nec	Causing adverse effects; other psychotropic agents
E939.8 Adv Eff Psychotropic Nec	Causing adverse effects; other psychotropic agents
E939.9 Adv Eff Psychotropic Nos	Causing adverse effects; unspecified psychotropic agent
E939.9 Adv Eff Psychotropic Nos	Causing adverse effects; unspecified psychotropic agent
E940.1 Adv Eff Opiat Antagonist	Causing adverse effects; opiate antagonists, Levallorphan, Nalorphine, Naloxone
E940.1 Adv Eff Opiat Antagonist	Causing adverse effects; opiate antagonists, Levallorphan, Nalorphine, Naloxone
E941.0 Adv Eff Cholinergics	Causing adverse effects; parasympathomimetics [cholinergics], Acetylcholine, Pilocarpine, Anticholinesterase: organophosphorus, reversible
E941.0 Adv Eff Cholinergics	Causing adverse effects; parasympathomimetics [cholinergics], Acetylcholine, Pilocarpine, Anticholinesterase: organophosphorus, reversible
E941.1 Adv Eff Parasympatholytc	Causing adverse effects; parasympatholytics [anticholinergics and antimuscarinics] and spasmolytics, Atropine, Homatropine, Hyoscine [scopolamine], Quaternary ammonium derivatives
E941.1 Adv Eff Parasympatholytc	Causing adverse effects; parasympatholytics [anticholinergics and antimuscarinics] and spasmolytics, Atropine, Homatropine, Hyoscine [scopolamine], Quaternary ammonium derivatives
E941.2 Adv Eff Sympathomimetics	Causing adverse effects; sympathomimetics [adrenergics], Epinephrine [adrenalin], Levarterenol [noradrenalin]
E941.2 Adv Eff Sympathomimetics	Causing adverse effects; sympathomimetics [adrenergics], Epinephrine [adrenalin], Levarterenol [noradrenalin]
E941.3 Adv Eff Sympatholytics	Causing adverse effects; sympatholytics [antiadrenergics], Phenoxybenzamine, Tolazoline hydrochloride
E941.3 Adv Eff Sympatholytics	Causing adverse effects; sympatholytics [antiadrenergics], Phenoxybenzamine, Tolazoline hydrochloride
E941.9 Adv Eff Autonom Agnt Nos	Causing adverse effects; unspecified drug primarily affecting the autonomic nervous system
E942.0 Adv Eff Card Rhyth Regul	Causing adverse effects; cardiac rhythm regulators, Practolol, Procainamide, Propranolol, Quinidine
E942.0 Adv Eff Card Rhyth Regul	Causing adverse effects; cardiac rhythm regulators, Practolol, Procainamide, Propranolol, Quinidine
E942.1 Adv Eff Cardiotonics	Causing adverse effects; cardiotonic glycosides and drugs of similar action, Digitalis glycosides, Digoxin, Strophanthins
E942.1 Adv Eff Cardiotonics	Causing adverse effects; cardiotonic glycosides and drugs of similar action, Digitalis glycosides, Digoxin, Strophanthins
E942.2 Adv Eff Antilipemics	Causing adverse effects; antilipemic and antiarteriosclerotic drugs, Cholestyramine, Clofibrate
E942.2 Adv Eff Antilipemics	Causing adverse effects; antilipemic and antiarteriosclerotic drugs, Cholestyramine, Clofibrate
E942.4 Adv Eff Coronary Vasodil	Causing adverse effects; coronary vasodilators, Dipyridamole, Nitrates [nitroglycerin], Nitrites, Prenylamine
E942.4 Adv Eff Coronary Vasodil	Causing adverse effects; coronary vasodilators, Dipyridamole, Nitrates [nitroglycerin], Nitrites, Prenylamine
E942.5 Adv Eff Vasodilators Nec	Causing adverse effects; other vasodilators, Cyclandelate, Diazoxide, Hydralazine, Papaverine
E942.5 Adv Eff Vasodilators Nec	Causing adverse effects; other vasodilators, Cyclandelate, Diazoxide, Hydralazine, Papaverine
E942.6 Adv Eff Antihyperten Agt	Causing adverse effects; other antihypertensive agents, Clonidine, Guanethidine, Rauwolfia alkaloids, Reserpine
E942.6 Adv Eff Antihyperten Agt	Causing adverse effects; other antihypertensive agents, Clonidine, Guanethidine, Rauwolfia alkaloids, Reserpine
E942.9 Adv Eff Cardiovasc Nec	Causing adverse effects; other and unspecified agents primarily affecting the cardiovascular system
E942.9 Adv Eff Cardiovasc Nec	Causing adverse effects; other and unspecified agents primarily affecting the cardiovascular system
E943.0 Adv Eff Antacids	Causing adverse effects; antacids and antigastric secretion drugs, Aluminum hydroxide, Magnesium trisilicate
E943.0 Adv Eff Antacids	Causing adverse effects; antacids and antigastric secretion drugs, Aluminum hydroxide, Magnesium trisilicate

(Continued)

**Table 2** (Continued)

ICD code	Diagnoses
E943.1 Adv Eff Irrit Cathartic	Causing adverse effects; irritant cathartics, Bisacodyl, Castor oil, Phenolphthalein
E943.1 Adv Eff Irrit Cathartic	Causing adverse effects; irritant cathartics, Bisacodyl, Castor oil, Phenolphthalein
E943.2 Adv Eff Emoll Cathartics	Causing adverse effects; emollient cathartics, Sodium dioctyl sulfosuccinate
E943.2 Adv Eff Emoll Cathartics	Causing adverse effects; emollient cathartics, Sodium dioctyl sulfosuccinate
E943.3 Adv Eff Cathartics Nec	Causing adverse effects; other cathartics, including intestinal atonia drugs, Magnesium sulfate
E943.3 Adv Eff Cathartics Nec	Causing adverse effects ; other cathartics, including intestinal atonia drugs, Magnesium sulfate
E943.5 Adv Eff Antidiarrhea Agt	Causing adverse effects; antidiarrheal drugs, Bismuth subcarbonate, Kaolin, Pectin
E943.5 Adv Eff Antidiarrhea Agt	Causing adverse effects; antidiarrheal drugs, Bismuth subcarbonate, Kaolin, Pectin
E943.8 Adv Eff Gi Agent Nec	Causing adverse effects; other specified agents primarily affecting the gastrointestinal system
E943.8 Adv Eff Gi Agent Nec	Causing adverse effects; other specified agents primarily affecting the gastrointestinal system
E944.1 Adv Eff Purine Diuretics	Causing adverse effects; purine derivative diuretics, Theobromine, Theophylline
E944.1 Adv Eff Purine Diuretics	Causing adverse effects; purine derivative diuretics, Theobromine, Theophylline
E944.2 Adv Eff Acetazolamide	Causing adverse effects; carbonic acid anhydrase inhibitors, Acetazolamide
E944.2 Adv Eff Acetazolamide	Causing adverse effects; carbonic acid anhydrase inhibitors, Acetazolamide
E944.3 Adv Eff Saluretics	Causing adverse effects; saluretics, Benzothiadiazides, Chlorothiazide group
E944.3 Adv Eff Saluretics	Causing adverse effects; saluretics, Benzothiadiazides, Chlorothiazide group
E944.4 Adv Eff Diuretics Nec	Causing adverse effects; other diuretics, Ethacrynic acid, Furosemide
E944.4 Adv Eff Diuretics Nec	Causing adverse effects; other diuretics, Ethacrynic acid, Furosemide
E944.5 Adv Eff Electrolyte Agnt	Causing adverse effects; electrolytic, caloric, and water-balance agents
E944.5 Adv Eff Electrolyte Agnt	Causing adverse effects; electrolytic, caloric, and water-balance agents
E944.7 Adv Eff Uric Acid Metab	Causing adverse effects; uric acid metabolism drugs, Phenoquin, Probenecid
E944.7 Adv Eff Uric Acid Metab	Causing adverse effects; uric acid metabolism drugs, Phenoquin, Probenecid
E945.1 Adv Eff Smooth Musc Relx	Causing adverse effects; smooth muscle relaxants, Adiphenine, Metaproterenol [orciprenaline]
E945.1 Adv Eff Smooth Musc Relx	Causing adverse effects; smooth muscle relaxants, Adiphenine, Metaproterenol [orciprenaline]
E945.2 Adv Eff Skelet Musc Relx	Causing adverse effects; skeletal muscle relaxants, Alcuronium chloride, Suxamethonium chloride
E945.2 Adv Eff Skelet Musc Relx	Causing adverse effects; skeletal muscle relaxants, Alcuronium chloride, Suxamethonium chloride
E945.3 Adv Eff Musc Agt Nec/Nos	Causing adverse effects; other and unspecified drugs acting on muscles
E945.4 Adv Eff Antitussives	Causing adverse effects; antitussives, Dextromethorphan, Pipazethate hydrochloride
E945.5 Adv Eff Expectorants	Causing adverse effects; expectorants, Acetylcysteine, Cocillana, Terpin hydrate
E945.7 Adv Eff Antiasthmatics	Causing adverse effects; antiasthmatics, Aminophylline [theophylline ethylenediamine]
E945.7 Adv Eff Antiasthmatics	Causing adverse effects; antiasthmatics, Aminophylline [theophylline ethylenediamine]
E945.8 Adv Eff Resp Drg Nec/Nos	Causing adverse effects; other and unspecified respiratory drugs
E946.0 Adv Eff Loc Anti-Infectv	Causing adverse effects; local anti-infectives and anti-inflammatory drugs
E946.0 Adv Eff Loc Anti-Infectv	Causing adverse effects; local anti-infectives and anti-inflammatory drugs
E946.1 Adv Eff Antipruritics	Causing adverse effects; antipruritics
E946.3 Adv Eff Emollient/Demulc	Causing adverse effects; emollients, demulcents, and protectants
E946.5 Adv Eff Eye Anti-Inf/Drg	Causing adverse effects; eye anti-infectives and other eye drugs, Idoxuridine
E946.5 Adv Eff Eye Anti-Inf/Drg	Causing adverse effects; eye anti-infectives and other eye drugs, Idoxuridine
E946.6 Adv Eff Ent Anti-Inf/Drg	Causing adverse effects; anti-infectives and other drugs and preparations for ear, nose, and throat
E947.8 Adv Eff Medicinal Nec	Causing adverse effects; other drugs and medicinal substances, Contrast media used for diagnostic x-ray procedures, Diagnostic agents and kits

(Continued)

**Table 2** (Continued)

ICD code	Diagnoses
E947.8 Adv Eff Medicinal Nec	Causing adverse effects; other drugs and medicinal substances, Contrast media used for diagnostic x-ray procedures, Diagnostic agents and kits
E947.9 Adv Eff Medicinal Nos	Causing adverse effects; unspecified drug or medicinal substance
E947.9 Adv Eff Medicinal Nos	Causing adverse effects; unspecified drug or medicinal substance
E948.0 Adv Eff Bcg Vaccine	Causing adverse effects; BCG vaccine
E948.8 Adv Eff Bact Vac Nec/Nos	Causing adverse effects; other and unspecified bacterial vaccines
E949.6 Adv Eff Viral Vacc Nec	Causing adverse effects; other and unspecified viral and rickettsial vaccines, Mumps vaccine
E949.9 Adv Eff Biologic Nec/Nos	Causing adverse effects; other and unspecified vaccines and biological substances

### Clinical Pharmacology: Advances and Applications

Dovepress

#### Publish your work in this journal

Clinical Pharmacology: Advances and Applications is an international, peer-reviewed, open access journal publishing original research, reports, reviews and commentaries on all areas of drug experience in humans. The manuscript management system is completely online and includes a very quick and fair peer-review system, which is all easy to use.

Visit <http://www.dovepress.com/testimonials.php> to read real quotes from published authors.

Submit your manuscript here: <http://www.dovepress.com/clinical-pharmacology-advances-and-applications-journal>