

# Medication-related emergency department visits and hospitalizations among older adults

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## Abstract

**Objective** To identify medications that have a high risk of adverse drug effects (ADEs) among seniors, using data from publicly available administrative databases.

**Design** Cross-sectional study using the Discharge Abstracts Database (DAD) (which contains data on acute care institutions in all provinces and territories except Quebec), the National Ambulatory Care Reporting System (NACRS) (which contains data on emergency department [ED] visits in Ontario), and the IMS Brogan database Canadian CompuScript.

### EDITOR'S KEY POINTS

- Prevention of adverse drug effects (ADEs) during routine medication use is a priority. Currently, there are limited data on medication-related ADEs requiring hospitalization or emergency department (ED) visits in patients 65 years of age and older.
- The goal of this study was to describe medication-related adverse events associated with ED visits or hospitalizations among older adults using administrative data and to compare these findings with the drug classes most frequently prescribed by primary care physicians.
- This study found that the drug classes most associated with ADEs leading to hospitalizations or ED visits were anticoagulants, opioids, antibiotics, cardiovascular drugs, and nonsteroidal anti-inflammatory drugs and that these drugs were associated with harm that was out of proportion with the frequency with which they were prescribed, particularly for older adults. Regular monitoring of many of these medications is recommended.

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**Setting** Canada.

**Participants** Adults 65 years of age and older with diagnostic codes for drugs, medicaments, and biologic substances causing adverse effects in therapeutic use.

**Main outcome measures** Adverse drug events from 2006 to 2008 associated with hospitalizations and ED visits among adults 65 years of age and older were identified by the DAD and the NACRS. The medications most frequently prescribed by primary care providers in 2008 were identified using data from Canadian CompuScript.

**Results** From 2006 to 2008, the DAD identified 92 141 ADEs among older adults, and the NACRS identified 23 845 ADEs among older adults in Ontario EDs, which represented 2.9% of inpatients and 0.8% of ED patients (21.5% of whom were admitted to hospital). Drugs implicated in the DAD ADEs included anticoagulants (15.4%), antineoplastic agents (10.6%), opioids (9.2%), and nonsteroidal anti-inflammatory drugs (6.5%); drugs included in the ADEs of ED visits were anti-infective agents (15.9%), anticoagulants (14.2%), antineoplastic agents (9.6%), and opioids (7.3%).

**Conclusion** Among older adults, the drug classes most often associated with causing harm in the hospital setting and occurring out of proportion to the frequency prescribed were anticoagulants, opioids, antibiotics, and cardiovascular drugs. Thus, these drug classes should be the focus of quality improvement efforts in primary care.

# Les visites de personnes âgées à l'urgence pour des problèmes liés à la médication

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## Résumé

**Objectif** À l'aide de bases de données administratives accessibles au public, identifier les médicaments qui ont un risque élevé d'effets médicamenteux indésirables (EMI) chez les personnes âgées.

**Type d'étude** Étude transversale à l'aide de la Discharge Abstracts Database (DAD), qui possède des données sur les établissements de soins aigus de toutes les provinces et territoires à l'exception du Québec; du Système national d'information sur les soins ambulatoires (SNISA), qui possède des données sur les visites aux départements d'urgence (DU) de l'Ontario; et du Canadian CompuScript de la base de données IMS Brogan.

**Contexte** Le Canada.

**Participants** Les personnes de 65 ans ou plus ayant des codes de diagnostic pour des drogues, médicaments ou substances biologiques pouvant causer des effets indésirables en usage thérapeutique.

**Principaux paramètres à l'étude** Le DAD et le SNISA ont servi à identifier les cas d'effets indésirables survenus entre 2006 et 2008 chez des personnes de 65 ans ou plus lors d'hospitalisations ou de visites à des DU. On a utilisé les données du Canadian CompuScript pour identifier les médicaments les plus fréquemment prescrits en 2008 par des soignants de première ligne.

**Résultats** Entre 2006 et 2008, le DAD a identifié 92 141 EMI chez les personnes âgées, tandis que le SNISA en dénombrait 23 845 chez les personnes âgées ayant visité les DU ontariens, ce qui représente 2,9 % des patients hospitalisés et 0,8 % des patients des urgences (dont 21,5 % ont été hospitalisés). Les médicaments responsables des EMI selon le DAD comprenaient les anticoagulants (15,4 %), les agents antinéoplasiques (10,6 %), les opiacés (9,2 %) et les AINS (6,5 %); dans le cas du SNISA, les EMI observés dans les DU étaient dus à des agents anti-infectieux (15,9 %), anticoagulants (14,2 %), agents antinéoplasiques (9,6 %) et opiacés (7,3 %).

**Conclusion** Chez les personnes âgées, les classes de médicaments qui sont le plus souvent responsables d'effets indésirables en contexte hospitalier et dont la fréquence est hors de proportion avec ce qui est prescrit étaient les anticoagulants, les opiacés, les antibiotiques et les médicaments cardiovasculaires. Par conséquent, c'est sur ces classes de médicaments que les efforts d'amélioration de la qualité des soins primaires devraient être dirigés.

## POINTS DE REPÈRE DU RÉDACTEUR

- Prévenir les effets médicamenteux indésirables (EMI) lors de l'utilisation régulière d'une médication est une priorité. À l'heure actuelle, il y a peu de données sur les EMI liés aux médicaments qui nécessitent une hospitalisation ou une visite à l'urgence chez des patients de 65 ans ou plus.
- Cette étude avait pour but de décrire les EMI associés à des visites à l'urgence ou à des hospitalisations chez des personnes âgées en se servant de données administratives, pour ensuite comparer ces observations aux classes de médicaments les plus souvent prescrites par les médecins de première ligne.
- Cette étude a montré que les classes de médicaments les plus souvent associées à des EMI entraînant des hospitalisations ou des visites à l'urgence étaient les anticoagulants, les opiacés, les antibiotiques, les médicaments cardiovasculaires et les AINS, et que ces agents causaient des problèmes hors de proportion avec la fréquence à laquelle ils sont prescrits, notamment chez les personnes âgées. Il est donc recommandé de faire un suivi régulier de ces médicaments.

Cet article a fait l'objet d'une révision par des pairs.  
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The prevention of adverse drug events (ADEs), defined as injuries occurring as a result of medication use,<sup>1</sup> is an important priority for patient safety. A systematic review<sup>2</sup> reported that 7.1% of hospital admissions were medication-related (interquartile range [IQR] 5.7% to 16.2%), of which 59% (IQR 50% to 73%) were classified as preventable. Estimates of the incidence of ADEs in nursing homes range from 1.19 to 9.8 ADEs per 100 resident-months.<sup>3</sup> In ambulatory care, where most medications are prescribed, between 2.8% and 34.7% (median 12.8% [IQR 5.5% to 24.5%]) of patients experience 1 or more ADEs,<sup>4</sup> of which 16.5% (IQR 12% to 23.8%) are potentially preventable. A recent study in the United States found that drugs for which regular monitoring is recommended to prevent toxicity (including warfarin, insulin, oral hypoglycemic agents, digoxin, renin-angiotensin inhibitors, anticonvulsants, and diuretics) accounted for 67.1% of ADE-related hospitalizations of individuals 65 years of age and older.<sup>5</sup>

Information regarding the epidemiology of ADEs in Canadian community settings is sparse. Our objective was to identify high-risk medications in primary care settings. Because no administrative data exist on ADEs in Canadian community settings, we described medication-related adverse events associated with emergency department (ED) visits or hospitalizations among older adults using administrative data and compared these findings with the drug classes most frequently prescribed by primary care physicians. This study was part of a larger project using clinical scenarios to examine primary care physicians' use of drug-laboratory alerts in prescribing decisions.

## METHODS

We report on data from the Discharge Abstracts Database (DAD)<sup>6</sup> and the National Ambulatory Care Reporting System (NACRS) database<sup>7</sup> from 2006 to 2008 for adults 65 years of age and older with diagnostic codes for drugs, medicaments, and biologic substances causing adverse effects in therapeutic use (ICD-10-CA codes Y40.0 to Y57.9). Before 2006, some provinces were reporting to the DAD using ICD-9 codes, so we restricted our data to the interval after this transition to ensure comparability of data. Newborns, stillbirths, or cadaveric donors were excluded, as were drugs taken accidentally in overdose or instances in which the wrong drug was given or taken in error. The DAD database contains demographic, administrative, and clinical data on all separations from acute care institutions from all provinces and territories except Quebec,<sup>6</sup> while the NACRS database reports on ED visits in Ontario<sup>7</sup>; both report all diagnoses explicitly identified in the clinical record.

To identify medications commonly prescribed in primary care, we used data from the Canadian CompuScript database by IMS Brogan, a multinational corporation that conducts pharmaceutical market research and audits prescriptions dispensed from approximately 5700 pharmacies, representing roughly 70% of all Canadian retail pharmacies. Canadian CompuScript stratifies data by province, pharmacy type, and size, then projects them for each province and adds provincial totals to generate national estimates.

The data received from IMS Brogan included the top 100 products dispensed from prescriptions written by family physicians or general practitioners for adult patients, organized by province and reported by product name and dose. Products were grouped in a step-wise fashion by generic name and drug class, but not by age, using Anatomic Therapeutic Chemical classification codes. National totals were generated. Research ethics board approval was unnecessary because the data were aggregate and nonidentifiable.

We compared the medication classes most frequently associated with ADE in hospital and ED settings with medications frequently prescribed in primary care to identify high-risk medications.

## Analysis

We reported on the overall frequency with which ADEs were identified in inpatient discharge abstracts across Canada and in the ED records of Ontario (the NACRS database includes only Ontario ED data) and the frequency with which medications were prescribed by primary care physicians.

## RESULTS

From 2006 to 2008, the DAD reports 92 141 ADEs among older adult inpatients and 23 845 ADEs among patients seen in Ontario EDs, representing a prevalence of 2.9% among older inpatients and 0.8% among older Ontario ED patients. In the latter group, 21.5% were admitted to hospital. Medications were grouped into drug classes. The most frequently identified drug classes are summarized in **Table 1**. The drug classes most frequently implicated in hospitalizations among older adults were anticoagulants (15.4%), antineoplastic agents (10.6%), opioids (9.2%), antimicrobial agents (7.8%), diuretics (6.7%), and nonsteroidal anti-inflammatory drugs (NSAIDs) (6.5%) (**Table 1**). The drug classes most frequently associated with ADEs in ED visits (**Table 2**) were antimicrobial agents (15.9%), anticoagulants (14.2%), antineoplastic agents (9.6%), and opioids (7.3%).

In total, almost 348 million prescriptions written by family physicians and general practitioners were dispensed in 2008, representing more than 19 billion

**Table 1. Number of adverse drug events associated with hospitalizations among older adult inpatients (≥ 65 years) between 2006 and 2008: N=92 141.**

DRUG CLASS	NO. OF ADVERSE DRUG EVENTS ASSOCIATED WITH HOSPITALIZATIONS, %*
Anticoagulants	14 223 (15.4)
Antineoplastic agents	9762 (10.6)
Opioids	8458 (9.2)
All anti-infective agents	7215 (7.8)
All diuretics	6182 (6.7)
NSAIDs (including salicylates)	6030 (6.5)
Cardiac stimulant glycosides	3982 (4.3)
Glucocorticoids	3624 (3.9)
β-Blockers	3526 (3.8)
Angiotensin-converting enzyme inhibitors	2004 (2.2)
Antipsychotics and neuroleptics	1713 (1.9)
Calcium channel blockers	1643 (1.8)
Insulin and oral hypoglycemic agents	1551 (1.7)
Other antidysrhythmic drugs not otherwise classified	1488 (1.6)
Benzodiazepines, other sedatives, and anti-anxiety medications	1441 (1.6)
Antidepressants	1199 (1.3)
X-ray contrast media	1038 (1.1)

NSAIDs—nonsteroidal anti-inflammatory drugs.  
\*Small cells are suppressed. Total does not add to 100%.

**Table 2. Number of adverse drug events associated with ED visits among older adult inpatients (≥ 65 years) between 2006 and 2008: N=23 845.**

DRUG CLASS	NO. OF ADVERSE DRUG EVENTS ASSOCIATED WITH ED VISITS, %*
Anti-infective agents	3786 (15.9)
Anticoagulants	3381 (14.2)
Antineoplastic agents	2284 (9.6)
Opioids	1731 (7.3)
Cardiac stimulant glycosides	887 (3.7)
NSAIDs (including salicylates)	760 (3.2)
Angiotensin-converting enzyme inhibitors	547 (2.3)
β-blockers	523 (2.2)
Antidepressants	439 (1.8)
Insulin and oral hypoglycemic agents	406 (1.7)
Other antidysrhythmic drugs not otherwise classified	404 (1.7)
Coronary vasodilators, not elsewhere classified	373 (1.6)
Glucocorticoids	372 (1.6)
Calcium channel blockers	344 (1.4)
X-ray contrast media	316 (1.3)
4-Aminophenol derivatives (acetaminophen)	278 (1.2)
Antipsychotics and neuroleptics	278 (1.2)

ED—emergency department, NSAIDs—nonsteroidal anti-inflammatory drugs.  
\*Small cells are suppressed. Total does not add to 100%.

dispensed units in total. The 100 products most frequently dispensed represent 49.6% of all medications dispensed from prescriptions written by primary care physicians in 2008 (Table 3). Cardiovascular drugs were predominant, representing 22.5% of the total. The most commonly prescribed drug classes were anti-infective agents (7.9%), lipid-lowering agents (5.7%), angiotensin-converting enzyme inhibitors and angiotensin receptor blockers (5.2%), and anticoagulants and antiplatelet agents (4.2%). However, no single drug class represented more than 8% of the overall total.

## DISCUSSION

We found a substantially lower prevalence of ADEs among inpatients than previously published studies, reported at 26.3% among older hospitalized adults,<sup>8</sup> but a similar rate to that estimated among older ED patients in the United States<sup>9</sup> (based on an American ED surveillance system, which prospectively gathered reports through chart review). Previous reports have used a combination of chart review,<sup>1,10-13</sup> computer-generated signals,<sup>14-16</sup>

and patient self-reports,<sup>17</sup> followed by consensus-based review of potential ADEs. These methodologies, while comprehensive, are costly and labour intensive.

## Limitations

Limited literature exists regarding the reliability and validity of reports of ADEs from administrative databases. One study<sup>18</sup> found a 10% sensitivity and 97% specificity of ICD-9 codes compared with structured chart review of a random sample of 1961 inpatient charts. Our estimate of the prevalence of medication-related hospitalizations is conservative, in part owing to classification systems. In accordance with the coding standards of the Canadian Institute for Health Information,<sup>6</sup> adverse events occurring when medications are taken incorrectly or when prescribed drugs are combined with either self-prescribed drugs or alcohol are classified as poisonings rather than ADEs. Furthermore, adverse events must be specifically identified as such in the patient record, meaning that when clinical manifestations of ADEs are described without explicit attribution of causality, the events are not coded as ADEs. This information

**Table 3. Estimated number of dispensed prescriptions written by primary care providers in 2008: Some of the 100 products most frequently dispensed.**

DRUG CLASS	ESTIMATED NO. OF PRESCRIPTIONS DISPENSED FROM CANADIAN RETAIL PHARMACIES, %*
Anti-infective agents	27 562 270 (7.9)
Lipid-lowering agents	19 761 056 (5.7)
ACEIs; ARBs; and ARBs plus diuretics	18 170 979 (5.2)
Anticoagulant or antiplatelet agents	14 475 103 (4.2)
Proton pump inhibitors	13 837 645 (4.0)
Antidepressants	11 387 899 (3.3)
Thyroid medications	11 172 316 (3.2)
Diuretics	10 390 598 (3.0)
Calcium channel blockers	8 960 364 (2.9)
Chronic airway obstruction treatment	8 745 648 (2.5)
Glucose-lowering agents	7 881 004 (2.3)
β-blockers	6 521 109 (1.9)
Benzodiazepines	6 201 612 (1.8)
Opioids	5 966 812 (1.7)
Bisphosphonate	4 305 263 (1.2)
Oral contraceptives	4 324 106 (1.2)
Antiseizure medications	2 869 022 (0.8)
NSAIDs	2 787 668 (0.8)
Atypical antipsychotics	2 734 171 (0.8)
Urologics	1 987 426 (0.6)
H <sub>2</sub> receptor antagonists	1 117 132 (0.3)
Smoking cessation (eg, bupropion) drugs	998 535 (0.3)
Cholinesterase inhibitors	916 689 (0.3)

ACEI—angiotensin-converting enzyme inhibitor, ARB—angiotensin receptor blocker, NSAIDs—nonsteroidal anti-inflammatory drugs.  
\*The total estimated number of dispensed prescriptions in 2008 was 347 956 493.

bias in which abstractors and coders are systemically misclassifying events, and physicians are not identifying ADEs in their clinical documentation, represents a limitation of our findings. It is unclear whether this bias occurs differentially across various drug classes. These codes also fail to identify other important drug-related problems, such as prescribing the wrong drug or the wrong dose to the wrong patient. Together, these various limitations might explain the discrepancy between our findings and those in a study about a large urban ED,<sup>19</sup> which reported that 12% of ED visits (all ages) were medication related, using a detailed patient-interview process with additional data gathered from families, other health care providers, and the provincial medication database. This methodology has the potential to identify a broader range of medication-related problems but is laborious and costly.

Also the epidemiology of ADEs in community settings might differ from those identified in ED visits or inpatients. No community-based data on ADEs exist, so comparisons are not possible.

Notwithstanding the limitations, there is consistency between these data and published accounts regarding drug classes that represent the greatest risk of adverse events. We found that anticoagulants, opioids, antibiotics, cardiovascular drugs, and NSAIDs are associated with harm that is out of proportion with the frequency with which they are prescribed, particularly for older adults. Regular monitoring is recommended for many of these medications,<sup>5</sup> suggesting the potential to reduce ADEs through quality improvement interventions targeting potentially preventable ADEs.

## Conclusion

Drug classes most associated with ADEs leading to hospitalizations or ED visits were anticoagulants, opioids, antibiotics, cardiovascular drugs, and NSAIDs. Because these drug classes have important beneficial effects, quality improvement efforts focused on appropriate prescribing and monitoring are a priority.

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### Contributors

**Dr Bayoumi** conceptualized and designed the study, analyzed the data, and drafted and revised the manuscript. **Drs Dolovich, Hutchison, and Holbrook** assisted in project design, data analysis, and revision of the manuscript. All authors approved the manuscript in its final form.

### Competing interests

None declared

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