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# ***Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS)***

## ***Human Antimicrobial Use Report***

**2011**



***...working towards the preservation of effective antimicrobials for  
humans and animals...***

**Canada**

# ***Healthy Canadians and communities in a healthier world***

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## Executive Summary

In 2011, there was a total of 250,603 kg of oral antimicrobials dispensed or purchased in Canada; representing a 6% increase compared to 2010. Total consumption of oral antimicrobial agents increased by 5% from 19.42 defined daily doses/1,000 inhabitants per day (DID) in 2010 to 20.44 DID in 2011. Antimicrobial agents dispensed through Canadian pharmacies consisted of 92% of the overall consumption. Since 2000, the total consumption of antimicrobial agents in humans has increased by 10% in Nova Scotia and in Prince Edward Island (compared to 2005, first year of data).

Between 2006 and 2010 a steady decline was observed in the total consumption of oral antimicrobials dispensed by Canadian pharmacies. In 2011 we observed the first reversal to this trend with a slight increase being reported from 17.87 DID (2010) to 18.81 DID (2011). Total expenditure for antimicrobial agents between these two years was reduced by \$9,051,708, a reflection of the use or introduction of generic products rather than reduction of use. The most pronounced increase was observed in the consumption of combinations of penicillins, including  $\beta$ -lactamase inhibitors, which increased by 31% between 2010 and 2011. Penicillins with extended spectrum, macrolides and tetracyclines continued to represent 61% of all the oral antimicrobial agents dispensed through pharmacies in Canada. Overall, Newfoundland and Labrador had the highest levels of consumption and expenditures related to oral antimicrobial agents, while Québec and British Columbia had the lowest level of consumption and expenditure, respectively. Levels of trimethoprim-sulfamethoxazole use were 3 times higher in Newfoundland and Labrador when compared to the levels reported by Québec. Although Québec had the lowest level of overall consumption, it was however the second province with the highest level of fluoroquinolone and the highest for vancomycin use. When reviewing the cost per unit for oral antimicrobials dispensed through pharmacies, Alberta had the highest cost per unit for several antimicrobial agents, including ciprofloxacin (tablets), trimethoprim (tablets), and clindamycin (tablets). Internationally, Canada had one of the lowest levels of penicillin use (ranking 5<sup>th</sup>) and one of the the highest levels of use for macrolides, lincosamides and streptogramins (ranking 25<sup>th</sup>) and quinolones (ranking 19<sup>th</sup>) when compared with European countries. Overall, Canada ranked 12<sup>th</sup> out of 27 countries classified by increasing level of total consumption of oral antimicrobials.

In 2011, a 7% increase was observed in the total amount of antimicrobial agents (kg) purchased by hospitals compared to 2010. Total costs associated with antimicrobial purchases by hospitals decreased \$5,217,095, due mainly to introductions and use of generic drugs, not a reflection on decreases of use. Higher increases were observed among the tetracyclines (22%) and combinations of penicillins, including  $\beta$ -lactamase inhibitors (18%). Fifty-two percent (0.84 DIDs) of all antimicrobials purchased were for oral intake. Fluoroquinolones (24%), macrolides (15%) and tetracyclines (12%) are the main oral antimicrobial purchased, while  $\beta$ -lactamase sensitive penicillins (32%) and cephalosporins (26%) were the main parenteral drugs purchased by hospitals in 2011. Manitoba had the highest purchases of antimicrobials compared to the rest of Canada, while British Columbia had the highest expenditures associated with these purchases. Manitoba also had the highest cost associated with each unit of antimicrobial purchased. Large differences were observed in the cost per unit when comparing at the antimicrobial level across provinces. Some of these large differences were due to the different forms of drugs purchased (tablet vs. IV) or the strength of the antimicrobial (1 g vs 6 g). Saskatchewan had 4 times the levels of oral macrolide use compared to Québec, the province with the lowest macrolide consumption. Similarly, British Columbia had 7 times the levels of oral tetracycline use compared to Québec.

Eight percent of clinical diagnoses provided by office based physicians resulted in an antimicrobial being recommended in 2011. Fifty-one percent of these were for the treatment of diseases of the respiratory system, followed by 14% for infections of the urinary tract and 11% for diseases of skin and subcutaneous tissue. Antimicrobial recommendations were highest for patients in the age groups of 0 to 2, 3 to 9 and 65 or older. Antimicrobial recommendation rates decreased between 2007 and 2011 for diseases of the respiratory system, infections of the urinary tract and diseases of the skin and subcutaneous tissue, while the rates for diseases of the genitourinary system and diseases of the ear remained stable. Overall, the most commonly recommended antimicrobials included macrolides, penicillins with extended spectrum and fluoroquinolones. Provincial differences were observed in the antimicrobial recommendation rates and antimicrobial selected for treatment, with the Atlantic region and Québec having higher rates of

antimicrobial recommendations compared to the national levels. British Columbia had the lowest rate of antimicrobial recommendations for diseases of the respiratory system, while Québec and the Atlantic region had the highest for diseases of the ear. The Prairies had the lowest rate of antimicrobial recommendations for infections of the urinary tract, but did observe an increase in these between 2010 and 2011. A similar rate of antimicrobial recommendations across the country was observed for diseases of the genitourinary system, while decreases in recommendations were observed across the country for diseases of the skin and subcutaneous tissue.

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## Preamble

### About CIPARS

The Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) presents an independent report on antimicrobial use (AMU) in humans. This document contains final data of AMU surveillance in humans from 2000 to 2011 inclusive.

#### CIPARS Objectives

- Provide a unified approach to monitor trends in antimicrobial resistance and antimicrobial use in humans and animals.
- Facilitate assessment of the public health impact of antimicrobials used in humans and agricultural sectors.
- Allow accurate comparisons with data from other countries that use similar surveillance systems.

#### Surveillance of Human Antimicrobial Use

Antimicrobial use surveillance in humans includes data obtained from the Canadian CompuScript, Canadian Drug Store & Hospital Purchases and the Canadian Disease & Therapeutic Index datasets purchased from IMS Health Canada Inc. for the years 2000 through 2011. These datasets contain information on prescriptions for oral antimicrobials dispensed by a representative sample of Canadian retail pharmacies, purchases of antimicrobials by hospitals (excluding quantities returned to the manufacturer) and diagnosis for which physicians recommended an antimicrobial. The Territories were not included in any of these datasets due to their low volumes of antimicrobials.

Defined daily doses (DDDs) were based on the WHO Collaborating Centre for Drug Statistics Methodology guidelines<sup>1</sup>. The DDDs are the assumed average maintenance dose per day for a drug used for its main indication in adults. This statistical measure is used to standardize antimicrobial usage and allow international comparisons to be made.

### What's new in the 2011 Human Antimicrobial Use Report

- Two new sections have been included to demonstrate trends in antimicrobials that are purchased by hospitals for their use at the national and regional levels, as well as trends in antimicrobials recommended by physicians to treat disease in Canada.
- The total cost of prescriptions in Canada was calculated accounting for inflation values to observe true cost trends across Canada.
- A new metric has been introduced for monitoring antimicrobials dispensed through Canadian pharmacies. The metric of defined daily doses (DDDs) per prescription aims to determine changes over time on the dosage or length of time for which prescriptions have been dispensed.
- Total cost per unit of antimicrobial was calculated for the year 2011 at the individual province or region for the pharmacy and hospital data.

<sup>1</sup> WHO Collaborating Centre for Drug Statistics Methodology. Guidelines for ATC Classification and DDD assignment 2013. Available at: [www.whocc.no/filearchive/publications/1\\_2013guidelines.pdf](http://www.whocc.no/filearchive/publications/1_2013guidelines.pdf). Accessed March 2014.

## Important Notes

### Antimicrobial Groupings

Category of importance in human medicine: Antimicrobials have been categorized on the basis of importance in human medicine in accordance with the classification system of the Veterinary Drugs Directorate Health Canada (categories revised in April 2009, Table A.1, Appendix A).

ATC class: Antimicrobials have been classified by the WHO Anatomical Therapeutic Chemical (ATC) classification system<sup>1</sup> (Table A.2, Appendix A).

### Abbreviations of Canadian Provinces/Regions

BC	British Columbia
AB	Alberta
SK	Saskatchewan
MB	Manitoba
ON	Ontario
QC	Québec
NB	New Brunswick
NS	Nova Scotia
PEI	Prince Edward Island
NL	Newfoundland and Labrador
Prairies	Alberta, Saskatchewan and Manitoba
Atlantic Labrador	New Brunswick, Nova Scotia, Prince Edward Island and Newfoundland and Labrador

### General Abbreviations

ATC	Anatomical Therapeutic Chemical
DDDs	Defined daily doses
DID	Total number of DDDs per 1,000 inhabitants per day
NAP	No antimicrobials purchased
NAS	No antimicrobials suggested (recommended)
NC	Not classified
NPD	No prescription dispensed
Rx	Prescription

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<sup>1</sup> World Health Organization Collaborating Center for Drug Statistics Methodology. Available at: [www.whocc.no/atc\\_ddd\\_index/](http://www.whocc.no/atc_ddd_index/). Accessed November 2013.

## Physician Diagnosis Data

The Canadian Disease and Therapeutic Index (CDTI) dataset provides information about the patterns and treatments of disease encountered by office-based physicians from five regions [Atlantic (New Brunswick, Newfoundland and Labrador, Nova Scotia, and Prince Edward Island), Québec, Ontario, the Prairies (Alberta, Manitoba, and Saskatchewan), and British Columbia]. Values are estimated based on quarterly data from a sample of approximately 652 physicians stratified by region and specialty. For four consecutive quarters, each physician maintains a practice diary describing information on every patient visit during a randomly selected 48-hour period. This information is then extrapolated using a projection factor to estimate the “universe” comprised of approximately 52,959 physicians, roughly representing all Canadian data.

The information contained in this analysis is for drugs for which a physician has provided a recommendation or prescription, and does not represent actual prescriptions dispensed by pharmacists or consumed by the patient. This data does not include patient visits to a primary care nurse, and diagnosis visits do not translate into the total number of patients, as some visit multiple times for the same reason or were diagnosed with multiple diseases. Due to the methods of data collection, sample size is sometimes considered too small for decision making. However, information is still included in this analysis to provide a view of practices which may require further studies.

More detailed information on IMS Health Canada data collection and CIPARS analytic methods are described in Appendix A.

### National Level

Over the five-year surveillance period (2007 to 2011), physicians saw patients for almost 1.5 billion diagnoses and provided a total of 14,443 antimicrobial recommendations/10,000 inhabitants (Table 1). In 2011, 8% of diagnoses resulted with an antimicrobial recommendation representing a total of 6,550 antimicrobial recommendations/10,000 inhabitants (Table B.1, Appendix B). The overall number of antimicrobial recommendations per 10,000 inhabitants were lowest in 2011 than in any of the previous years (Table 2), decreasing 13% since 2007 (6,550 in 2011 and 7,527 in 2007).

In 2011, of all the antimicrobial recommendations provided by office-based physicians, 51% of these were provided for the treatment of diseases of the respiratory system (3,360 recommendations/10,000 inhabitants). This was followed by recommendations for the treatment of infections of the urinary tract (14%, 949/6,550), diseases of the skin and subcutaneous tissue (11%, 737/6,550) and diseases of the ear (10%, 645/6,550). The percentage of diagnoses which received an antimicrobial recommendation in 2007, 2010 and 2011 is presented in Figure 1. Overall, decreases in the percentage of diagnoses that received an antimicrobial recommendation were observed during this time period for infections of the urinary tract (11%), diseases of the central nervous system (10%), diseases of blood/blood-forming organs (7%), diseases of the respiratory system (6%), diseases of the skin and subcutaneous tissue (5%) and diseases of the ear (4%). In 2011, 47% of all diagnoses of infections of the urinary tract resulted in an antimicrobial recommendation (Figure 1), followed by diseases of the respiratory system (31%), diseases of the ear (29%) and diseases of the skin and subcutaneous tissue (12%).

In 2011, patients aged 65 or older had the largest rate of diagnoses (152/10 inhabitants) followed by patients aged 0 to 2 (123/10 inhabitants) and patients aged 60 to 64 (122/10 inhabitants, Table 3). The age range that had the lowest rate of diagnoses was from 10 to 19 years (42/10 inhabitants). In 2011, age and gender were unspecified for 1% and 2% of the total diagnoses, respectively. In 2011, the number of antimicrobial recommendations per 10 inhabitants was highest in the age group of 0 to 2 years (12/10 inhabitants) followed by 3 to 9 (9/10 inhabitants) and 60 to 64 and 65 or older (7/10 inhabitants each). Overall, 17% of diagnoses in patients between the ages of 3 to 9 years received an antimicrobial recommendation, followed by patients between the ages of 10 to 19 (13%) and 20 to 39 (11%). In 2011, the rate of diagnosis was highest among the female population (9/10 inhabitant)

compared to male patients (7/10 inhabitants). Diagnoses for females and males received similar antimicrobial recommendations (female: 8%; male: 8%).

### Diseases of the Respiratory System

The number of antimicrobial recommendations made for diseases of the respiratory system decreased 12% (473 recommendations/10,000 inhabitants) since 2007 (Table 4). In 2011, the three most common diseases for which an antimicrobial recommendation was made included acute bronchitis (640/10,000 inhabitants), acute sinusitis-unspecified (470/10,000 inhabitants), and acute upper respiratory infections-unspecified site (365/10,000 inhabitants).

Higher rates of antimicrobial recommendations was observed among patients 0 to 2 years of age (46/100 persons), 3 to 9 (44/100 persons) and 65 or older (39/100 persons). The main clinical diagnosis for which an antimicrobial was recommended among patients 0 to 2 years was acute upper respiratory infections-unspecified site (26%) followed by pneumonia-organism unspecified (11%). Acute tonsillitis was the primary clinical diagnosis for patients 3 to 9 (23%), followed by acute upper respiratory infections-unspecified site (14%), and acute pharyngitis (13%). Among the 65 or older age group, acute bronchitis (24%), pneumonia-organism unspecified (18%), and chronic airway obstruction, not elsewhere classified (11%) were the main clinical diagnoses identified. A higher rate of antimicrobial recommendations was observed among female patients (35/100 persons) compared to male patients (31/100 persons).

In 2011, the most common antimicrobials recommended to treat diseases of the respiratory system included amoxicillin (29%, 969/10,000 inhabitants), clarithromycin (25%, 843/10,000 inhabitants), azithromycin (14%, 464/10,000 inhabitants), and moxifloxacin (11%, 366/10,000 inhabitants) (Table 5). Amoxicillin was mainly used for the treatment of acute upper respiratory infections-unspecified sites (17% of all amoxicillin recommendations, 180/10,000 inhabitants), followed by acute pharyngitis (16%, 176/10,000 inhabitants), and acute sinusitis-unspecified (15%, 162/10,000 inhabitants). While both clarithromycin and azithromycin were mainly used for the treatment of acute bronchitis (32%, 271/10,000 inhabitants; 29%, 135/10,000 inhabitants, respectively), moxifloxacin was used mainly for the treatment of pneumonia-organism unspecified (22%, 79/10,000 inhabitants). Thirty-seven percent (47/10,000 inhabitants) of all penicillin V recommendations were made for the treatment of acute tonsillitis, with 29% (37/10,000 inhabitants) of the remaining recommendations for treating streptococcal sore throat and acute pharyngitis. However, 58% of the pharyngitis cases were treated with amoxicillin, while only 12% were treated with penicillin V, which is the recommended antimicrobial for treatment<sup>1</sup>.

### Infections of the Urinary Tract

The number of antimicrobial recommendations made for treatment of infections of the urinary tract decreased 18% (209 recommendations/10,000 inhabitants) since 2007 (Table 4). In 2011, the three most common disease for which an antimicrobial recommendation was made included urinary tract infection-site unspecified (619/10,000 inhabitants), acute cystitis (196/10,000 inhabitants), and cystitis-unspecified (48/10,000 inhabitants).

The top three age groups of patients diagnosed with an infection of the urinary tract with higher rates of antimicrobial recommendations were 65 or older (16 recommendations/100 inhabitants), 20 to 39 (12/100 inhabitants) and 60 to 64 (10/100 inhabitants). All three had urinary tract infections-site unspecified (60% to 66%, depending on the age group) and acute cystitis (20% to 24%) as the main clinical diagnosis related to these recommendations. Rate of antimicrobial recommendation was much higher in female (16/100 inhabitants) than male (3/100 inhabitants) patients.

The most common antimicrobials recommended to treat infections of the urinary tract included ciprofloxacin (50%, 471/10,000 inhabitants) and nitrofurantoin (32%, 307/10,000 inhabitants) (Table 5). Both antimicrobials were recommended for treating the urinary tract infections-site unspecified (275 and

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<sup>1</sup> Blondel-Hill E and Fryters S. Bugs & Drugs: an antimicrobial/infectious diseases reference. Alberta Health Services, 2012.

221 recommendations/10,000 inhabitants, respectively) and acute cystitis (126 and 57/10,000 inhabitants, respectively). In addition, ciprofloxacin was the main antimicrobial recommended for treatment of acute and non-acute pyelonephritis, consisting of 56% of all antimicrobials recommended (11 recommendations/10,000 inhabitants). Ceftriaxone (28% of all recommendations), levofloxacin (8%) and gentamicin (8%) were also recommended for treatment of this disease. To a lesser extent, sulfamethoxazole-trimethoprim drugs (co-trimoxazole) represented less than 1% (0.69%, 7 recommendations/10,000 inhabitants) of all antimicrobials recommended for treatment of infections of the urinary tract. This antimicrobial was used specifically for treatment of urinary tract infection-site unspecified (75%, 5/10,000 inhabitants) and acute cystitis (25%, 2/10,000 inhabitants).

### **Diseases of the Skin and Subcutaneous Tissue**

The number of antimicrobial recommendations decreased 12% (96 recommendations/10,000 inhabitants) from 2007 to 2011 (Table 4). The top three diseases for which antimicrobials were recommended within this class in 2011 included cellulitis and abscess-unspecified site (188/10,000 inhabitants), acne-unspecified (49/10,000 inhabitants), and cellulitis and abscess of leg-except foot (46/10,000 inhabitants).

Patients between the ages of 10 to 19 had the highest rate of antimicrobial recommendations (9/100 inhabitants) followed by ages 60 to 64 (8/100 inhabitants) and 65 or older (7.4/100 inhabitants). Cellulitis and abscess-unspecified site was the most common reason of treatment for patients between the ages of 60 to 64 and 65 or older (36%, 18/10,000 inhabitants and 41%, 44/10,000 inhabitants, respectively). Patients between 10 to 19 years were treated mainly for acne-unspecified (23%, 25/10,000 inhabitants) and cellulitis and abscess-unspecified site (14%, 16/10,000 inhabitants). Slightly higher rates of antimicrobial recommendations were observed among female patients (8/100 inhabitants) than in male patients (7/100 inhabitants).

The antimicrobials most commonly recommended for treatment of the skin and subcutaneous tissue included cephalexin (264 recommendations/10,000 inhabitants), cloxacillin (85/10,000 inhabitants), and minocycline (69/10,000 inhabitants) (Table 5). Cephalexin and cloxacillin were recommended mainly for the treatment of cellulitis and abscess-unspecified site (42%, 110 recommendations/10,000 inhabitants and 23%, 20/10,000 inhabitants, respectively). In addition, cloxacillin was recommended for treating ingrown nail (14%, 11/10,000 inhabitants), impetigo (12%, 10/10,000 inhabitants) and cellulitis and abscess of leg-except foot (11%, 10/10,000 inhabitants). Minocycline was mainly recommended for treating issues with acne (76%, 52/10,000 inhabitants) and rosacea (13%, 9/10,000 inhabitants).

### **Diseases of the Ear**

The total number of antimicrobial recommendations provided for treatment of diseases of the ear remained the similar in 2011 (645 recommendations/10,000 inhabitants) compared to 2007 (678/10,000 inhabitants) (Table 4). The main reason for recommending an antimicrobial for this disease classification was to treat unspecified otitis media (604 recommendations/10,000 inhabitants), representing 94% of all antimicrobial recommendations. The next two most common diagnoses treated with an antimicrobial included infective otitis externa (22/10,000 inhabitants) and acute non-suppurative otitis media (8/10,000 inhabitants).

Children between the age of 0 to 2 years had the highest rate of antimicrobial recommendation (53/100 inhabitants), followed by children between the age of 3 to 9 years (30/100 inhabitants) and between 10 to 19 years (6/100 inhabitants). Unspecified otitis media was the main clinical diagnosis associated with these recommendations, ranging from 89% (10 to 19 years) to 98% (3 to 9 years). Rates of antimicrobial recommendations were slightly higher among male patients (7/100 inhabitants) compared to female patients (6/100 inhabitants).

In 2011, 56% of the antimicrobials recommended for treating diseases of the ear were amoxicillin (358 recommendations/10,000 inhabitants), followed by clarithromycin (17%, 107/10,000 inhabitants) and cefprozil (10%, 66/10,000 inhabitants) (Table 5). Ninety-six percent (369 recommendations/10,000 inhabitants) of the amoxicillin recommendations were for the treatment of unspecified otitis media,



followed by infective otitis externa (2%, 9/10,000 inhabitants). Similarly, 94% of the clarithromycin recommendations were for the treatment of unspecified otitis media (101/10,000 inhabitants), while 3% (3/10,000 inhabitants) and 2% (2/10,000 inhabitants) of the recommendations were provided for acute non-suppurative and suppurative otitis media infections, respectively.

### Diseases of the Genitourinary System

The total number of antimicrobial recommendations made for treatment of diseases of the genitourinary system remained relatively stable between 2011 (237 recommendations/10,000 inhabitants) compared to 2007 (247/10,000 inhabitants) (Table 4). However, the number of antimicrobial recommendations decreased 10% in 2011 from 2010 (262 and 237/10,000 inhabitants, respectively). In 2011, the top three diagnostic codes within this disease classification for which antimicrobials were recommended included other disease due to virus and *Chlamydia* (62 recommendations/10,000 inhabitants), venereal disease-unspecified (26/10,000 inhabitants) and inflammatory disorder of the breast (22/10,000 inhabitants).

There were no reported diagnoses of diseases of the genitourinary system for patients 3 to 9 years of age. Patients in the age group 20 to 39 had the highest rate of antimicrobial recommendations with 4.3 recommendations per 100 persons. This was followed by age group 10 to 19 (3/100 persons) and 60 to 64 (2/100 persons). The main clinical diagnosis associated with the recommendation of an antimicrobial to patients between the ages of 20 to 39 and 10 to 19 was other specified diseases due to viruses and Chlamydiae (40% for both age groups). Prostatitis-unspecified was the main clinical diagnosis (38%) for patients between the ages of 60 to 64 that received an antimicrobial recommendation. Similar rates of recommendations were observed from females (3/100 persons) and males (2/100 persons).

Approximately half of the antimicrobials recommended to treat diseases of the genitals were azithromycin (26%, 62 recommendations/10,000 inhabitants) and ciprofloxacin (24%, 57/10,000 inhabitants) (Table 5). The next most commonly recommended antimicrobial was cefixime (11%, 26/10,000 inhabitants). Both azithromycin and cefixime were recommended for the treatment of other disease due to virus and *Chlamydia* (76%, 47/10,000 inhabitants and 38%, 10/10,000 inhabitants, respectively) and venereal disease-unspecified (21%, 13/10,000 inhabitants and 37%, 10/10,000 inhabitants, respectively). Ciprofloxacin was mainly recommended for treating orchitis and epididymitis, without abscess-unspecified (25%, 14/10,000 inhabitants), acute prostatitis (24%, 14/10,000 inhabitants), prostatitis-unspecified (15%, 9/10,000 inhabitants) and chronic prostatitis (13%, 8/10,000 inhabitants).

### Diseases of the Gastrointestinal System

The total number of antimicrobial recommendations made for treating diseases of the gastrointestinal system remained the same from 2007 (31/10,000 inhabitants) to 2011 (31/10,000 inhabitants) (Table 4). Increases were observed in the total number of antimicrobial recommendations provided for the diagnostic classes diarrhea presumed infectious (12/10,000 in 2007 up to 18/10,000 inhabitants in 2011) and other specified bacteria (1/10,000 in 2007 up to 3/10,000 inhabitants in 2011). Declines in the total number of antimicrobial recommendations were reported for colitis enteritis gastritis presumed infectious (13/10,000 in 2007 down to 6/10,000 inhabitants in 2011).

There were no reported diagnoses of diseases of the gastrointestinal system for patients 0 to 2 and 10 to 19 years of age. This could be a reflection of the sampling mechanisms employed for collecting patient level information as part of this database. Among the age groups represented in this data, patients 3 to 9, 20 to 39, and 40 to 59 had the highest rate of antimicrobial recommendation (0.4/100 persons). Ninety-three percent of patients 20 to 39 years that received an antimicrobial recommendation were clinically diagnosed with diarrhoea presumed infectious, while 53% of those 3 to 9 years and 43% of those 40 to 59 were clinically diagnosed with colitis, enteritis, and gastroenteritis of presumed infectious origin. Higher rates of antimicrobial recommendations were observed among female (0.4/100 persons) than male (0.2/100 persons) patients.

The only antimicrobials recommended to treat diseases of the gastrointestinal system in 2011 included ciprofloxacin (83%, 26 recommendations/10,000 inhabitants), vancomycin (8%, 2/10,000 inhabitants), azithromycin (5%, 1/10,000 inhabitants), doxycycline (3%, 1/10,000 inhabitants), and ampicillin (2%, 1/10,000 inhabitants) (Table 5). In 2011, within the diseases of the gastrointestinal system, both food poisoning-unspecified and bacterial enteritis-unspecified received no antimicrobial recommendations (Table 6). The only antimicrobial recommended for treating *Salmonella* infection-unspecified was ciprofloxacin (2 recommendations/10,000 inhabitants), also recommended to treat infectious colitis enteritis gastroenteritis or colitis enteritis gastritis presumed infectious (2/10,000 inhabitants and 6/10,000 inhabitants, respectively). For treating *E. coli*, physicians recommended ampicillin (1 recommendation/10,000 inhabitants). Vancomycin and doxycycline were recommended for treating other specified bacteria (2 and 1 recommendation/10,000 inhabitants, respectively), and ciprofloxacin and azithromycin were recommended for treating diarrhea presumed infectious (16 and 1 recommendation/10,000 inhabitants, respectively).

### Antimicrobial Classes

In 2011, the most commonly recommended antimicrobial class was macrolides (J01FA; 1,638 recommendations/10,000 inhabitants) (Table 7 and Table 8). Macrolides were most commonly recommended for treating diseases of the respiratory system (81%, 1,327 recommendations/10,000 inhabitants), diseases of the ear (10%, 157/10,000 inhabitants), and diseases of the genitourinary system (4%, 62/10,000 inhabitants). Overall, macrolide recommendations have been decreasing steadily since 2007 (down 14% from 2007, 263 recommendations/10,000 inhabitants). This decrease was observed across all macrolides: clarithromycin (161 recommendations/10,000 inhabitants), erythromycin (30/10,000 inhabitants), and azithromycin (51/10,000 inhabitants). Telithromycin has not been recommended for use since 2009.

In 2011, the second most commonly recommended antimicrobial class was the penicillins with extended spectrum (J01CA, 1,504 recommendations/10,000 inhabitants) (Table 7 and Table 8). This class was recommended primarily for treating diseases of the respiratory system (64%, 975/10,000 inhabitants), diseases of the ear (24%, 358/10,000 inhabitants), and other diseases of the digestive system (3%, 42/10,000 inhabitants). Physician recommendations of penicillin with extended spectrum have remained stable over time with a slight decrease of 41 recommendations/10,000 inhabitants observed between 2007 and 2011. Within this class of drugs, amoxicillin is the primary antimicrobial recommended, with 1,483 recommendations/10,000 inhabitants reported in 2011 (Table 8). There were no recommendations made for pivampicillin, carbenicillin or piperacillin in 2011.

The third most commonly recommended antimicrobials were the fluoroquinolones (J01MA, 1,202 recommendations/10,000 inhabitants) (Table 7 and Table 8). Fluoroquinolone recommendations have decreased 16% (229 recommendations/10,000 inhabitants) since 2007. This decrease was observed among all fluoroquinolone drugs except for moxifloxacin (3% increase since 2007, 10 recommendations/10,000 inhabitants) (Table 8). Ciprofloxacin is the most common fluoroquinolone recommended (682/10,000 inhabitants), although a 19% decrease (163/10,000 inhabitants) was observed compared to 2007. There were no recommendations made for gemifloxacin and gatifloxacin in 2011. In 2011, the most common reasons for recommending fluoroquinolones included infections of the urinary tract (42%, 508 recommendations/10,000 inhabitants), diseases of the respiratory system (39%, 466/10,000 inhabitants), and diseases of the genitourinary system (6%, 66/10,000 inhabitants).

Although the main antimicrobial classes recommended by physicians were macrolides, fluoroquinolones, and penicillins with extended spectrum, since 2007 there have been increases in the number of physicians recommending antimicrobials of lesser use. Third-generation cephalosporins (J01DD) represent 2% (135 recommendations/10,000 inhabitants) of all antimicrobial recommendations in 2011 (Table 7). However, since 2007, this class has observed a 42% increase (40 recommendations/10,000 inhabitants). This increase has been driven by higher number of physician recommendations for the treatment of diseases of the respiratory system (153% increase, 23 recommendations/10,000 inhabitants), diseases of the genitourinary system (114% increase, 16/10,000 inhabitants) and infections of the urinary tract (56% increase, 10/10,000 inhabitants). Ceftriaxone

(59/10,000 inhabitants) and cefixime (68/10,000 inhabitants) are the main two antimicrobials used within this class.

In 2011, there was a wide variation in recommendations of antimicrobial classes across the different age ranges (Figure 2). The antimicrobial recommendations among the age ranges 0 to 2, 3 to 9, and 10 to 19 were mostly for penicillins with extended spectrum (J01CA; 333, 209 and 95 recommendations/100 inhabitants, respectively) and macrolides (J01FA; 171, 106 and 85 recommendations/100 inhabitants, respectively). The age ranges 20 to 39 and 40 to 59 were most commonly macrolides (125 and 116 recommendations/100 inhabitants, respectively) and fluoroquinolones (J01MA; 90 and 103 recommendations/100 inhabitants, respectively). Patients 60 years of age or older were more commonly recommended fluoroquinolones (144 and 195 recommendations/100 inhabitants, respectively) followed by macrolides (135 and 121 recommendations/100 inhabitants).

## Provincial/Regional Level

Both the Atlantic region (New Brunswick, Newfoundland and Labrador, Nova Scotia and Prince Edward Island combined) and Québec had a higher number of antimicrobial recommendations per 10,000 inhabitants (7,101 and 8,268, respectively) compared to the National overall level. The total number of antimicrobial recommendations in British Columbia was 5,650/10,000 inhabitants, 6,019/10,000 inhabitants in the Prairies (Alberta, Saskatchewan and Manitoba combined) and 6,034/10,000 inhabitants in Ontario (Table 9).

### Diseases of the Respiratory System

Rates of diagnosis for diseases of the respiratory system ranged from 9,687 diagnosis/10,000 inhabitants in Ontario to 13,044/10,000 inhabitants in Québec (Table 9). British Columbia had the lowest percentage of diagnosis leading to an antimicrobial recommendation (27%), while Québec had the highest level observed (34%).

In 2011, the number of antimicrobial recommendations ranged from 2,649/10,000 inhabitants (British Columbia) to 4,377/10,000 inhabitants (Québec) (Table 10). Total number of antimicrobial recommendations has been decreasing in the provinces of Ontario and the Atlantic region since 2007 (Figure 2), with a continued decline observed in 2011 compared to 2010. However, British Columbia, the Prairies, and Québec observed an increase between 2010 and 2011. The highest increase in the antimicrobial recommendation rate was observed in the Prairies, where rates increased from 277 to 331 recommendations/1,000 inhabitants between 2010 and 2011.

The main antimicrobial recommended for treating diseases of the respiratory system in British Columbia, the Prairies, and Ontario was amoxicillin (Table 10), while in Québec and the Atlantic region clarithromycin was the main choice of treatment. Recommendations of clarithromycin and amoxicillin in the Atlantic region decreased between 2010 and 2011, with clarithromycin decreasing from 121 to 95 recommendations/1,000 inhabitants and amoxicillin from 128 to 86 recommendations/1,000 inhabitants, respectively (Figure 3). Simultaneously, recommendation rates for azithromycin and moxifloxacin increased during this same time period in this region. Ontario is the only province where the rates of antimicrobial recommendation for azithromycin, moxifloxacin and penicillin V appear to have remained stable since 2007, with the only changes being observed among amoxicillin and clarithromycin where decreases were observed between 2010 and 2011.

### Infections of the Urinary Tract

In 2011, rates of diagnosis of infections of the urinary tract ranged from 1,869 to 3,164 diagnosis/10,000 inhabitants in Ontario and the Atlantic region, respectively (Table 9). While the Atlantic region had the highest rate of diagnoses, it had the lowest percentage of diagnosis leading to an antimicrobial

recommendation (36%). Québec had the second lowest rate of diagnosis and the highest percentage of diagnosis with an antimicrobial recommendation (60%) (Table 9).

The total number of antimicrobial recommendations in 2011 ranged from 825/10,000 inhabitants (the Prairies) to 1,143/10,000 inhabitants (Québec) (Table 10). Increases in the rate of antimicrobial recommendations were observed among the Prairies, where the number of antimicrobial recommendations/1,000 inhabitants increased from 66 (2010) to 82 (2011) (Figure 4). All other provinces observed a decrease in the number of antimicrobial recommendations during this time period. Since 2007, the Atlantic region has been observing a decrease in the total number of antimicrobial recommendations/1,000 inhabitants, decreasing from 194 to 113 recommendations/1,000 inhabitants.

Provincial variation in the antimicrobial most commonly recommended in 2011 was observed, with the provinces of British Columbia and Ontario recommending nitrofurantoin, while the remaining provinces recommend ciprofloxacin as the antimicrobial of choice. Québec had the highest number of ciprofloxacin recommendations (87 recommendations/1,000 inhabitants) compared with the lowest rate observed in Ontario (29/1,000 inhabitants) in 2011. Recommendations for amoxicillin, cephalixin and norfloxacin have been decreasing since 2007, with some of these drugs not having been recommended in 2011 depending on the province (Figure 4).

### **Diseases of the Skin and Subcutaneous Tissue**

In 2011, the total number of diagnoses for this disease classification ranged from 5,866 (Ontario) to 7,602 (British Columbia) diagnoses/10,000 inhabitants (Table 9). The Atlantic region had the second highest rate of diagnosis but reported the lowest percentage of diagnosis leading to an antimicrobial recommendation (9%), while Ontario had the lowest diagnosis rate but the highest percentage of antimicrobial recommendations (14%).

The total number of antimicrobial recommendations for treatment of diseases of the skin and subcutaneous tissue in 2011 ranged from 631/10,000 inhabitants (Atlantic region) to 820/10,000 inhabitants in British Columbia (Table 10). There was a marked decrease in the total number of antimicrobial recommendations per 1,000 inhabitants for treating diseases of the skin and subcutaneous tissue across all provinces, with the exception of British Columbia, where these remained the same between the 2010 and 2011 (Figure 5). The sharpest decrease observed was in the Atlantic region where the total number of all antimicrobial recommendations/1,000 inhabitants decreased from 956 to 63 recommendations from 2010 to 2011, respectively. Cephalixin was the main antimicrobial recommended for treatment across all Canadian provinces, with the total number of antimicrobial recommendations/10,000 inhabitants ranging from 154 in Québec to 367 in the Atlantic region (Table 10). All provinces exhibited an increase in the total number of cephalixin recommendations/1,000 inhabitants between 2010 and 2011 (Figure 5).

### **Diseases of the Ear**

Rates of diagnosis of diseases of the ear ranged between 1,628 diagnosis/10,000 inhabitants in the Prairies to 3,348/10,000 inhabitants in the Atlantic region for 2011 (Table 9). In British Columbia, 15% of diagnosis led to an antimicrobial recommendation, lowest level reported, while in Québec 37% of diagnosis led to an antimicrobial recommendation.

In 2011 the total number of antimicrobial recommendations ranged from 349/10,000 inhabitants in British Columbia to 1,168/10,000 inhabitants in Québec (Table 10). The antimicrobial recommendation rates decreased between 2010 and 2011 among Canadian provinces, with the exception of the provinces of Québec (95 to 117 recommendations/1,000 inhabitants, respectively) and the Atlantic region (67 to 70/1,000 inhabitants, respectively) where increases were observed (Figure 6). The main antimicrobial recommended by Canadian physicians for treating diseases of the ear is amoxicillin. Rates of amoxicillin recommendations increased in 2011 compared to 2010 in Québec, the Prairies and the Atlantic region, while decreases were observed in British Columbia and Ontario (Figure 6).

### Diseases of the Genitourinary System

In 2011, rates of diagnosis for diseases of the genitourinary system in Canada ranged from 3,500 diagnoses/10,000 inhabitants in the Prairies to 4,957 diagnoses/10,000 inhabitants in the Atlantic region (Table 9). Although the Atlantic region had the highest diagnosis rate, it reported the lowest percent of diagnosis leading to an antimicrobial recommendation (5%). Québec and the Prairies had the highest percentage of diagnosis with antimicrobial recommendations at 7% each.

The total number of antimicrobial recommendation rates across all provinces was fairly similar, with rates ranging from 207 in British Columbia to 277/10,000 inhabitants in Québec (Table 10). Decreases in the total number of antimicrobial recommendations/1,000 inhabitants were observed in British Columbia, Québec and the Atlantic region in 2011 compared to 2010 (Figure 7). The Prairies observed an increase from 18 antimicrobial recommendations/1,000 inhabitants (2010) to 25/1,000 inhabitants (2011). Ontario observed a smaller increase from 21 (2010) to 22 (2011) recommendations/1,000 inhabitants.

Provincial variation in the antimicrobial recommended in 2011 was observed (Table 10). British Columbia and the Atlantic region had higher recommendation rates for ciprofloxacin (7 and 17 recommendations/1,000 inhabitants, respectively), compared to the Prairies, Ontario and Québec which reported azithromycin as the main choice of treatment (8, 5, and 9 recommendations/1,000 inhabitants, respectively). While the majority of the Canadian provinces appeared to rely on multiple antimicrobials (azithromycin, cefixime, cephalexin, ciprofloxacin and doxycycline) for treating diseases of the genitourinary system, the Atlantic region relied on ciprofloxacin as its main antimicrobial of choice (Figure 7). Recommendations for all other antimicrobials in that region have been decreasing since 2007.

### Diseases of the Gastrointestinal System

The total diagnosis rate of diseases of the gastrointestinal system in 2011 ranged from 445/10,000 inhabitants observed in the Atlantic region to 530/10,000 inhabitants observed in Québec. The Prairies reported 2% of their diagnosis having received an antimicrobial recommendation, while 16% of the diagnosis in the Atlantic region led to an antimicrobial recommendation (Table 9).

Provincial variation in the rates of antimicrobial recommendations were observed, with the lowest number of antimicrobial recommendations/1,000 inhabitants in the Prairies (9 recommendations/10,000 inhabitants) and the highest rate of recommendations observed in the Atlantic region (69/10,000 inhabitants) (Figure 8 and Table 10). Decreases between 2010 and 2011 in the antimicrobial recommendation rate were observed in the Prairies (1.2 and 0.9 recommendations/1,000 inhabitants, respectively) and in Ontario (3.3 and 2.9/1,000 inhabitants, respectively). The highest increase in the antimicrobial recommendation rate was observed in the Atlantic region (1.0 and 6.9/1,000 inhabitants, respectively), followed by British Columbia (3.4 and 5.3/1,000 inhabitants, respectively).

Ciprofloxacin was the main antimicrobial used for treating diseases of the gastrointestinal system among all Canadian provinces (Figure 8). Ontario is the only province that has physicians continuing to recommend the use of vancomycin since 2007, as British Columbia and the Prairies only reported recommendations in 2008 and Québec in 2010. There were two drugs that had not been recommended for treatment in previous years in any of the provinces: ampicillin and doxycycline were reported for the first time to have been recommended in British Columbia and Ontario in 2011, respectively. Caution should be taken when interpreting the changes over time as the total number of diagnosis captured through this program are very small due to the sampling scheme and changed could be due to data capture rather than physician practices.

In 2011, 8% of all diagnoses made by office-based physicians in Canada had an antimicrobial recommended for its treatment. Fifty-one percent of all antimicrobial recommendations were made for the treatment of diseases of the respiratory system, followed by infections of the urinary tract (14%), diseases of the skin and subcutaneous tissue (11%) and diseases of the ear (10%).

Antimicrobials were recommended to all age groups in 2011, with proportionally higher recommendation rates to patients in the age group 0 to 2 years (12 antimicrobial recommendations/10 inhabitants), 3 to 9 (9/10 inhabitants) and 60 to 64 and older than 65 (7/10 inhabitants each) years of age.

The most commonly recommended antimicrobials in 2011 were the macrolides (1,638 recommendations/10,000 inhabitants), penicillins with extended spectrum (1,504/10,000 inhabitants), and the fluoroquinolones (1,202/10,000 inhabitants). However, high increases in the number of physician recommendations were observed for third-generation cephalosporins (42% increase compared to 2007) due to increase in recommendations for treatment of diseases of the respiratory system, disease of the genitourinary system and infections of the urinary tract.

Provincial variation in the total number of antimicrobial recommendations/1,000 inhabitants was observed, with the Atlantic region (7,101 recommendations/10,000 inhabitants) and Québec (8,268 recommendations/10,000 inhabitants) having the highest rates compared to the National overall level. Rates of diagnoses and antimicrobial recommendations/10,000 inhabitants varied depending on the province and disease of treatment. Provincial preferences for antimicrobial of choice for treatment of disease were also observed.

**Table 1. Total number of office-based diagnoses, diagnosis rate, total number of antimicrobial recommendations, antimicrobial recommendation rate, and percentage of diagnoses with antimicrobial recommendations by office-based physicians in Canada, by diagnostic class, 2007–2011.**

Diagnostic class	Total diagnoses	Number of diagnoses / 10,000 inhabitants	Antimicrobial recommendations (N)	Number of antimicrobial recommendations / 10,000 inhabitants	Percentage of diagnoses with antimicrobial recommendations
Complications of pregnancy, childbirth, and puerperal	6,404,610	767	111,750	13	1.7
Congenital anomalies	4,803,940	575	63,070	8	1.3
Diseases of blood/blood-forming organs	14,114,360	1,689	214,690	26	1.5
Diseases of skin and subcutaneous tissue	110,490,540	13,224	13,832,250	1,656	12.5
Diseases of the central nervous system	53,731,950	6,431	812,750	97	1.5
Diseases of the circulatory system	173,166,080	20,726	278,820	33	0.2
Diseases of the ear	38,297,150	4,584	11,798,650	1,412	30.8
Diseases of the gastrointestinal system	8,499,550	1,017	443,560	53	5.2
Diseases of the genitourinary system	65,321,910	7,818	4,178,160	500	6.4
Diseases of the respiratory system	189,220,070	22,647	60,214,420	7,207	31.8
Endocrine, nutritional, metabolic, and immunity diseases	143,006,430	17,116	344,220	41	0.2
Infections of the urinary tract	35,926,720	4,300	18,373,650	2,199	51.1
Injuries and poisonings	65,662,210	7,859	1,544,920	185	2.4
Musculoskeletal diseases	148,584,310	17,784	870,200	104	0.6
Neoplasms	37,634,850	4,504	498,550	60	1.3
Other diseases of the digestive system	88,030,490	10,536	4,041,020	484	4.6
Perinatal conditions	2,155,790	258	101,420	12	4.7
Supplementary classifications	195,318,820	23,377	1,157,420	139	0.6
Symptoms and ill-defined conditions	106,937,270	12,799	1,792,200	215	1.7
<b>Total</b>	<b>1,487,307,050</b>	<b>178,013</b>	<b>120,671,720</b>	<b>14,443</b>	<b>8.1</b>

Data does not represent actual prescriptions dispensed by pharmacists or products consumed by the patient, as information on patient compliance was not available. Diagnosis does not represent the number of times a person visits, but represents every time a diagnosis is provided; if a person presents with multiple diseases each individual disease/diagnosis is recorded separately.

**Table 2. Total number of antimicrobial recommendations/10,000 inhabitants provided by office-based physicians in Canada by diagnostic class, by year, 2007–2011.**

Diagnostic class	Number of antimicrobial recommendations / 10,000 inhabitants				
	2007	2008	2009	2010	2011
Complications of pregnancy, childbirth, and puerperal	1	5	11	10	5
Congenital anomalies	5	2	1	5	6
Diseases of blood/blood-forming organs	17	17	10	7	13
Diseases of skin and subcutaneous tissue	833	830	860	829	737
Diseases of the central nervous system	55	53	53	36	43
Diseases of the circulatory system	17	11	22	15	18
Diseases of the ear	678	786	729	650	645
Diseases of the gastrointestinal system	31	21	23	25	31
Diseases of the genitourinary system	247	236	251	262	237
Diseases of the respiratory system	3,833	3,743	3,560	3,312	3,360
Endocrine, nutritional, metabolic, and immunity diseases	24	13	23	23	18
Infections of the urinary tract	1,158	1,151	1,163	1,014	949
Injuries and poisonings	95	76	102	92	92
Musculoskeletal diseases	67	51	49	51	39
Neoplasms	27	21	34	37	27
Other diseases of the digestive system	245	262	261	229	198
Perinatal conditions	3	8	5	10	4
Supplementary classifications	91	146	57	29	22
Symptoms and ill-defined conditions	98	104	112	111	104
<b>Total</b>	<b>7,527</b>	<b>7,534</b>	<b>7,328</b>	<b>6,749</b>	<b>6,550</b>

Data does not represent actual prescriptions dispensed by pharmacists or antimicrobials consumed by the patient, as information on patient compliance was not available.

Diagnosis does not represent the number of times a person visits, but represents every time a diagnosis is provided; if a person presents with multiple diseases each individual disease/diagnosis is recorded separately.



**Table 3. Diagnosis rate, antimicrobial recommendation rate and percentage of diagnosis with antimicrobial recommendation provided by office-based physicians in Canada, by age and by gender, 2011.**

Demographics: age (year) or gender	Number of diagnoses / 10 inhabitants	Antimicrobial recommendations / 10 inhabitants	Percentage of diagnoses with antimicrobial recommendations
<b>Age</b>			
0 to 2	123	12	9.7
3 to 9	52	9	16.5
10 to 19	42	6	13.0
20 to 39	59	6	10.7
40 to 59	81	5	6.6
60 to 64	122	7	5.5
65 or older	152	7	4.9
<b>Gender</b>			
Female	93	7	7.7
Male	71	6	8.0

Data does not represent actual prescriptions dispensed by pharmacists or products consumed by the patient, as information on patient compliance was not available.

Diagnosis does not represent the number of times a person visits, but represents every time a diagnosis is provided; if a person presents with multiple diseases each individual disease/diagnosis is recorded separately.

**Table 4. Total number of antimicrobial recommendations/10,000 inhabitants provided by office-based physicians in Canada by diagnostic class and ICD-9 diagnostic code, 2007–2011.**

ICD-9 diagnostic class diagnostic code	Number of antimicrobial recommendations / 10,000 inhabitants				
	2007	2008	2009	2010	2011
<b>Diseases of skin and subcutaneous tissue</b>					
6829 Cellulitis and abscess-unspecified site	169	195	202	185	188
7061 Acne-unspecified	98	76	77	81	49
6826 Cellulitis and abscess of leg-except foot	46	38	51	47	46
6869 Localized infection of skin and subcutaneous tissue-unspecified	41	41	47	43	38
6840 Impetigo	50	33	33	25	29
Other diagnostic codes	429	447	449	449	387
Total	833	830	860	829	737
<b>Diseases of the ear</b>					
3829 Unspecified otitis media	614	727	648	592	604
3801 Infective otitis externa	26	36	55	22	22
3810 Acute nonsuppurative otitis media	13	9	12	15	8
3842 Perforation of tympanic membrane	1	NAS	NAS	2	3
3889 Unspecified disorders of ear	2	NAS	NAS	2	2
Other diagnostic codes	23	14	13	18	5
Total	678	786	729	650	645
<b>Diseases of the gastrointestinal system</b>					
0093 Diarrhea presumed infectious	12	9	15	11	18
0091 Colitis enteritis gastritis presumed infectious	13	8	7	8	6
0084 Other specified bacteria	1	5	1	5	3
0039 <i>Salmonella</i> infection-unspecified	NAS	NAS	NAS	2	2
0090 Infectious colitis enteritis gastroenteritis	2	NAS	NAS	NAS	2
Other diagnostic codes	3	NAS	NAS	NAS	1
Total	31	21	23	25	31

Data does not represent actual prescriptions dispensed by pharmacists or antimicrobials consumed by the patient, as information on patient compliance was not available.

NAS = No antimicrobials suggested (recommended).

Diagnosis does not represent the number of times a person visits, but represents every time a diagnosis is provided; if a person presents with multiple diseases each individual disease/diagnosis is recorded separately.

The top 5 diagnostic codes for each diagnostic class are presented based on the 2011 data.

**Table 4 (continued). Total number of antimicrobial recommendations/10,000 inhabitants provided by office-based physicians in Canada by diagnostic class and ICD-9 diagnostic code, 2007–2011.**

ICD-9 diagnostic class diagnostic code	Number of antimicrobial recommendations / 10,000 inhabitants				
	2007	2008	2009	2010	2011
<b>Diseases of the genitourinary system</b>					
0788 Other disease due to virus and <i>Chlamydia</i>	48	47	77	57	62
0999 Venereal diseases-unspecific	11	26	22	31	26
6110 Inflammatory disorder of breast	30	43	20	40	22
6049 Orchitis epididymitis, w ithout abscess	19	18	26	17	18
6010 Acute prostatitis	24	18	15	11	15
Other diagnostic codes	115	85	92	106	93
Total	247	236	251	262	237
<b>Diseases of the respiratory system</b>					
4660 Bronchitis-acute	683	674	620	627	640
4619 Sinusitis acute-unspecified	504	498	482	426	470
4659 Acute upper respiratory infections-unspecified site	404	338	381	275	365
4860 Pneumonia-organism unspecified	287	310	290	320	304
4620 Pharyngitis-acute	445	367	371	372	304
Other diagnostic codes	1,510	1,556	1,416	1,292	1,276
Total	3,833	3,743	3,560	3,312	3,360
<b>Infections of the urinary tract</b>					
5990 Urinary tract infection-site unspecified	801	845	790	726	619
5950 Acute cystitis	211	160	190	160	196
5959 Cystitis-unspecified	60	30	65	43	48
7881 Dysuria	11	20	14	15	15
5901 Acute pyelonephritis and pyelonephrosis	21	16	21	19	12
Other diagnostic codes	54	80	84	51	58
Total	1,158	1,151	1,163	1,014	949

Data does not represent actual prescriptions dispensed by pharmacists or antimicrobials consumed by the patient, as information on patient compliance was not available.  
 Diagnosis does not represent the number of times a person visits, but represents every time a diagnosis is provided; if a person presents with multiple diseases each individual disease/diagnosis is recorded separately.  
 The top 5 diagnostic codes for each diagnostic class are presented based on the 2011 data.

**Table 4 (continued). Total number of antimicrobial recommendations/10,000 inhabitants provided by office-based physicians in Canada by diagnostic class and ICD-9 diagnostic code, 2007–2011.**

ICD-9 diagnostic class diagnostic code	Number of antimicrobial recommendations / 10,000 inhabitants				
	2007	2008	2009	2010	2011
<b>Other diagnostic classes</b>					
Complications of pregnancy, childbirth, and puerperal	1	5	11	10	5
Congenital anomalies	5	2	1	5	6
Diseases of blood/blood-forming organs	17	17	10	7	13
Diseases of the central nervous system	55	53	53	36	43
Diseases of the circulatory system	17	11	22	15	18
Endocrine, nutritional, metabolic, and immunity diseases	24	13	23	23	18
Injuries and poisonings	95	76	102	92	92
Musculoskeletal diseases	67	51	49	51	39
Neoplasms	27	21	34	37	27
Other diseases of the digestive system	245	262	261	229	198
Perinatal conditions	3	8	5	10	4
Supplementary classifications	91	146	57	29	22
Symptoms and ill-defined conditions	98	104	112	111	104
Total	746	767	742	656	590
<b>All diagnostic classes total</b>	<b>7,527</b>	<b>7,534</b>	<b>7,328</b>	<b>6,749</b>	<b>6,550</b>

Data does not represent actual prescriptions dispensed by pharmacists or antimicrobials consumed by the patient, as information on patient compliance was not available.  
 Diagnosis does not represent the number of times a person visits, but represents every time a diagnosis is provided; if a person presents with multiple diseases each individual disease/diagnosis is recorded separately.  
 The top 5 diagnostic codes for each diagnostic class are presented based on the 2011 data.

**Table 5. Total number of antimicrobial recommendations/10,000 inhabitants provided by office-based physicians in Canada by diagnostic class and antimicrobial, 2007–2011.**

Diagnostic class	Recommended antimicrobial	Number of antimicrobial recommendations / 10,000 inhabitants				
		2007	2008	2009	2010	2011
Diseases of skin and subcutaneous tissue	Cephalexin	252	257	256	230	264
	Cloxacillin	83	112	84	112	85
	Minocycline	123	104	106	105	69
	Amoxicillin	29	45	38	54	42
	Amoxicillin and enzyme inhibitor	22	31	30	42	39
	Other antimicrobial drugs	323	282	347	287	239
	Total	833	830	860	829	737
Diseases of the ear	Amoxicillin	304	390	379	356	358
	Clarithromycin	112	122	106	110	107
	Cefprozil	76	79	60	52	66
	Azithromycin	45	70	70	54	48
	Amoxicillin and enzyme inhibitor	51	41	33	37	26
	Other antimicrobial drugs	90	84	82	40	39
	Total	678	786	729	650	645
Diseases of the gastrointestinal system	Ciprofloxacin	21	11	19	19	26
	Vancomycin	1	5	3	3	2
	Azithromycin	NAS	3	1	1	1
	Doxycycline	NAS	NAS	NAS	NAS	1
	Ampicillin	NAS	NAS	NAS	NAS	1
	Other antimicrobial drugs	8	2	1	1	NAS
	Total	31	21	23	25	31
Diseases of the genitourinary system	Azithromycin	41	46	56	68	62
	Ciprofloxacin	64	58	53	63	57
	Cefixime	14	19	26	23	26
	Cephalexin	22	30	19	21	22
	Doxycycline	20	16	33	18	21
	Other antimicrobial drugs	86	67	64	68	49
	Total	247	236	251	262	237

Data does not represent actual prescriptions dispensed by pharmacists or antimicrobials consumed by the patient, as information on patient compliance was not available.

NAS = No antimicrobials suggested (recommended).

Diagnosis does not represent the number of times a person visits, but represents every time a diagnosis is provided; if a person presents with multiple diseases each individual disease/diagnosis is recorded separately.

The top 5 antimicrobials prescribed for each diagnostic class are presented based on the 2011 data.

**Table 5 (continued). Total number of antimicrobial recommendations/10,000 inhabitants provided by office-based physicians in Canada by diagnostic class and antimicrobial, 2007–2011.**

Diagnostic class	Recommended antimicrobial	Number of antimicrobial recommendations / 10,000 inhabitants				
		2007	2008	2009	2010	2011
Diseases of the respiratory system	Amoxicillin	1,002	952	970	894	969
	Clarithromycin	972	919	948	916	843
	Azithromycin	532	566	404	437	464
	Moxifloxacin	354	359	321	339	366
	Penicillin v	183	170	151	150	127
	Other antimicrobial drugs	790	777	766	576	591
	<b>Total</b>	<b>3,833</b>	<b>3,743</b>	<b>3,560</b>	<b>3,312</b>	<b>3,360</b>
Infections of the urinary tract	Ciprofloxacin	496	494	510	482	471
	Nitrofurantoin	286	288	296	333	307
	Amoxicillin	36	46	43	28	38
	Norfloxacin	68	53	77	40	27
	Cephalexin	18	11	14	11	22
	Other antimicrobial drugs	253	259	223	120	85
	<b>Total</b>	<b>1,158</b>	<b>1,151</b>	<b>1,163</b>	<b>1,014</b>	<b>949</b>
Other diagnostic classes	Ciprofloxacin	162	207	137	81	84
	Cephalexin	106	100	107	76	84
	Amoxicillin	88	92	90	78	71
	Amoxicillin and enzyme inhibitor	33	18	31	33	43
	Clindamycin	40	45	41	42	29
	Other antimicrobial drugs	317	305	336	346	279
	<b>Total</b>	<b>746</b>	<b>767</b>	<b>742</b>	<b>656</b>	<b>590</b>
<b>All diagnostic classes</b>	<b>Total</b>	<b>7,527</b>	<b>7,534</b>	<b>7,328</b>	<b>6,749</b>	<b>6,550</b>

Data does not represent actual prescriptions dispensed by pharmacists or antimicrobials consumed by the patient, as information on patient compliance was not available.

Diagnosis does not represent the number of times a person visits, but represents every time a diagnosis is provided; if a person presents with multiple diseases each individual disease/diagnosis is recorded separately.

The top 5 antimicrobials prescribed for each diagnostic class are presented based on the 2011 data.

**Table 6. Total number of antimicrobial recommendations/10,000 inhabitants provided by office-based physicians in Canada, for diseases of the gastrointestinal system by ICD-9 diagnostic code and recommended antimicrobial, 2007–2011.**

ICD-9 diagnostic code	Recommended antimicrobial	Number of antimicrobial recommendations / 10,000 inhabitants				
		2007	2008	2009	2010	2011
0039 <i>Salmonella</i> infection-unspecified	Ciprofloxacin	NAS	NAS	NAS	2	2
0059 Food poisoning-unspecified	Ciprofloxacin	1	NAS	NAS	NAS	NAS
0084 Other specified bacteria	Vancomycin	1	4	1	2	2
	Doxycycline	NAS	NAS	NAS	NAS	1
	Ciprofloxacin	NAS	NAS	NAS	3	NAS
	Metronidazole	NAS	1	NAS	NAS	NAS
	Total	1	5	1	5	3
0085 Bacterial enteritis-unspecified	Ciprofloxacin	2	NAS	NAS	NAS	NAS
0090 Infectious colitis enteritis gastroenteritis	Ciprofloxacin	NAS	NAS	NAS	NAS	2
	Cefuroxime axetil	2	NAS	NAS	NAS	NAS
	Total	2	NAS	NAS	NAS	2
0091 Colitis enteritis gastritis presumed infectious	Ciprofloxacin	8	8	6	4	6
	Vancomycin	NAS	NAS	NAS	1	NAS
	Azithromycin	NAS	NAS	NAS	1	NAS
	Levofloxacin	NAS	NAS	NAS	1	NAS
	Cefuroxime axetil	NAS	NAS	1	NAS	NAS
	Metronidazole	2	NAS	NAS	NAS	NAS
	Cephalexin	2	NAS	NAS	NAS	NAS
	Sulfamethoxazole and trimethoprim	2	NAS	NAS	NAS	NAS
	Total	13	8	7	8	6
0093 Diarrhea presumed infectious	Ciprofloxacin	10	3	13	10	16
	Azithromycin	NAS	3	1	NAS	1
	Vancomycin	1	1	2	1	NAS
	Sulfamethoxazole and trimethoprim	2	2	NAS	NAS	NAS
	Total	12	9	15	11	18
0414 <i>Escherichia coli</i>	Ampicillin	NAS	NAS	NAS	NAS	1
<b>All diagnostic codes</b>	<b>Total</b>	<b>31</b>	<b>21</b>	<b>23</b>	<b>25</b>	<b>31</b>

Data does not represent actual prescriptions dispensed by pharmacists or antimicrobials consumed by the patient, as information on patient compliance was not available.

NAS = No antimicrobials suggested (recommended).

Diagnosis does not represent the number of times a person visits, but represents every time a diagnosis is provided; if a person presents with multiple diseases each individual disease/diagnosis is recorded separately.

It is possible that some *Escherichia coli* were causing a urinary tract infection as opposed to a disease of the gastrointestinal system; however, due to the way data was coded, it was difficult to ascertain this information.

**Table 7. Total number of antimicrobial recommendations/10,000 inhabitants provided by office-based physicians in Canada, by antimicrobial classification and respective top three diagnostic classes, 2007–2011.**

ATC class	Diagnostic class	Number of antimicrobial recommendations / 10,000 inhabitants				
		2007	2008	2009	2010	2011
Combinations of penicillins, including $\beta$ -lactamase inhibitors (J01CR)	Diseases of the respiratory system	118	143	143	103	130
	Diseases of skin and subcutaneous tissue	25	31	36	45	40
	Diseases of the ear	51	41	33	37	26
	Total number of diagnoses	247	240	264	243	267
Third-generation cephalosporins (J01DD)	Diseases of the respiratory system	15	31	25	33	38
	Diseases of the genitourinary system	14	19	28	27	30
	Infections of the urinary tract	18	21	10	18	28
	Total number of diagnoses	95	95	105	107	135
Carbapenems (J01DH)	Diseases of the respiratory system	NAS	4	3	4	2
	Musculoskeletal diseases	2	2	1	NAS	2
	Diseases of the central nervous system	NAS	NAS	NAS	NAS	1
	Total number of visits	4	13	8	13	7
I Fourth-generation cephalosporins (J01DI)	Diseases of the respiratory system	NAS	NAS	NAS	1	NAS
	Total number of diagnoses	NAS	NAS	NAS	1	NAS
Fluoroquinolones (J01MA)	Infections of the urinary tract	574	554	598	529	508
	Diseases of the respiratory system	516	506	446	458	466
	Diseases of the genitourinary system	86	71	72	73	66
	Total number of diagnoses	1,431	1,427	1,366	1,217	1,202
Glycopeptides (J01XA)	Symptoms and ill-defined conditions	4	3	6	9	7
	Diseases of skin and subcutaneous tissue	5	5	4	1	5
	Musculoskeletal diseases	6	1	4	4	4
	Total number of diagnoses	30	22	28	29	28
Imidazole (J01XD)	Diseases of the respiratory system	NAS	4	3	1	NAS
	Other diseases of the digestive system	7	2	7	1	1
	Infections of the urinary tract	NAS	1	NAS	1	NAS
	Total number of diagnoses	15	9	15	3	1

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

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ATC = Anatomical Therapeutic Chemical. NAS = No antimicrobials suggested (recommended).

Diagnosis does not represent the number of times a person visits, but represents every time a diagnosis is provided; if a person presents with multiple diseases each individual disease/diagnosis is recorded separately.

The top 3 diagnostic classes for each antimicrobial class are presented based on the 2011 data. The exceptions are intermediate-acting sulfonamides (based on 2011 and then 2009 data) and imidazole (based on the 2011 and then 2010 data).



**Table 7 (continued). Total number of antimicrobial recommendations/10,000 inhabitants provided by office-based physicians in Canada, by antimicrobial classification and respective top three diagnostic classes, 2007–2011.**

ATC class	Diagnostic class	Number of antimicrobial recommendations / 10,000 inhabitants				
		2007	2008	2009	2010	2011
Penicillins with extended spectrum (J01CA)	Diseases of the respiratory system	1,058	975	980	902	975
	Diseases of the ear	307	395	379	357	358
	Other diseases of the digestive system	50	54	45	59	42
	Total number of diagnoses	1,545	1,577	1,553	1,442	1,504
β-lactamase sensitive penicillins (J01CE)	Diseases of the respiratory system	191	175	163	156	131
	Other diseases of the digestive system	36	47	33	43	28
	Diseases of skin and subcutaneous tissue	7	5	7	19	14
	Total number of diagnoses	241	243	216	232	182
β-lactamase resistant penicillins (J01CF)	Diseases of skin and subcutaneous tissue	83	112	84	112	87
	Diseases of the genitourinary system	11	16	4	17	10
	Injuries and poisonings	6	8	6	21	6
	Total number of diagnoses	130	155	122	181	129
First-generation cephalosporins (J01DB)	Diseases of skin and subcutaneous tissue	272	293	300	257	289
	Diseases of the respiratory system	71	29	32	37	41
	Injuries and poisonings	32	27	47	27	29
	Total number of diagnoses	527	488	511	437	478
Second-generation cephalosporins (J01DC)	Diseases of the respiratory system	194	234	259	191	186
	Diseases of the ear	96	101	82	60	74
	Diseases of skin and subcutaneous tissue	31	35	31	17	12
	Total number of diagnoses	343	394	398	296	293
Combinations of sulfonamides and trimethoprim, including derivatives (J01EE)	Infections of the urinary tract	181	181	150	43	9
	Diseases of the respiratory system	40	48	38	12	3
	Diseases of the genitourinary system	12	3	10	1	2
	Total number of diagnoses	289	273	239	73	16

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

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Diagnosis does not represent the number of times a person visits, but represents every time a diagnosis is provided; if a person presents with multiple diseases each individual disease/diagnosis is recorded separately.

The top 3 diagnostic classes for each antimicrobial class are presented based on the 2011 data. The exceptions are intermediate-acting sulfonamides (based on 2011 and then 2009 data) and imidazole (based on the 2011 and then 2010 data).

**Table 7 (continued). Total number of antimicrobial recommendations/10,000 inhabitants provided by office-based physicians in Canada, by antimicrobial classification and respective top three diagnostic classes, 2007–2011.**

ATC class	Diagnostic class	Number of antimicrobial recommendations / 10,000 inhabitants				
		2007	2008	2009	2010	2011
Macrolides (J01FA)	Diseases of the respiratory system	1,557	1,522	1,379	1,368	1,327
	Diseases of the ear	163	197	178	165	157
	Diseases of the genitourinary system	46	46	58	68	62
	Total number of diagnoses	1,901	1,898	1,748	1,718	1,638
Lincosamides (J01FF)	Diseases of skin and subcutaneous tissue	31	23	51	52	31
	Other diseases of the digestive system	29	26	30	24	20
	Diseases of the respiratory system	17	19	19	9	17
	Total number of diagnoses	100	97	115	112	88
II Aminoglycosides (J01GB)	Infections of the urinary tract	5	1	3	6	6
	Diseases of the circulatory system	2	NAS	1	3	6
	Other diseases of the digestive system	3	1	NAS	1	3
	Total number of diagnoses	18	14	11	20	25
Steroid antibacterials (J01XC)	Diseases of skin and subcutaneous tissue	3	3	2	2	6
	Injuries and poisonings	NAS	NAS	3	9	2
	Endocrine, nutritional, metabolic, and immunity diseases	NAS	NAS	NAS	NAS	2
	Total number of diagnoses	5	5	9	11	14

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

Data does not represent actual prescriptions dispensed by pharmacists or antimicrobials consumed by the patient, as information on patient compliance was not available.

ATC = Anatomical Therapeutic Chemical. NAS = No antimicrobials suggested (recommended).

Diagnosis does not represent the number of times a person visits, but represents every time a diagnosis is provided; if a person presents with multiple diseases each individual disease/diagnosis is recorded separately.

The top 3 diagnostic classes for each antimicrobial class are presented based on the 2011 data. The exceptions are intermediate-acting sulfonamides (based on 2011 and then 2009 data) and imidazole (based on the 2011 and then 2010 data).

**Table 7 (continued). Total number of antimicrobial recommendations/10,000 inhabitants provided by office-based physicians in Canada, by antimicrobial classification and respective top three diagnostic classes, 2007–2011.**

ATC class	Diagnostic class	Number of antimicrobial recommendations / 10,000 inhabitants				
		2007	2008	2009	2010	2011
Tetracyclines (J01AA)	Diseases of skin and subcutaneous tissue	205	163	159	174	136
	Diseases of the respiratory system	35	37	55	31	38
	Diseases of the genitourinary system	22	18	37	24	21
	Total number of diagnoses	294	273	298	258	223
Trimethoprim and derivatives (J01EA)	Infections of the urinary tract	4	8	6	11	5
	Neoplasms	2	0	2	2	3
	Diseases of skin and subcutaneous tissue	1	NAS	NAS	NAS	1
	Total number of diagnoses	8	8	9	13	9
Intermediate-acting sulfonamides (J01EC)	Other diseases of the digestive system	NAS	NAS	NAS	NAS	0
	Infections of the urinary tract	NAS	NAS	3	NAS	NAS
	Diseases of skin and subcutaneous tissue	NAS	NAS	0	NAS	NAS
	Total number of diagnoses	3	NAS	4	NAS	0
Nitrofurantoin derivatives (J01XE)	Diseases of the genitourinary system	2	2	0	1	2
	Symptoms and ill-defined conditions	2	4	7	9	2
	Infections of the urinary tract	286	288	296	333	307
	Total number of diagnoses	295	299	307	342	312
<b>Total (J01)</b>		<b>7,527</b>	<b>7,534</b>	<b>7,328</b>	<b>6,749</b>	<b>6,550</b>

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

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ATC = Anatomical Therapeutic Chemical. NAS = No antimicrobials suggested (recommended).

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The top 3 diagnostic classes for each antimicrobial class are presented based on the 2011 data. The exceptions are intermediate-acting sulfonamides (based on 2011 and then 2009 data) and imidazole (based on the 2011 and then 2010 data).

**Table 8. Total number of antimicrobial recommendations/10,000 inhabitants provided by office-based physicians in Canada, by antimicrobial classification and antimicrobial, 2007–2011.**

ATC class	Recommended antimicrobial	Number of antimicrobial recommendations / 10,000 inhabitants				
		2007	2008	2009	2010	2011
Combinations of penicillins, including $\beta$ -lactamase inhibitors (J01CR)	Amoxicillin and enzyme inhibitor (J01CR02)	230	225	235	214	236
	Ticarcillin and enzyme inhibitor (J01CR03)	5	2	1	NAS	3
	Piperacillin and enzyme inhibitor (J01CR05)	12	13	28	29	27
Third-generation cephalosporins (J01DD)	Cefotaxime (J01DD01)	8	1	4	4	4
	Ceftazidime (J01DD02)	2	4	4	4	4
	Ceftriaxone (J01DD04)	40	44	43	49	59
	Ceftizoxime (J01DD07)	4	8	3	2	NAS
	Cefixime (J01DD08)	42	37	50	48	68
Carbapenems (J01DH)	Meropenem (J01DH02)	3	10	7	11	6
	Ertapenem (J01DH03)	1	1	1	1	1
	Imipenem and enzyme inhibitor (J01DH51)	NAS	2	NAS	NAS	NAS
I Fourth-generation cephalosporins (J01DI)	Ceftobiprole medocartil (J01DI01)	NAS	NAS	NAS	1	NAS
Fluoroquinolones (J01MA)	Ofloxacin (J01MA01)	8	10	12	2	3
	Ciprofloxacin (J01MA02)	845	845	811	720	682
	Norfloxacin (J01MA06)	81	61	90	53	36
	Levofloxacin (J01MA12)	119	121	114	89	98
	Moxifloxacin (J01MA14)	373	384	339	353	383
	Gemifloxacin (J01MA15)	3	6	NAS	NAS	NAS
	Gatifloxacin (J01MA16)	2	NAS	NAS	NAS	NAS
Glycopeptides (J01XA)	Vancomycin (J01XA01)	30	22	28	29	28
Imidazole (J01XD)	Metronidazole (J01XD01)	15	9	15	3	1
Linezolid (J01XX)	Linezolid (J01XX08)	4	1	3	1	NAS

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

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Diagnosis does not represent the number of times a person visits, but represents every time a diagnosis is provided; if a person presents with multiple diseases each individual disease/diagnosis is recorded separately.

Chloramphenicol was removed from this table due to low (< 0.01 prescriptions/1,000 inhabitants) to no sales reported during the study period.

**Table 8 (continued). Total number of antimicrobial recommendations/10,000 inhabitants provided by office-based physicians in Canada, by antimicrobial classification and antimicrobial, 2007–2011.**

ATC class	Recommended antimicrobial	Number of antimicrobial recommendations / 10,000 inhabitants				
		2007	2008	2009	2010	2011
Penicillins with extended spectrum (J01CA)	Ampicillin (J01CA01)	33	18	27	27	21
	Amoxicillin (J01CA04)	1,466	1,536	1,525	1,412	1,483
	Pivampicillin (J01CA02)	46	21	NAS	3	NAS
	Carbenicillin (J01CA03)	NAS	NAS	1	NAS	NAS
	Piperacillin (J01CA12)	NAS	2	1	NAS	NAS
$\beta$ -lactamase sensitive penicillins (J01CE)	Penicillin G (J01CE01)	14	12	22	25	16
	Penicillin V (J01CE02)	227	232	194	208	166
$\beta$ -lactamase resistant penicillins (J01CF)	Cloxacillin (J01CF02)	129	155	122	181	127
	Dicloxacillin (J01CF01)	NAS	NAS	NAS	NAS	2
	Flucloxacillin (J01CF05)	1	NAS	NAS	NAS	NAS
First-generation cephalosporins (J01DB)	Cephalexin (J01DB01)	485	442	436	381	441
	Cefadroxil (J01DB05)	31	39	67	49	30
	Cefazolin (J01DB04)	11	7	8	7	8
	Cephalothin (J01DB03)	NAS	0	NAS	NAS	NAS
Second-generation cephalosporins (J01DC)	Cefoxitin (J01DC01)	4	1	2	3	4
	Cefuroxime axetil (J01DC02)	111	140	145	104	115
	Cefaclor (J01DC04)	22	36	30	6	NAS
	Cefprozil (J01DC10)	207	217	221	183	174
Combinations of sulfonamides and trimethoprim, including derivatives (J01EE)	Sulfamethoxazole and trimethoprim (J01EE01)	284	265	233	72	11
	Sulfadiazine and trimethoprim (J01EE02)	5	8	6	1	5

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Diagnosis does not represent the number of times a person visits, but represents every time a diagnosis is provided; if a person presents with multiple diseases each individual disease/diagnosis is recorded separately.

Chloramphenicol was removed from this table due to low (< 0.01 prescriptions/1,000 inhabitants) to no sales reported during the study period.

**Table 8 (continued). Total number of antimicrobial recommendations/10,000 inhabitants provided by office-based physicians in Canada, by antimicrobial classification and antimicrobial, 2007–2011.**

	ATC class	Recommended antimicrobial	Number of antimicrobial recommendations / 10,000 inhabitants				
			2007	2008	2009	2010	2011
	Macrolides (J01FA)	Azithromycin (J01FA10)	658	749	577	599	607
		Clarithromycin (J01FA09)	1,156	1,081	1,119	1,095	995
		Erythromycin (J01FA01)	66	65	50	24	36
		Telithromycin (J01FA15)	21	3	2	NAS	NAS
	Lincosamides (J01FF)	Clindamycin (J01FF01)	100	97	115	112	88
II	Streptomycin (J01GA)	Streptomycin (J01GA01)	0	0	NAS	NAS	NAS
	Aminoglycosides (J01GB)	Tobramycin (J01GB01)	2	4	1	0	7
		Gentamicin (J01GB03)	14	10	10	19	19
		Amikacin (J01GB06)	1	NAS	NAS	NAS	NAS
	Sulfonamide combinations (excluding trimethoprim) (J01RA)	Erythromycin-sulfisoxazole (J01RA02)	1	2	NAS	NAS	NAS
	Steroid antimicrobials (J01XC)	Fusidic acid (J01XC01)	5	5	9	11	14
	Tetracyclines (J01AA)	Doxycycline (J01AA02)	99	115	147	94	105
		Minocycline (J01AA08)	126	109	111	109	75
		Tetracycline (J01AA07)	70	49	37	52	43
		Tigecycline (J01AA12)	NAS	NAS	2	3	NAS
III	Trimethoprim and derivatives (J01EA)	Trimethoprim (J01EA01)	8	8	9	13	9
	Intermediate-acting sulfonamides (J01EC)	Sulfadiazine (J01EC02), sulfamethoxazole (J01EC04)	3	NAS	4	NAS	0
	Nitrofurantoin derivatives (J01XE)	Nitrofurantoin (J01XE01)	295	299	307	342	312
<b>Total (J01)</b>			<b>7,527</b>	<b>7,534</b>	<b>7,328</b>	<b>6,749</b>	<b>6,550</b>

Data does not represent actual prescriptions dispensed by pharmacists or antimicrobials consumed by the patient, as information on patient compliance was not available.

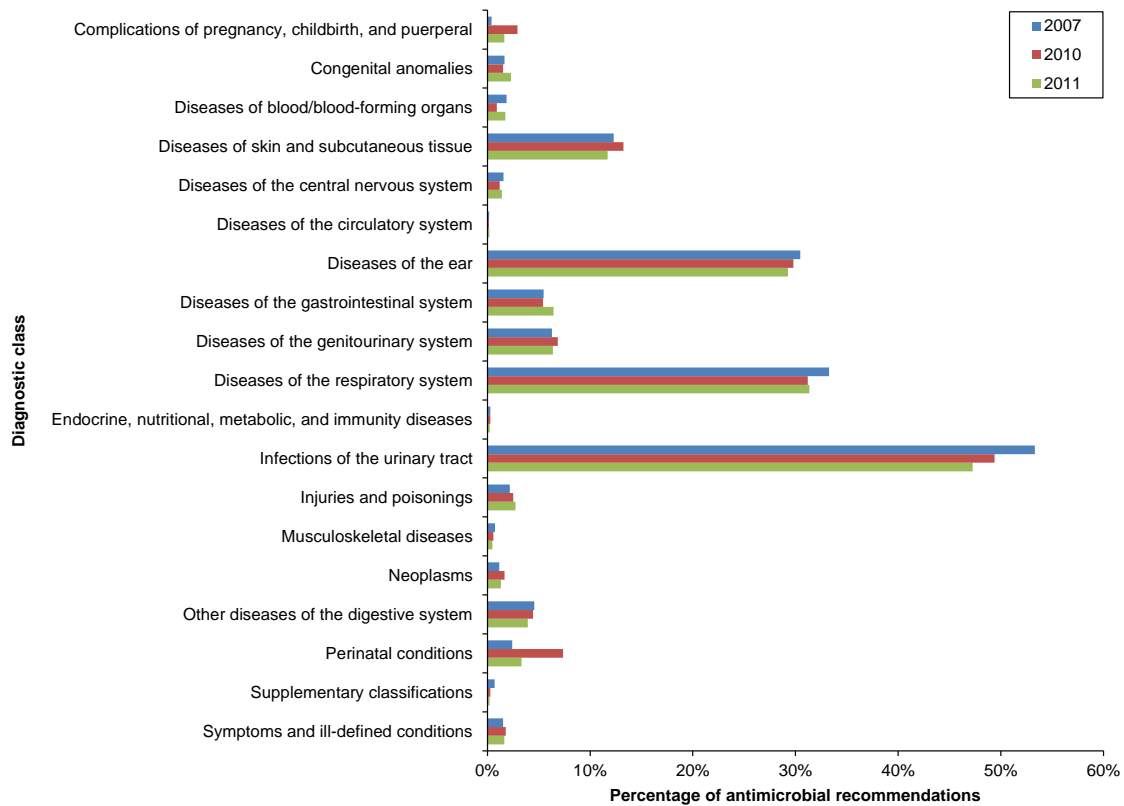
ATC = Anatomical Therapeutic Chemical. NAS = No antimicrobials suggested (recommended).

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

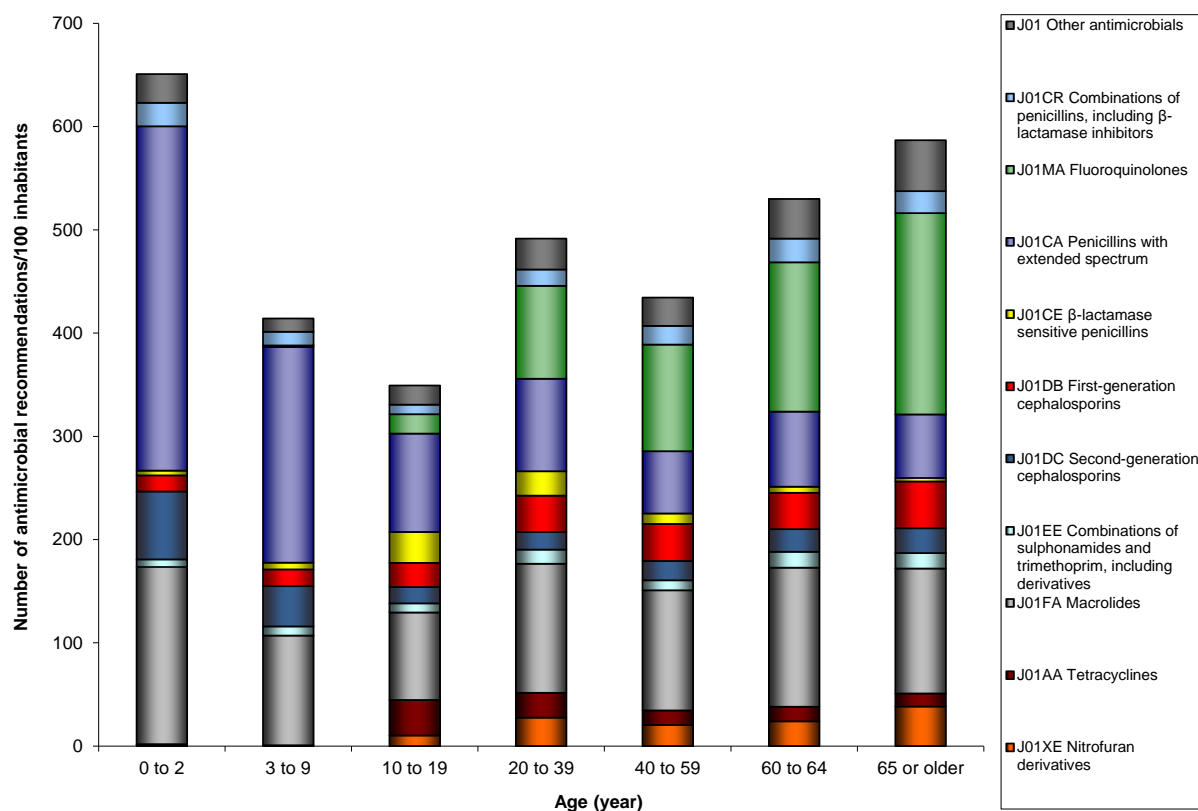
Diagnosis does not represent the number of times a person visits, but represents every time a diagnosis is provided; if a person presents with multiple diseases each individual disease/diagnosis is recorded separately.

Chloramphenicol was removed from this table due to low (< 0.01 prescriptions/1,000 inhabitants) to no sales reported during the study period.

**Figure 1. Percentage of diagnoses that received an antimicrobial recommendation by office-based physicians in Canada, 2007, 2010 and 2011.**



**Figure 2. Total number of antimicrobial recommendations/100 inhabitants provided by office-based physicians in Canada, by age and antimicrobial classification, 2007–2011.**



Alphanumeric codes represent Anatomical Therapeutic Chemical classes of antimicrobials.

Data does not represent actual prescriptions dispensed by pharmacists or antimicrobials consumed by the patient, as information on patient compliance was not available.

Diagnosis does not represent the number of times a person visits, but represents every time a diagnosis is provided; if a person presents with multiple diseases each individual disease/diagnosis is recorded separately.



**Table 9. Diagnosis rate, antimicrobial recommendation rate and percentage of diagnoses with antimicrobial recommendations provided by office-based physicians in Canada, by diagnostic class and province/region, 2011.**

Diagnostic class	Province / region	Number of diagnoses / 10,000 inhabitants	Antimicrobial recommendations / 10,000 inhabitants	Percentage of diagnoses with antimicrobial recommendations
Complications of pregnancy, childbirth, and puerperal	British Columbia	350	NAS	NAS
	Prairies	303	3	1.1
	Ontario	271	NAS	NAS
	Quebec	330	19	5.7
	Atlantic	298	NAS	NAS
	Total	302	5	1.6
Congenital anomalies	British Columbia	374	10	2.7
	Prairies	265	13	4.7
	Ontario	171	5	2.9
	Quebec	296	NAS	NAS
	Atlantic	530	10	1.9
	Total	267	6	2.3
Diseases of blood/blood-forming organs	British Columbia	715	NAS	NAS
	Prairies	665	12	1.8
	Ontario	744	20	2.7
	Quebec	707	13	1.9
	Atlantic	1,242	NAS	NAS
	Total	749	13	1.7
Diseases of skin and subcutaneous tissue	British Columbia	7,602	820	10.8
	Prairies	6,061	706	11.6
	Ontario	5,866	792	13.5
	Quebec	6,399	664	10.4
	Atlantic	6,741	631	9.4
	Total	6,295	737	11.7
Diseases of the central nervous system	British Columbia	3,472	73	2.1
	Prairies	2,440	33	1.3
	Ontario	3,297	39	1.2
	Quebec	3,020	37	1.2
	Atlantic	2,811	57	2.0
	Total	3,061	43	1.4
Diseases of the circulatory system	British Columbia	9,503	48	0.5
	Prairies	9,231	5	0.0
	Ontario	9,479	19	0.2
	Quebec	1,037	8	0.8
	Atlantic	12,081	24	0.2
	Total	9,792	18	0.2

Data does not represent actual prescriptions dispensed by pharmacists or products consumed by the patient, as information on patient compliance was not available.

NAS = No antimicrobials suggested (recommended).

Diagnosis does not represent the number of times a person visits, but represents every time a diagnosis is provided; if a person presents with multiple diseases each individual disease/diagnosis is recorded separately.

The Atlantic region includes the provinces of New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador.

The Prairies include the provinces of Alberta, Saskatchewan, and Manitoba.

**Table 9 (continued). Diagnosis rate, antimicrobial recommendation rate and percentage of diagnoses with antimicrobial recommendations provided by office-based physicians in Canada, by diagnostic class and province/region, 2011.**

Diagnostic class	Province / region	Number of diagnoses / 10,000 inhabitants	Antimicrobial recommendations / 10,000 inhabitants	Percentage of diagnoses with antimicrobial recommendations
Diseases of the ear	British Columbia	2,285	349	15.3
	Prairies	1,628	460	28.2
	Ontario	1,708	514	30.1
	Quebec	3,123	1,168	37.4
	Atlantic	3,348	702	21.0
	Total	2,204	645	29.3
Diseases of the gastrointestinal system	British Columbia	452	53	11.6
	Prairies	521	9	1.7
	Ontario	461	29	6.4
	Quebec	530	28	5.3
	Atlantic	445	69	15.6
	Total	484	31	6.4
Diseases of the genitourinary system	British Columbia	3,646	207	5.7
	Prairies	3,500	252	7.2
	Ontario	3,606	218	6.0
	Quebec	3,815	277	7.3
	Atlantic	4,957	243	4.9
	Total	3,722	237	6.4
Diseases of the respiratory system	British Columbia	9,699	2,649	27.3
	Prairies	10,193	3,307	32.4
	Ontario	9,687	3,000	31.0
	Quebec	13,044	4,377	33.6
	Atlantic	12,504	3,641	29.1
	Total	10,715	3,360	31.4
Endocrine, nutritional, metabolic, and immunity diseases	British Columbia	7,353	NAS	NAS
	Prairies	6,940	14	0.2
	Ontario	8,557	23	0.3
	Quebec	8,477	28	0.3
	Atlantic	11,215	5	< 0.1
	Total	8,247	18	0.2
Infections of the urinary tract	British Columbia	2,241	982	43.8
	Prairies	1,886	825	43.8
	Ontario	1,869	855	45.7
	Quebec	1,891	1,143	60.5
	Atlantic	3,164	1,134	35.8
	Total	2,009	949	47.3

Data does not represent actual prescriptions dispensed by pharmacists or products consumed by the patient, as information on patient compliance was not available.

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**Table 9 (continued). Diagnosis rate, antimicrobial recommendation rate and percentage of diagnoses with antimicrobial recommendations provided by office-based physicians in Canada, by diagnostic class and province/region, 2011.**

Diagnostic class	Province / region	Number of diagnoses / 10,000 inhabitants	Antimicrobial recommendations / 10,000 inhabitants	Percentage of diagnoses with antimicrobial recommendations
Injuries and poisonings	British Columbia	5,400	99	1.8
	Prairies	3,446	93	2.7
	Ontario	2,864	94	3.3
	Quebec	3,221	90	2.8
	Atlantic	2,398	73	3.0
	Total	3,345	92	2.7
Musculoskeletal diseases	British Columbia	8,402	4	< 0.1
	Prairies	8,748	53	0.6
	Ontario	7,911	56	0.7
	Quebec	6,804	13	0.2
	Atlantic	11,928	69	0.6
	Total	8,116	39	0.5
Neoplasms	British Columbia	2,012	10	0.5
	Prairies	1,630	3	0.2
	Ontario	1,840	8	0.5
	Quebec	2,645	95	3.6
	Atlantic	2,614	NAS	NAS
	Total	2,059	27	1.3
Other diseases of the digestive system	British Columbia	4,925	237	4.8
	Prairies	5,460	138	2.5
	Ontario	4,547	214	4.7
	Quebec	4,962	224	4.5
	Atlantic	7,311	106	1.5
	Total	5,028	198	3.9
Perinatal conditions	British Columbia	123	NAS	NAS
	Prairies	154	16	10.1
	Ontario	151	NAS	NAS
	Quebec	96	6	6.5
	Atlantic	35	NAS	NAS
	Total	127	4	3.3
Supplementary classifications	British Columbia	10,174	12	0.1
	Prairies	12,776	9	0.1
	Ontario	10,851	24	0.2
	Quebec	9,323	37	0.4
	Atlantic	10,867	21	0.2
	Total	10,714	22	0.2
Symptoms and ill-defined conditions	British Columbia	6,427	97	1.5
	Prairies	5,819	68	1.2
	Ontario	6,666	123	1.9
	Quebec	4,792	41	0.9
	Atlantic	10,502	315	3.0
	Total	6,291	104	1.7

Data does not represent actual prescriptions dispensed by pharmacists or products consumed by the patient, as information on patient compliance was not available.

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**Table 10. Total number of antimicrobial recommendations/10,000 inhabitants provided by office-based physicians for each diagnostic class, antimicrobial and Canadian province/region, 2011.**

Diagnostic class	Recommended antimicrobial	Number of antimicrobial recommendations / 10,000 inhabitants				
		British Columbia	Prairies	Ontario	Quebec	Atlantic
Diseases of skin and subcutaneous tissue	Amoxicillin	24	36	49	45	36
	Amoxicillin and enzyme inhibitor	48	18	29	70	24
	Cephalexin	367	333	265	154	271
	Cloxacillin	54	97	125	36	60
	Minocycline	86	55	67	84	40
	Other antimicrobial drugs	241	167	258	275	199
	Total	820	706	792	664	631
Diseases of the ear	Amoxicillin	216	328	292	570	383
	Amoxicillin and enzyme inhibitor	24	9	32	40	NAS
	Azithromycin	24	43	35	85	54
	Cefprozil	NAS	12	64	156	47
	Clarithromycin	60	54	56	264	103
	Other antimicrobial drugs	24	13	35	53	115
	Total	349	460	514	1,168	702
Diseases of the gastrointestinal system	Ampicillin	5	NAS	NAS	NAS	NAS
	Azithromycin	NAS	NAS	NAS	NAS	21
	Ciprofloxacin	48	9	21	28	48
	Doxycycline	NAS	NAS	2	NAS	NAS
	Vancomycin	NAS	NAS	6	NAS	NAS
	Total	53	9	29	28	69
Diseases of the genitourinary system	Azithromycin	36	82	51	91	24
	Cefixime	NAS	45	34	22	NAS
	Cephalexin	38	27	26	3	24
	Ciprofloxacin	72	44	38	59	171
	Doxycycline	9	18	20	37	NAS
	Other antimicrobial drugs	52	36	49	65	24
	Total	207	252	218	277	243

Data does not represent actual prescriptions dispensed by pharmacists or products consumed by the patient, as information on patient compliance was not available.

NAS = No antimicrobials suggested (recommended).

Diagnosis does not represent the number of times a person visits, but represents every time a diagnosis is provided; if a person presents with multiple diseases each individual disease/diagnosis is recorded separately.

Provincial summaries for each diagnostic class are based on the top five antimicrobial drugs for which a prescription was written within the respective class in 2011.

The Atlantic region includes the provinces of New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador.

The Prairies include the provinces of Alberta, Saskatchewan, and Manitoba.

**Table 10 (continued). Total number of antimicrobial recommendations/10,000 inhabitants provided by office-based physicians for each diagnostic class, antimicrobial and Canadian province/region, 2011.**

Diagnostic class	Recommended antimicrobial	Number of antimicrobial recommendations / 10,000 inhabitants				
		British Columbia	Prairies	Ontario	Quebec	Atlantic
Diseases of the respiratory system	Amoxicillin	937	1,327	902	872	856
	Azithromycin	329	582	448	490	448
	Clarithromycin	546	566	836	1,216	950
	Moxifloxacin	253	95	280	782	386
	Penicillin V	228	17	71	288	NAS
	Other antimicrobial drugs	356	721	463	728	1,002
	Total	2,649	3,307	3,000	4,377	3,641
Infections of the urinary tract	Amoxicillin	60	49	40	25	NAS
	Cephalexin	NAS	57	21	15	NAS
	Ciprofloxacin	356	379	291	871	618
	Nitrofurantoin	472	225	382	143	341
	Norfloxacin	NAS	23	54	2	24
	Other antimicrobial drugs	94	92	66	87	151
	Total	982	825	855	1,143	1,134
Other diagnostic classes	Ciprofloxacin	58	18	112	100	96
	Cephalexin	43	72	100	67	162
	Amoxicillin	72	69	63	55	175
	Amoxicillin and enzyme inhibitor	99	45	32	33	24
	Clindamycin	48	5	39	31	NAS
	Other antimicrobial drugs	269	251	279	325	223
	Total	590	459	625	611	680
<b>All diagnostic classes total</b>		<b>5,650</b>	<b>6,019</b>	<b>6,034</b>	<b>8,268</b>	<b>7,101</b>

Data does not represent actual prescriptions dispensed by pharmacists or products consumed by the patient, as information on patient compliance was not available.

NAS = No antimicrobials suggested (recommended).

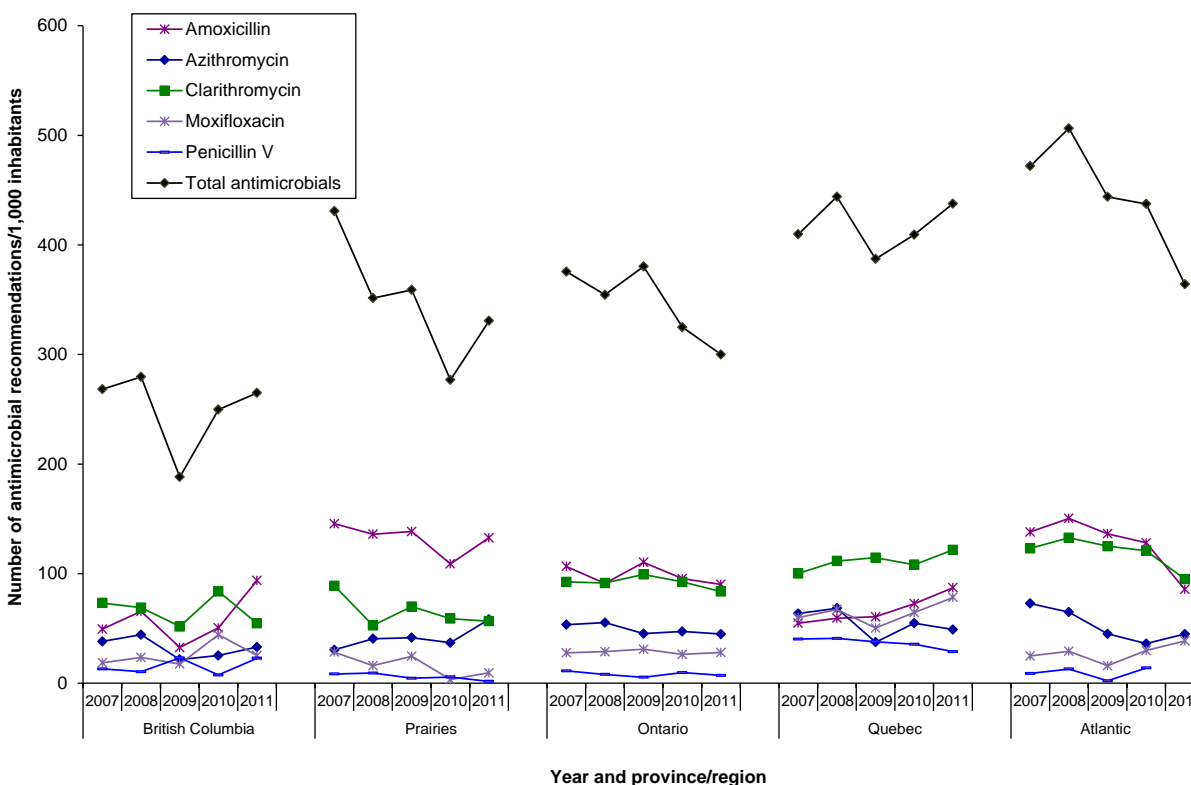
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**Figure 3. Top 5 antimicrobials recommended/1,000 inhabitants by office-based physicians in Canadian regions, for diseases of the respiratory system, 2007–2011.**



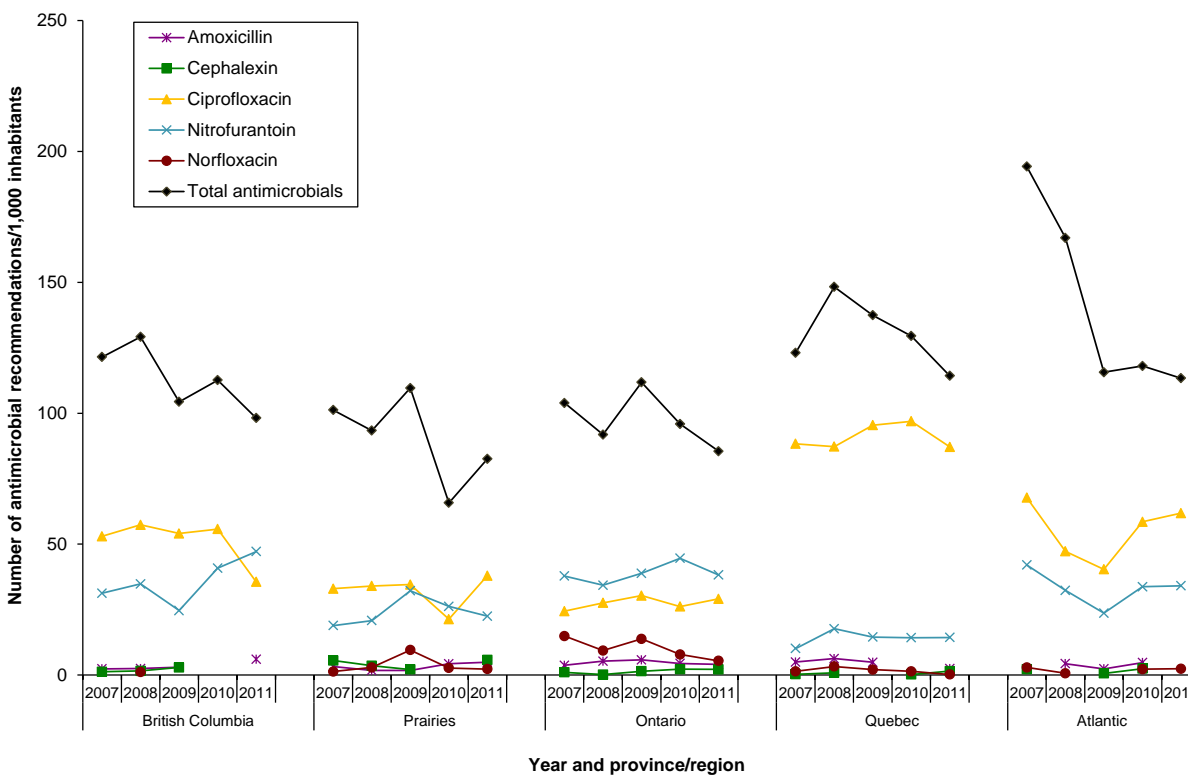
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Provincial summaries for each diagnostic class are based on the top five antimicrobial drugs for which a prescription was written within the respective class in 2011.

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**Figure 4. Top 5 antimicrobials recommended/1,000 inhabitants by office-based physicians in Canadian regions, for infections of the urinary tract, 2007–2011.**



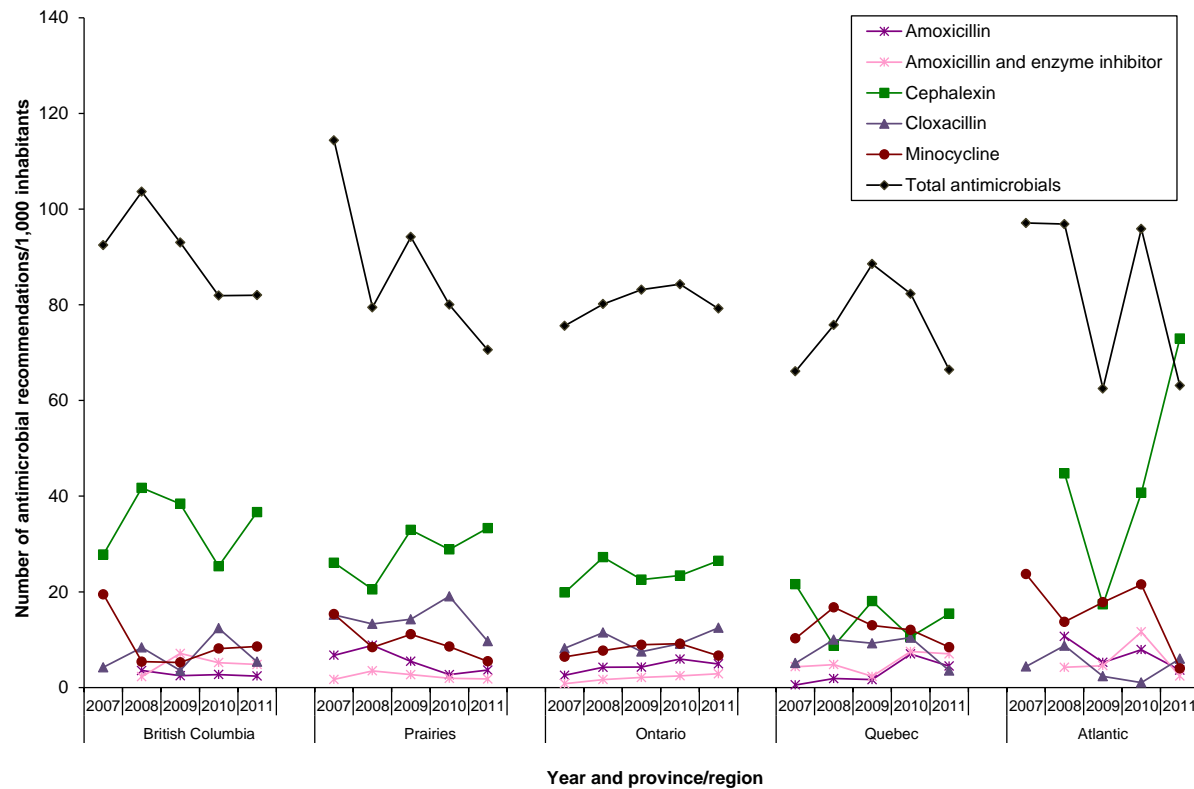
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**Figure 5. Top 5 antimicrobials recommended/1,000 inhabitants by office-based physicians in Canadian regions, for diseases of the skin and subcutaneous tissue, 2007–2011.**



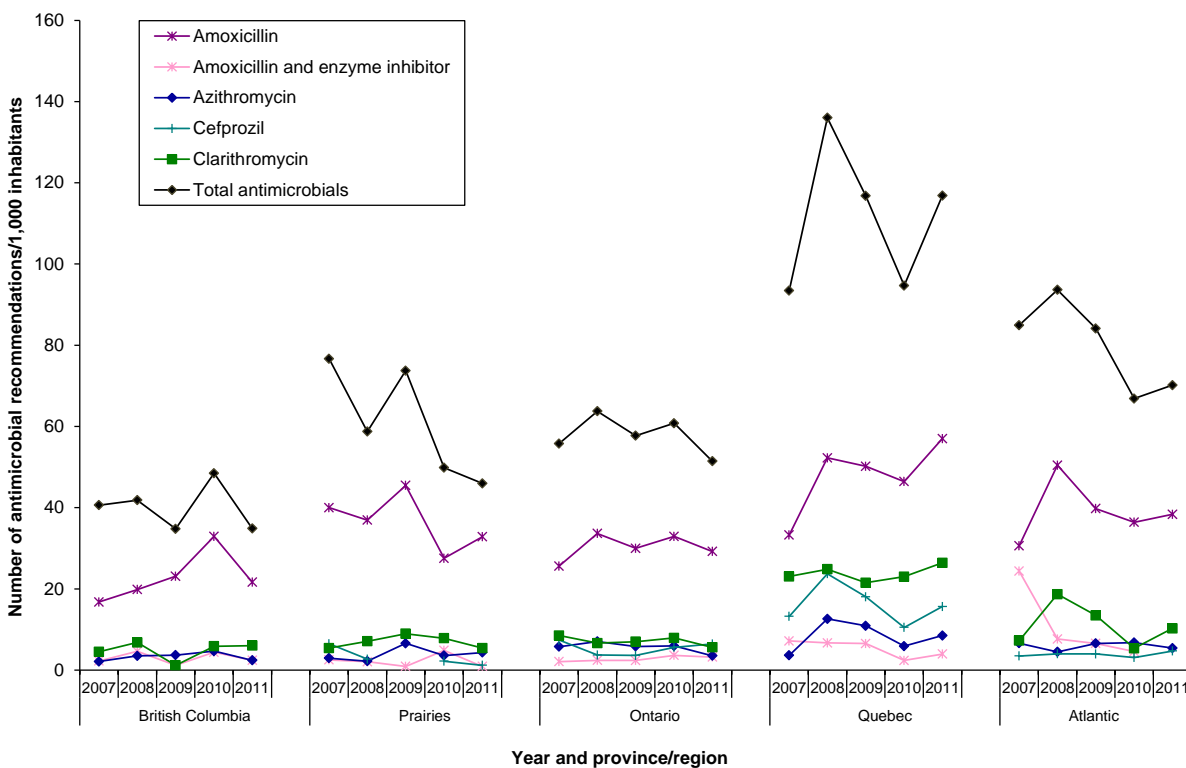
Diagnosis does not represent the number of times a person visits, but represents every time a diagnosis is provided; if a person presents with multiple diseases each individual disease/diagnosis is recorded separately. Provincial summaries for each diagnostic class are based on the top five antimicrobial drugs for which a prescription was written within the respective class in 2011.

The Atlantic region includes the provinces of New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador.

The Prairies include the provinces of Alberta, Saskatchewan, and Manitoba.



**Figure 6. Top 5 antimicrobials recommended/1,000 inhabitants by office-based physicians in Canadian regions, for diseases of the ear, 2007–2011.**



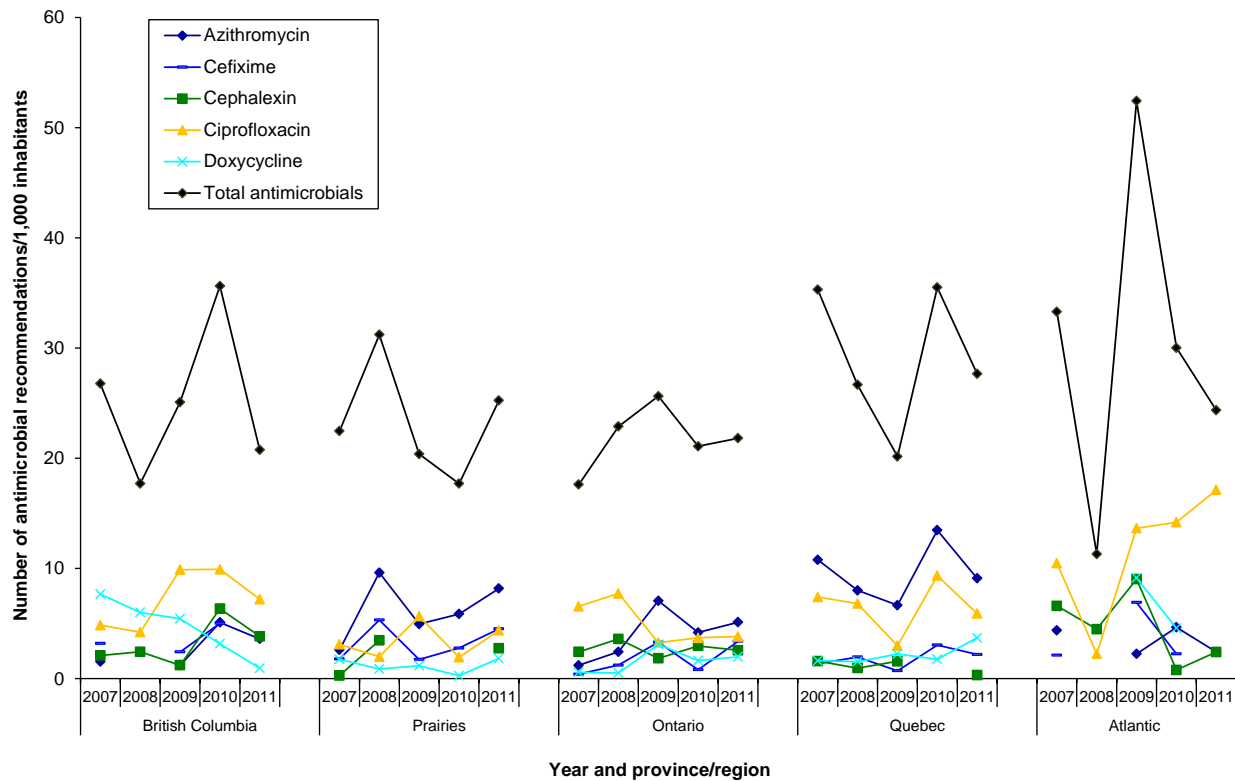
Diagnosis does not represent the number of times a person visits, but represents every time a diagnosis is provided; if a person presents with multiple diseases each individual disease/diagnosis is recorded separately.

Provincial summaries for each diagnostic class are based on the top five antimicrobial drugs for which a prescription was written within the respective class in 2011.

The Atlantic region is a region including the provinces of New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador.

The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

**Figure 7. Top 5 antimicrobials recommended/1,000 inhabitants by office-based physicians in Canadian regions, for diseases of the genitourinary system, 2007–2011.**



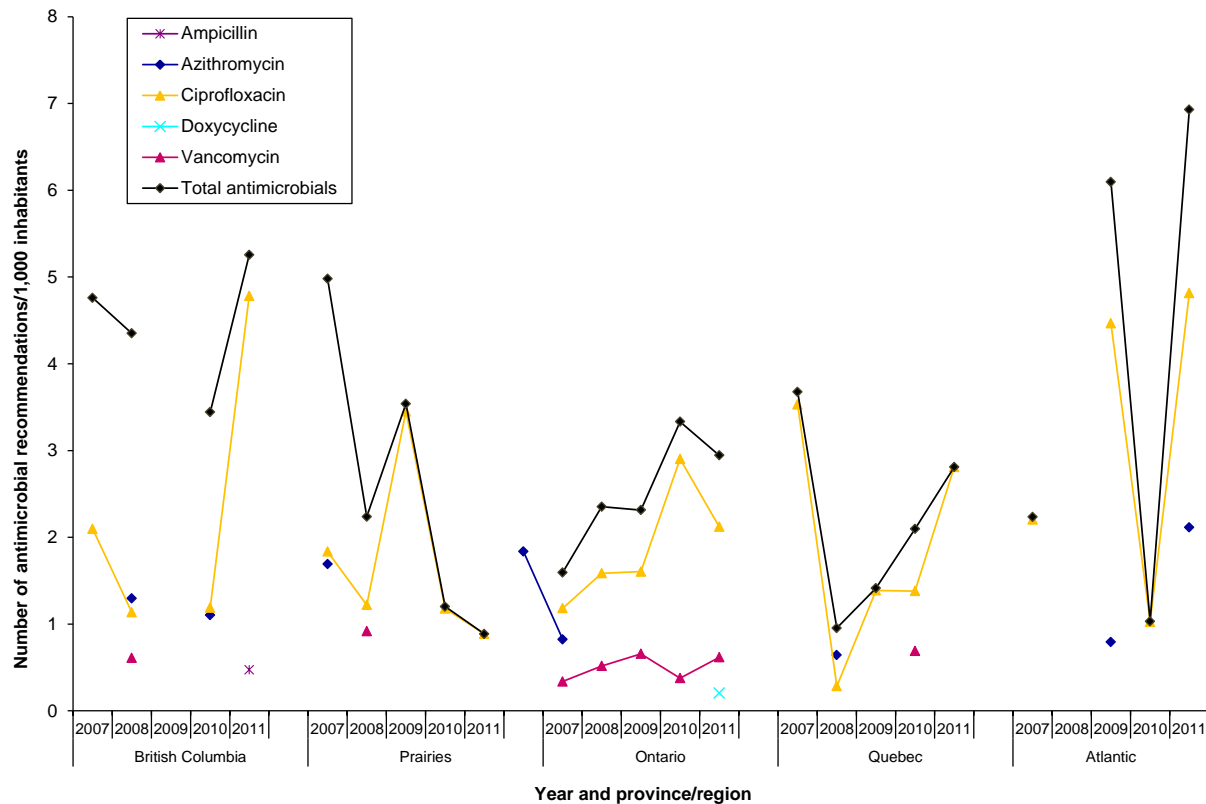
Diagnosis does not represent the number of times a person visits, but represents every time a diagnosis is provided; if a person presents with multiple diseases each individual disease/diagnosis is recorded separately.

Provincial summaries for each diagnostic class are based on the top five antimicrobial drugs for which a prescription was written within the respective class in 2011.

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**Figure 8. Top 5 antimicrobials recommended/1,000 inhabitants by office-based physicians in Canadian regions, for diseases of the gastrointestinal system, 2007–2011.**



Diagnosis does not represent the number of times a person visits, but represents every time a diagnosis is provided; if a person presents with multiple diseases each individual disease/diagnosis is recorded separately.

Provincial summaries for each diagnostic class are based on the top five antimicrobial drugs for which a prescription was written within the respective class in 2011.

The Atlantic region includes the provinces of New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador. The Prairies include the provinces of Alberta, Saskatchewan, and Manitoba.

## Pharmacy Dispensation Data

The Canadian CompuScript (CCS) dataset tracks the number and size of prescriptions dispensed by retail pharmacies in Canada. In 2011, 5,595 pharmacies provided information which was extrapolated to obtain the number of prescriptions dispensed by 8,700 pharmacies across the country. Prescription information for the Yukon, Northwest Territories and Nunavut are not included due to their low volumes and distinct prescribing trends. Information captured in this dataset includes product name, form, strength, province, number of prescriptions, units of product in prescription, and dollars spent monthly for each year. Due to the very small volumes of non-oral antimicrobials included in the CCS data, the analysis presented in this section will be focused only on orally administered drugs. All costs associated with antimicrobials dispensed through pharmacies have been calculated to account for inflation. Additional information on data collection and CIPARS analytic methods can be found in Appendix A.

### National Level

In 2011, the antimicrobial prescription dispensing rate (Table 11 and Figure 9) was slightly higher (675 prescriptions/1,000 inhabitants) than levels observed in 2010 (656 prescriptions/1,000 inhabitants). This increase is also reflected in the total active ingredients (kg) dispensed, with 206,197 kg dispensed in 2011 compared to 195,806 kg in 2010 (Table B.2, Appendix B). Higher changes were observed among the combination of penicillins, including  $\beta$ -lactamase inhibitors (35% increase) and  $\beta$ -lactamase resistant penicillins (27% decrease), respectively between 2010 and 2011. In 2011, the most frequently dispensed antimicrobials of very high importance to human medicine (Category I) were ciprofloxacin (63 prescriptions/1,000 inhabitants), amoxicillin and enzyme inhibitor (24 prescriptions/1,000 inhabitants), metronidazole (19 prescriptions/1,000 inhabitants), and moxifloxacin (17 prescriptions/1,000 inhabitants).

Total expenditure was lower in 2011 (\$20,778.51/1,000 inhabitants) compared to 2000 and 2010, after accounting for inflation (\$26,119.52/1,000 inhabitants and \$21,040.08/1,000 inhabitants, respectively) (Table 12 and Figure 9). The difference in total expenditures between 2010 and 2011 represents a reduction of \$9,051,708.30 spent on antibiotics dispensed through pharmacies in Canada. Of all the antimicrobials dispensed, an increase in levels of expenditures since 2000 was observed among four antimicrobial classes: the first-generation cephalosporins (\$922.81/1,000 inhabitants in 2000 to \$1,370.37/1,000 inhabitants in 2011), nitrofurantoin derivatives (\$364.43/1,000 inhabitants in 2000 to \$720.66/1,000 inhabitants in 2011), penicillins with extended spectrum (\$3,335.16/1,000 inhabitants in 2000 to \$3,525.37/1,000 inhabitants in 2011), and glycopeptides (\$63.92/1,000 inhabitants in 2000 to \$249.44/1,000 inhabitants in 2011).

The total number of defined daily doses per 1,000 inhabitants per day (DID) increased slightly from 17.87 DID in 2010 to 18.81 DID in 2011 (Table 13). However, since the beginning of the surveillance period in 2000, the total DID decreased by 3% (0.51 DID). Between 2010 and 2011, increases in consumption were observed in eight antimicrobial groups: the combinations of penicillins, including  $\beta$ -lactamase inhibitors (31%), penicillins with extended spectrum (8%), macrolides (7%), third-generation cephalosporins (7%), first-generation cephalosporins (6%), second-generation cephalosporins (5%), nitrofurantoin derivatives (5%), and tetracyclines (4%). Penicillins with extended spectrum represent the largest group of antimicrobial agents consumed (27%), followed by macrolides (21%), tetracyclines (13%), fluoroquinolones (10%), and cephalosporins (10%) (Table 13 and Figure 10). Antimicrobials classified of very high importance to human medicine (Category I) continued to represent a high proportion (17%, 3.17/18.81 DID) of the total DID dispensed. This percentage was the same as in 2010 (17%, 2.96/17.87 DID); however, it was higher than in 2000 (13%, 2.43/19.32 DID).

In 2011, tablets were prescribed 5 times more frequently than liquids (570 prescriptions/1,000 inhabitants and 105 prescriptions/1,000 inhabitants, respectively) (Table 14). Since 2000, the total number of tablet and liquid prescriptions per 1,000 inhabitants decreased 3% (16 prescriptions/1,000 inhabitants) and 32% (49 prescriptions/1,000 inhabitants), respectively. However, between 2010 and

2011, there was a 3% increase (14 prescriptions/1,000 inhabitants) in tablet prescriptions and a 5% increase (5 prescriptions/1,000 inhabitants) in liquid prescriptions.

The number of defined daily doses (DDDs) per prescription has been increasing since 2005 (Figure 11). This implies that since 2005 physicians are prescribing drugs for longer durations and/or for higher doses than in previous years. The DDDs per prescription was 6% higher (0.60 DDDs/prescription) in 2011 than in 2000 and 2% higher (0.23 DDDs/prescription) than in 2010. The number of DDDs per prescription had the largest proportional increase between 2010 and 2011. The increases observed for DDDs per prescription and tablet prescription could be a reflection of the aging population and an increase in prescribing for adults compared to children. Figure 11 shows a comparison of DDDs per prescription and the proportion of the Canadian population that are between the ages of 0 to 10 years and 65 years or older, over time.

### Penicillins (J01C)

Penicillins had the highest level of consumption<sup>1</sup> in 2011 (34%, 6.39 DID) (Table 13 and Figure 10). Consumption of penicillins increased by 8% (0.46 DID) compared with 2010. The total consumption remained relatively stable due to the increase in use of penicillins with extended spectrum (J01CA), and combinations of penicillins, including  $\beta$ -lactamase inhibitors (J01CR), and the concurrent decreased consumption of  $\beta$ -lactamase sensitive penicillins (J01CE), and  $\beta$ -lactamase resistant penicillins (J01CF). The increase observed in the consumption of combinations of penicillins, including  $\beta$ -lactamase inhibitors was the largest proportional increase among all antimicrobial classes observed between 2010 and 2011. On the other hand, the largest proportional decrease among all antimicrobial classes observed between 2010 and 2011 was among the  $\beta$ -lactamase resistant penicillins.

Trends observed within the penicillins class were driven by consumption of amoxicillin (J01CA04), as it was the main antimicrobial consumed within this group of antimicrobials (Table 3). Consumption of amoxicillin was higher in 2011 than in both 2000 (4%, 0.19 DID) and in 2010 (8%, 0.37 DID).

### Macrolides and Lincosamides (J01FA & J01FF)

Combined, macrolides and lincosamides were the second highest class consumed in 2011 (23%, 4.33 DID) (Table 13 and Figure 10). Consumption of lincosamides (J01FF) remained at the same level as it was in 2010 (0.41 DID) but has increased 71% (0.17 DID) since 2000 (Table 3). This increased consumption was driven mainly by an increase in consumption of clindamycin (J01FF01) as there has been very limited (less than 0.01 DID in 2000, 2003, and 2004) to no use (2001, 2002, and 2005 to 2011) of lincomycin across the country.

Consumption of macrolides (J01FA) has increased 7% (0.27 DID) since 2010 and 7% (0.25 DID) since 2000 (Table 13). Clarithromycin (J01FA09) and azithromycin (J01FA10) are the main macrolide drugs prescribed in Canada and have contributed to the increase observed within this class of antimicrobials since both 2000 and 2010 (Table 13). Azithromycin consumption in 2011 increased 89% (0.47 DID) and 30% (0.23 DID) since 2000 and 2010, respectively. Similarly, clarithromycin consumption increased 25% (0.56 DID) and 3% (0.09 DID) since 2000 and 2010, respectively. Consumption of erythromycin (J01FA01) continues to decrease, with overall consumption decreasing by 85% (0.78 DID) in 2011 compared to 2000, and by 30% (0.06 DID) compared to 2010.

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<sup>1</sup> Defined daily dosages were computed from data on dispensed prescriptions for orally administered antimicrobials. However, an unknown proportion of the drugs sold by retail pharmacies is not consumed. To improve text clarity, the word "consumption" is used, although the total DDDs estimates presented slightly overestimate true consumption.

### **Tetracyclines (J01A)**

Tetracyclines make up 13% of all DID of oral antimicrobials consumed in 2011 (Table 13 and Figure 10). Between 2010 and 2011, the increase observed in consumption of tetracyclines was small (5%, 0.11 DID). However, over the last 10 years, overall consumption has decreased by 8% (0.22 DID).

Doxycycline (J01AA02) and minocycline (J01AA08) were the most frequent tetracycline drugs dispensed in Canada (Table 13 and Figure 12). Doxycycline consumption increased 9% (0.10 DID) from 2010 to 2011, and increased 63% (0.47 DID) from 2000 to 2011. Minocycline consumption decreased slightly since 2010 (5%, 0.05 DID); however, consumption remained the same as it was in 2000.

### **Fluoroquinolones (J01MA)**

Fluoroquinolones account for 10% of the total antimicrobial consumption in 2011 (Table 13 and Figure 10). Overall consumption of fluoroquinolones has increased 8% (0.15 DID) since 2000 but remained the same as in 2010 (1.97 DID).

Over half (61%, 1.20/1.97 DID) of fluoroquinolone consumption was due to the use of ciprofloxacin (J01MA02), for which consumption has increased 2% (0.04 DID) since 2010 (Table 13). The greatest increase in consumption observed among fluoroquinolones during the 10-year surveillance period has been among moxifloxacin (J01MA14) products, which increased from 0.01 DID in 2000 to 0.42 DID in 2010 and remained at the same level in 2011. Ofloxacin (J01MA01), norfloxacin (J01MA06), and levofloxacin (J01MA12) consumption has decreased 83% (0.11 DID), 61% (0.05 DID), and 18% (0.05 DID) since 2000, respectively.

### **Cephalosporins (J01DB-DD)**

Other  $\beta$ -lactam antimicrobials, such as the cephalosporins, account for 10% of the overall consumption in Canada (Table 13 and Figure 10). Cephalosporin consumption has decreased 19% (0.42 DID) since 2000; however, has increased 6% (0.10 DID) since 2010.

Fifty-four percent of all cephalosporin consumption was a result of first-generation cephalosporin (J01DB) use, of which 97% (0.96/0.99 DID) was mainly cephalexin (J01DB01) (Table 13). The use of cephalexin drugs has increased 7% (0.06 DID) since 2010 and 33% (0.24 DID) since 2000.

The second-generation cephalosporins (J01DC) accounted for 41% of all cephalosporin consumption in 2011. Among the second-generation cephalosporins, decreases were observed for cefaclor (J01DC04) and cefuroxime axetil (J01DC02) drugs, consisting of 96% (0.36 DID) and 50% (0.40 DID), respectively since 2000 (Table 13). Although there was an overall decrease in the second-generation cephalosporin use, cefprozil use has increased 53% (0.11 DID) since 2000.

Cefixime (J01DD08) was the only oral third-generation cephalosporin monitored under this surveillance program and accounted for 5% of all cephalosporin consumption. From 2000 to 2011, the overall consumption of cefixime has decreased 10% (0.01 DID) (Table 13).

### **Nitrofurans (J01XE)**

Although nitrofurans (J01XE) represent 4% of all antimicrobials dispensed in Canada, it is an antimicrobial class that has seen an increase in the levels of dispensation since 2000. In 2011, a total of 0.73 DID was dispensed, an increase of 74% (0.31 DID) over the last 12 years of surveillance. This antimicrobial class is used mainly for the treatment of urinary tract infections, replacing sulfamethoxazole and trimethoprim (J01EE01) compounds to which community resistance levels are high (Figure 13).

## Provincial Level

In 2011, differences in the total number of prescriptions (per 1,000 inhabitants), total consumption of oral antimicrobials (in DDDs/1,000 inhabitant-days or DID) and total cost in dollars (per 1,000 inhabitant-days) were observed across Canada (Table 15, Table 16, Table 17, and Figure 14). Overall, consumption and total cost/1,000 inhabitant-days were the highest in Newfoundland and Labrador (30.51 DID and \$88.74/1,000 inhabitant-days, respectively); whereas Québec had the lowest overall antimicrobial consumption (15.28 DID) and British Columbia had the lowest overall cost (\$52.72/1,000 inhabitant-days).

Average cost per unit for each antimicrobial at the form (tablet vs. liquid) and provincial level was calculated (Table 18). Although Newfoundland and Labrador had the highest level of expenditures compared to all other provinces in 2011, it had the lowest cost per unit for 10 antimicrobial-form combinations compared to 9 in Ontario, 8 in Québec, 6 in Prince Edward Island, and 3 in Saskatchewan. There were an additional 6 antibiotic-form combinations for which Newfoundland and Labrador, together with one or more provinces, had the lowest cost per unit. In comparison, Alberta had 14 antibiotics with the highest cost per unit and an additional 4 drugs whose cost per unit was the highest in Alberta and in other provinces.

Among the antimicrobials classified of very high importance to human medicine (Category I), consumption of fluoroquinolones, imidazole, and third-generation cephalosporins, was the highest in Newfoundland and Labrador (4.34 DID, 0.34 DID, and 0.21 DID, respectively) (Table 16). Consumption of the combinations of penicillins, including  $\beta$ -lactamase inhibitors was the highest in Prince Edward Island (2.08 DID).

Compared to other provinces, Newfoundland and Labrador's consumption was driven primarily by higher consumption of antimicrobials belonging to classes of penicillins with extended spectrum (J01CA, 8.87 DID), macrolides (J01FA, 5.86 DID), and fluoroquinolones (J01MA, 4.34 DID) (Table 16). The higher consumption of penicillins with extended spectrum was attributable to amoxicillin consumption (8.72 DID in Newfoundland and Labrador compared to 3.44 DID in Québec, the province with the lowest amoxicillin use), and ampicillin consumption (0.14 DID in Newfoundland and Labrador compared to < 0.01 DID in Québec and Manitoba).

Consumption of macrolides (J01FA) in Newfoundland and Labrador was driven by consumption of clarithromycin (J01FA09), which was much higher in this province than that observed in the province with the lowest consumption, Saskatchewan, 4.59 DID and 1.46 DID, respectively (Table 16). Azithromycin (J01FA10) was the second most consumed macrolide across all provinces. From 2010 to 2011, azithromycin consumption increased for all provinces, with higher increases observed in British Columbia (0.41 DID versus 0.72 DID), Alberta (0.68 DID versus 1.03 DID) and Ontario (0.94 DID versus 1.25 DID) (Figure 15). Since 2000, increases in DID have been observed in British Columbia (0.52 DID), Alberta (0.58 DID), Saskatchewan (0.71 DID), and Manitoba (0.89 DID) when compared with 2011.

The higher consumption of fluoroquinolones in Newfoundland and Labrador was attributable to ciprofloxacin (J01MA02) consumption (3.55 DID versus 1.04 DID in Saskatchewan, the province with the lowest consumption (Table 16) and ofloxacin (J01MA01) consumption (0.10 DID versus less than 0.01 DID in Saskatchewan). Inter-provincial variation was also observed among the other fluoroquinolone drugs. Prince Edward Island had the highest level of consumption of moxifloxacin (J01MA14, 0.72 DID) versus Manitoba (0.19 DID). New Brunswick had a higher level of consumption of norfloxacin (J01MA06, 0.41 DID) compared to Saskatchewan (0.01 DID). Manitoba had higher consumption of levofloxacin (J01MA12, 0.34 DID) than New Brunswick and British Columbia (the provinces with the lowest levofloxacin use), 0.05 DID and 0.05 DID, respectively.

In 2010, Prince Edward Island and Newfoundland and Labrador had the highest consumption of combinations of penicillins, including  $\beta$ -lactamase inhibitors (J01CR) (Figure 16). The drug shortage in

2010, affecting all Canadian provinces<sup>1</sup>, may have contributed to the drop in amoxicillin-clavulanic acid (J01CR02) consumption. During this time, the drop was the greatest in Prince Edward Island. From 2010 to 2011, consumption increased for all provinces. The increase in Prince Edward Island was more than double that of all others, and in 2011, it was the province with the highest amoxicillin-clavulanic acid consumption. A possible explanation for the drug shortage impact on consumption in Prince Edward Island may be that the shortage had a greater impact on provinces with greater use.

Saskatchewan had the second highest total consumption of antimicrobials in 2011, driven by higher consumption of antimicrobials belonging to classes of penicillins with extended spectrum (J01CA, 7.10 DID), tetracyclines (J01AA, 4.58 DID), and macrolides (J01FA, 3.13 DID) (Table 16). In Saskatchewan, the higher consumption of tetracyclines was attributed to the use of doxycycline (J01AA02). From 2010 to 2011 doxycycline consumption decreased 10% (0.40 DID); however, doxycycline use in Saskatchewan was more than double the use in all other provinces (Figure 17).

Consumption of tetracycline (J01AA07) was the highest in Prince Edward Island (0.80 DID) compared to Québec, which had the lowest tetracycline consumption (0.10 DID) (Table 16 and Figure 18). The consumption of tetracycline in all provinces decreased between the first (January to March) and second (April to June) quarters of 2010. This decrease may be explained by a drug shortage observed during 2010<sup>1</sup>. Between the third (July to September) and fourth (October to December) quarters, consumption of tetracycline increased in all provinces. However, throughout 2011 it remained at approximately half the level it was prior to Quarter 1 of 2010 for all provinces.

Québec had the lowest overall antimicrobial consumption of all Canadian provinces (Table 16 and Figure 14). However, the consumption of vancomycin (J01XA01) in this province was the highest and is currently at double that of all other provinces (Table 16 and Figure 19). Although vancomycin use increased in all provinces from 2010 to 2011, its increase continues to be the greatest in Québec. The ability for physicians in the province of Québec to write a prescription for vancomycin without special authorization and the use of vancomycin as a preferred treatment for more severe cases of *Clostridium difficile* may have contributed to the higher vancomycin consumption in this province.

## International Comparisons

The estimate of the total amount of oral antimicrobials dispensed in 2010 by Canadian retail pharmacies was compared with the total amount of outpatient antimicrobial use in 26 European countries in the same year (Figure 20). This comparison showed that the level of consumption in Canada was similar to the level of consumption of the Czech Republic and slightly higher than Denmark. Canada's oral antimicrobial consumption represented over one and a half times the level of antimicrobial consumption reported by Estonia (country with the lowest level of consumption) and less than half the level estimated in Greece (country with the highest level of total consumption). Overall, Canada ranked 12th out of the 27 countries classified by increasing level of total antimicrobial consumption. Canada ranked 25th for its level of consumption of macrolides, lincosamides and streptogramins, 20th for its level of consumption of sulfonamides and trimethoprim, 19th for its level of consumption of quinolones (largely consisting of fluoroquinolones), and 18th for its level of consumption of tetracyclines. Canada was 16th for its level of cephalosporin and other  $\beta$ -lactam consumption and 5th for its penicillin consumption.

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<sup>1</sup> Eggertson, L. Continuing drug shortages affect North American patients. Available at: [www.cmaj.ca/content/182/18/E811.full](http://www.cmaj.ca/content/182/18/E811.full). Accessed November 2013.



In 2011, the antimicrobial prescription dispensing rate was slightly higher than levels observed in 2010. Category I antimicrobials continued to represent a high proportion (17%) of the total DDDs/1,000 inhabitant-days dispensed during 2011. Between 2010 and 2011, Canada observed the largest proportional increase of DDDs per prescription, representing an increase in the dosage or length of prescription dispensed by community pharmacies.

In 2011, tablets were prescribed 5 times more frequently than liquids (570 prescriptions/1,000 inhabitants and 105 prescriptions/1,000 inhabitants, respectively).

Overall, consumption and total cost/1,000 inhabitant-days were the highest in Newfoundland and Labrador (30.51 DID and \$88.74/1,000 inhabitant-days, respectively); whereas Québec had the lowest overall antimicrobial consumption (15.28 DIDs) and British Columbia had the lowest overall cost (\$52.72/1,000 inhabitant-days).

However, in Québec, the consumption of vancomycin (J01XA01) was the highest and is currently at double that of all other provinces. Similarly, Saskatchewan had the second highest levels of consumption, with dispensation of doxycycline (J01AA02) being double that the use in all other provinces.

When the total amount of oral antimicrobials dispensed in 2010 by Canadian retail pharmacies was compared with the total outpatient use in 26 European countries in the same year, Canadian consumption was similar to the level of consumption of the Czech Republic. Canada ranked 12th out of the 27 countries classified by increasing level of total antimicrobial consumption. Canada ranked 25th for its level of consumption of macrolides, lincosamides and streptogramins, 19th for its level of consumption of quinolones (largely consisting of fluoroquinolones), and 5th for its penicillin consumption.

**Table 11. Total number of prescriptions of oral antimicrobials dispensed by Canadian retail pharmacies per 1,000 inhabitants, 2000–2011.**

ATC Class and antimicrobial		Number of prescriptions/1,000 inhabitants											
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>Combinations of penicillins, including <math>\beta</math>-lactamase inhibitors (J01CR)</b>													
	Amoxicillin and enzyme inhibitor (J01CR02)	18.66	18.41	17.54	17.69	16.98	18.66	19.35	19.67	20.53	20.85	18.06	23.53
<b>Third-generation cephalosporins (J01DD)</b>													
	Cefixime (J01DD08)	5.66	5.28	4.83	4.23	3.68	3.74	3.77	3.98	4.23	4.40	5.25	5.68
<b>Fluoroquinolones (J01MA)</b>													
	Ofloxacin (J01MA01)	1.78	1.47	1.22	1.09	0.98	0.84	0.85	0.74	0.64	0.55	0.43	0.31
	Ciprofloxacin (J01MA02)	51.25	47.70	48.32	51.35	53.46	55.90	61.06	61.76	62.53	60.58	61.93	62.68
I	Norfloxacin (J01MA06)	12.49	12.06	11.43	10.71	10.06	9.30	8.83	7.58	6.96	6.15	5.69	5.10
	Levofloxacin (J01MA12)	10.35	14.32	13.11	13.36	13.10	11.48	10.52	9.68	9.67	9.26	8.60	8.71
	Moxifloxacin (J01MA14)	0.36	4.68	7.89	10.23	11.07	13.35	16.55	17.66	17.47	17.66	17.27	17.32
<b>Glycopeptides (J01XA)</b>													
	Vancomycin (J01XA01)	0.14	0.14	0.16	0.19	0.34	0.39	0.37	0.40	0.43	0.47	0.51	0.64
<b>Imidazole (J01XD)</b>													
	Metronidazole (J01XD01)	NPD	16.65	16.71	17.09	17.25	17.41	18.50	17.70	18.06	18.23	19.04	19.13
<b>Linezolid (J01XX)</b>													
	Linezolid (J01XX08)	NPD	< 0.01	0.01	0.02	0.04	0.04	0.04	0.05	0.05	0.06	0.06	0.06
<b>Penicillins with extended spectrum (J01CA)</b>													
	Ampicillin (J01CA01)	3.28	2.77	2.22	1.98	1.68	1.36	1.19	0.98	0.86	0.80	0.73	0.65
	Amoxicillin (J01CA04)	179.87	172.09	162.04	162.10	149.79	163.86	165.55	155.76	154.24	154.58	157.92	168.78
	Pivampicillin (J01CA02)	9.75	8.48	6.64	5.70	4.60	3.12	2.19	1.78	0.63	0.01	< 0.01	< 0.01
II	<b><math>\beta</math>-lactamase sensitive penicillins (J01CE)</b>												
	Penicillin G (J01CE01)	0.13	0.08	0.02	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
	Penicillin V (J01CE02)	45.29	42.02	39.83	39.62	36.59	36.89	37.25	34.87	32.92	32.17	28.38	24.70
<b><math>\beta</math>-lactamase resistant penicillins (J01CF)</b>													
	Cloxacillin (J01CF02)	19.78	18.38	16.78	15.61	14.17	12.49	11.87	10.34	9.29	8.41	10.26	7.34

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

ATC = Anatomical Therapeutic Chemical. NPD = No prescriptions dispensed.

Chloramphenicol was removed from this table due to low (< 0.01 prescriptions/1,000 inhabitants) to no sales reported during the study period.

**Table 11 (continued). Total number of prescriptions of oral antimicrobials dispensed by Canadian retail pharmacies per 1,000 inhabitants, 2000–2011.**

ATC Class and antimicrobial		Number of prescriptions/1,000 inhabitants											
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>First-generation cephalosporins (J01DB)</b>													
	Cephalexin (J01DB01)	39.09	39.63	40.87	42.88	43.28	45.93	48.70	47.15	47.22	46.41	44.62	48.03
	Cefadroxil (J01DB05)	1.94	2.07	2.20	2.36	2.38	2.42	2.77	2.80	2.92	3.02	2.64	2.28
<b>Second-generation cephalosporins (J01DC)</b>													
	Cefaclor (J01DC04)	18.62	13.78	9.73	7.19	4.98	4.36	3.23	2.54	2.07	1.69	0.36	0.08
	Cefprozil (J01DC10)	14.59	16.47	18.50	21.20	22.98	23.82	23.44	20.01	18.94	18.58	17.78	17.82
	Cefuroxime axetil (J01DC02)	21.89	18.71	14.83	13.03	11.40	11.47	10.73	10.10	9.76	9.72	8.40	9.32
<b>Combinations of sulfonamides and trimethoprim, including derivatives (J01EE)</b>													
	Sulfamethoxazole and trimethoprim (J01EE01)	56.27	50.43	44.41	40.95	37.07	35.14	35.45	33.67	33.56	33.38	33.45	31.42
	Sulfadiazine and trimethoprim (J01EE02)	0.25	0.20	0.15	0.11	0.05	0.01	< 0.01	NPD	< 0.01	< 0.01	NPD	NPD
<b>Macrolides (J01FA)</b>													
II	Azithromycin (J01FA10)	42.49	52.86	59.62	66.16	61.02	66.06	65.36	59.71	58.98	58.47	53.80	57.71
	Clarithromycin (J01FA09)	69.20	69.22	64.72	63.47	59.11	65.01	67.07	65.07	64.98	65.44	63.79	66.17
	Erythromycin (J01FA01)	34.14	26.99	20.63	18.69	15.06	12.65	11.14	9.09	8.55	6.84	6.22	4.20
<b>Lincosamides (J01FF)</b>													
	Clindamycin (J01FF01)	15.92	16.74	17.63	18.48	18.85	19.73	21.86	21.94	22.10	21.61	23.31	22.82
<b>Other quinolones, excluding fluoroquinolones (J01MB)</b>													
	Nalidixic acid (J01MB02)	0.08	0.06	0.05	0.04	0.05	< 0.01	< 0.01	< 0.01	NPD	< 0.01	NPD	NPD
<b>Sulfonamide combinations, excluding trimethoprim (J01RA)</b>													
	Erythromycin-sulfisoxazole (J01RA02)	3.50	2.43	1.58	1.05	0.67	0.60	0.52	0.36	0.12	< 0.01	NPD	< 0.01
<b>Steroid antimicrobials (J01XC)</b>													
	Fusidic acid (J01XC01)	0.06	0.06	0.05	0.05	0.05	0.06	0.07	0.05	0.04	0.02	< 0.01	< 0.01

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

ATC = Anatomical Therapeutic Chemical. NPD = No prescriptions dispensed.

Chloramphenicol was removed from this table due to low (< 0.01 prescriptions/1,000 inhabitants) to no sales reported during the study period.

**Table 11 (continued). Total number of prescriptions of oral antimicrobials dispensed by Canadian retail pharmacies per 1,000 inhabitants, 2000–2011.**

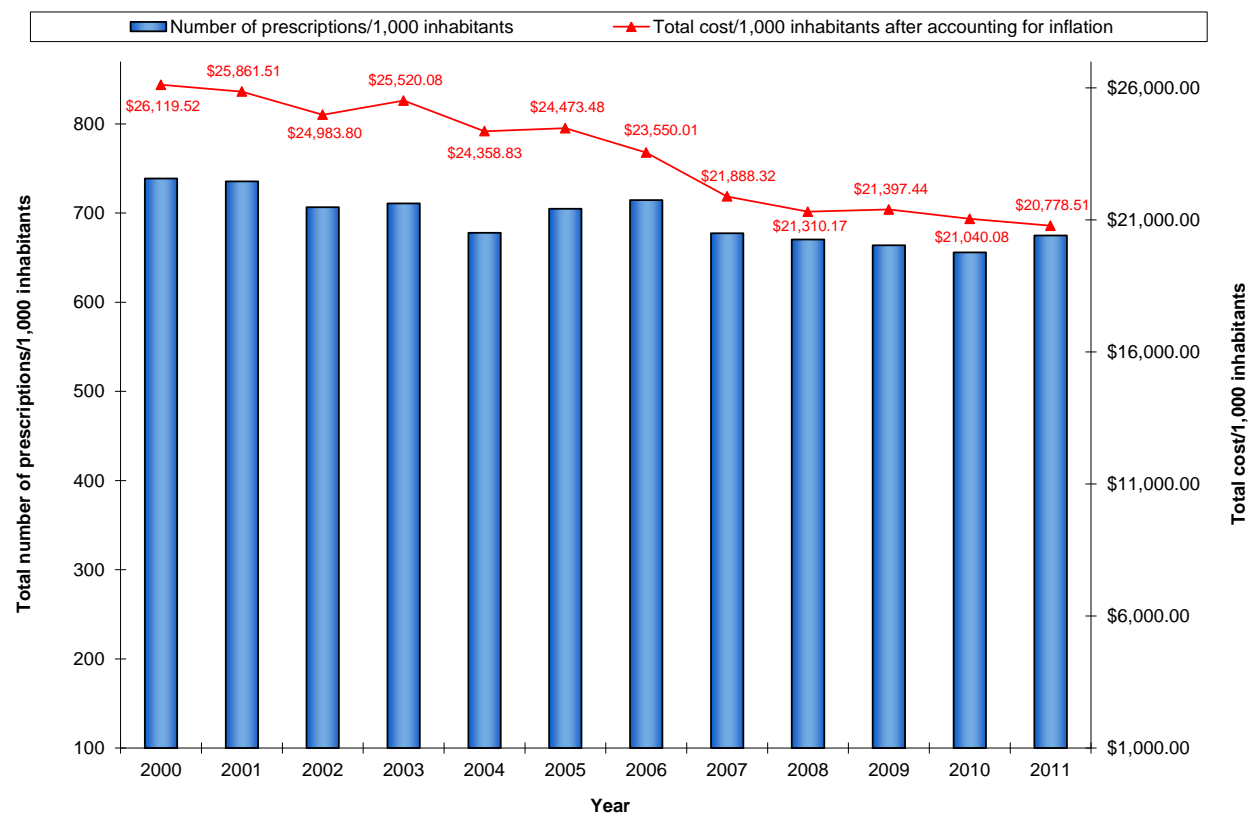
ATC Class and antimicrobial		Number of prescriptions/1,000 inhabitants											
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>Tetracyclines (J01AA)</b>													
	Doxycycline (J01AA02)	11.79	11.00	10.17	10.07	9.55	10.07	10.92	11.43	12.03	12.35	14.41	15.60
	Minocycline (J01AA08)	16.76	16.90	17.01	17.23	17.11	16.97	17.45	16.49	16.33	15.69	17.18	16.39
	Tetracycline (J01AA07)	14.91	13.23	12.08	11.07	10.01	9.26	8.66	7.64	7.14	7.02	3.90	4.70
<b>Trimethoprim and derivatives (J01EA)</b>													
	Trimethoprim (J01EA01)	2.22	2.12	2.13	2.16	2.02	1.85	1.95	1.93	1.87	1.99	2.01	1.96
<b>Short-acting sulfonamides (J01EB)</b>													
III	Sulfamethizole (J01EB02), sulfapyridine (J01EB04), sulfisoxazole (J01EB05)	0.07	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
<b>Intermediate-acting sulfonamides (J01EC)</b>													
	Sulfadiazine (J01EC02), sulfamethoxazole (J01EC04)	0.02	< 0.01	< 0.01	0.01	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
<b>Nitrofurantoin derivatives (J01XE)</b>													
	Nitrofurantoin (J01XE01)	14.61	15.76	16.41	17.48	19.13	20.35	22.67	23.20	24.89	27.18	29.34	31.31
<b>Fosfomycin (J01XX)</b>													
	Fosfomycin (J01XX01)	0.44	0.47	0.29	0.21	0.14	0.11	0.09	0.05	0.01	0.02	0.01	< 0.01
<b>Methenamine (J01XX)</b>													
NC	Methenamine (J01XX05)	0.26	0.27	0.28	0.26	0.24	0.23	0.23	0.23	0.16	0.24	0.28	0.28
<b>Total (J01)</b>		<b>738.88</b>	<b>735.55</b>	<b>706.51</b>	<b>710.84</b>	<b>677.80</b>	<b>704.94</b>	<b>714.47</b>	<b>677.41</b>	<b>670.48</b>	<b>663.98</b>	<b>655.79</b>	<b>674.88</b>

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

ATC = Anatomical Therapeutic Chemical. NC = Not classified. NPD = No prescriptions dispensed.

Chloramphenicol was removed from this table due to low (< 0.01 prescriptions/1,000 inhabitants) to no sales reported during the study period.

**Figure 9. Total number of prescriptions and total cost per 1,000 inhabitants after accounting for inflation<sup>1</sup> for oral antimicrobials dispensed by Canadian retail pharmacies, 2000–2011.**



<sup>1</sup> Bank of Canada. Inflation Calculator. Available at: [www.bankofcanada.ca/rates/related/inflation-calculator/](http://www.bankofcanada.ca/rates/related/inflation-calculator/). Accessed November 2013.

**Table 12. Total cost per 1,000 inhabitants, after accounting for inflation<sup>1</sup>, for oral antimicrobials dispensed by Canadian retail pharmacies, 2000–2011.**

ATC Class and antimicrobial	Total cost/1,000 inhabitants (\$)											
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>Combinations of penicillins, including <math>\beta</math>-lactamase inhibitors (J01CR)</b>												
Amoxicillin and enzyme inhibitor	950.33	904.66	769.96	740.16	668.17	707.10	726.08	718.61	715.31	743.99	657.81	786.73
<b>Third-generation cephalosporins (J01DD)</b>												
Cefixime	265.88	239.98	214.41	181.67	152.25	154.05	149.21	158.20	164.59	175.22	211.92	230.19
<b>Fluoroquinolones (J01MA)</b>												
I Ofloxacin, ciprofloxacin, norfloxacin, levofloxacin, moxifloxacin	5,368.32	5,556.05	5,681.54	5,939.99	5,553.37	4,795.79	4,573.28	4,496.89	4,345.71	4,224.25	3,974.60	3,692.44
<b>Glycopeptides (J01XA)</b>												
Vancomycin	63.92	66.93	74.13	89.33	149.98	166.89	159.34	170.81	168.85	184.06	205.74	249.44
<b>Imidazole (J01XD)</b>												
Metronidazole	NPD	242.55	268.12	284.51	298.53	77.02	323.87	302.23	301.22	312.40	381.80	388.91
<b>Linezolid (J01XX)</b>												
Linezolid	NPD	7.76	23.32	51.01	81.82	107.36	100.31	106.04	101.90	107.26	113.92	106.31
<b>Penicillins with extended spectrum (J01CA)</b>												
Ampicillin, amoxicillin, pivampicillin	3,335.16	3,120.87	2,885.07	2,872.88	2,623.04	2,747.83	2,706.25	2,558.97	2,990.53	3,116.88	3,254.38	3,525.37
<b><math>\beta</math>-lactamase sensitive penicillins (J01CE)</b>												
II Penicillin G, penicillin V	622.95	569.88	540.59	541.84	498.23	484.16	479.99	451.04	464.95	471.97	435.53	375.37
<b><math>\beta</math>-lactamase resistant penicillins (J01CF)</b>												
Cloxacillin	360.38	332.54	300.39	283.26	258.45	220.85	206.97	181.06	206.45	196.15	244.35	174.43

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.  
ATC = Anatomical Therapeutic Chemical. NPD = No prescriptions dispensed.

<sup>1</sup> Bank of Canada. Inflation Calculator. Available at: [www.bankofcanada.ca/rates/related/inflation-calculator/](http://www.bankofcanada.ca/rates/related/inflation-calculator/). Accessed November 2013.

**Table 12 (continued). Total cost per 1,000 inhabitants, after accounting for inflation<sup>1</sup>, for oral antimicrobials dispensed by Canadian retail pharmacies, 2000–2011.**

ATC Class and antimicrobial	Total cost/1,000 inhabitants (\$)											
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>First-generation cephalosporins (J01DB)</b>												
Cephalexin, cefadroxil	922.81	922.49	953.96	1,009.60	1,017.55	1,045.41	1,095.18	1,050.34	1,258.35	1,290.33	1,303.13	1,370.37
<b>Second-generation cephalosporins (J01DC)</b>												
Cefaclor, cefprozil, cefuroxime axetil	2,925.96	2,602.88	2,173.27	2,113.88	2,054.58	2,075.00	1,987.59	1,651.02	1,334.97	1,298.25	1,126.92	1,018.30
<b>Combinations of sulfonamides and trimethoprim, including derivatives (J01EE)</b>												
Sulfamethoxazole and trimethoprim, sulfadiazine and trimethoprim	791.79	696.40	610.16	562.70	501.47	456.87	451.18	426.85	412.26	414.27	456.92	415.55
<b>Macrolides (J01FA)</b>												
Azithromycin, clarithromycin, erythromycin	7,265.49	7,533.46	7,425.96	7,765.67	7,453.50	8,170.69	7,426.06	6,539.49	5,919.98	5,921.97	5,550.61	5,436.10
<b>Lincosamides (J01FF)</b>												
Clindamycin	835.24	738.54	758.26	765.79	771.73	782.97	846.90	837.35	809.17	809.03	866.93	770.59
<b>Other quinolones, excluding fluoroquinolones (J01MB)</b>												
Nalidixic acid	4.53	3.67	3.02	2.65	2.47	0.08	0.02	< 0.01	NPD	< 0.01	NPD	NPD
<b>Sulfonamide combinations, excluding trimethoprim (J01RA)</b>												
Erythromycin-sulfisoxazole (J01RA02)	119.17	80.76	51.90	34.36	22.40	20.40	17.31	12.12	3.94	< 0.01	NPD	< 0.01
<b>Steroid antimicrobials (J01XC)</b>												
Fusidic acid	7.69	8.22	7.21	7.37	7.13	7.78	7.89	5.98	4.95	2.14	0.14	0.13

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

ATC = Anatomical Therapeutic Chemical. NPD = No prescriptions dispensed.

<sup>1</sup> Bank of Canada. Inflation Calculator. Available at: [www.bankofcanada.ca/rates/related/inflation-calculator/](http://www.bankofcanada.ca/rates/related/inflation-calculator/). Accessed November 2013.

**Table 12 (continued). Total cost per 1,000 inhabitants, after accounting for inflation<sup>1</sup>, for oral antimicrobials dispensed by Canadian retail pharmacies, 2000–2011.**

ATC Class and antimicrobial		Total cost/1,000 inhabitants (\$)											
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
III	<b>Tetracyclines (J01AA)</b>												
	Doxycycline, minocycline, tetracycline	1,823.94	1,770.52	1,774.20	1,783.57	1,728.53	1,698.98	1,715.31	1,638.48	1,506.73	1,459.80	1,525.05	1,472.61
	<b>Amphenicols (J01BA)</b>												
	Chloramphenicol	0.03	0.06	0.01	NPD	< 0.01	< 0.01	NPD	NPD	NPD	NPD	< 0.01	NPD
	<b>Trimethoprim and derivatives (J01EA)</b>												
	Trimethoprim	59.71	53.27	49.85	46.34	40.03	35.41	35.53	33.73	30.39	35.92	38.16	36.93
	<b>Short-acting sulfonamides (J01EB)</b>												
	Sulfamethizole, sulfapyridine, sulfisoxazole	3.49	0.43	0.04	0.02	0.02	< 0.01	0.01	< 0.01	< 0.01	NPD	NPD	NPD
	<b>Intermediate-acting sulfonamides (J01EC)</b>												
	Sulfadiazine, sulfamethoxazole	0.56	0.49	0.38	0.56	0.25	0.19	0.18	0.19	0.15	< 0.01	< 0.01	< 0.01
	<b>Nitrofurantoin derivatives (J01XE)</b>												
	Nitrofurantoin	364.43	380.89	397.41	426.82	462.26	483.71	531.97	540.73	565.58	626.89	683.89	720.66
	<b>Fosfomycin (J01XX)</b>												
	Fosfomycin	18.43	19.59	12.41	8.89	6.31	4.96	3.93	2.26	0.39	1.01	0.66	0.06
NC	<b>Methenamine (J01XX)</b>												
	Methenamine	9.33	8.61	8.24	7.18	6.78	5.88	5.66	5.92	3.79	5.64	7.62	8.01
	<b>Total (J01)</b>	<b>26,119.52</b>	<b>25,861.51</b>	<b>24,983.80</b>	<b>25,520.08</b>	<b>24,358.83</b>	<b>24,473.48</b>	<b>23,550.01</b>	<b>21,888.32</b>	<b>21,310.17</b>	<b>21,397.44</b>	<b>21,040.08</b>	<b>20,778.51</b>

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.  
 ATC = Anatomical Therapeutic Chemical. NC = Not classified. NPD = No prescriptions dispensed.

<sup>1</sup> Bank of Canada. Inflation Calculator. Available at: [www.bankofcanada.ca/rates/related/inflation-calculator/](http://www.bankofcanada.ca/rates/related/inflation-calculator/). Accessed November 2013.



**Table 13. Total defined daily doses per 1,000 inhabitant-days for oral antimicrobials dispensed by Canadian retail pharmacies, 2000–2011.**

ATC Class and antimicrobial		DDDs/1,000 inhabitant-days											
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
I	<b>Combinations of penicillins, including <math>\beta</math>-lactamase inhibitors (J01CR)</b>												
	Amoxicillin and enzyme inhibitor (J01CR02)	0.51	0.52	0.50	0.52	0.52	0.59	0.64	0.67	0.71	0.74	0.65	0.85
	<b>Third-generation cephalosporins (J01DD)</b>												
	Cefixime (J01DD08)	0.10	0.09	0.08	0.07	0.06	0.06	0.06	0.06	0.07	0.07	0.08	0.09
	<b>Fluoroquinolones (J01MA)</b>												
	Ofloxacin (J01MA01)	0.13	0.11	0.09	0.08	0.07	0.06	0.06	0.05	0.05	0.04	0.03	0.02
	Ciprofloxacin (J01MA02)	1.14	1.06	1.04	1.07	1.08	1.11	1.20	1.20	1.20	1.15	1.18	1.20
	Norfloxacin (J01MA06)	0.28	0.27	0.26	0.24	0.22	0.21	0.19	0.17	0.15	0.13	0.12	0.11
	Levofloxacin (J01MA12)	0.27	0.36	0.32	0.33	0.32	0.29	0.27	0.25	0.24	0.23	0.22	0.22
	Moxifloxacin (J01MA14)	0.01	0.11	0.19	0.24	0.26	0.32	0.40	0.43	0.42	0.42	0.42	0.42
II	<b>Imidazole (J01XD)</b>												
	Metronidazole (J01XD01)	NPD	0.21	0.22	0.22	0.22	0.23	0.24	0.23	0.24	0.24	0.25	0.25
	<b>Penicillins with extended spectrum (J01CA)</b>												
	Ampicillin (J01CA01)	0.06	0.05	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.01	0.01
	Amoxicillin (J01CA04)	4.79	4.66	4.43	4.40	4.24	4.42	4.53	4.36	4.39	4.45	4.61	4.98
	Pivampicillin (J01CA02)	0.21	0.19	0.15	0.13	0.11	0.08	0.06	0.05	0.02	< 0.01	< 0.01	< 0.01
	<b><math>\beta</math>-lactamase sensitive penicillins (J01CE)</b>												
	Penicillin V (J01CE02)	0.67	0.63	0.60	0.60	0.55	0.56	0.57	0.54	0.51	0.50	0.44	0.39
	<b><math>\beta</math>-lactamase resistant penicillins (J01CF)</b>												
	Cloxacillin (J01CF02)	0.37	0.35	0.32	0.31	0.28	0.25	0.24	0.21	0.19	0.18	0.22	0.16

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

ATC = Anatomical Therapeutic Chemical. DDD<sub>s</sub> = Defined daily doses. NPD = No prescriptions dispensed.

Certain antimicrobials were removed from this table due to low (< 0.01 prescriptions/1,000 inhabitants) to no sales reported during the study period. These were: chloramphenicol, fosfomycin, fusidic acid, linezolid, nalidixic acid, penicillin G, sulfadiazine, sulfamethoxazole, and vancomycin.

**Table 13 (continued). Total defined daily doses per 1,000 inhabitant-days for oral antimicrobials dispensed by Canadian retail pharmacies, 2000–2011.**

ATC Class and antimicrobial		DDDs/1,000 inhabitant-days											
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
II	First-generation cephalosporins (J01DB)												
	Cephalexin (J01DB01)	0.72	0.74	0.78	0.82	0.84	0.89	0.96	0.94	0.94	0.92	0.90	0.96
	Cefadroxil (J01DB05)	0.02	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.03
	Second-generation cephalosporins (J01DC)												
	Cefaclor (J01DC04)	0.37	0.27	0.19	0.15	0.11	0.09	0.07	0.05	0.04	0.04	0.01	< 0.01
	Cefprozil (J01DC10)	0.22	0.25	0.29	0.34	0.38	0.39	0.39	0.35	0.34	0.33	0.33	0.33
	Cefuroxime axetil (J01DC02)	0.80	0.69	0.56	0.51	0.46	0.47	0.45	0.43	0.42	0.42	0.36	0.40
	Combinations of sulfonamides and trimethoprim, including derivatives (J01EE)												
	Sulfamethoxazole and trimethoprim (J01EE01)	1.38	1.25	1.12	1.04	0.92	0.84	0.84	0.78	0.77	0.77	0.76	0.74
	Sulfadiazine and trimethoprim (J01EE02)	0.01	0.01	0.01	< 0.01	< 0.01	< 0.01	< 0.01	NPD	< 0.01	< 0.01	NPD	NPD
	Macrolides (J01FA)												
	Azithromycin (J01FA10)	0.53	0.65	0.73	0.82	0.76	0.83	0.83	0.78	0.78	0.79	0.77	1.00
	Clarithromycin (J01FA09)	2.22	2.25	2.11	2.23	2.18	2.48	2.64	2.68	2.70	2.74	2.69	2.78
	Erythromycin (J01FA01)	0.92	0.74	0.59	0.53	0.44	0.37	0.34	0.28	0.25	0.21	0.20	0.14
	Lincosamides (J01FF)												
	Clindamycin (J01FF01)	0.24	0.27	0.28	0.31	0.32	0.32	0.36	0.37	0.38	0.37	0.41	0.41
Sulfonamide combinations, excluding trimethoprim (J01RA)													
Erythromycin-sulfisoxazole (J01RA02)	0.09	0.06	0.04	0.03	0.02	0.02	0.01	0.01	< 0.01	< 0.01	NPD	< 0.01	

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

ATC = Anatomical Therapeutic Chemical. DDDs = Defined daily doses. NPD = No prescriptions dispensed.

Certain antimicrobials were removed from this table due to low (< 0.01 prescriptions/1,000 inhabitants) to no sales reported during the study period. These were: chloramphenicol, fosfomycin, fusidic acid, linezolid, nalidixic acid, penicillin G, sulfadiazine, sulfamethoxazole, and vancomycin.

**Table 13 (continued). Total defined daily doses per 1,000 inhabitant-days for oral antimicrobials dispensed by Canadian retail pharmacies, 2000–2011.**

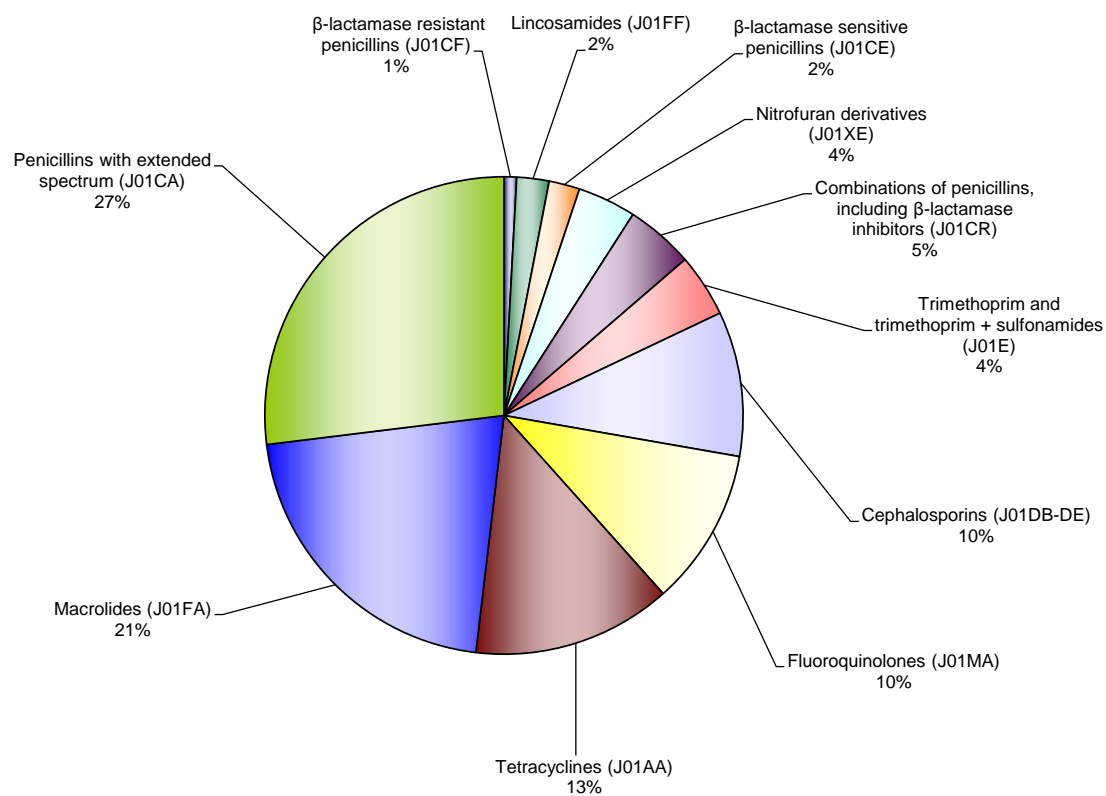
ATC Class and antimicrobial		DDDs/1,000 inhabitant-days											
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
III	<b>Tetracyclines (J01AA)</b>												
	Doxycycline (J01AA02)	0.75	0.73	0.70	0.71	0.70	0.74	0.81	0.85	0.91	0.94	1.12	1.22
	Minocycline (J01AA08)	0.97	1.00	1.01	1.04	1.03	1.04	1.07	1.02	1.00	0.95	1.02	0.97
	Tetracycline (J01AA07)	0.99	0.89	0.83	0.75	0.67	0.63	0.60	0.52	0.48	0.46	0.25	0.31
	<b>Trimethoprim and derivatives (J01EA)</b>												
	Trimethoprim (J01EA01)	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05
	<b>Short-acting sulfonamides (J01EB)</b>												
	Sulfamethizole (J01EB02), sulfapyridine (J01EB04), sulfisoxazole (J01EB05)	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NPD	NPD	NPD
NC	<b>Nitrofuran derivatives (J01XE)</b>												
	Nitrofurantoin (J01XE01)	0.42	0.44	0.45	0.47	0.49	0.52	0.57	0.58	0.61	0.66	0.70	0.73
	<b>Methenamine (J01XX)</b>												
	Methenamine (J01XX05)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	< 0.01	0.01	0.01	0.01
<b>Total (J01)</b>		<b>19.32</b>	<b>19.00</b>	<b>18.15</b>	<b>18.25</b>	<b>17.60</b>	<b>18.14</b>	<b>18.60</b>	<b>17.99</b>	<b>17.92</b>	<b>17.87</b>	<b>17.87</b>	<b>18.81</b>

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

ATC = Anatomical Therapeutic Chemical. DDDs = Defined daily doses. NC = Not classified. NPD = No prescriptions dispensed.

Certain antimicrobials were removed from this table due to low (< 0.01 prescriptions/1,000 inhabitants) to no sales reported during the study period. These were: chloramphenicol, fosfomycin, fusidic acid, linezolid, nalidixic acid, penicillin G, sulfadiazine, sulfamethoxazole, and vancomycin.

**Figure 10. Percentages of the total number of defined daily doses per 1,000 inhabitant-days for oral antimicrobials dispensed by Canadian retail pharmacies, 2011.**



Alphanumeric codes in parentheses represent Anatomical Therapeutic Chemical classes of antimicrobials.

**Table 14. Total number of tablet and liquid prescriptions for oral antimicrobials dispensed by Canadian retail pharmacies per 1,000 inhabitants, 2000–2011.**

ATC Class and antimicrobial		Form	Number of prescriptions/1,000 inhabitants											
			2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
I	Combinations of penicillins, including $\beta$ -lactamase inhibitors (J01CR)													
	Amoxicillin and enzyme inhibitor	Tablets	12.22	12.22	11.60	12.15	11.96	13.28	14.34	15.10	16.14	16.57	13.85	18.62
		Liquid	6.45	6.20	5.94	5.54	5.02	5.37	5.01	4.58	4.39	4.28	4.21	4.91
	Third-generation cephalosporins (J01DD)													
	Cefixime	Tablets	3.18	3.06	2.86	2.63	2.38	2.43	2.58	2.77	2.95	3.06	3.73	3.90
		Liquid	2.48	2.22	1.98	1.60	1.29	1.32	1.20	1.21	1.28	1.34	1.51	1.78
	Fluoroquinolones (J01MA)													
	Ofloxacin, ciprofloxacin, norfloxacin, levofloxacin, moxifloxacin	Tablets	76.09	80.87	85.58	91.59	94.07	95.15	98.50	97.43	97.23	94.04	93.76	93.97
		Liquid	0.14	0.15	0.15	0.14	0.15	0.15	0.16	0.15	0.15	0.16	0.15	0.15
	Glycopeptides (J01XA)													
	Vancomycin	Tablets	0.14	0.14	0.16	0.19	0.34	0.39	0.37	0.40	0.43	0.47	0.51	0.64
	Imidazole (J01XD)													
	Metronidazole	Tablets	NPD	16.65	16.71	17.09	17.25	17.41	18.50	17.70	18.06	18.23	19.04	19.13
	Linezolid (J01XX)													
Linezolid	Tablets	NPD	< 0.01	0.01	0.02	0.04	0.04	0.04	0.05	0.05	0.06	0.06	0.06	
II	Penicillins with extended spectrum (J01CA)													
	Ampicillin, amoxicillin, pivampicillin	Tablets	125.80	120.62	112.37	114.18	108.37	115.67	117.37	112.34	109.57	108.83	111.54	117.06
		Liquid	67.39	62.92	58.68	55.63	47.70	52.67	51.57	46.18	46.16	46.56	47.11	52.37
	$\beta$ -lactamase sensitive penicillins (J01CE)													
	Penicillin G, penicillin V	Tablets	40.76	38.04	36.23	36.11	33.64	34.03	34.38	32.22	30.40	29.72	25.26	22.87
		Liquid	4.66	4.07	3.63	3.51	2.95	2.86	2.87	2.65	2.52	2.44	3.11	1.83
	$\beta$ -lactamase resistant penicillins (J01CF)													
	Cloxacillin	Tablets	18.57	17.26	15.79	14.72	13.37	11.79	11.19	9.72	8.73	7.91	9.73	6.91
		Liquid	1.20	1.12	0.99	0.89	0.80	0.70	0.68	0.62	0.56	0.49	0.53	0.43
	First-generation cephalosporins (J01DB)													
	Cephalexin, cefadroxil	Tablets	36.48	37.37	38.71	40.66	41.41	43.79	46.77	45.46	45.60	43.72	41.38	44.91
		Liquid	4.55	4.32	4.36	4.58	4.25	4.57	4.71	4.49	4.55	5.72	5.89	5.40
	Second-generation cephalosporins (J01DC)													
	Cefaclor, cefprozil, cefuroxime axetil	Tablets	34.18	29.89	25.61	25.50	24.61	24.51	23.10	21.07	20.03	19.28	17.36	17.83
Liquid		20.91	19.06	17.45	15.92	14.75	15.13	14.30	11.58	10.73	10.72	9.18	9.40	

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

ATC = Anatomical Therapeutic Chemical. DDDs = Defined daily doses. NPD = No prescriptions dispensed.

Certain antimicrobials were removed from this table due to low (< 0.01 prescriptions/1,000 inhabitants) to no sales reported during the study period. These include: (for liquid) chloramphenicol, fusidic acid, linezolid, methenamine, metronidazole, nalidixic acid, sulfadiazine, sulfamethizole, sulfamethoxazole, sulfapyridine, sulfisoxazole, trimethoprim, and vancomycin and (for tablet) chloramphenicol, erythromycin-sulfisoxazole, and fosfomycin.

**Table 14 (continued). Total number of tablet and liquid prescriptions for oral antimicrobials dispensed by Canadian retail pharmacies per 1,000 inhabitants, 2000–2011.**

ATC Class and antimicrobial		Form	Number of prescriptions/1,000 inhabitants											
			2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>Combinations of sulfonamides and trimethoprim, including derivatives (J01EE)</b>														
Sulfamethoxazole and trimethoprim, sulfadiazine and trimethoprim		Tablets	43.96	39.91	35.67	33.26	30.40	28.64	29.28	28.18	28.26	28.50	28.73	29.00
		Liquid	12.56	10.71	8.90	7.80	6.71	6.51	6.17	5.49	5.30	4.87	4.72	2.43
<b>Macrolides (J01FA)</b>														
Azithromycin, clarithromycin, erythromycin		Tablets	118.24	119.32	113.29	116.32	109.87	118.07	116.06	109.40	108.76	106.37	101.07	102.60
		Liquid	28.31	30.40	32.19	32.68	28.64	31.17	30.87	25.29	23.94	24.49	22.90	25.64
<b>Lincosamides (J01FF)</b>														
II	Clindamycin	Tablets	15.50	16.35	17.19	18.02	18.43	19.30	21.41	21.50	21.64	21.13	22.82	22.26
		Liquid	0.42	0.39	0.44	0.46	0.42	0.43	0.46	0.45	0.46	0.48	0.49	0.56
<b>Other quinolones, excluding fluoroquinolones (J01MB)</b>														
Nalidixic acid		Tablets	0.08	0.06	0.05	0.04	0.05	< 0.01	< 0.01	< 0.01	NPD	< 0.01	NPD	NPD
<b>Sulfonamide combinations, excluding trimethoprim (J01RA)</b>														
Erythromycin-sulfisoxazole (J01RA02)		Liquid	3.50	2.43	1.58	1.05	0.67	0.60	0.52	0.36	0.12	< 0.01	NPD	< 0.01
<b>Steroid antimicrobials (J01XC)</b>														
Fusidic acid		Tablets	0.05	0.06	0.05	0.05	0.05	0.06	0.07	0.05	0.04	0.02	< 0.01	< 0.01

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

ATC = Anatomical Therapeutic Chemical. DDDs = Defined daily doses. NPD = No prescriptions dispensed.

Certain antimicrobials were removed from this table due to low (< 0.01 prescriptions/1,000 inhabitants) to no sales reported during the study period. These include: (for liquid) chloramphenicol, fusidic acid, linezolid, methenamine, metronidazole, nalidixic acid, sulfadiazine, sulfamethizole, sulfamethoxazole, sulfapyridine, sulfisoxazole, trimethoprim, and vancomycin and (for tablet) chloramphenicol, erythromycin-sulfisoxazole, and fosfomycin.

**Table 14 (continued). Total number of tablet and liquid prescriptions for oral antimicrobials dispensed by Canadian retail pharmacies per 1,000 inhabitants, 2000–2011.**

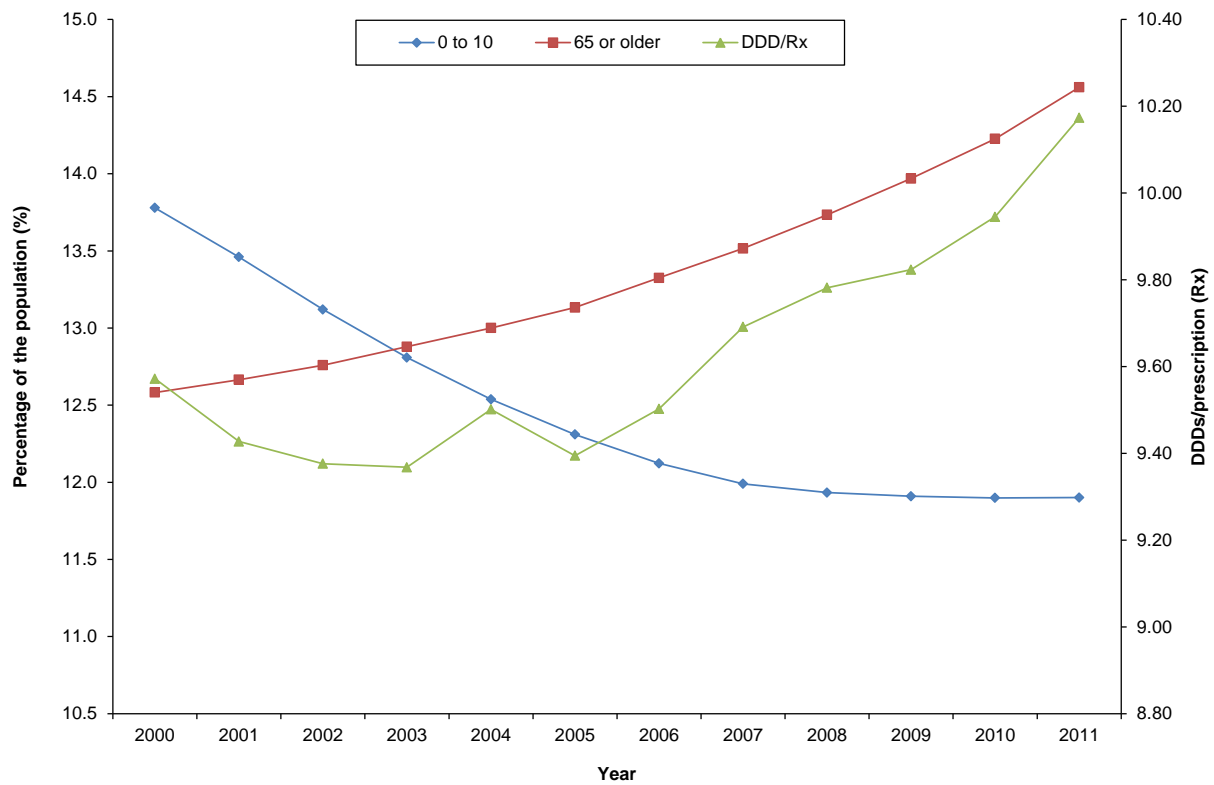
ATC Class and antimicrobial		Form	Number of prescriptions/1,000 inhabitants											
			2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
III	<b>Tetracyclines (J01AA)</b>													
	Doxycycline, minocycline, tetracycline	Tablets	43.34	41.13	39.31	38.41	36.71	36.33	37.07	35.58	35.50	35.07	35.50	36.68
		Liquid	0.13	0.04	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NPD	< 0.01
	<b>Trimethoprim and derivatives (J01EA)</b>													
	Trimethoprim	Tablets	2.22	2.12	2.13	2.16	2.02	1.85	1.95	1.93	1.87	1.99	2.01	1.96
	<b>Short-acting sulfonamides (J01EB)</b>													
	Sulfamethizole, sulfapyridine, sulfisoxazole	Tablets	0.07	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NPD	NPD	NPD
	<b>Intermediate-acting sulfonamides (J01EC)</b>													
	Sulfadiazine, sulfamethoxazole	Tablets	0.02	< 0.01	< 0.01	0.01	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
	<b>Nitrofurantoin derivatives (J01XE)</b>													
	Nitrofurantoin	Tablets	14.32	15.53	16.36	17.48	19.13	20.35	22.67	23.20	24.89	27.18	29.34	31.31
		Liquid	0.29	0.22	0.05	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NPD
NC	<b>Fosfomycin (J01XX)</b>													
	Fosfomycin	Liquid	0.44	0.47	0.29	0.21	0.14	0.11	0.09	0.05	0.01	0.02	0.01	< 0.01
	<b>Methenamine (J01XX)</b>													
	Methenamine	Tablets	0.26	0.27	0.28	0.26	0.24	0.23	0.23	0.23	0.16	0.24	0.28	0.28
	<b>Total (J01)</b>													
		Tablets	585.54	590.89	569.96	580.87	564.34	583.33	595.87	574.32	570.30	562.40	555.97	569.98
		Liquid	153.42	144.72	136.60	130.01	113.50	121.61	118.60	103.09	100.17	101.58	99.82	104.90
	<b>Total (J01)</b>		<b>738.96</b>	<b>735.61</b>	<b>706.56</b>	<b>710.88</b>	<b>677.85</b>	<b>704.95</b>	<b>714.47</b>	<b>677.41</b>	<b>670.48</b>	<b>663.98</b>	<b>655.79</b>	<b>674.88</b>

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

ATC = Anatomical Therapeutic Chemical. DDDs = Defined daily doses. NC = Not classified. NPD = No prescriptions dispensed.

Certain antimicrobials were removed from this table due to low (< 0.01 prescriptions/1,000 inhabitants) to no sales reported during the study period. These include: (for liquid) chloramphenicol, fusidic acid, linezolid, methenamine, metronidazole, nalidixic acid, sulfadiazine, sulfamethizole, sulfamethoxazole, sulfapyridine, sulfisoxazole, trimethoprim, and vancomycin and (for tablet) chloramphenicol, erythromycin-sulfisoxazole, and fosfomycin.

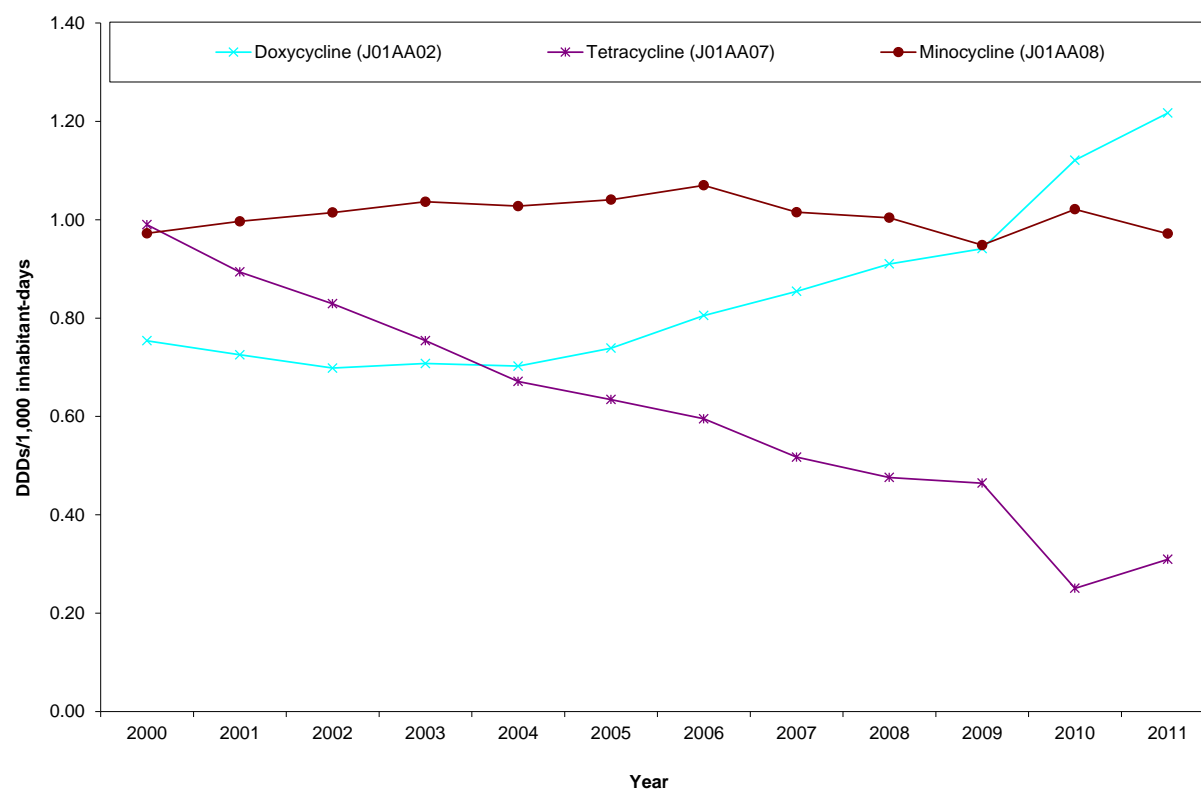
**Figure 11. Total DDDs per prescription of oral antimicrobials (J01) dispensed by Canadian retail pharmacies and the proportion of the Canadian population under the age of 10 years and over 65 years, 2000–2011.**



DDDs = Defined daily doses. Rx = Prescription.

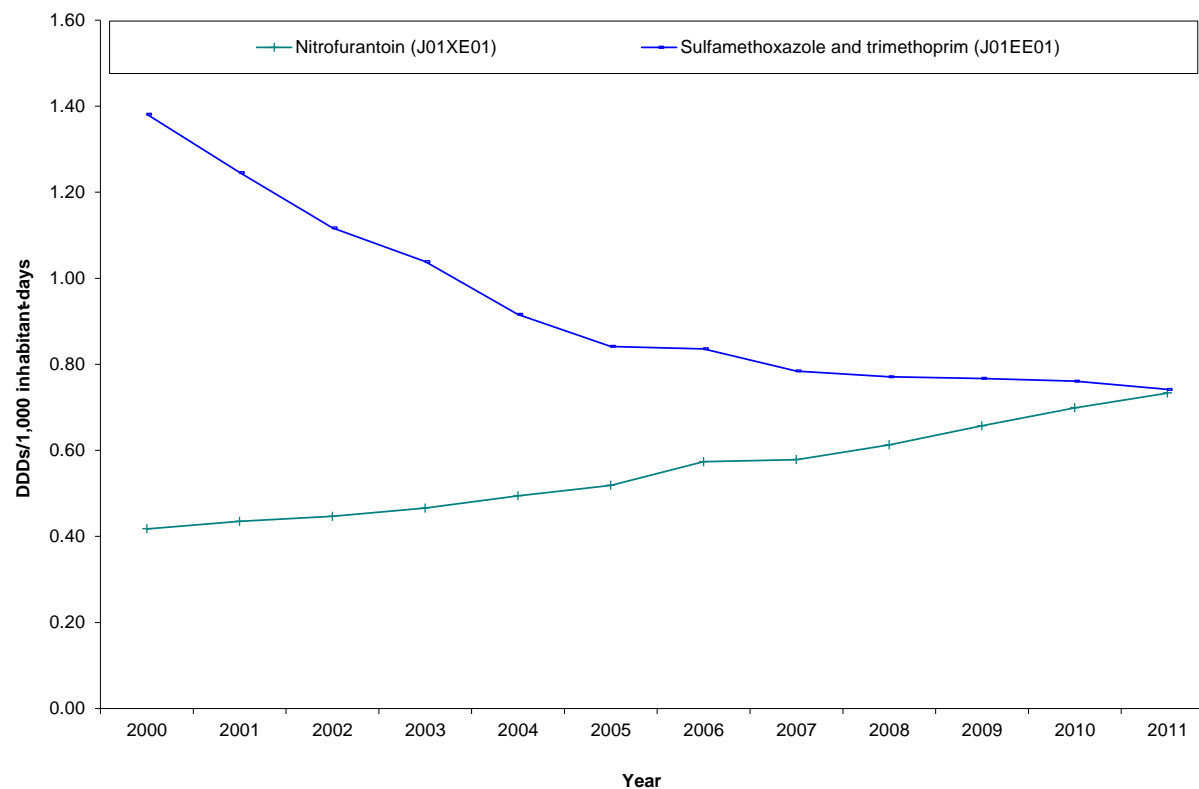


**Figure 12. Total consumption (DDDs/1,000 inhabitant-days) of oral tetracyclines (J01AA) dispensed by Canadian retail pharmacies, 2000–2011.**



Alphanumeric codes represent Anatomical Therapeutic Chemical classes of antimicrobials.  
 DDDs = Defined daily doses.

**Figure 13. Total consumption (DDDs/1,000 inhabitant-days) of oral nitrofurantoin (J01XE01) and sulfamethoxazole and trimethoprim (J01EE01) dispensed by Canadian retail pharmacies, 2000–2011.**



Alphanumeric codes represent Anatomical Therapeutic Chemical classes of antimicrobials.  
DDDs = Defined daily doses.

**Table 15. Total number of prescriptions of oral antimicrobials dispensed by provincial retail pharmacies per 1,000 inhabitants in Canada, 2011.**

Antimicrobial	ATC Class	Number of prescriptions/1,000 inhabitants									
		BC	AB	SK	MB	ON	QC	NB	NS	PEI	NL
Amoxicillin and enzyme inhibitor	Combinations of penicillins, including $\beta$ -lactamase inhibitors (J01CR)	20.96	28.35	19.77	22.04	17.45	31.10	26.18	25.46	65.57	49.11
Cefixime	Third-generation cephalosporins (J01DD)	6.04	6.36	2.15	3.48	5.97	5.24	4.04	6.30	14.77	9.45
I Ofloxacin, ciprofloxacin, norfloxacin, levofloxacin, moxifloxacin	Fluoroquinolones (J01MA)	81.82	93.88	67.02	82.25	87.89	115.35	95.58	81.10	110.56	160.68
Vancomycin	Glycopeptides (J01XA)	0.54	0.32	0.26	0.16	0.26	1.75	0.21	0.38	0.11	0.12
Metronidazole	Imidazole (J01XD)	19.48	22.02	23.53	19.58	19.33	15.97	20.20	21.94	18.20	26.19
Linezolid	Linezolid (J01XX)	0.05	0.04	0.07	0.01	0.04	0.15	0.02	0.02	NPD	NPD
Ampicillin, amoxicillin, pivampicillin	Penicillins with extended spectrum (J01CA)	157.33	192.82	253.59	179.68	193.67	103.76	172.17	186.68	184.55	292.33
Penicillin G, penicillin V	$\beta$ -lactamase sensitive penicillins (J01CE)	24.74	27.95	15.75	25.36	19.89	31.42	33.72	25.77	25.32	28.52
Cloxacillin	$\beta$ -lactamase resistant penicillins (J01CF)	7.20	7.34	14.17	15.91	6.98	5.49	5.60	7.70	10.61	14.47
Cephalexin, cefadroxil	First-generation cephalosporins (J01DB)	59.37	60.05	99.20	62.50	51.74	26.39	57.26	61.69	61.65	78.36
II Cefaclor, cefprozil, cefuroxime axetil	Second-generation cephalosporins (J01DC)	13.13	24.57	13.81	14.96	32.18	30.31	37.04	36.87	13.72	30.61
Sulfamethoxazole and trimethoprim, sulfadiazine and trimethoprim	Combinations of sulfonamides and trimethoprim, including derivatives (J01EE)	31.17	33.58	57.11	41.24	31.28	21.54	40.76	47.76	51.88	55.58
Azithromycin, clarithromycin, erythromycin	Macrolides (J01FA)	98.74	130.94	131.68	124.25	141.40	116.95	151.09	134.51	158.36	180.78
Clindamycin	Lincosamides (J01FF)	22.14	29.08	32.80	18.98	22.13	20.98	24.70	23.99	17.39	19.58
Doxycycline, minocycline, tetracycline	Tetracyclines (J01AA)	45.48	45.59	61.88	32.99	28.32	37.65	34.05	48.49	45.27	40.37
III Trimethoprim	Trimethoprim and derivatives (J01EA)	0.81	1.01	2.55	0.48	1.82	3.63	1.90	0.84	1.09	2.06
Nitrofurantoin	Nitrofurans derivatives (J01XE)	38.41	26.29	43.09	19.26	38.82	17.36	30.53	40.68	25.09	23.46
Fosfomycin	Fosfomycin (J01XX)	< 0.01	NPD	0.01	NPD	< 0.01	NPD	< 0.01	0.01	NPD	NPD
NC Methenamine	Methenamine (J01XX)	0.30	0.11	0.12	0.00	0.13	0.71	0.19	0.01	NPD	0.04
<b>Total (J01)</b>		<b>627.70</b>	<b>730.29</b>	<b>838.56</b>	<b>663.12</b>	<b>699.28</b>	<b>585.73</b>	<b>735.22</b>	<b>750.20</b>	<b>804.16</b>	<b>1,011.72</b>

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

ATC = Anatomical Therapeutic Chemical. NC = Not classified. NPD = No prescriptions dispensed.

Certain antimicrobials were removed from this table due to low (< 0.01 prescriptions/1,000 inhabitants) to no sales reported among the provinces. These are: chloramphenicol, erythromycin-sulfisoxazole, fusidic acid, nalidixic acid, sulfadiazine, sulfamethizole, sulfamethoxazole, sulfapyridine, and sulfisoxazole.

**Table 16. Total consumption (DDDs/1,000 inhabitant-days) of oral antimicrobials dispensed by provincial retail pharmacies in Canada, 2011.**

ATC Class	Antimicrobial	DDDs/1,000 inhabitant-days									
		BC	AB	SK	MB	ON	QC	NB	NS	PEI	NL
I	Combinations of penicillins, including $\beta$ -lactamase inhibitors (J01CR)	0.74	0.99	0.64	0.84	0.65	1.13	1.04	0.95	2.08	1.74
	Third-generation cephalosporins (J01DD)	0.12	0.11	0.03	0.06	0.09	0.06	0.07	0.10	0.30	0.21
	Ofloxacin (J01MA01)	0.01	0.01	< 0.01	0.01	0.03	0.02	0.02	0.05	0.09	0.10
	Ciprofloxacin (J01MA02)	1.19	1.32	1.04	1.18	1.10	1.23	1.05	1.18	1.18	3.55
	Norfloxacin (J01MA06)	0.02	0.09	0.01	0.02	0.20	0.02	0.41	0.08	0.23	0.25
	Levofloxacin (J01MA12)	0.05	0.31	0.06	0.34	0.28	0.19	0.05	0.27	0.25	0.06
	Moxifloxacin (J01MA14)	0.37	0.28	0.28	0.19	0.40	0.61	0.60	0.31	0.72	0.38
	Glycopeptides (J01XA)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.01	< 0.01	< 0.01	< 0.01	< 0.01
	Imidazole (J01XD)	0.26	0.29	0.30	0.28	0.26	0.21	0.28	0.29	0.25	0.34
	Penicillins with extended spectrum (J01CA)	0.01	0.01	0.09	< 0.01	0.01	< 0.01	0.01	0.02	0.05	0.14
	Amoxicillin (J01CA04)	4.46	5.53	7.01	5.42	5.55	3.44	5.56	5.58	5.30	8.72
	$\beta$ -lactamase sensitive penicillins (J01CE)	0.40	0.46	0.28	0.37	0.31	0.47	0.54	0.42	0.51	0.49
	$\beta$ -lactamase resistant penicillins (J01CF)	0.15	0.15	0.29	0.34	0.15	0.12	0.13	0.17	0.22	0.33
	First-generation cephalosporins (J01DB)	1.14	1.20	1.95	1.23	1.04	0.33	1.23	1.33	1.21	1.70
	Cefadroxil (J01DB05)	< 0.01	< 0.01	NPD	< 0.01	< 0.01	0.12	0.01	< 0.01	NPD	< 0.01
	Cefaclor (J01DC04)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.01	< 0.01	< 0.01	0.01
	Cefprozil (J01DC10)	0.01	0.27	0.06	0.17	0.42	0.51	0.17	0.36	0.13	0.01
	Cefuroxime axetil (J01DC02)	0.52	0.38	0.33	0.23	0.37	0.25	1.33	0.81	0.26	1.37
	Combinations of sulfonamides and trimethoprim, including derivatives (J01EE)	0.84	0.95	1.30	0.99	0.71	0.41	0.97	1.08	1.33	1.54
II	Second-generation cephalosporins (J01DC)	0.72	1.03	1.13	1.35	1.25	0.69	1.00	0.94	0.89	1.02
	Azithromycin (J01FA10)	2.61	3.15	1.46	1.62	2.89	2.76	3.44	2.67	2.76	4.59
	Clarithromycin (J01FA09)	0.21	0.14	0.54	0.18	0.11	0.04	0.15	0.25	0.64	0.25
	Erythromycin (J01FA01)	0.39	0.53	0.61	0.36	0.38	0.38	0.49	0.44	0.38	0.37
Lincosamides (J01FF)		0.39	0.53	0.61	0.36	0.38	0.38	0.49	0.44	0.38	0.37
Clindamycin (J01FF01)		0.39	0.53	0.61	0.36	0.38	0.38	0.49	0.44	0.38	0.37

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

ATC = Anatomical Therapeutic Chemical. DDDs = Defined daily doses. NPD = No prescriptions dispensed.

Certain antimicrobials were removed from this table due to low (< 0.01 prescriptions/1,000 inhabitants) to no sales reported among the provinces. These are: chloramphenicol, erythromycin-sulfisoxazole, fosfomicin, fusidic acid, linezolid, nalidixic acid, penicillin G, pivampicillin, sulfadiazine, sulfadiazine and trimethoprim, sulfamethizole, sulfamethoxazole, sulfapyridine, and sulfisoxazole.

**Table 16 (continued). Total consumption (DDDs/1,000 inhabitant-days) of all oral antimicrobials dispensed by provincial retail pharmacies in Canadian provinces, 2011.**

		DDDs/1,000 inhabitant-days									
ATC Class	Antimicrobial	BC	AB	SK	MB	ON	QC	NB	NS	PEI	NL
III	Doxycycline (J01AA02)	1.90	1.47	3.91	1.17	1.01	0.70	1.07	1.52	1.44	1.12
	Tetracyclines (J01AA)	1.00	1.53	0.35	0.92	0.81	1.04	0.87	1.27	0.84	1.11
	Minocycline (J01AA08)	0.34	0.21	0.31	0.33	0.45	0.10	0.20	0.30	0.80	0.34
III	Tetracycline (J01AA07)	0.03	0.03	0.10	0.02	0.06	0.05	0.05	0.03	0.02	0.09
	Trimethoprim and derivatives (J01EA)	0.87	0.68	1.08	0.50	0.90	0.36	0.80	1.05	0.75	0.68
	Nitrofurantoin (J01XE01)	0.01	0.01	0.01	< 0.01	< 0.01	0.01	0.01	< 0.01	NPD	< 0.01
NC	Methenamine (J01XX)	0.01	0.01	0.01	< 0.01	< 0.01	0.01	0.01	< 0.01	NPD	< 0.01
	Methenamine (J01XX05)	0.01	0.01	0.01	< 0.01	< 0.01	0.01	0.01	< 0.01	NPD	< 0.01
<b>Total (J01)</b>		<b>18.36</b>	<b>21.14</b>	<b>23.18</b>	<b>18.12</b>	<b>19.45</b>	<b>15.28</b>	<b>21.57</b>	<b>21.48</b>	<b>22.64</b>	<b>30.51</b>

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

ATC = Anatomical Therapeutic Chemical. DDDs = Defined daily doses. NC = Not classified. NPD = No prescriptions dispensed.

Certain antimicrobials were removed from this table due to low (< 0.01 prescriptions/1,000 inhabitants) to no sales reported among the provinces. These are: chloramphenicol, erythromycin-sulfisoxazole, fosfomycin, fusidic acid, linezolid, nalidixic acid, penicillin G, pivampicillin, sulfadiazine, sulfadiazine and trimethoprim, sulfamethizole, sulfamethoxazole, sulfapyridine, and sulfisoxazole.

**Table 17. Total cost per 1,000 inhabitant-days for oral antimicrobials dispensed by provincial retail pharmacies in Canada, 2011.**

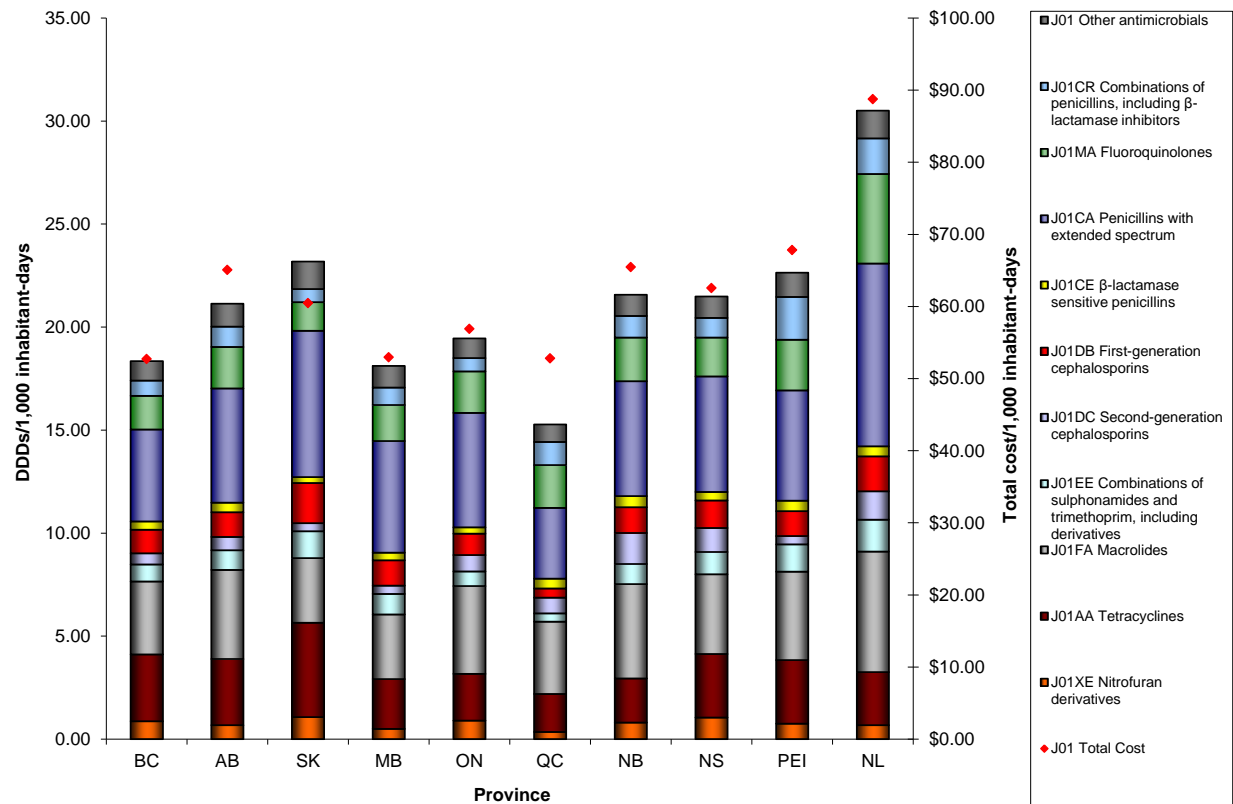
Antimicrobial		ATC Class	Total cost/1,000 inhabitant-days (\$)									
			BC	AB	SK	MB	ON	QC	NB	NS	PEI	NL
I	Amoxicillin and enzyme inhibitor	Combinations of penicillins, including $\beta$ -lactamase inhibitors (J01CR)	1.90	2.75	1.72	2.38	1.52	2.79	2.71	2.57	6.10	4.89
	Cefixime	Third-generation cephalosporins (J01DD)	0.74	0.76	0.20	0.41	0.67	0.48	0.49	0.71	2.05	1.20
	Ofloxacin, ciprofloxacin, norfloxacin, levofloxacin, moxifloxacin	Fluoroquinolones (J01MA)	9.24	10.96	7.57	9.26	9.15	11.53	12.04	9.80	14.42	21.03
	Vancomycin	Glycopeptides (J01XA)	0.67	0.43	0.32	0.23	0.42	1.48	0.31	0.49	0.17	0.26
	Metronidazole	Imidazole (J01XD)	0.94	1.22	1.24	0.87	1.25	0.75	1.08	1.12	0.91	1.43
	Linezolid	Linezolid (J01XX)	0.29	0.20	0.39	0.05	0.22	0.55	0.11	0.11	NPD	NPD
II	Ampicillin, amoxicillin, pivampicillin	Penicillins w with extended spectrum (J01CA)	9.04	11.27	13.03	9.59	10.69	6.88	9.39	9.98	9.07	14.77
	Penicillin G, penicillin V	$\beta$ -lactamase sensitive penicillins (J01CE)	1.09	1.26	0.59	1.03	0.81	1.32	1.22	0.96	0.89	0.97
	Cloxacillin	$\beta$ -lactamase resistant penicillins (J01CF)	0.48	0.50	0.88	1.02	0.45	0.37	0.35	0.49	0.62	0.89
	Cephalexin, cefadroxil	First-generation cephalosporins (J01DB)	4.49	4.52	7.18	4.53	3.87	2.00	4.20	4.54	4.22	5.60
	Cefaclor, cefprozil, cefuroxime axetil	Second-generation cephalosporins (J01DC)	1.46	2.69	1.36	1.75	2.95	3.29	4.84	4.27	1.66	4.14
	Sulfamethoxazole and trimethoprim, sulfadiazine and trimethoprim	Combinations of sulfonamides and trimethoprim, including derivatives (J01EE)	1.29	1.46	1.98	1.58	1.12	0.62	1.40	1.70	1.66	1.89
	Azithromycin, clarithromycin, erythromycin	Macrolides (J01FA)	11.89	16.07	12.70	13.15	15.62	14.54	18.98	15.49	18.24	23.44
	Clindamycin	Lincosamides (J01FF)	2.26	3.18	3.31	2.10	1.79	1.82	2.78	2.52	2.13	2.17
III	Doxycycline, minocycline, tetracycline	Tetracyclines (J01AA)	4.29	5.83	4.90	3.78	3.76	3.38	3.48	5.05	4.16	4.39
	Trimethoprim	Trimethoprim and derivatives (J01EA)	0.06	0.07	0.18	0.03	0.11	0.12	0.10	0.05	0.05	0.15
	Nitrofurantoin	Nitrofuran derivatives (J01XE)	2.55	1.88	2.90	1.21	2.46	0.85	1.95	2.69	1.47	1.51
NC	Methenamine	Methenamine (J01XX)	0.03	0.02	0.02	< 0.01	0.01	0.04	0.02	< 0.01	NPD	0.01
Total (J01)			52.72	65.05	60.46	52.96	56.89	52.80	65.46	62.55	67.82	88.74

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

ATC = Anatomical Therapeutic Chemical. NC = Not classified. NPD = No prescriptions dispensed.

Certain antimicrobials were removed from this table due to low (< 0.01 prescriptions/1,000 inhabitants) to no sales reported among the provinces. These are: chloramphenicol, erythromycin-sulfisoxazole, fosfomicin, fusidic acid, nalidixic acid, sulfadiazine, sulfamethizole, sulfamethoxazole, sulfapyridine, and sulfisoxazole.

**Figure 14. Total consumption (DDDs/1,000 inhabitant-days) and total cost of oral antimicrobials dispensed by provincial retail pharmacies in Canada, 2011.**



Alphanumeric codes represent Anatomical Therapeutic Chemical classes of antimicrobials.  
DDDs = Defined daily doses.

**Table 18. Average cost per unit for oral antimicrobials dispensed by provincial retail pharmacies in Canada, 2011.**

ATC Class	Antimicrobial	Form	Cost (\$)/unit of antimicrobial									
			BC	AB	SK	MB	ON	QC	NB	NS	PE	NL
I	Combinations of penicillins, including $\beta$ -lactamase inhibitors (J01CR)	Liquid	0.24	0.25	0.25	0.23	0.24	0.25	0.23	0.24	0.25	0.21
		Tablet	1.82	2.00	1.81	1.66	1.55	1.61	1.71	1.76	1.63	1.66
	Third-generation cephalosporins (J01DD)	Liquid	0.60	0.60	0.59	0.59	0.60	0.57	0.56	0.57	0.58	0.55
		Tablet	5.32	5.56	6.24	5.39	6.19	5.60	5.17	5.41	4.97	4.96
	Fluoroquinolones (J01MA)	Ciprofloxacin (J01MA02)	Liquid	0.72	0.73	0.75	0.71	0.73	0.69	0.74	0.70	0.73
			Tablet	2.85	2.94	2.58	2.84	2.12	2.38	2.76	2.47	2.48
		Levofloxacin (J01MA12)	Liquid	6.59	5.65	4.82	5.77	4.97	4.86	4.97	5.65	5.72
			Tablet	7.91	7.78	8.04	7.72	7.68	7.15	7.69	7.66	7.73
		Moxifloxacin (J01MA14)	Liquid	2.06	2.21	1.92	2.18	1.47	1.78	1.99	2.03	1.93
			Tablet	2.01	1.97	2.18	2.11	1.98	2.27	2.36	1.89	2.06
	Glycopeptides (J01XA)	Vancomycin (J01XA01)	Liquid	14.24	12.74	13.13	13.93	14.77	12.44	13.23	13.43	13.04
			Tablet	1.64	1.78	1.40	1.22	1.39	1.45	1.22	1.12	1.00
	Imidazole (J01XD)	Metronidazole (J01XD01)	Tablet	1.64	1.78	1.40	1.22	1.39	1.45	1.22	1.12	1.00
	Linezolid (J01XX)	Linezolid (J01XX08)	Tablet	80.52	79.36	74.80	83.78	80.32	75.84	81.54	80.31	NPD
II	Penicillins with extended spectrum (J01CA)	Amoxicillin (J01CA04)	Liquid	0.14	0.13	0.12	0.12	0.13	0.12	0.10	0.11	0.10
			Tablet	0.82	0.83	0.68	0.67	0.73	0.72	0.65	0.77	0.69
		Ampicillin (J01CA01)	Tablet	0.80	0.73	0.78	0.70	0.69	0.81	0.71	0.73	0.74
	$\beta$ -lactamase sensitive penicillins (J01CE)	Penicillin V (J01CE02)	Liquid	0.13	0.14	0.12	0.13	0.12	0.13	0.12	0.12	0.12
			Tablet	0.40	0.39	0.30	0.39	0.37	0.46	0.31	0.33	0.25
	$\beta$ -lactamase resistant penicillins (J01CF)	Cloxacillin (J01CF02)	Liquid	0.10	0.10	0.09	0.08	0.09	0.09	0.08	0.08	0.09
			Tablet	0.61	0.61	0.56	0.58	0.56	0.61	0.52	0.56	0.52
		Cefadroxil (J01DB05)	Tablet	1.39	1.36	NPD	1.56	1.28	1.56	1.32	1.48	NPD
	First-generation cephalosporins (J01DB)	Cephalexin (J01DB01)	Liquid	0.20	0.19	0.18	0.17	0.18	0.15	0.17	0.18	0.17
			Tablet	0.75	0.86	0.63	0.67	0.77	0.75	0.62	0.65	0.61

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

ATC = Anatomical Therapeutic Chemical. NPD = No prescriptions dispensed.

Certain antimicrobials were removed from this table due to low (< 0.01 prescriptions/1,000 inhabitants) to no purchases being reported during the study period. The excluded antimicrobials were: demeclocycline, gemifloxacin, penicillin G, pivampicillin, spiramycin, sulfadiazine, sulfamethoxazole, and telithromycin.



**Table 18 (continued). Average cost per unit for oral antimicrobials dispensed by provincial retail pharmacies in Canada, 2011.**

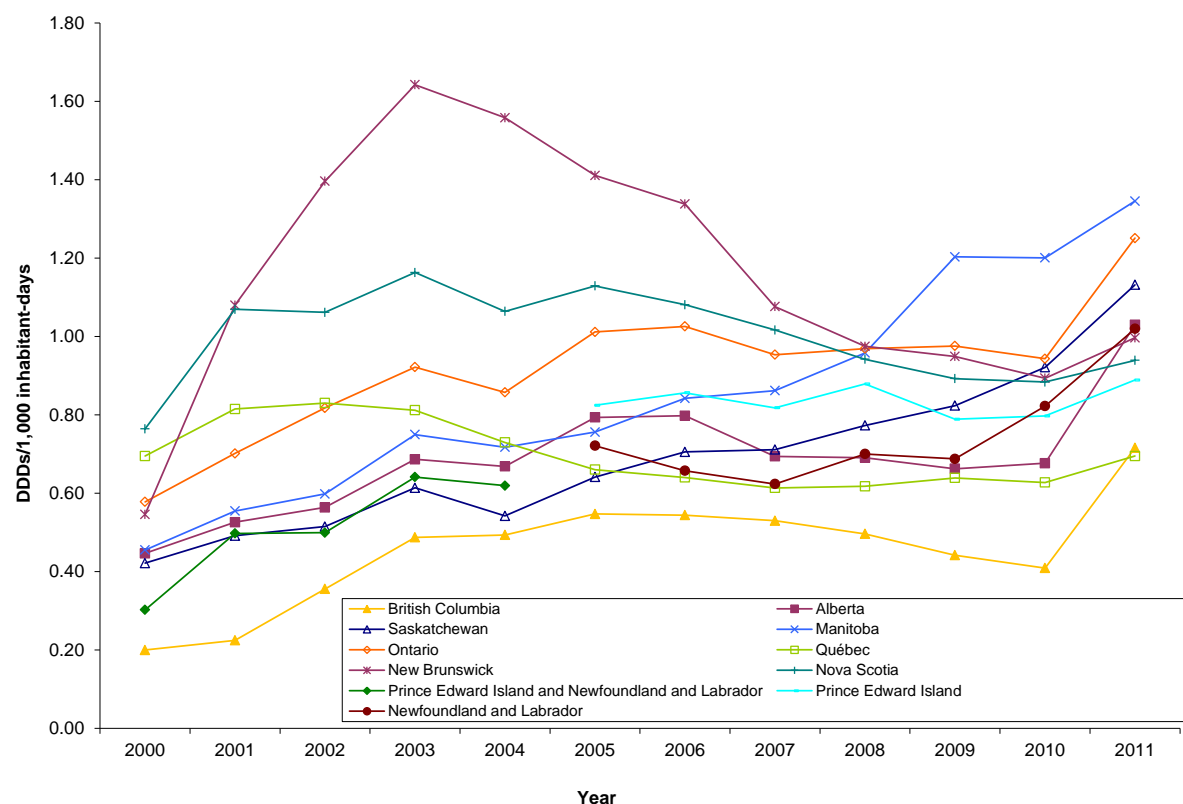
ATC Class		Antimicrobial	Form	Cost (\$)/unit of antimicrobial									
				BC	AB	SK	MB	ON	QC	NB	NS	PE	NL
II	Second-generation cephalosporins (J01DC)	Cefaclor (J01DC04)	Liquid	0.30	0.28	0.29	0.27	0.25	0.31	0.27	0.26	0.29	0.19
			Tablet	2.07	1.99	2.52	2.03	1.98	2.28	2.12	2.36	2.37	2.26
		Cefprozil (J01DC10)	Liquid	0.33	0.31	0.29	0.29	0.28	0.27	0.28	0.28	0.30	0.30
			Tablet	2.85	2.41	2.20	2.23	2.01	2.10	2.38	2.17	2.43	2.80
		Cefuroxime axetil (J01DC02)	Liquid	0.27	0.28	0.28	0.27	0.27	0.26	0.25	0.25	0.26	0.25
			Tablet	2.31	2.40	2.29	2.47	2.18	2.30	2.33	2.18	2.18	2.33
	Combinations of sulfonamides and trimethoprim, including derivatives (J01EE)	Sulfamethoxazole and trimethoprim (J01EE01)	Liquid	0.19	0.18	0.21	0.16	0.16	0.21	0.16	0.16	0.16	0.14
			Tablet	0.54	0.64	0.53	0.54	0.53	0.55	0.43	0.49	0.40	0.38
	Macrolides (J01FA)	Azithromycin (J01FA10)	Liquid	1.53	1.55	1.54	1.20	1.52	1.54	1.62	1.64	1.64	1.60
			Tablet	5.60	5.91	5.57	6.51	5.86	5.66	5.50	5.53	5.22	5.73
Liquid			0.59	0.59	0.60	0.58	0.60	0.58	0.58	0.57	0.59	0.57	
Tablet			2.24	2.32	2.32	2.48	2.34	2.23	2.45	2.39	2.51	2.50	
Erythromycin (J01FA01)		Liquid	0.20	0.22	0.19	1.09	0.18	0.42	0.17	0.20	0.22	0.20	
		Tablet	0.78	0.72	0.77	0.60	0.59	0.69	0.66	0.67	0.69	0.71	
		Spiramycin (J01FA02)	Tablet	2.24	2.37	NPD	1.90	2.40	2.45	2.23	2.75	1.61	3.18
		Telithromycin (J01FA15)	Tablet	4.31	4.32	NPD	NPD	4.47	3.98	4.06	4.28	NPD	NPD
Lincosamides (J01FF)	Clindamycin (J01FF01)	Liquid	0.18	0.18	0.18	0.18	0.17	0.18	0.17	0.17	0.18	0.17	
		Tablet	1.17	1.49	1.05	1.21	0.97	1.05	1.05	1.22	1.09	1.13	
III	Tetracyclines (J01AA)	Doxycycline (J01AA02)	Tablet	1.41	1.28	1.04	1.42	1.42	1.38	1.23	1.42	1.13	1.09
		Minocycline (J01AA08)	Tablet	0.82	1.21	0.97	1.09	1.08	0.90	0.96	1.00	1.05	1.07
		Tetracycline (J01AA07)	Tablet	0.18	0.20	0.19	0.18	0.17	0.17	0.15	0.17	0.15	0.14
	Nitrofuran derivatives (J01XE)	Nitrofurantoin (J01XE01)	Tablet	0.90	1.05	0.82	0.85	0.83	0.87	0.73	0.81	0.72	0.73
Fosfomycin (J01XX)	Fosfomycin (J01XX01)	Tablet	25.49	NPD	33.76	NPD	25.89	NPD	9.00	13.02	NPD	NPD	
NC	Trimethoprim and derivatives (J01EA)	Trimethoprim (J01EA01)	Tablet	0.74	1.22	0.72	0.70	0.71	0.92	0.72	0.73	0.86	0.61
	Methenamine (J01XX)	Methenamine (J01XX05)	Tablet	0.47	0.46	0.48	0.46	0.57	0.67	0.46	0.41	NPD	0.41

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

ATC = Anatomical Therapeutic Chemical. NC = Not classified. NPD = No prescriptions dispensed.

Certain antimicrobials were removed from this table due to low (< 0.01 prescriptions/1,000 inhabitants) to no purchases being reported during the study period. The excluded antimicrobials were: demeclocycline, gemifloxacin, penicillin G, pivampicillin, spiramycin, sulfadiazine, sulfamethoxazole, and telithromycin.

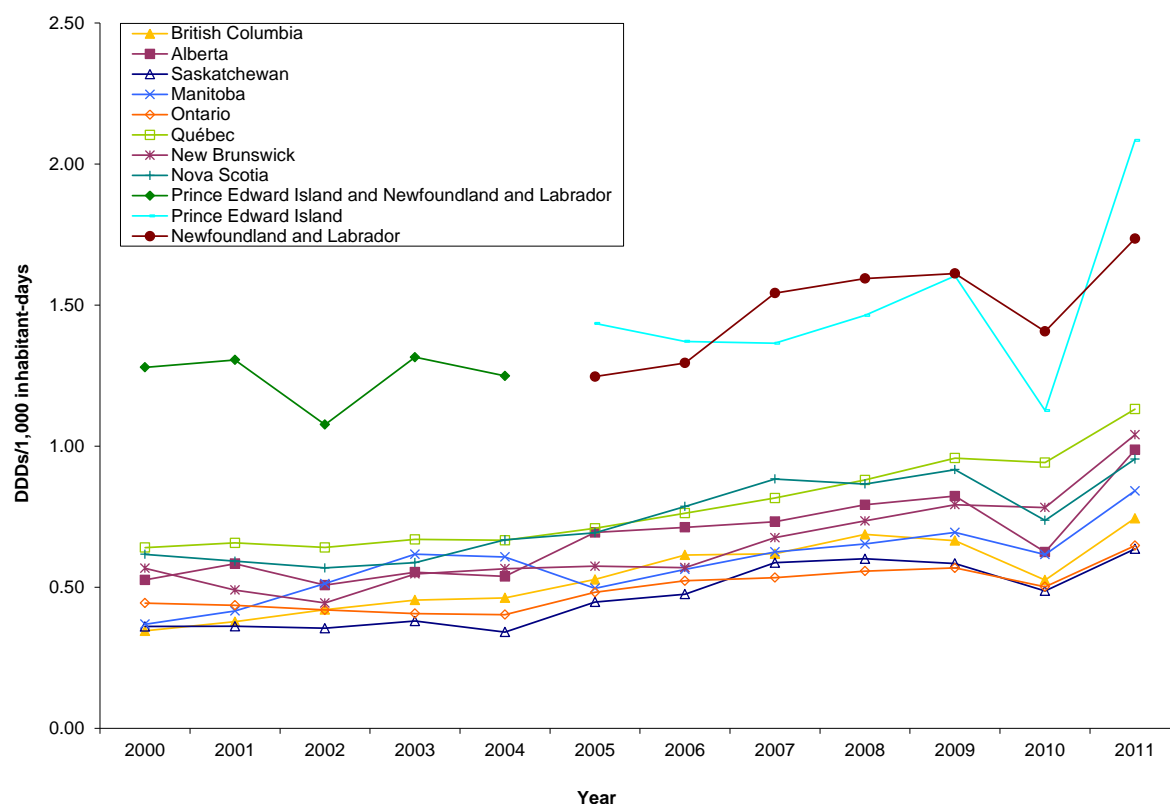
**Figure 15. Total consumption (DDDs/1,000 inhabitant-days) of oral azithromycin (J01FA10) dispensed by provincial retail pharmacies in Canada, 2000–2011.**



DDDs = Defined daily doses.

Prior to 2005, data for the provinces of Prince Edward Island and Newfoundland and Labrador were provided in a combined format. As of 2005, data is available at the individual provincial level.

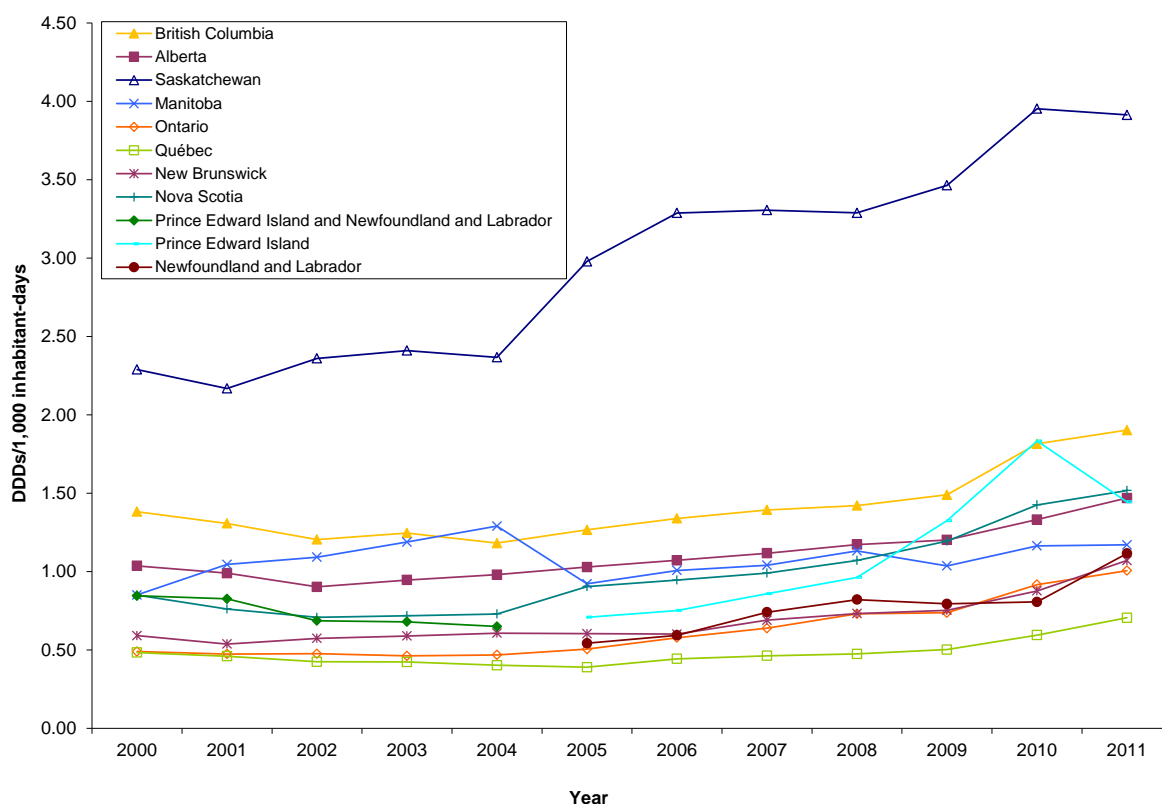
**Figure 16. Total consumption (DDDs/1,000 inhabitant-days) by year of oral amoxicillin-clavulanic acid (J01CR02) dispensed by provincial retail pharmacies in Canada, 2000–2011.**



DDDs = Defined daily doses.

Prior to 2005, data for the provinces of Prince Edward Island and Newfoundland and Labrador were provided in a combined format. As of 2005, data is available at the individual provincial level.

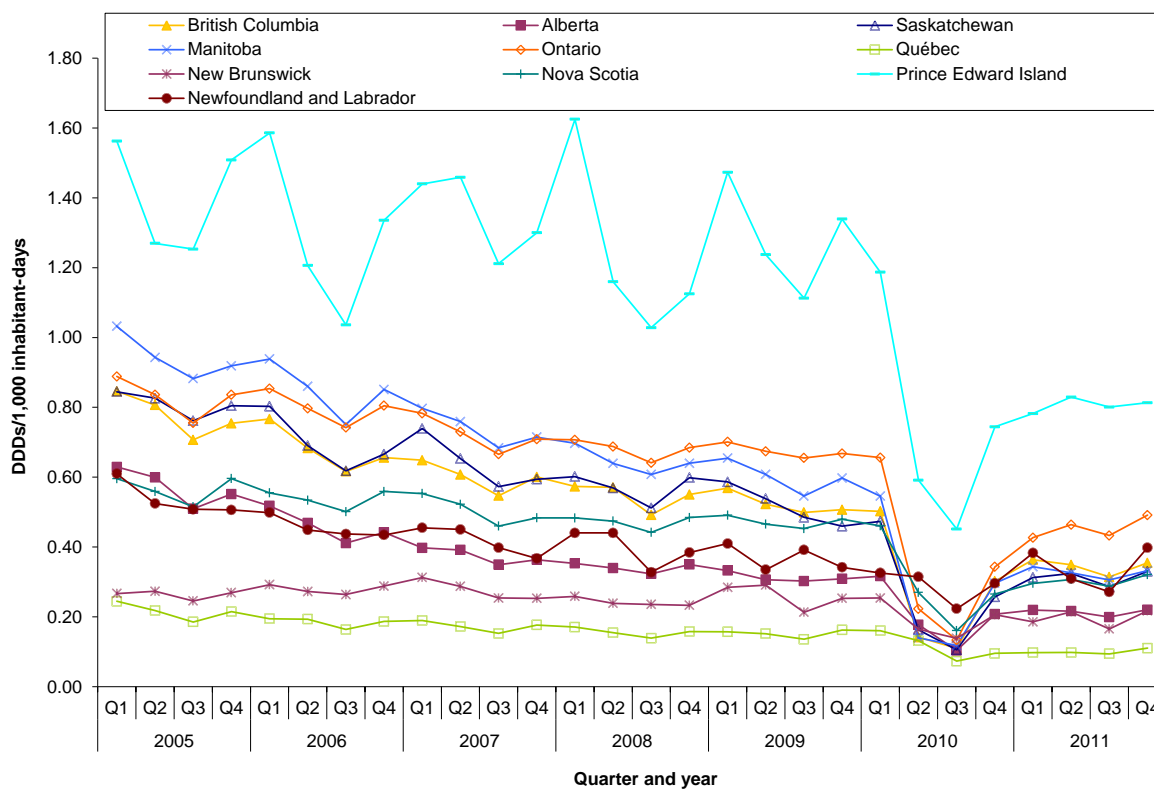
**Figure 17. Total consumption (DDDs/1,000 inhabitant-days) of oral doxycycline (J01AA02) dispensed by provincial retail pharmacies in Canada, 2000–2011.**



DDDs = Defined daily doses.

Prior to 2005, data for the provinces of Prince Edward Island and Newfoundland and Labrador were provided in a combined format. As of 2005, data is available at the individual provincial level.

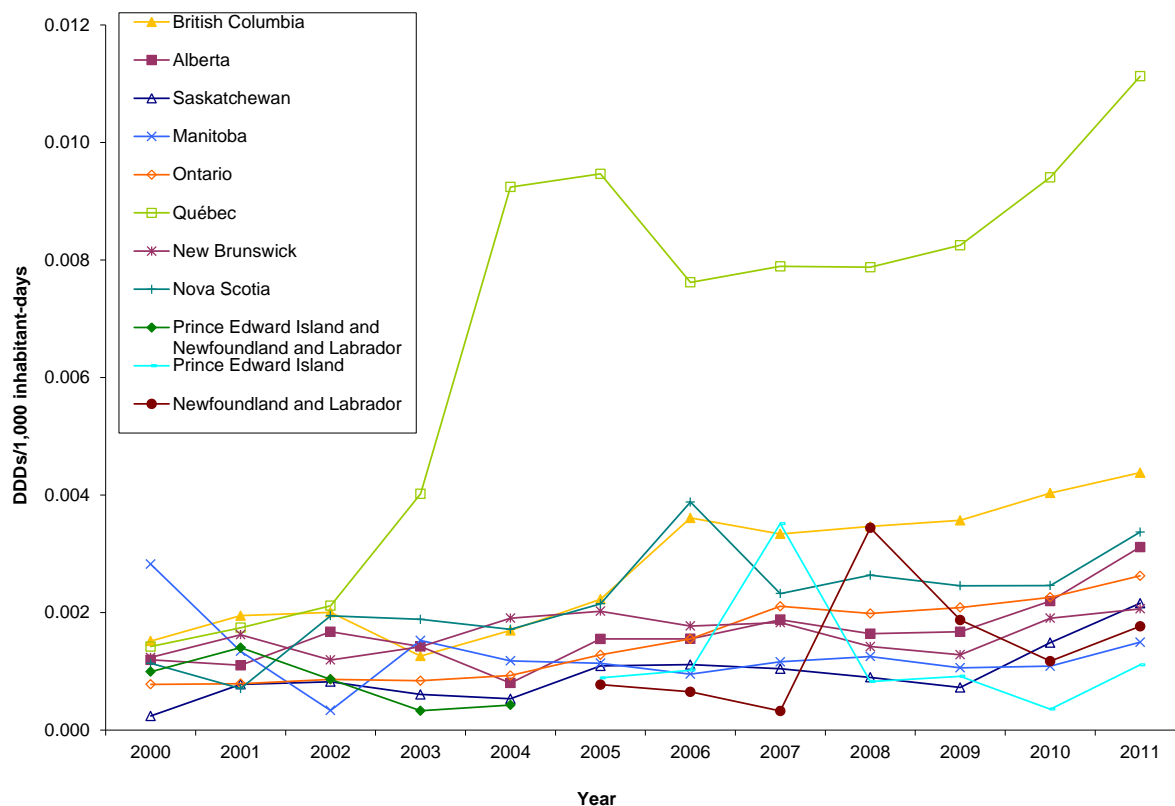
**Figure 18. Total consumption (DDDs/1,000 inhabitant-days) by quarter of oral tetracycline (J01AA07) dispensed by provincial retail pharmacies in Canada, 2000–2011.**



DDDs = Defined daily doses.

Prior to 2005, data for the provinces of Prince Edward Island and Newfoundland and Labrador were provided in a combined format. As of 2005, data is available at the individual provincial level.

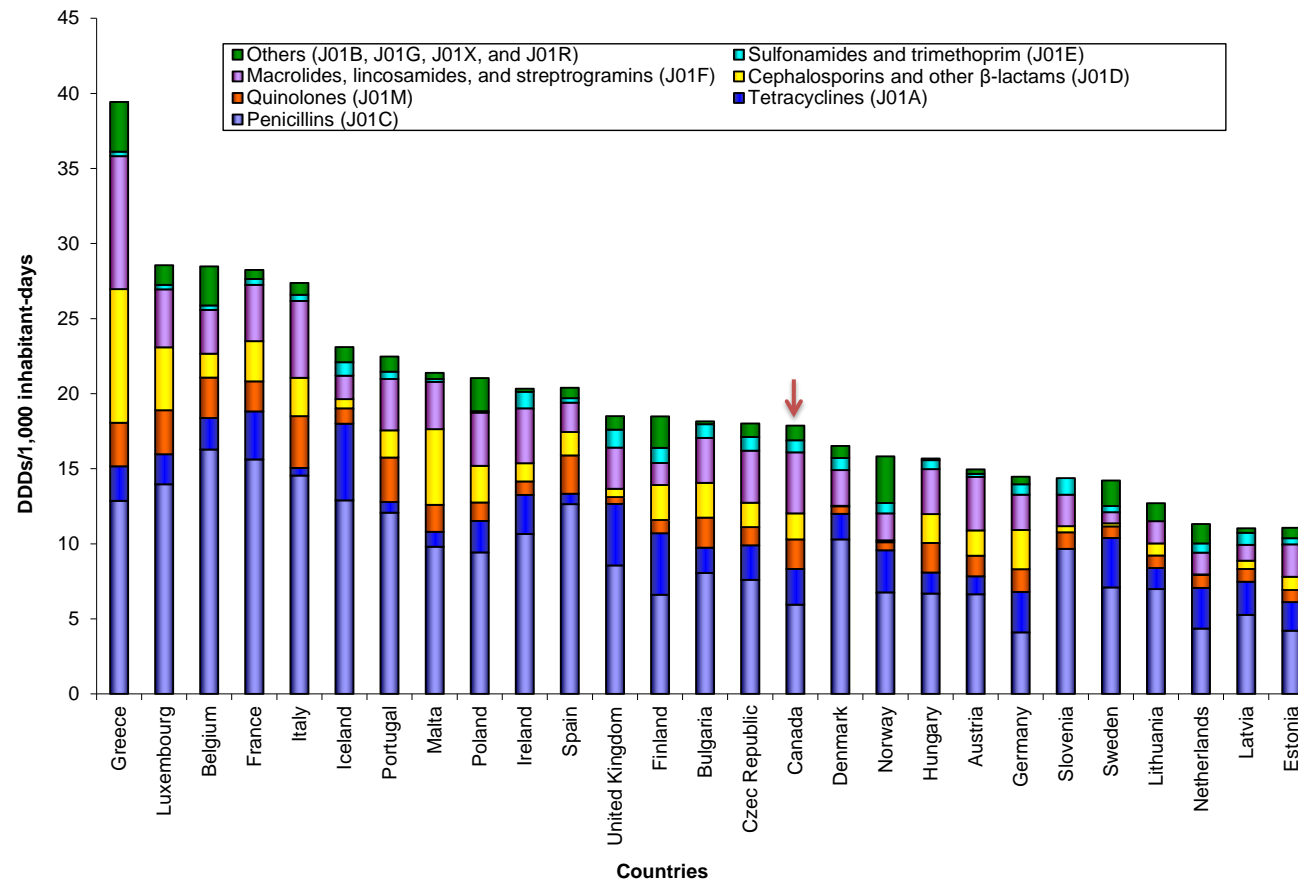
**Figure 19. Total consumption (DDDs/1,000 inhabitant-days) of oral vancomycin (J01XA01) dispensed by provincial retail pharmacies in Canada, 2000–2011.**



DDDs = Defined daily doses.

Prior to 2005, data for the provinces of Prince Edward Island and Newfoundland and Labrador were provided in a combined format. As of 2005, data is available at the individual provincial level.

**Figure 20. Antimicrobial consumption (DDDs/1,000 inhabitant-days) in 26 European countries and Canada; European Surveillance of Antimicrobial Consumption and CIPARS, 2010<sup>1</sup>.**



DDDs = Defined daily doses.

Greece and Iceland: Total use, including the hospital sector.

Spain: Reimbursement data, does not include over-the-counter sales without prescription.

Luxembourg: Updated with insured population data.

<sup>1</sup> ECDC. Surveillance report: Surveillance of antimicrobial consumption in Europe 2010. Available at: <http://www.ecdc.europa.eu/en/publications/Publications/antimicrobial-antibiotic-consumption-ESAC-report-2010-data.pdf>. Accessed November 2013.

## Hospital Purchasing Data

The Canadian Drugstore and Hospital Purchases Audit (CDH) measures the dollar value and unit volume of pharmaceutical products purchased by nearly all Canadian hospitals excluding those in the Yukon, Northwest Territories and Nunavut. Information was collected from over 700 hospitals and extrapolated to represent purchases by over 800 hospitals in Canada. The provinces of Prince Edward Island and Newfoundland and Labrador were grouped due to the small volume within each province. Hospital patient days or number of hospital beds was not available for this data; general population information was used for developing the rates of purchasing. Additional information on data collection and CIPARS analytic methods are described in Appendix A. For the purpose of this document we will use the term “consumption” to reflect hospital purchases.

### National Level

In 2011, there was a total of 44,406 kg of active ingredients of oral and parenteral antimicrobials purchased by hospitals in Canada, an increase of 7% (2,954 kg) and 27% (9,448 kg) compared to 2010 and 2001, respectively (Table 19 and Figure 21). Although increases were observed among most of the antimicrobial classes in 2011 compared to 2010, higher increases were observed among the tetracyclines (22%), combinations of penicillins, including  $\beta$ -lactamase inhibitors (18%), third-generation cephalosporins (11%), fourth-generation cephalosporins (11%) and nitrofurantoin derivatives (10%). Higher decreases were observed among amphenicols (32%) and methenamines (25%).

After accounting for inflation, total expenditures for both oral and parenteral antimicrobials were lower in 2011 compared to 2010 and 2001 (Table 20, Table 21 and Figure 21). Total cost of oral antimicrobials decreased 7% in 2011 compared to 2010 (Table 20 and Figure 21), representing a reduction of \$5,217,095.00. During this time period, high decreases in expenditures among oral methenamines (28%), combinations of sulfonamides and trimethoprim, including derivatives (27%), glycopeptides (25%), second-generation cephalosporins (21%) and imidazole (21%) were observed. However, high increases were observed among trimethoprim and derivatives (38%), tetracyclines (32%), third-generation cephalosporins (21%),  $\beta$ -lactamase sensitive penicillins (21%) and nitrofurantoin derivatives (14%). Similarly, total expenditures for parenteral drugs decreased 4% between 2011 and 2010, driven mainly by higher decreases among polymyxins (74%), amphenicols (40%), first-generation cephalosporins (23%) and aminoglycosides (13%). Higher increases were observed among daptomycin (67%), penicillins with extended spectrum (20%), and  $\beta$ -lactamase sensitive penicillins (17%) (Table 21 and Figure 21).

The total number of defined daily doses per 1,000 inhabitant-days (DID) have remained fairly stable for both oral and parenteral antimicrobials since 2001 (Table 22 and Table 23). There were slight increases observed among the oral (8%) and parenteral (3%) antimicrobials in 2011 compared to 2010. The increase in oral antimicrobial consumption was driven by slight increases among the tetracyclines (25%), combinations of penicillins, including  $\beta$ -lactamase inhibitors (25%), and macrolides (8%) (Table 22). Similarly, increases in consumption of parenteral drugs was mainly due to increases in combinations of penicillins, including  $\beta$ -lactamase inhibitors (20%) and third-generation cephalosporins (14%) (Table 23). Fluoroquinolones represent the largest group of oral antimicrobial agents consumed (24%), followed by macrolides (15%), tetracyclines (12%), cephalosporins (12%), and penicillin with extended spectrum (11%) (Figure 22).  $\beta$ -Lactamase sensitive penicillins (penicillin G and penicillin V) (32%) and cephalosporins (26%) are the largest group of parenteral antimicrobial drugs purchased by Canadian hospitals (Figure 23). Antimicrobials considered of very high importance to human medicine (Category I) represent 35% and 34% of the total DID of oral and parenteral antimicrobials purchased by hospitals, respectively (Table 22 and Table 23). This percentage has increased since 2001, when these antimicrobials among the oral form represented 33% and parenteral drugs represented 28%.



### Fluoroquinolones (J01MA)

Fluoroquinolones account for 24% and 6% of all DID for oral and parenteral antimicrobials, respectively, purchased by Canadian hospitals (Table 22, Table 23, Figure 22, and Figure 23). Consumption of oral fluoroquinolones has decreased 9% (0.02 DID) since 2001 but remained similar to 2010 (0.20 DID), while consumption of parenteral products have remained the same in 2011 (0.05 DID) since 2001 (0.05 DID) and 2010 (0.05 DID).

Ciprofloxacin (J01MA02) consumption represents 51% of all (both oral and parenteral combined) fluoroquinolones in 2011. Consumption of this product decreased 2% since 2010 and 26% since 2001 (Table B.3, Appendix B). The greatest increase in DIDs was observed among moxifloxacin (J01MA14), which increased 1233% since 2001, but decreased 2% when compared to 2010. Norfloxacin (J01MA06), ofloxacin (J01MA01), and levofloxacin (J01MA12) decreased 60%, 54%, and 34% since 2001, respectively. Gatifloxacin (J01MA16) has not been purchased by hospitals since 2008.

### Macrolides (J01FA)

Macrolides was the second largest group of oral antimicrobials purchased by Canadian hospitals (15%), while representing only 2% of all parenteral drugs (Table 22, Table 23, Figure 22, and Figure 23). Both oral and parenteral consumption for macrolides has remained the same since 2001 (0.13 and 0.01 DID, respectively). However, between 2010 and 2011, consumption of macrolides in an oral format increased 8% (0.01 DID).

Clarithromycin (J01FA09), azithromycin (J01FA10) and erythromycin (J01FA01) are the main macrolides purchased by Canadian hospitals. Since 2001, azithromycin consumption has increased 66%, while consumption of both clarithromycin and erythromycin has decreased during this time period (30%, 54%, respectively) (Table B.3, Appendix B). The highest increase observed in 2011 was for erythromycin whose consumption increased 14% compared to 2010, followed by azithromycin (9%) and clarithromycin (3%). Purchasing of spiramycin (J01FA02) and telithromycin (J01FA15) has been very limited, if not negligible, during this surveillance period.

### Tetracyclines (J01AA)

Tetracyclines represent 12% of all oral antimicrobials purchased by Canadian hospitals in 2011 (Table 22 and Figure 23). Tetracycline consumption has remained fairly stable since 2001 (0.06 DID) but increased 25% (0.02 DID) in 2011 compared to 2010.

Doxycycline (J01AA02) is the main tetracycline drug used in hospitals, representing 90% of all tetracyclines purchased (Table B.3, Appendix B). Doxycycline consumption has increased over time with an increase of 120% (5.05 DID) and 24% (1.77 DID) observed in 2011 compared to 2001 and 2010, respectively. Tetracycline (J01AA07) and minocycline (J01AA08) decreased 59% and 25% since 2001, respectively. Demeclocycline (J01AA01) has not been reported to be purchased by hospitals as of 2008, while hospitals began purchasing tigecycline (J01AA12) as of 2007, with 2011 seeing a 22% decrease compared to 2010.

### Cephalosporins (J01DB-DE)

Cephalosporins represented the second (26%) and fourth (12%) largest group of antimicrobials in parenteral and oral forms, respectively, purchased by hospitals (Table 22, Table 23, Figure 22, and Figure 23). Consumption of both parenteral and oral cephalosporins have decreased since 2001, with 54% (0.31 DID) and 23% (0.03 DID) decreases in 2011, respectively. However, between 2010 and 2011, oral cephalosporin use increased 8% (0.02 DID), while use of parenteral cephalosporins increased 25% (0.02 DID).

First-generation cephalosporins (J01DB) represent 47% of all cephalosporins in 2011, consisting mainly of cefazolin (J01DB04), a parenteral drug (Table B.3, Appendix B). Among the third-generation cephalosporins (J01DD), ceftriaxone (J01DD04) represents 75% of all drugs within this class. Purchases

of ceftriaxone in 2011 have increased 484% and 15% since 2001 and 2010, respectively. The only parenteral product within this class is cefixime (J01DD08), which increased 25% between 2010 and 2011. Ceftizoxime (J01DD07), another third-generation cephalosporin, has not been purchased by hospitals for use since 2007.

Twelve percent of all cephalosporins consist of second-generation cephalosporins (J01DC), of which cefuroxime axetil (J01DC02) represent 82% of all drugs in this class (Table B.3, Appendix B). Consumption of cefoxitin (J01DC01), cefaclor (J01DC04), and cefprozil (J01DC10) between 2010 and 2011 have remained fairly stable. Consumption increases were observed among cefuroxime axetil products, which between 2010 and 2011 increased 18%. No purchases for cefotetan (J01DC05) have been reported since 2007. Fourth-generation cephalosporins (J01DE) represent less than one percent of cephalosporin use by hospitals. The only product used in 2011 was cefepime (J01DE01,  $0.14 \times 10^{-2}$  DID), while ceftobiprole has not been reported as purchased except for 2008 to 2010, when very small quantities (less than  $0.01 \times 10^{-2}$  DID) were used.

### Carbapenems (J01DH)

Carbapenems (J01DH) represent 4% of all parenteral antimicrobials purchased by hospitals and have increased 300% and 33% compared to 2001 and 2011, respectively (Table B.3, Appendix B). The main contributor to this increase is ertapenem (J01DH03) which hospitals began purchasing in 2003 and observed a 39% increase between 2010 and 2011. Meropenem (J01DH02) saw a smaller increase, 2%, between 2010 and 2011, while imipenem use decreased 59% during this time period.

### $\beta$ -Lactamase Sensitive Penicillins (J01CE)

$\beta$ -Lactamase sensitive penicillins represent 32% and 2% of all parenteral and oral antimicrobials used by Canadian hospitals, respectively (Table 22, Table 23, Figure 22, and Figure 23). Consumption of products within this antimicrobial class have remained fairly stable since 2001.

There are only two antimicrobial products that belong to this class reported within this data: penicillin G (J01CE01) and penicillin V (J01CE02) (Table B.3, Appendix B). Ninety-four percent of all consumption consists of penicillin G and consumption between 2010 and 2011 remained the same. Consumption practices for penicillin V have changed over time, with decreased use reported between 2001 and 2011 (20%) and increases reported between 2010 and 2011 (81%) (Table B.3, Appendix B).

## Provincial Level

In 2011, differences in total consumption and total cost in dollars (per 1,000 inhabitant-days) for antimicrobial purchases by Canadian hospitals were observed across Canada (Table 24, Table 25, Table 26, and Figure 24). Overall, consumption of antimicrobials was highest in Manitoba (2.61 DID), whereas Ontario had the lowest levels reported (1.26 DID) (Figure 24). Total cost associated with antimicrobial purchases for hospital use was highest in British Columbia (\$12.13/1,000 inhabitant-days) and lower levels observed in Ontario (\$6.72/1,000 inhabitant-days) (Table 26 and Figure 24).

Provincial variation was observed across all antimicrobials for the cost per unit of antimicrobial purchased (Table 27). Overall, Manitoba had the highest cost associated for each unit of antimicrobial purchased (alone or together with another province) for a total of 29 antimicrobials, while Nova Scotia had the highest cost for two drugs. The biggest differences observed were for IV products of ticarcillin (J01CR03) where the cost per unit ranged from \$10.11 in Ontario to \$50.99 in Québec. This difference was due to Québec being the only province that purchased IV products of 31 g, while other provinces purchased units of smaller volume (3.1 g). Similarly, the difference observed for injectable tobramycin products, where cost per unit ranged from \$1.00 in Saskatchewan to \$35.35 in Québec, were due to the type of drug and strength of the drug purchased. Saskatchewan only purchased products of 10 mg/mL and 40

mg/mL strength, while the remaining provinces also purchased products of 1.2 g, whose cost per unit ranged from \$108 to \$151.

Among Category I antimicrobials, consumption of oral and parenteral fluoroquinolones was the highest in Prince Edward Island/Newfoundland and Labrador (0.39 DID), of third-generation cephalosporins in Manitoba (0.24 DID) of combinations of penicillins, including  $\beta$ -lactamase inhibitors in Manitoba (0.16 DID), of imidazole drugs in Nova Scotia (0.09 DID), and of carbapenems in British Columbia (0.06 DID) (Table 24 and Table 25).

### Oral Antimicrobials

Higher consumption of oral antimicrobials observed in Manitoba were driven by higher levels of consumption of penicillins with extended spectrum (0.30 DID), combinations of sulfonamides and trimethoprim, including derivatives (0.18 DID), first-generation cephalosporins (0.16 DID), combinations of penicillins, including  $\beta$ -lactamase inhibitors (0.11 DID),  $\beta$ -lactamase sensitive and resistant penicillins (0.06 and 0.03 DID, respectively), and lincosamides (0.04 DID) (Table 24). The higher consumption of penicillins with extended spectrum was attributable to amoxicillin consumption (0.30 DID) in Manitoba compared to Ontario (0.05 DID), the province with the lowest consumption (Figure 25). However, between 2001 and 2010, Prince Edward Island/Newfoundland and Labrador had the highest level of amoxicillin use, 0.27 DID reported in 2011. Over time, most of the provincial amoxicillin consumption across Canada has remained relatively stable (Figure 25), with the exception of Saskatchewan, where consumption increased 162% (0.13 DID) since 2001, making it the province with the third highest level of consumption in 2011.

Consumption of first-generation cephalosporins in Manitoba (0.16 DID) was driven by cephalexin (J01DB01) use which was approximately 5 times the reported consumption in Québec (0.03 DID), the province with the lowest consumption level reported (Figure 26). The second drug within this class, cefadroxil (J01DB05), has very little to no use reported among all provinces, with the exception of Québec (Figure 27). Although the amount of cefadroxil use in Québec is still relatively small (0.006 DID), levels of use in this province have been increasing since 2001, when consumption was reported at 0.002 DID.

The provinces of Nova Scotia and Prince Edward Island/Newfoundland and Labrador reported higher levels of consumption of second-generation cephalosporins in Canada, with 0.08 DID each in 2011 (Table 24). This is due to the high levels of cefuroxime axetil (J01DC02) consumption which were reported to be 0.08 DID in these provinces, compared to 0.02 DID reported in Ontario, the province with the lowest consumption. Cefprozil (J01DC10), a second-generation cephalosporin, had high levels of reported use in Québec (0.01 DID) with consumption approximately 17 times the level reported by Prince Edward Island/Newfoundland and Labrador ( $0.06 \times 10^{-2}$  DID), the provinces with the lowest consumption (Figure 28). Although cefaclor (J01DC04) is not one of the main second-generation cephalosporins used in hospitals, its use has been declining since 2001. New Brunswick had the highest levels of consumption in 2001 (0.02 DID), and in 2011 ( $0.06 \times 10^{-2}$  DID), still continues to have higher levels than the rest of Canada. However, cefaclor use has decreased 96% in that province, while no use was reported in the provinces of Alberta, British Columbia, Nova Scotia, and Saskatchewan (Figure 29).

Saskatchewan had the third highest level of consumption of oral antimicrobials in 2011, driven by higher consumption of antimicrobials belonging to third-generation cephalosporins (J01DD, 0.04 DID) and macrolides (J01FA, 0.38 DID) (Table 24). The province of Saskatchewan had the lowest levels of cefixime (J01DD08) consumption, a third-generation cephalosporin, between 2001 and 2008 (Figure 30). As of 2009, increased levels of cefixime use in this province have been reported, with Saskatchewan having the highest level reported in 2011 (0.04 DID) compared to British Columbia (0.02 DID, 2nd highest level reported) and Québec (0.005 DID, lowest level reported) (Figure 30). Since 2001, cefixime consumption has increased 2640% (0.04 DID).

In 2011, consumption of oral macrolides was highest in the province of Saskatchewan (0.38 DID), driven mainly by higher levels of azithromycin (J01FA10) use (0.29 DID) compared to Québec (0.05 DID), the province with the lowest consumption in 2011 (Figure 31). Azithromycin consumption has remained relatively stable across time for most of the provinces, with the exception of Saskatchewan, Manitoba, and Alberta (Figure 31). In 2001, use of azithromycin was highest in Saskatchewan compared to other

provinces. However, in 2004, use in this province observed an 83% decrease (0.20 DID), remaining stable until 2008. Since 2009, consumption levels began to increase leading to the higher levels observed in 2011. In contrast, the province of Alberta represented the second lowest level of azithromycin consumption in 2001 (0.03 DID), later becoming the province with the highest use in 2009 (0.14 DID), and experiencing a 62% decrease (0.08 DID) in 2011 (Figure 31). Consumption of clarithromycin (J01FA09), another macrolide antimicrobial, has remained fairly similar and stable across the Canadian provinces, with the exception of Prince Edward Island/Newfoundland and Labrador (Figure 32). Prince Edward Island/Newfoundland and Labrador observed a marked increase in reported use of clarithromycin in 2003, with levels remaining higher compared to use in the other provinces across time. In 2011, use in Prince Edward Island/Newfoundland and Labrador was reported to be 0.09 DID, compared to 0.06 DID in British Columbia (province with second highest level of use) and 0.03 DID in Ontario (province with lowest level of use).

### Parenteral Antimicrobials

Higher levels of parenteral antimicrobials were reported in Nova Scotia (1.03 DID), followed by Saskatchewan (1.00 DID) and Manitoba (0.98 DID) (Table 25). Both Nova Scotia and New Brunswick reported higher levels of fluoroquinolones use (J01MA, 0.12 DID each). Nova Scotia also reported higher levels of imidazole (J01XD, 0.05 DID), aminoglycosides (J01GB, 0.04 DID) and macrolides (J01FA, 0.02 DID). Five percent (0.05/1.03 DID) of all parenteral use in Nova Scotia consists of the glycopeptide vancomycin (J01XA01) (Table 25). In 2001, Nova Scotia had the highest level of use of this antimicrobial (0.14 DID) compared to 0.04 DID in Prince Edward Island/Newfoundland and Labrador (Figure 33). In 2003, Nova Scotia observed a 79% decrease in vancomycin use with levels continuing to decrease for the following two years. As of 2006, vancomycin use began to increase with levels reported in 2011 being the second highest for the country, with Québec representing the province with the highest vancomycin use (0.06 DID). Vancomycin use in Québec has remained relatively stable since 2001.

The higher levels of use reported by Manitoba were driven by higher consumption of third-generation cephalosporins (J01DD), specifically ceftriaxone (J01DD04). Across Canada, levels of ceftriaxone use have been increasing at a slow rate. However, in Manitoba, levels of ceftriaxone consumption have been rapidly increasing since 2007, with levels reported in 2011 (0.21 DID) being approximately twice of the levels reported by British Columbia (0.11 DID, province with second highest use) and approximately nine times that of Prince Edward Island/Newfoundland and Labrador (0.02 DID, province with lowest reported use) (Figure 34). Ceftriaxone use in Manitoba could be replacing the use of cefotaxime (J01DD01) in hospitals, as reported consumption of this antimicrobial in Manitoba has been decreasing over time (Figure 35).

Ertapenem (J01DH03), a parenteral carbapenem, was introduced in hospitals in 2003, with purchases reported in the provinces of Alberta, British Columbia and Québec (Figure 36). In 2006 all provinces reported purchasing this antimicrobial, with Québec reporting higher levels of use (0.006 DID). Ertapenem use has been increasing over time, with greater increases observed in the province of British Columbia. In 2011, British Columbia reported the highest level of ertapenem use (0.03 DID) compared to Alberta (0.02 DID, second highest use reported) and Ontario (0.004 DID, lowest use reported) (Figure 36).

**In 2011, there was a 7% (2,954 kg) increase in total antimicrobials purchased by Canadian hospitals, with slight increases in the levels of consumption for oral (8% increase) and parenteral (3% increase) antimicrobials. Antimicrobials considered of very high importance to human medicine (Category I) continued to represent a high proportion (0.56/1.62 DID) of the total antimicrobials used in hospitals in 2011.**

**Overall, consumption (DID) of antimicrobials was highest in Manitoba (2.61 DID) and total cost in dollars (per 1,000 inhabitant-days) was highest in British Columbia (\$12.13/1,000 inhabitant-days); whereas Ontario had the lowest levels of consumption (1.26 DID) and lowest overall cost (\$6.72/1,000 inhabitant-days). New Brunswick had the highest proportion of Category I consumption (43%, 0.62/1.43 DID) for 2011, driven by higher levels of fluoroquinolones consumed in that province.**

**Table 19. Total mass of active ingredients (kg) of oral and parenteral antimicrobials purchased by hospitals in Canada, 2001–2011.**

ATC Class and antimicrobial	Total active ingredients (kg)										
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>Combinations of penicillins, including <math>\beta</math>-lactamase inhibitors (J01CR)</b>											
Amoxicillin and enzyme inhibitor, piperacillin and enzyme inhibitor, ticarcillin and enzyme inhibitor	3,296.60	4,089.66	4,966.64	4,442.58	5,488.31	6,285.29	7,167.02	7,818.75	10,219.54	10,553.59	12,488.59
<b>Third-generation cephalosporins (J01DD)</b>											
Cefixime, cefotaxime, ceftazidime, ceftizoxime, ceftriaxone	1,281.64	1,728.40	1,984.75	2,128.23	2,403.03	2,283.37	2,091.15	2,039.01	2,290.09	2,071.16	2,309.94
<b>Fourth-generation cephalosporins (J01DE)</b>											
Cefepime, ceftobiprole	12.26	42.02	290.83	666.55	354.18	333.92	272.32	29.95	32.31	31.37	34.81
<b>Carbapenems (J01DH)</b>											
Doripenem, ertapenem, imipenem, meropenem	443.74	1,183.29	1,327.36	485.36	543.86	655.12	721.61	776.54	896.46	883.45	803.45
<b>Streptogramins (J01FG)</b>											
Quinupristin-dalfopristin	2.49	0.65	0.53	1.14	1.65	0.57	0.78	0.23	NAP	NAP	NAP
<b>I Fluoroquinolones (J01MA)</b>											
Ofloxacin, ciprofloxacin, norfloxacin, levofloxacin, moxifloxacin, gatifloxacin, gemifloxacin, trovafloxacin	2,308.78	2,272.00	2,401.64	2,491.77	2,324.51	2,389.95	2,383.50	2,381.81	2,399.32	2,110.79	2,159.97
<b>Glycopeptides (J01XA)</b>											
Vancomycin	892.69	1,001.21	493.02	426.15	425.42	331.77	317.79	338.50	391.71	392.80	400.77
<b>Polymyxins J01XB)</b>											
Colistin	2.41	2.89	2.68	2.37	2.09	3.13	3.40	3.47	2.69	1.86	0.50
<b>Imidazole (J01XD)</b>											
Metronidazole	1,820.59	1,160.66	1,003.14	1,122.90	1,047.88	1,061.67	1,119.98	1,010.20	955.62	954.09	921.30
<b>Daptomycin (J01XX)</b>											
Daptomycin	NAP	NAP	NAP	NAP	NAP	NAP	NAP	0.20	2.59	4.64	8.07
<b>Linezolid (J01XX)</b>											
Linezolid	3.97	10.73	13.22	15.39	24.60	27.18	33.57	39.74	44.07	39.22	41.10

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

ATC = Anatomical Therapeutic Chemical. NAP = No antimicrobials purchased.

**Table 19 (continued). Total mass of active ingredients of oral and parenteral antimicrobials purchased by hospitals in Canada, 2001–2011.**

	ATC Class and antimicrobial	Total active ingredients (kg)										
		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
II	<b>Penicillins with extended spectrum (J01CA)</b> Ampicillin, amoxicillin, pivampicillin, bacampicillin, piperacillin, pivmecillinam	3,401.12	2,577.72	2,580.25	2,549.58	2,572.00	2,340.40	2,233.04	2,136.77	2,142.21	2,119.38	2,187.63
	<b>β-lactamase sensitive penicillins (J01CE)</b> Penicillin G, penicillin V	9,038.56	8,300.62	9,932.84	11,872.74	12,266.59	12,034.49	11,542.59	12,123.97	12,003.32	11,479.15	11,946.42
	<b>β-lactamase resistant penicillins (J01CF)</b> Cloxacillin	1,626.03	1,550.90	1,517.02	1,454.71	1,413.03	1,336.41	1,311.96	1,256.98	1,396.81	1,243.47	1,300.61
	<b>First-generation cephalosporins (J01DB)</b> Cephalexin, cefadroxil, cefazolin, cephalothin	5,018.11	5,366.67	5,522.63	5,390.89	5,536.21	5,586.22	5,552.17	5,686.98	6,002.43	5,626.29	5,695.27
	<b>Second-generation cephalosporins (J01DC)</b> Cefaclor, cefprozil, cefuroxime, cefuroxime axetil, cefotetan, cefoxitin	1,865.55	1,957.09	1,606.93	1,087.06	972.86	755.16	693.81	611.47	623.51	501.64	520.39
	<b>Combinations of sulfonamides and trimethoprim, including derivatives (J01EE)</b> Sulfamethoxazole and trimethoprim, sulfadiazine and trimethoprim	1,992.47	1,672.69	1,759.62	1,627.26	1,670.47	1,719.65	1,602.25	1,559.30	1,611.91	1,496.47	1,529.66
	<b>Macrolides (J01FA)</b> Azithromycin, clarithromycin, erythromycin, spiramycin, telithromycin	816.99	844.65	885.72	761.50	785.67	717.61	764.75	777.95	827.86	707.40	771.25
	<b>Lincosamides (J01FF)</b> Clindamycin, lincomycin	604.43	588.62	557.01	515.88	547.79	866.45	919.31	907.93	920.11	857.60	883.93
	<b>Streptomycin (J01GA)</b> Streptomycin	0.04	0.09	0.33	0.51	0.78	0.93	1.64	2.22	2.15	1.09	1.11
	<b>Aminoglycosides (J01GB)</b> Amikacin, gentamicin, netilmicin, tobramycin	157.19	133.12	79.99	48.50	77.63	155.66	156.83	140.52	129.83	123.61	112.76

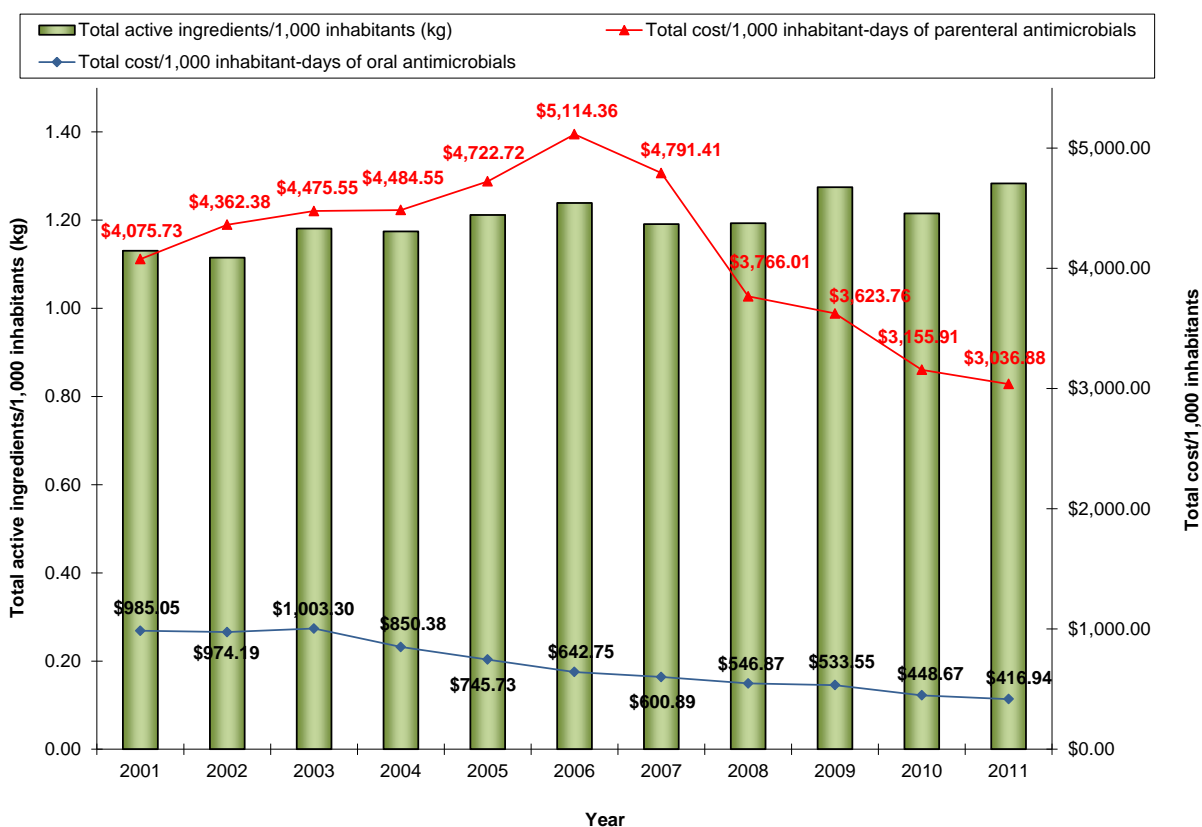
Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.  
ATC = Anatomical Therapeutic Chemical.

**Table 19 (continued). Total mass of active ingredients of oral and parenteral antimicrobials purchased by hospitals in Canada, 2001–2011.**

ATC Class and antimicrobial		Total active ingredients (kg)										
		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
II	Other quinolones, excluding fluoroquinolones (J01MB)											
	Nalidixic acid	1.68	1.90	0.78	0.70	0.06	NAP	NAP	NAP	NAP	NAP	NAP
	Sulfonamide combinations, excluding trimethoprim (J01RA)											
	Erythromycin-sulfisoxazole	75.87	100.87	58.88	24.29	30.18	15.74	26.86	3.06	NAP	NAP	NAP
	Steroid antibacterials (J01XC)											
	Fusidic acid	9.73	9.72	9.89	10.47	6.98	9.00	8.45	7.60	2.00	NAP	NAP
III	Tetracyclines (J01AA)											
	Doxycycline, minocycline, tetracycline, demeclocycline, tigecycline	181.00	163.37	156.17	147.28	140.46	144.30	186.38	235.38	194.14	148.19	181.11
	Amphenicols (J01BA)											
	Chloramphenicol	9.13	6.45	5.50	9.15	5.87	5.17	1.07	5.08	2.47	4.50	3.07
	Trimethoprim and derivatives (J01EA)											
	Trimethoprim	10.53	10.33	15.79	10.32	10.98	12.23	10.06	7.68	7.80	7.23	7.60
NC	Nitrofuran derivatives (J01XE)											
	Nitrofurantoin	50.21	57.58	58.91	67.74	70.77	71.73	69.92	66.99	67.81	77.17	85.24
	Fosfomycin (J01XX)											
	Fosfomycin	0.25	0.19	0.08	0.21	0.14	0.14	0.08	NAP	0.02	0.06	NAP
	Methenamine (J01XX)											
	Methenamine	34.35	32.05	32.55	33.40	23.35	22.10	18.80	8.00	13.40	15.75	11.80
Total (J01)		34,958.30	34,866.14	37,264.71	37,394.60	38,747.33	39,165.36	39,211.11	39,976.28	43,182.18	41,451.97	44,406.35

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.  
ATC = Anatomical Therapeutic Chemical. NAP = No antimicrobials purchased. NC = Not classified.

**Figure 21. Total number of active ingredients (kg) per 1,000 inhabitants and total cost (after accounting for inflation<sup>1</sup>) per 1,000 inhabitants for oral and parenteral antimicrobials purchased by hospitals in Canada, 2001–2011.**



<sup>1</sup> Bank of Canada. Inflation Calculator. Available at: [www.bankofcanada.ca/rates/related/inflation-calculator/](http://www.bankofcanada.ca/rates/related/inflation-calculator/). Accessed November 2013.



**Table 20. Total cost per 1,000 inhabitants for oral antimicrobials purchased by hospitals in Canada, 2001–2011.**

ATC Class and antimicrobial	Total cost/1,000 inhabitants (\$)										
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>Combinations of penicillins, including <math>\beta</math>-lactamase inhibitors (J01CR)</b>											
Amoxicillin and enzyme inhibitor	25.28	25.57	24.74	22.24	22.82	23.01	17.23	16.75	20.04	19.58	18.84
<b>Third-generation cephalosporins (J01DD)</b>											
Cefixime	12.05	12.69	11.18	7.20	8.32	8.62	10.46	11.65	14.80	15.66	18.92
<b>Fluoroquinolones (J01MA)</b>											
Ofloxacin, ciprofloxacin, norfloxacin, levofloxacin, moxifloxacin, gatifloxacin, gemifloxacin	502.18	490.36	503.73	370.84	248.84	216.92	206.46	182.72	174.92	128.08	118.95
<b>Glycopeptides (J01XA)</b>											
Vancomycin	26.38	22.17	31.72	55.89	43.71	40.57	45.72	43.51	45.38	30.84	23.25
<b>Imidazole (J01XD)</b>											
Metronidazole	3.47	4.20	4.41	5.86	5.73	6.38	6.90	6.18	6.32	11.89	9.42
<b>Linezolid (J01XX)</b>											
Linezolid	13.85	34.62	42.29	44.29	67.24	74.26	81.08	93.52	98.78	86.39	85.00
<b>Penicillins with extended spectrum (J01CA)</b>											
Ampicillin, amoxicillin, pivampicillin, bacampicillin, pivmecillinam	12.51	11.00	10.45	9.06	10.01	9.12	9.16	9.22	10.20	11.22	10.28
<b><math>\beta</math>-lactamase sensitive penicillins (J01CE)</b>											
Penicillin G, penicillin V	3.06	3.51	3.39	2.78	2.61	2.55	1.67	2.33	2.71	2.29	2.77
<b><math>\beta</math>-lactamase resistant penicillins (J01CF)</b>											
Cloxacillin	4.13	4.17	4.47	4.07	3.98	3.29	2.75	2.43	2.09	2.76	2.31
<b>I First-generation cephalosporins (J01DB)</b>											
Cephalexin, cefadroxil	16.49	16.39	19.24	18.38	19.29	23.04	16.13	15.60	15.19	14.66	16.08
<b>Second-generation cephalosporins (J01DC)</b>											
Cefaclor, cefprozil, cefuroxime axetil	89.61	62.92	49.72	39.45	34.59	30.11	30.18	23.11	22.93	26.16	20.55
<b>Combinations of sulfonamides and trimethoprim, including derivatives (J01EE)</b>											
Sulfamethoxazole and trimethoprim, sulfadiazine and trimethoprim	8.79	8.70	7.58	6.40	6.07	6.07	5.71	4.97	4.99	4.65	3.37

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.  
ATC = Anatomical Therapeutic Chemical.

**Table 20 (continued). Total cost per 1,000 inhabitants for oral antimicrobials purchased by hospitals in Canada, 2001–2011.**

ATC Class and antimicrobial		Total cost/1,000 inhabitants (\$)										
		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
I	<b>Macrolides (J01FA)</b>											
	Azithromycin, clarithromycin, erythromycin, spiramycin, telithromycin	212.42	210.08	242.93	221.18	233.95	161.90	129.31	98.23	85.73	66.28	56.56
	<b>Lincosamides (J01FF)</b>											
	Clindamycin	26.86	26.56	23.04	19.33	15.82	14.14	14.46	12.70	11.33	9.83	8.45
	<b>Other quinolones, excluding fluoroquinolones (J01MB)</b>											
	Nalidixic acid	0.07	0.07	0.04	0.03	< 0.01	NAP	NAP	NAP	NAP	NAP	NAP
	<b>Sulfonamide combinations, excluding trimethoprim (J01RA)</b>											
	Erythromycin-sulfisoxazole	1.99	1.97	1.48	0.61	0.80	0.41	0.66	0.07	NAP	NAP	NAP
	<b>Steroid antibacterials (J01XC)</b>											
	Fusidic acid	1.61	1.60	1.66	1.72	1.18	1.44	1.27	1.10	0.28	NAP	NAP
II	<b>Tetracyclines (J01AA)</b>											
	Doxycycline, minocycline, tetracycline, demeclocycline	16.63	16.45	12.82	11.00	10.17	10.16	11.12	12.43	6.80	6.93	9.13
	<b>Trimethoprim and derivatives (J01EA)</b>											
	Trimethoprim	1.20	1.19	0.84	0.65	0.69	0.74	0.59	0.44	0.44	0.40	0.55
	<b>Nitrofurantoin (J01XE)</b>											
III	Nitrofurantoin	4.90	4.85	7.09	8.90	9.55	9.73	9.78	9.79	10.39	10.82	12.33
	<b>Fosfomycin (J01XX)</b>											
	Fosfomycin	0.07	0.07	0.02	0.06	0.03	0.03	0.02	NAP	< 0.01	0.01	NAP
	<b>Methenamine (J01XX)</b>											
	Methenamine	0.53	0.52	0.45	0.47	0.32	0.29	0.24	0.11	0.19	0.25	0.18
<b>Total (J01)</b>		<b>985.05</b>	<b>974.19</b>	<b>1,003.30</b>	<b>850.38</b>	<b>745.73</b>	<b>642.75</b>	<b>600.89</b>	<b>546.87</b>	<b>533.55</b>	<b>448.67</b>	<b>416.94</b>

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.  
 ATC = Anatomical Therapeutic Chemical. NAP = No antimicrobials purchased. NC = Not classified.

**Table 21. Total cost per 1,000 inhabitants for parenteral antimicrobials purchased by hospitals in Canada, 2001–2011.**

ATC Class and antimicrobial	Total cost/1,000 inhabitants (\$)										
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>Combinations of penicillins, including <math>\beta</math>-lactamase inhibitors (J01CR)</b>											
Piperacillin and enzyme inhibitor, ticarcillin and enzyme inhibitor	518.04	529.55	663.70	638.08	778.33	881.02	1,008.38	825.78	590.95	502.22	526.59
<b>Third-generation cephalosporins (J01DD)</b>											
Cefotaxime, ceftazidime, ceftizoxime, ceftriaxone	1,065.96	1,084.50	1,098.85	1,168.92	1,187.88	1,191.27	842.68	389.32	330.90	191.99	179.83
<b>Fourth-generation cephalosporins (J01DE)</b>											
Cefepime, ceftobiprole	0.76	2.56	17.21	30.20	16.42	13.88	12.18	11.44	19.28	12.14	10.92
<b>Carbapenems (J01DH)</b>											
Doripenem, ertapenem, imipenem, meropenem	488.59	690.44	658.15	656.19	680.82	885.25	935.03	1,002.15	1,171.81	1,139.48	1,055.07
<b>Streptogramins (J01FG)</b>											
Quinupristin-dalfopristin	17.53	4.56	3.55	7.28	10.29	3.55	4.58	1.29	NAP	NAP	NAP
<b>I Fluoroquinolones (J01MA)</b>											
Ofloxacin, ciprofloxacin, norfloxacin, levofloxacin, moxifloxacin	831.30	962.48	1,032.65	1,116.18	1,135.80	1,178.04	957.74	580.40	385.04	275.43	267.68
<b>Glycopeptides (J01XA)</b>											
Vancomycin	111.82	153.41	133.24	147.13	164.47	121.24	119.86	90.80	116.49	104.32	98.12
<b>Polymyxins (J01XB)</b>											
Colistin	21.60	25.28	22.40	19.22	15.99	22.53	22.70	22.15	16.89	11.41	2.95
<b>Imidazole (J01XD)</b>											
Metronidazole	28.96	41.55	14.79	15.02	12.92	12.68	14.76	10.69	8.22	8.76	9.13
<b>Daptomycin (J01XX)</b>											
Daptomycin	NAP	NAP	NAP	NAP	NAP	NAP	NAP	2.09	26.56	47.63	79.73
<b>Linezolid (J01XX)</b>											
Linezolid	6.24	19.85	20.50	29.47	49.19	51.77	67.10	74.45	87.23	72.81	75.80

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.  
ATC = Anatomical Therapeutic Chemical. NAP = No antimicrobials purchased.

Table 21 (continued). Total cost per 1,000 inhabitants for parenteral antimicrobials purchased by hospitals in Canada, 2001–2011.

ATC Class and antimicrobial		Total cost/1,000 inhabitants (\$)										
		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
II	<b>Penicillins with extended spectrum (J01CA)</b>											
	Ampicillin, pivampicillin	127.56	51.20	74.62	66.35	55.09	47.33	46.50	35.61	39.85	40.35	48.35
	<b>β-lactamase sensitive penicillins (J01CE)</b>											
	Penicillin G	22.51	21.52	23.61	22.39	21.80	20.76	21.02	20.77	47.23	23.52	27.44
	<b>β-lactamase resistant penicillins (J01CF)</b>											
	Cloxacillin	38.80	40.53	42.24	43.73	46.19	49.93	55.58	53.64	77.95	74.72	81.11
	<b>First-generation cephalosporins (J01DB)</b>											
	Cefazolin, cephalothin	197.90	207.75	201.17	179.58	180.02	163.53	188.28	156.46	160.58	218.52	173.04
	<b>Second-generation cephalosporins (J01DC)</b>											
	Cefotetan, cefoxitin, cefuroxime	279.45	238.54	219.59	134.57	133.96	94.90	81.82	61.28	59.37	41.25	41.54
	<b>Combinations of sulfonamides and trimethoprim, including derivatives (J01EE)</b>											
	Sulfamethoxazole and trimethoprim	19.97	24.36	27.69	30.82	30.28	32.02	28.75	29.20	32.45	27.23	28.04
	<b>Macrolides (J01FA)</b>											
	Azithromycin, erythromycin	82.49	87.60	105.80	96.95	87.83	89.66	93.04	99.63	113.60	47.12	50.14
	<b>Lincosamides (J01FF)</b>											
	Clindamycin	74.72	65.57	53.65	45.24	47.80	104.53	105.96	104.01	108.49	94.42	94.01
	<b>Streptomycin (J01GA)</b>											
	Streptomycin	0.01	0.08	0.31	0.54	0.88	1.23	2.35	3.03	2.93	1.46	1.41
	<b>Aminoglycosides (J01GB)</b>											
Amikacin, gentamicin, netilmicin, tobramycin	138.87	108.90	60.45	34.79	65.51	147.56	170.17	159.48	167.05	160.51	140.36	
<b>Steroid antibacterials (J01XC)</b>												
Fusidic acid	1.27	0.97	0.42	0.32	NAP	NAP	NAP	NAP	NAP	NAP	NAP	
III	<b>Tetracyclines (J01AA)</b>											
	Tigecycline	NAP	NAP	NAP	NAP	NAP	NAP	12.54	30.48	59.73	58.39	44.29
	<b>Amphenicols (J01BA)</b>											
	Chloramphenicol	1.43	1.16	0.98	1.57	1.24	1.70	0.40	1.85	1.17	2.24	1.34
<b>Total (J01)</b>		<b>4,075.73</b>	<b>4,362.38</b>	<b>4,475.55</b>	<b>4,484.55</b>	<b>4,722.72</b>	<b>5,114.36</b>	<b>4,791.41</b>	<b>3,766.01</b>	<b>3,623.76</b>	<b>3,155.91</b>	<b>3,036.88</b>

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

ATC = Anatomical Therapeutic Chemical. NAP = No antimicrobials purchased.

**Table 22. Defined daily doses per 1,000 inhabitant-days for oral antimicrobials purchased by hospitals in Canada, 2001–2011.**

ATC Class and antimicrobial	DDDs/1,000 inhabitant-days										
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>Combinations of penicillins, including <math>\beta</math>-lactamase inhibitors (J01CR)</b>											
Amoxicillin and enzyme inhibitor	0.02	0.02	0.03	0.03	0.04	0.04	0.03	0.03	0.04	0.04	0.05
<b>Third-generation cephalosporins (J01DD)</b>											
Cefixime	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
<b>I Fluoroquinolones (J01MA)</b>											
Ofloxacin, ciprofloxacin, norfloxacin, levofloxacin, moxifloxacin, gatifloxacin, gemifloxacin	0.22	0.22	0.24	0.24	0.23	0.23	0.23	0.22	0.23	0.20	0.20
<b>Imidazole (J01XD)</b>											
Metronidazole	0.04	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03
<b>Penicillins with extended spectrum (J01CA)</b>											
Ampicillin, amoxicillin, pivampicillin, bacampicillin, pivmecillinam	0.11	0.11	0.10	0.09	0.10	0.09	0.08	0.08	0.08	0.09	0.09
<b><math>\beta</math>-lactamase sensitive penicillins (J01CE)</b>											
Penicillin G, penicillin V	0.02	0.03	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.02
<b>II <math>\beta</math>-lactamase resistant penicillins (J01CF)</b>											
Cloxacillin	0.03	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01
<b>First-generation cephalosporins (J01DB)</b>											
Cephalexin, cefadroxil	0.05	0.05	0.05	0.05	0.06	0.07	0.05	0.05	0.05	0.04	0.05
<b>Second-generation cephalosporins (J01DC)</b>											
Cefaclor, cefprozil, cefuroxime axetil	0.07	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.03	0.04

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

ATC = Anatomical Therapeutic Chemical. DDDs = Defined daily doses.

**Table 22 (continued). Defined daily doses per 1,000 inhabitant-days for oral antimicrobials purchased by hospitals in Canada, 2001–2011.**

ATC Class and antimicrobial	DDDs/1,000 inhabitant-days										
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>Combinations of sulfonamides and trimethoprim, including derivatives (J01EE)</b>											
Sulfamethoxazole and trimethoprim, sulfadiazine and trimethoprim	0.09	0.07	0.08	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06
<b>II Macrolides (J01FA)</b>											
Azithromycin, clarithromycin, erythromycin, spiramycin, telithromycin	0.13	0.13	0.14	0.12	0.13	0.12	0.13	0.13	0.14	0.12	0.13
<b>Lincosamides (J01FF)</b>											
Clindamycin	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.01
<b>Tetracyclines (J01AA)</b>											
Doxycycline, minocycline, tetracycline, demeclocycline	0.06	0.05	0.05	0.06	0.05	0.06	0.08	0.12	0.08	0.08	0.10
<b>III Nitrofurans derivatives (J01XE)</b>											
Nitrofurantoin	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
<b>Total (J01)</b>	<b>0.88</b>	<b>0.84</b>	<b>0.87</b>	<b>0.86</b>	<b>0.86</b>	<b>0.86</b>	<b>0.83</b>	<b>0.85</b>	<b>0.84</b>	<b>0.78</b>	<b>0.84</b>

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.  
 ATC = Anatomical Therapeutic Chemical. DDDs = Defined daily doses.

**Table 23. Defined daily doses per 1,000 inhabitant-days for parenteral antimicrobials purchased by hospitals in Canada, 2001–2011.**

ATC Class and antimicrobial	DDDs/1,000 inhabitant-days										
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>Combinations of penicillins, including <math>\beta</math>-lactamase inhibitors (J01CR)</b>											
Piperacillin and enzyme inhibitor, ticarcillin and enzyme inhibitor	0.02	0.02	0.03	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06
<b>Third-generation cephalosporins (J01DD)</b>											
Cefotaxime, ceftazidime, ceftizoxime, ceftriaxone	0.03	0.05	0.06	0.06	0.07	0.07	0.06	0.07	0.08	0.07	0.08
<b>Fourth-generation cephalosporins (J01DE)</b>											
Cefepime, cefetobiprole	< 0.01	< 0.01	0.01	0.03	0.02	0.01	0.01	< 0.01	< 0.01	< 0.01	< 0.01
<b>I Carbapenems (J01DH)</b>											
Doripenem, ertapenem, imipenem, meropenem	0.01	0.03	0.03	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.04
<b>Fluoroquinolones (J01MA)</b>											
Ofloxacin, ciprofloxacin, norfloxacin, levofloxacin, moxifloxacin	0.05	0.06	0.06	0.07	0.07	0.08	0.06	0.06	0.06	0.05	0.05
<b>Glycopeptides (J01XA)</b>											
Vancomycin	0.04	0.04	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.02	0.02
<b>Imidazole (J01XD)</b>											
Metronidazole	0.06	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Roman numerals I to II indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.  
 ATC = Anatomical Therapeutic Chemical. DDDs = Defined daily doses.

**Table 23 (continued). Defined daily doses per 1,000 inhabitant-days for parenteral antimicrobials purchased by hospitals in Canada, 2001–2011.**

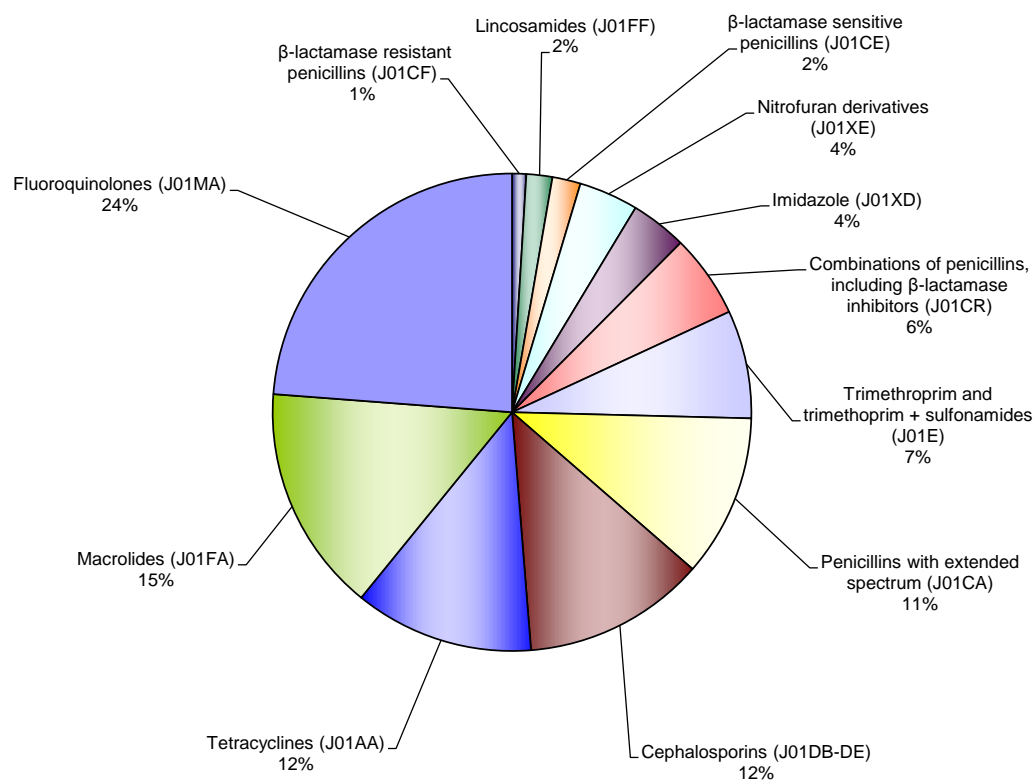
	ATC Class and antimicrobial	DDDs/1,000 inhabitant-days										
		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
II	<b>Penicillins with extended spectrum (J01CA)</b>											
	Ampicillin, pivampicillin	0.07	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04
	<b>β-lactamase sensitive penicillins (J01CE)</b>											
	Penicillin G	0.21	0.19	0.22	0.27	0.28	0.28	0.26	0.27	0.26	0.25	0.25
	<b>β-lactamase resistant penicillins (J01CF)</b>											
	Cloxacillin	0.05	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.05	0.04	0.04
	<b>First-generation cephalosporins (J01DB)</b>											
	Cefazolin, cephalothin	0.12	0.12	0.12	0.12	0.12	0.11	0.12	0.12	0.13	0.12	0.12
	<b>Second-generation cephalosporins (J01DC)</b>											
	Cefotetan, cefoxitin, cefuroxime	0.04	0.04	0.03	0.02	0.01	0.01	0.01	0.01	0.01	< 0.01	< 0.01
	<b>Macrolides (J01FA)</b>											
	Azithromycin, erythromycin	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	<b>Lincosamides (J01FF)</b>											
	Clindamycin	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03
<b>Aminoglycosides (J01GB)</b>												
Amikacin, gentamicin, netilmicin, tobramycin	0.06	0.05	0.03	0.02	0.03	0.05	0.05	0.04	0.04	0.04	0.03	
	<b>Total (J01)</b>	<b>0.78</b>	<b>0.76</b>	<b>0.76</b>	<b>0.77</b>	<b>0.79</b>	<b>0.83</b>	<b>0.80</b>	<b>0.79</b>	<b>0.82</b>	<b>0.77</b>	<b>0.79</b>

Roman numerals I to II indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

ATC = Anatomical Therapeutic Chemical. DDDs = Defined daily doses.

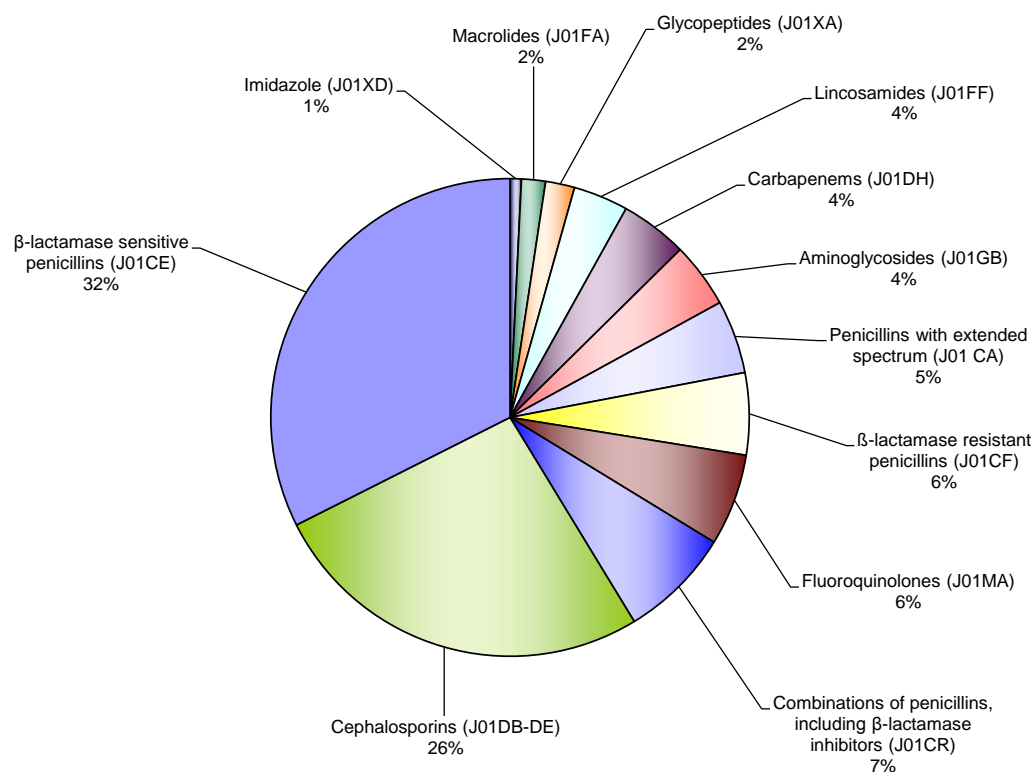


**Figure 22. Percentages of total number of defined daily doses per 1,000 inhabitant-days for oral antimicrobials purchased by hospitals in Canada, 2011.**



Alphanumeric codes in parentheses represent Anatomical Therapeutic Chemical classes of antimicrobials.

**Figure 23. Percentages of total number of defined daily doses per 1,000 inhabitant-days for parenteral antimicrobials purchased by hospitals in Canada, 2011.**



Alphanumeric codes in parentheses represent Anatomical Therapeutic Chemical classes of antimicrobials.

**Table 24. Total consumption (DDDs/1,000 inhabitant-days) of oral antimicrobials purchased by hospitals in Canadian provinces, 2011.**

Antimicrobial		ATC Class		DDDs/1,000 inhabitant-days							
		BC	AB	SK	MB	ON	QC	NB	NS	PE/NL	
I	Amoxicillin and enzyme inhibitor	Combinations of penicillins, including $\beta$ -lactamase inhibitors (J01CR)		0.04	0.05	0.03	0.11	0.03	0.08	0.04	0.04
	Cefixime	Third-generation cephalosporins (J01DD)		0.02	0.02	0.04	0.01	0.01	0.01	0.01	0.01
	Ofloxacin, ciprofloxacin, norfloxacin, levofloxacin, moxifloxacin, gatifloxacin, gemifloxacin	Fluoroquinolones (J01MA)		0.18	0.22	0.21	0.26	0.17	0.23	0.24	0.23
	Metronidazole	Imidazole (J01XD)		0.05	0.04	0.03	0.03	0.03	0.03	0.02	0.04
II	Ampicillin, amoxicillin, pivampicillin, bacampicillin, pivmecillinam	Penicillins with extended spectrum (J01CA)		0.14	0.07	0.22	0.30	0.05	0.09	0.07	0.09
	Penicillin G, penicillin V	$\beta$ -lactamase sensitive penicillins (J01CE)		0.03	0.01	0.02	0.06	0.01	0.02	0.01	0.01
	Cloxacillin	$\beta$ -lactamase resistant penicillins (J01CF)		0.01	0.01	0.01	0.03	0.01	0.01	0.01	0.01
	Cephalexin, cefadroxil	First-generation cephalosporins (J01DB)		0.05	0.04	0.07	0.16	0.03	0.03	0.04	0.06
	Cefaclor, cefprozil, cefuroxime axetil	Second-generation cephalosporins (J01DC)		0.04	0.04	0.05	0.04	0.02	0.04	0.07	0.08
	Sulfamethoxazole and trimethoprim, sulfadiazine and trimethoprim	Combinations of sulfonamides and trimethoprim, including derivatives (J01EE)		0.08	0.07	0.09	0.18	0.04	0.05	0.04	0.08
	Azithromycin, clarithromycin, erythromycin, spiramycin, telithromycin	Macrolides (J01FA)		0.16	0.10	0.38	0.26	0.11	0.09	0.14	0.12
	Clindamycin	Lincosamides (J01FF)		0.02	0.02	0.02	0.04	0.01	0.01	0.01	0.02
III	Doxycycline, minocycline, tetracycline, demeclocycline	Tetracyclines (J01AA)		0.29	0.06	0.14	0.10	0.09	0.04	0.05	0.06
	Nitrofurantoin	Nitrofuran derivatives (J01XE)		0.07	0.03	0.06	0.06	0.03	0.02	0.03	0.04
	Total (J01)		1.19	0.78	1.36	1.62	0.64	0.74	0.80	0.87	1.41

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.  
 ATC = Anatomical Therapeutic Chemical. DDDs = Defined daily doses.

**Table 25. Total consumption (DDDs/1,000 inhabitant-days) of parenteral antimicrobials purchased by hospitals in Canadian provinces, 2011.**

Antimicrobial		ATC Class	DDDs/1,000 inhabitant-days								
			BC	AB	SK	MB	ON	QC	NB	NS	PE/NL
I	Piperacillin and enzyme inhibitor, ticarcillin and enzyme inhibitor	Combinations of penicillins, including $\beta$ -lactamase inhibitors (J01CR)	0.06	0.05	0.06	0.06	0.05	0.09	0.04	0.04	0.04
	Cefotaxime, ceftazidime, ceftizoxime, ceftriaxone	Third-generation cephalosporins (J01DD)	0.11	0.09	0.13	0.22	0.07	0.05	0.07	0.11	0.05
	Doripenem, ertapenem, imipenem, meropenem	Carbapenems (J01DH)	0.06	0.04	0.03	0.03	0.02	0.05	0.04	0.03	0.03
	Ofloxacin, ciprofloxacin, norfloxacin, levofloxacin, moxifloxacin	Fluoroquinolones (J01MA)	0.03	0.02	0.04	0.03	0.06	0.04	0.12	0.12	0.08
	Vancomycin	Glycopeptides (J01XA)	< 0.01	< 0.01	NAP	< 0.01	< 0.01	0.06	< 0.01	0.05	0.04
	Metronidazole	Imidazole (J01XD)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.02	< 0.01	0.05	NAP
	Daptomycin	Daptomycin (J01XX)	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
II	Ampicillin, pivampicillin	Penicillins with extended spectrum (J01CA)	0.03	0.04	0.04	0.04	0.04	0.05	0.04	0.04	0.02
	Penicillin G	$\beta$ -lactamase sensitive penicillins (J01CE)	0.32	0.29	0.33	0.30	0.19	0.32	0.08	0.32	0.05
	Cloxacillin	$\beta$ -lactamase resistant penicillins (J01CF)	0.08	0.04	0.04	0.06	0.04	0.03	0.05	0.04	0.04
	Cefazolin, cephalothin	First-generation cephalosporins (J01DB)	0.14	0.21	0.23	0.14	0.08	0.12	0.04	0.13	0.15
	Cefotetan, cefoxitin, cefuroxime	Second-generation cephalosporins (J01DC)	< 0.01	< 0.01	< 0.01	0.01	< 0.01	0.01	0.01	0.01	< 0.01
	Azithromycin, erythromycin	Macrolides (J01FA)	0.02	0.01	0.02	0.01	0.01	0.01	0.02	0.02	0.02
	Clindamycin	Lincosamides (J01FF)	0.03	0.04	0.05	0.04	0.02	0.03	0.04	0.04	0.04
	Amikacin, gentamicin, netilmicin, tobramycin	Aminoglycosides (J01GB)	0.03	0.03	0.03	0.03	0.04	0.04	0.03	0.04	0.01
	Total (J01)		0.92	0.85	1.00	0.98	0.61	0.91	0.56	1.03	0.56

Roman numerals I to II indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.  
 ATC = Anatomical Therapeutic Chemical. DDDs = Defined daily doses. NAP = No antimicrobials purchased.

**Table 26. Total cost per 1,000 inhabitant-days for oral and parenteral antimicrobials purchased by hospitals in Canadian provinces, 2011.**

	Antimicrobial	ATC Class	Total cost/1,000 inhabitant-days (\$)								
			BC	AB	SK	MB	ON	QC	NB	NS	PE/NL
I	Amoxicillin and enzyme inhibitor, piperacillin and enzyme inhibitor, ticarcillin and enzyme inhibitor	Combinations of penicillins, including $\beta$ -lactamase inhibitors (J01CR)	1.76	1.35	1.72	1.63	1.14	2.16	0.87	0.85	0.98
	Cefixime, cefotaxime, ceftazidime, ceftizoxime, ceftriaxone	Third-generation cephalosporins (J01DD)	0.62	0.62	1.14	1.22	0.40	0.50	0.58	0.77	0.68
	Cefepime, ceftobiprole	Fourth-generation cephalosporins (J01DE)	0.01	0.04	0.09	NAP	0.01	0.07	0.06	0.03	0.04
	Doripenem, ertapenem, imipenem, meropenem	Carbapenems (J01DH)	4.67	2.73	2.28	2.49	1.75	4.06	3.12	2.68	2.62
	Ofloxacin, ciprofloxacin, norfloxacin, levofloxacin, moxifloxacin, gatifloxacin, gemifloxacin, trovafloxacin	Fluoroquinolones (J01MA)	0.85	0.64	1.44	1.37	1.15	0.89	1.92	1.84	2.03
	Vancomycin	Glycopeptides (J01XA)	0.02	0.08	0.08	0.21	0.08	1.01	0.30	1.05	0.61
	Colistin	Polymyxins J01XB)	< 0.01	NAP	0.01	< 0.01	< 0.01	0.02	0.01	0.02	0.06
	Metronidazole	Imidazole (J01XD)	0.03	0.03	0.02	0.07	0.03	0.10	0.05	0.23	0.04
	Daptomycin	Daptomycin (J01XX)	0.70	0.24	0.22	0.02	0.11	0.17	0.12	0.07	0.35
	Linezolid	Linezolid (J01XX)	0.69	0.76	0.33	0.35	0.24	0.59	0.13	0.15	0.32
II	Ampicillin, amoxicillin, pivampicillin, bacampicillin, piperacillin, pivmecillinam	Penicillins with extended spectrum (J01CA)	0.13	0.13	0.27	0.31	0.14	0.19	0.22	0.14	0.23
	Penicillin G, penicillin V	$\beta$ -lactamase sensitive penicillins (J01CE)	0.11	0.10	0.09	0.08	0.06	0.10	0.08	0.04	0.06
	Cloxacillin	$\beta$ -lactamase resistant penicillins (J01CF)	0.41	0.25	0.24	0.42	0.19	0.16	0.20	0.17	0.26
	Cephalexin, cefadroxil, cefazolin, cephalothin	First-generation cephalosporins (J01DB)	0.72	1.13	0.88	0.99	0.31	0.36	0.38	0.50	0.53
	Cefaclor, cefprozil, cefuroxime, cefuroxime axetil, cefotetan, cefoxitin	Second-generation cephalosporins (J01DC)	0.14	0.10	0.23	0.44	0.09	0.29	0.29	0.25	0.15
	Sulfamethoxazole and trimethoprim, sulfadiazine and trimethoprim	Combinations of sulfonamides and trimethoprim, including derivatives (J01EE)	0.09	0.09	0.09	0.12	0.07	0.10	0.10	0.08	0.07

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

ATC = Anatomical Therapeutic Chemical. NAP = No antimicrobials purchased.

**Table 26 (continued). Total cost per 1,000 inhabitant-days for oral and parenteral antimicrobials purchased by hospitals in Canadian provinces, 2011.**

Antimicrobial		ATC Class	Total cost/1,000 inhabitant-days (\$)								
			BC	AB	SK	MB	ON	QC	NB	NS	PE/NL
II	Azithromycin, clarithromycin, erythromycin, spiramycin, telithromycin	Macrolides (J01FA)	0.34	0.26	0.99	0.46	0.21	0.24	0.53	0.32	0.67
	Clindamycin, lincomycin	Lincosamides (J01FF)	0.29	0.35	0.40	0.52	0.21	0.28	0.44	0.35	0.42
	Streptomycin	Streptomycin (J01GA)	0.02	< 0.01	NAP	0.01	< 0.01	< 0.01	0.01	NAP	0.01
	Amikacin, gentamicin, netilmicin, tobramycin	Aminoglycosides (J01GB)	0.27	0.28	0.25	0.35	0.42	0.49	0.33	0.37	0.20
III	Doxycycline, minocycline, tetracycline, demeclocycline, tigecycline	Tetracyclines (J01AA)	0.18	0.18	0.09	0.06	0.09	0.27	0.02	0.02	0.03
	Chloramphenicol	Amphenicols (J01BA)	0.01	< 0.01	< 0.01	< 0.01	0.01	< 0.01	< 0.01	< 0.01	0.01
	Nitrofurantoin	Nitrofuran derivatives (J01XE)	0.08	0.03	0.08	0.06	0.02	0.01	0.03	0.04	0.06
		Total (J01)	12.13	9.39	10.95	11.19	6.72	12.06	9.80	9.98	10.46

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

ATC = Anatomical Therapeutic Chemical. NAP = No antimicrobials purchased.

**Table 27. Average cost per unit for oral and parenteral antimicrobials purchased by hospitals in Canadian provinces, 2011.**

ATC Class	Antimicrobial	Form	Cost (\$)/unit of antimicrobial								
			BC	AB	SK	MB	ON	QC	NB	NS	PE/NL
Combinations of penicillins, including β-lactamase inhibitors (J01CR)	Amoxicillin and enzyme inhibitor (J01CR02)	Liquid	0.15	0.16	0.12	0.13	0.15	0.10	0.14	0.06	0.06
		Tablet	0.76	0.81	0.71	0.76	0.84	0.64	0.84	0.64	0.50
	Ticarcillin and enzyme inhibitor (J01CR03)	IV	10.53	10.60	11.20	NAP	10.11	50.99	10.15	10.21	10.15
	Piperacillin and enzyme inhibitor (J01CR05)	IV	10.23	10.50	10.87	12.25	9.11	8.50	7.94	8.55	5.32
Third-generation cephalosporins (J01DD)	Cefotaxime (J01DD01)	Injectable	7.97	9.38	7.74	8.26	7.51	6.82	6.12	8.65	6.34
	Ceftazidime (J01DD02)	IV	NAP	NAP	NAP	31.01	30.20	17.17	15.41	17.63	11.77
		Injectable	133.30	122.28	NAP	0.90	45.46	29.35	6.27	NAP	0.19
	Cefixime (J01DD08)	Liquid	0.38	0.38	0.40	0.42	0.37	0.35	0.38	0.35	0.40
		Tablet	3.37	3.43	3.46	3.50	3.49	3.18	3.36	3.23	3.57
	Ceftriaxone (J01DD04)	Injectable	7.04	11.38	11.17	7.16	8.70	5.82	11.02	7.04	8.64
Fourth-generation cephalosporins (J01DE)	Cefepime (J01DE01)	Injectable	20.89	18.72	23.96	NAP	21.09	18.08	25.22	19.05	25.53
Carbapenems (J01DH)	Meropenem (J01DH02)	IV	36.98	36.57	36.53	36.53	36.81	37.61	36.84	36.64	36.96
	Ertapenem (J01DH03)	Injectable	49.95	50.06	50.27	49.99	50.10	51.75	51.96	50.02	50.57
	Doripenem (J01DH04)	IV	NAP	24.50	NAP	NAP	24.48	33.76	NAP	NAP	NAP
	Imipenem (J01DH51)	IV	19.57	17.82	24.38	23.87	20.24	6.86	22.47	3.42	24.74
	Ofloxacin (J01MA01)	Tablet	1.57	1.43	NAP	1.60	1.46	1.14	NAP	1.53	0.73
Fluoroquinolones (J01MA)		IV	0.15	0.25	0.18	0.11	0.12	0.09	0.03	0.03	0.06
	Ciprofloxacin (J01MA02)	Liquid	0.56	0.56	0.56	0.58	0.56	0.56	0.57	0.56	0.57
		Tablet	0.55	0.48	0.76	0.69	0.69	0.40	0.37	0.26	0.25
	Norfloxacin (J01MA06)	Tablet	0.58	0.80	0.69	1.24	0.56	0.68	0.48	0.49	0.48
		IV	0.23	0.23	0.24	0.23	0.23	0.24	0.25	0.23	0.26
	Levofloxacin (J01MA12)	Tablet	2.19	2.33	2.83	2.92	1.67	0.94	1.83	0.64	1.98
		IV	0.07	0.08	0.09	0.14	0.09	0.11	0.10	0.08	0.09
	Moxifloxacin (J01MA14)	Tablet	4.08	3.97	4.05	4.26	3.95	4.49	4.36	3.99	5.62

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.  
 IV = Intravenous. NAP = No antimicrobials purchased.

**Table 27 (continued). Average cost per unit for oral and parenteral antimicrobials dispensed by provincial retail pharmacies in Canada, 2011.**

ATC Class			Antimicrobial		Form	Cost (\$)/unit of antimicrobial								
						BC	AB	SK	MB	ON	QC	NB	NS	PE/NL
I	Glycopeptides (J01XA)	Vancomycin (J01XA01)	IV			40.27	59.21	NAP	35.45	144.23	37.32	9.10	35.79	24.60
			Injectable			40.37	49.71	NAP	43.64	43.95	14.88	NAP	NAP	3.28
			Tablet			13.21	11.90	12.66	9.72	13.16	11.50	12.42	9.43	13.49
	Polymyxins (J01XB)	Colistin (J01XB01)	Injectable			31.08	30.42	35.17	32.52	34.71	27.91	32.29	30.42	31.45
	Imidazole (J01XD)	Metronidazole (J01XD01)	Injectable			0.02	0.02	0.02	0.02	0.02	0.01	0.07	0.01	NAP
			Tablet			0.42	0.71	0.39	0.40	0.52	0.48	0.31	0.31	0.43
	Daptomycin (J01XX)	Daptomycin (J01XX09)	IV			170.97	170.88	171.06	172.13	170.76	170.96	170.75	171.00	171.10
	Linezolid (J01XX)	Linezolid (J01XX08)	IV			0.32	0.32	0.33	0.33	0.32	0.33	0.32	0.32	0.32
			Liquid			2.35	2.35	NAP	2.46	NAP	2.43	NAP	2.45	2.52
			Tablet			70.82	70.86	73.31	72.25	70.68	72.20	70.83	70.66	70.50
II	Penicillins with extended spectrum (J01CA)	Ampicillin (J01CA01)	Injectable			1.55	1.58	2.48	1.63	1.75	1.99	2.12	1.42	5.03
			Tablet			0.18	0.10	0.42	NAP	0.30	0.25	0.27	0.40	0.47
		Amoxicillin (J01CA04)	Liquid			0.03	0.03	0.04	0.03	0.03	0.02	0.03	0.02	0.02
			Tablet			0.11	0.10	0.10	0.15	0.08	0.11	0.05	0.06	0.06
			Piperacillin (J01CA12)	IV			10.23	10.50	10.87	12.25	9.11	8.50	7.94	8.55
	β-lactamase sensitive penicillins (J01CE)	Penicillin G (J01CE01)	Injectable			5.53	4.85	3.90	1.85	6.65	3.68	6.85	1.08	9.09
			Liquid			0.05	0.06	0.06	0.06	0.05	0.05	0.06	0.02	0.04
		Tablet			0.05	0.05	0.05	0.06	0.05	0.07	0.05	0.03	0.04	
	β-lactamase resistant penicillins (J01CF)	Cloxacillin (J01CF02)	Injectable			4.09	4.23	4.06	5.22	3.62	4.26	3.45	3.22	4.10
			Liquid			0.04	0.04	0.03	0.04	0.03	0.02	0.02	0.01	0.01
Tablet					0.16	0.15	0.16	0.17	0.11	0.08	0.07	0.11	0.08	
First-generation cephalosporins (J01DB)	Cephalexin (J01DB01)	Liquid			0.07	0.07	0.06	0.09	0.07	0.05	0.06	0.04	0.06	
		Tablet			0.15	0.13	0.12	0.17	0.14	0.12	0.11	0.10	0.09	
	Cefazolin (J01DB04)	IV			7.50	7.60	7.50	7.70	7.62	7.84	NAP	7.50	5.74	
		Injectable			9.30	18.57	11.27	12.87	7.63	3.88	14.70	4.03	2.99	
		Cefadroxil (J01DB05)	Tablet			NAP	0.49	NAP	NAP	0.72	0.48	0.49	NAP	NAP

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.  
 IV = Intravenous. NAP = No antimicrobials purchased.



**Table 27 (continued). Average cost per unit for oral and parenteral antimicrobials dispensed by provincial retail pharmacies in Canada, 2011.**

ATC Class		Antimicrobial	Form	Cost (\$)/unit of antimicrobial									
				BC	AB	SK	MB	ON	QC	NB	NS	PE/NL	
Second-generation cephalosporins (J01DC)	Cefoxitin (J01DC01)	Injectable		0.43	0.43	0.41	0.46	0.43	0.32	0.38	0.34	0.83	
		IV		NAP	NAP	NAP	18.06	34.20	19.47	4.29	4.00	3.98	
	Cefuroxime (J01DC02)	Liquid		0.18	0.18	0.18	0.18	0.18	0.17	0.17	0.17	0.18	
		Tablet		1.14	1.32	1.05	1.04	1.36	0.97	1.10	0.75	0.69	
	Cefaclor (J01DC04)	Liquid		NAP	NAP	NAP	NAP	NAP	0.21	0.16	NAP	NAP	
		Tablet		NAP	NAP	NAP	1.07	1.33	1.33	1.04	NAP	0.68	
	Cefprozil (J01DC10)	Liquid		0.14	0.14	0.15	0.19	0.14	0.11	0.15	0.13	0.18	
Combinations of sulfonamides and trimethoprim, including derivatives (J01EE)		Tablet		0.97	1.08	0.85	1.64	0.96	0.94	0.93	0.99	1.16	
	Sulfamethoxazole and trimethoprim (J01EE01)	Injectable		1.30	1.30	1.32	1.31	1.27	1.23	1.25	1.24	1.29	
		Liquid		0.02	0.03	0.03	0.06	0.02	0.02	0.02	0.01	0.06	
		Tablet		0.06	0.06	0.06	0.06	0.07	0.06	0.06	0.05	0.06	
	Macrolides (J01FA)		IV		20.25	19.88	63.01	54.48	21.97	62.28	45.36	64.44	20.32
		Erythromycin (J01FA01)	Liquid		0.12	0.13	0.14	0.11	0.09	0.06	0.12	NAP	0.13
			Tablet		0.25	0.13	0.19	0.19	0.16	0.26	0.25	0.27	0.23
Spiramycin (J01FA02)		Tablet		2.49	NAP	NAP	NAP	1.30	1.79	NAP	NAP	NAP	
Clarithromycin (J01FA09)		Liquid		0.36	0.39	0.38	0.37	0.37	0.37	0.29	0.28	0.34	
		Tablet		0.71	0.67	0.82	1.25	0.92	0.59	1.20	0.75	0.78	
Azithromycin (J01FA10)		IV		6.72	6.59	19.57	8.84	6.81	9.28	12.29	8.67	17.16	
	Liquid		0.62	0.74	0.89	0.73	0.83	0.64	0.79	0.48	0.74		
	Tablet		2.06	1.54	2.16	2.13	1.63	1.02	2.57	1.07	1.72		

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

IV = Intravenous. NAP = No antimicrobials purchased.

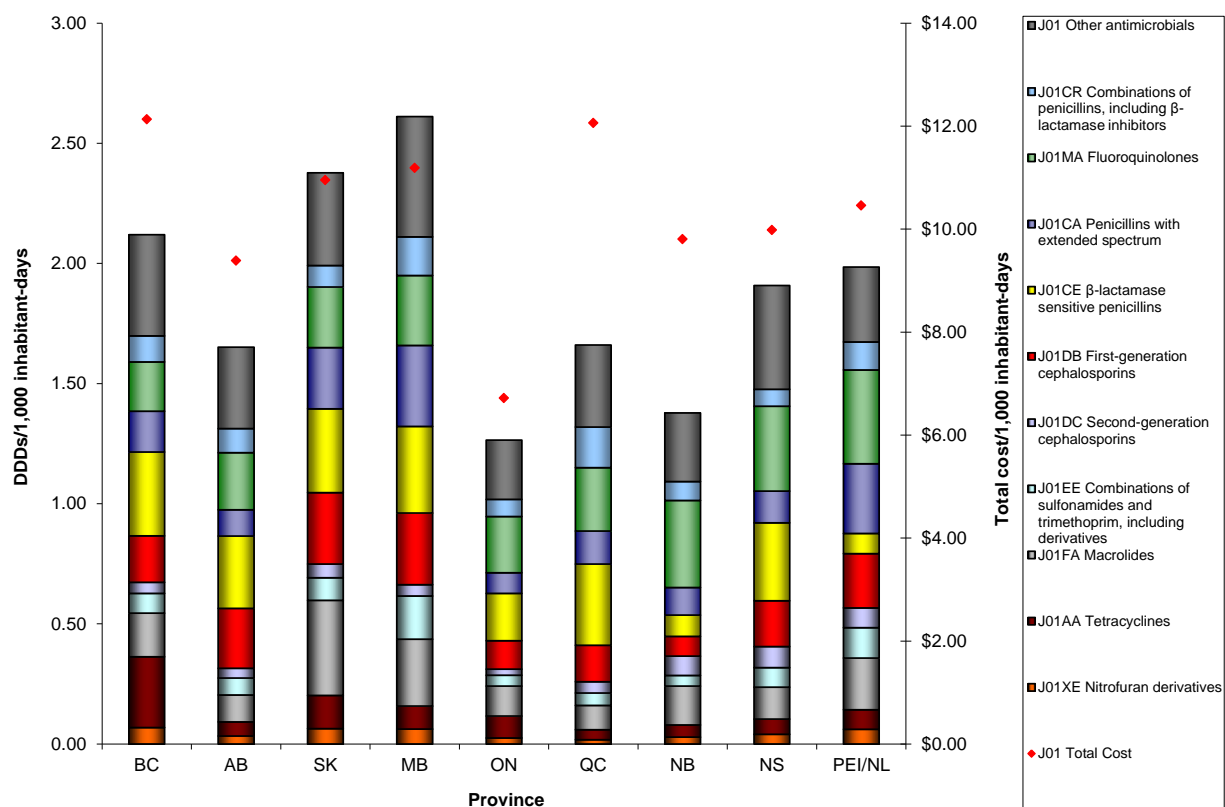
**Table 27 (continued). Average cost per unit for oral and parenteral antimicrobials dispensed by provincial retail pharmacies in Canada, 2011.**

ATC Class	Antimicrobial	Form	Cost (\$)/unit of antimicrobial								
			BC	AB	SK	MB	ON	QC	NB	NS	PE/NL
Lincosamides (J01FF)	Clindamycin (J01FF01)	IV	0.70	0.70	0.57	0.68	0.72	0.60	0.81	0.76	0.71
		Injectable	0.73	0.71	0.74	1.03	0.81	0.88	0.78	0.76	0.85
		Liquid	0.12	0.12	0.12	0.13	0.10	0.11	0.09	0.11	0.11
		Tablet	0.33	0.24	0.43	0.47	0.39	0.22	0.25	0.21	0.25
	Lincomycin (J01FF02)	Injectable	NAP	2.85	NAP	NAP	2.73	2.60	NAP	NAP	NAP
II Streptomycin (J01GA)	Streptomycin (J01GA01)	Injectable	43.69	43.61	NAP	44.27	43.79	44.69	44.52	NAP	45.78
	Tobramycin (J01GB01)	Injectable	25.71	19.97	1.00	24.63	22.52	35.35	6.95	4.82	2.58
		Tablet	10.42	10.36	10.56	NAP	10.46	10.73	10.18	14.78	10.37
	Other aminoglycosides (J01GB)	IV	NAP	NAP	NAP	NAP	NAP	0.07	NAP	NAP	NAP
		Injectable	0.22	NAP	NAP	NAP	NAP	0.03	0.08	NAP	NAP
	Amikacin (J01GB06)	Injectable	9.90	9.48	9.31	12.23	11.73	13.83	15.34	12.43	16.32
Tetracyclines (J01AA)	Doxycycline (J01AA02)	Tablet	0.26	0.23	0.23	0.47	0.25	0.18	0.24	0.09	0.15
	Tetracycline (J01AA07)	Tablet	0.07	0.07	0.07	0.07	0.07	0.06	0.07	0.06	0.07
	Minocycline (J01AA08)	Tablet	0.29	0.29	0.45	0.57	0.48	0.27	0.30	0.24	0.20
	Tigecycline (J01AA12)	IV	80.29	80.25	86.89	80.27	80.27	82.93	81.62	80.02	81.28
	Amphenicols (J01BA)	Injectable	16.84	18.00	24.10	24.10	15.88	8.34	19.60	14.50	18.28
III	Trimethoprim and derivatives (J01EA)	Tablet	0.10	0.09	0.15	0.09	0.10	0.10	0.12	0.07	0.08
	Nitrofurantoin derivatives (J01XE)	Tablet	0.34	0.30	0.44	0.36	0.30	0.34	0.39	0.33	0.33
	NC Methenamine (J01XX)	Tablet	0.25	0.23	NAP	NAP	0.23	0.36	0.26	0.23	NAP

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

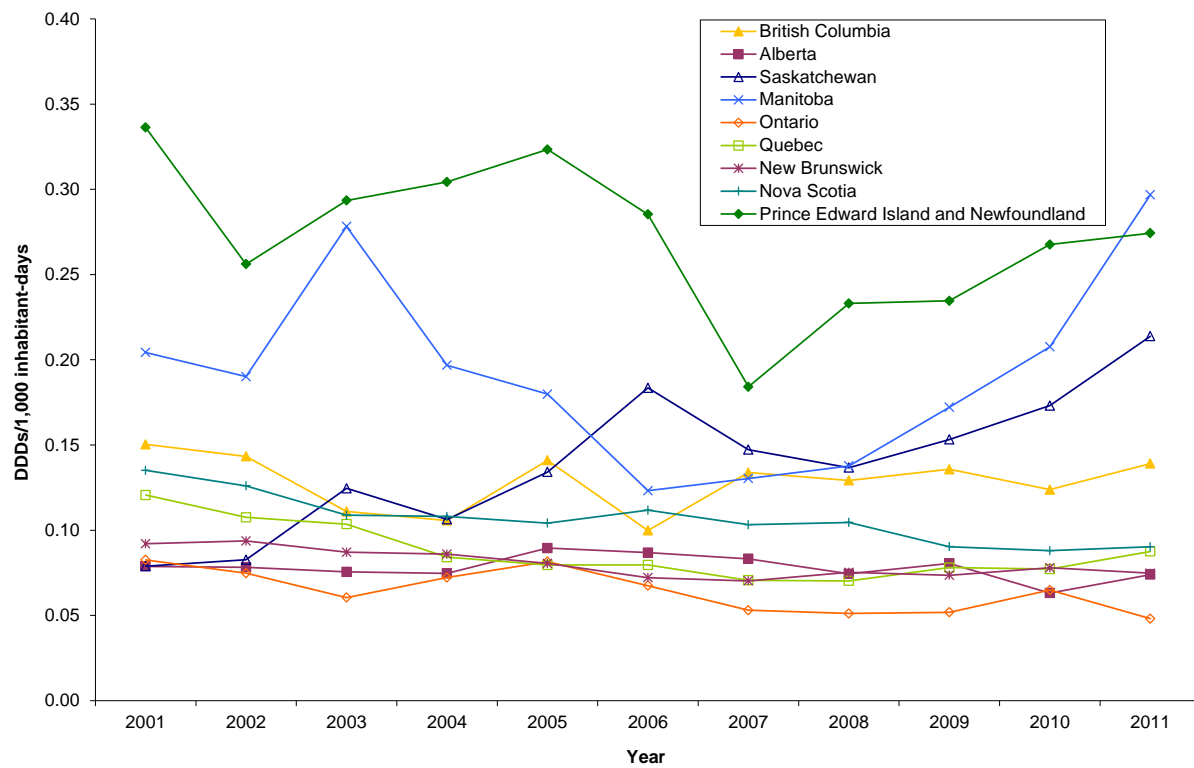
IV = Intravenous. NAP = No antimicrobials purchased. NC = Not classified.

**Figure 24. Total consumption (DDDs/1,000 inhabitant-days) and total cost of oral and parenteral antimicrobials purchased by hospitals in Canadian provinces, 2011.**



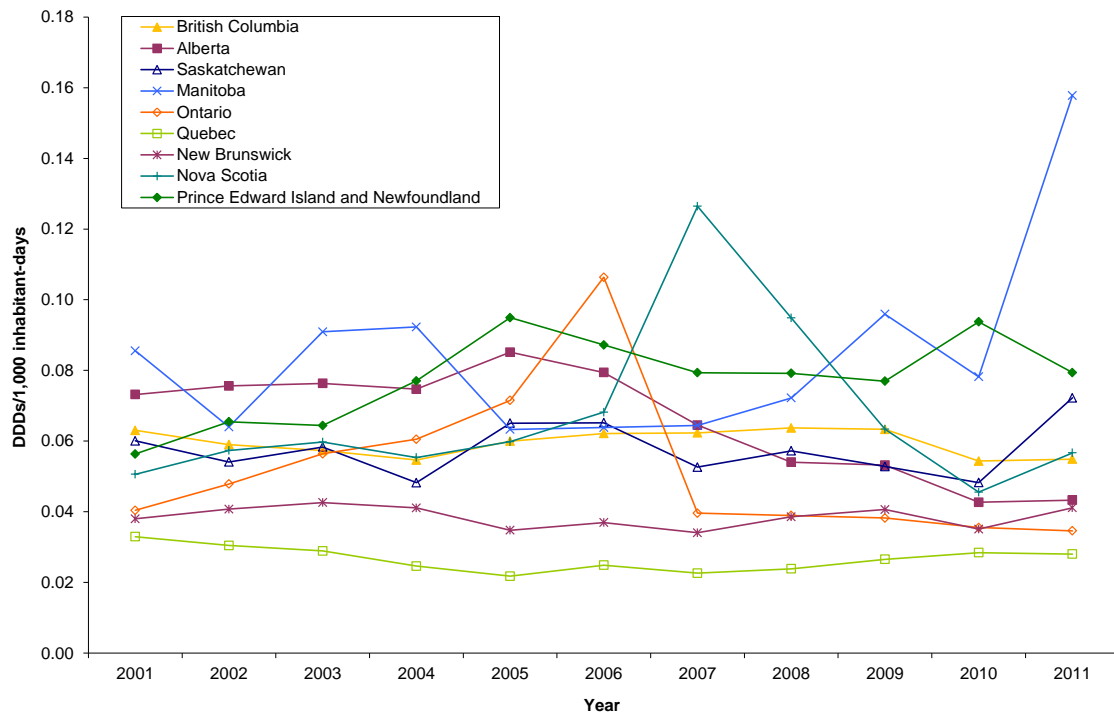
Alphanumeric codes represent Anatomical Therapeutic Chemical classes of antimicrobials.  
 DDDs = Defined daily doses.

**Figure 25. Total consumption (DDDs/1,000 inhabitant-days) of amoxicillin (J01CA04) purchased by hospitals in Canada, 2001–2011.**



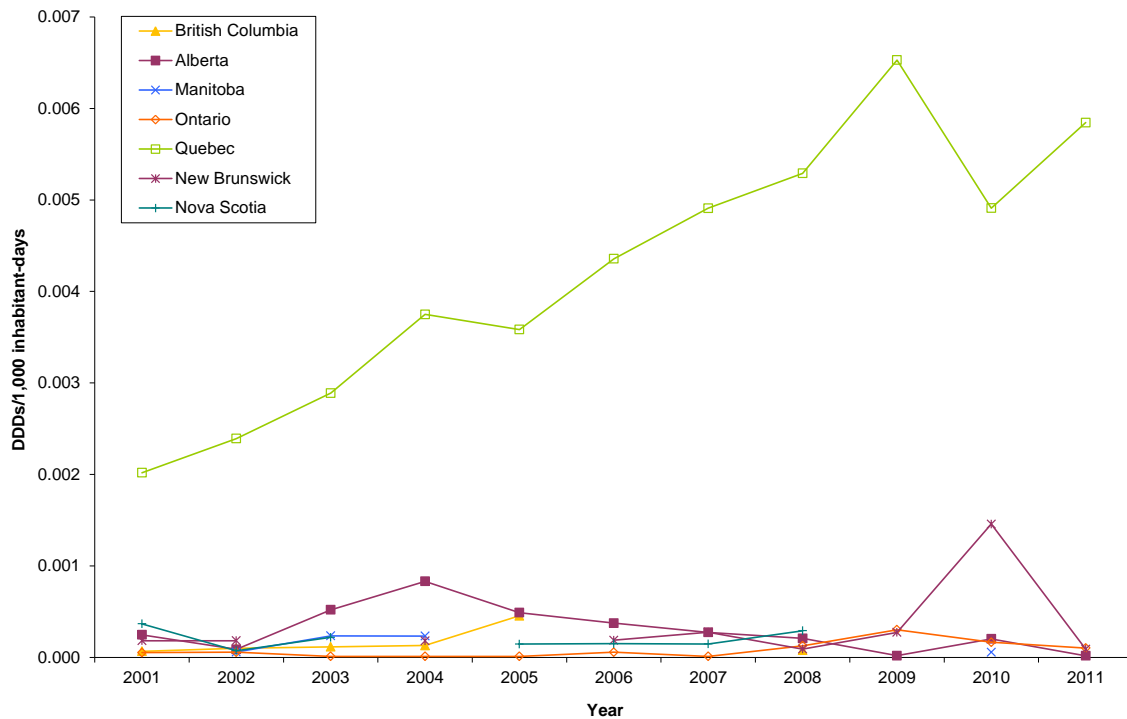
DDDs = Defined daily doses.

**Figure 26. Total consumption (DDDs/1,000 inhabitant-days) of cephalexin (J01DB01) purchased by hospitals in Canada, 2001–2011.**



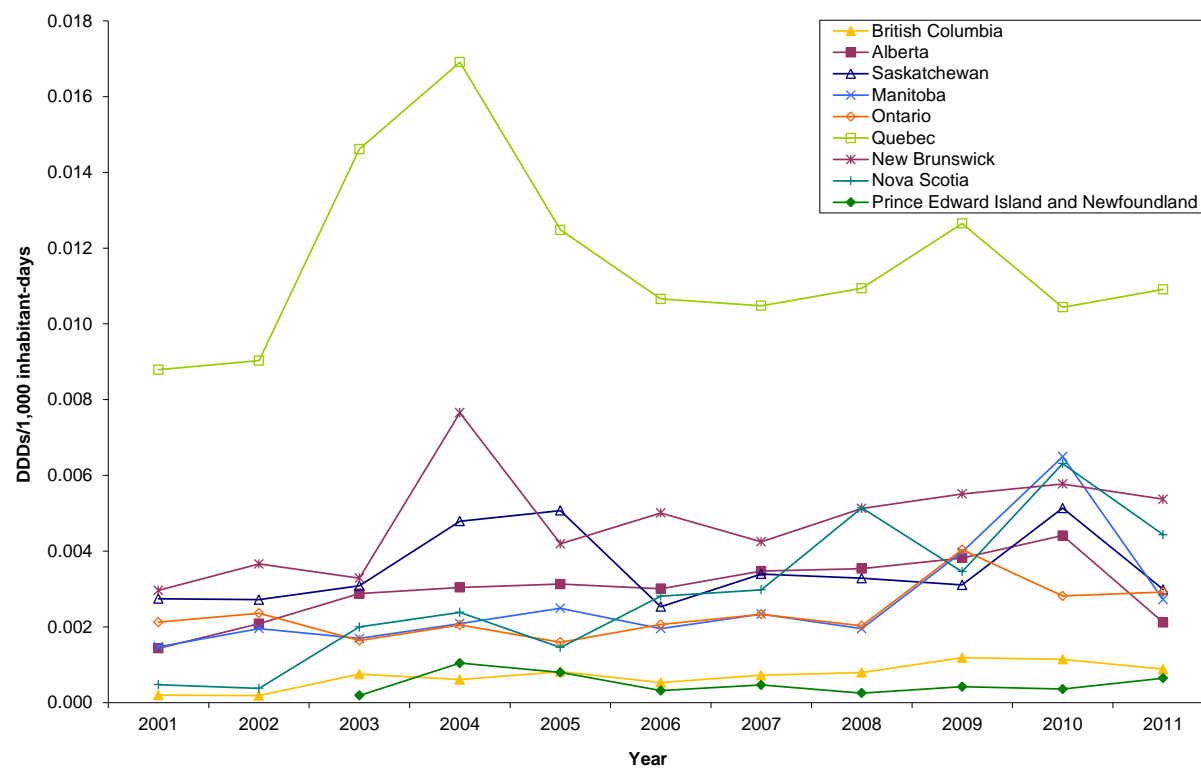
DDDs = Defined daily doses.

**Figure 27. Total consumption (DDDs/1,000 inhabitant-days) cephradroxil (J01DB05) purchased by hospitals in Canada, 2001–2011.**



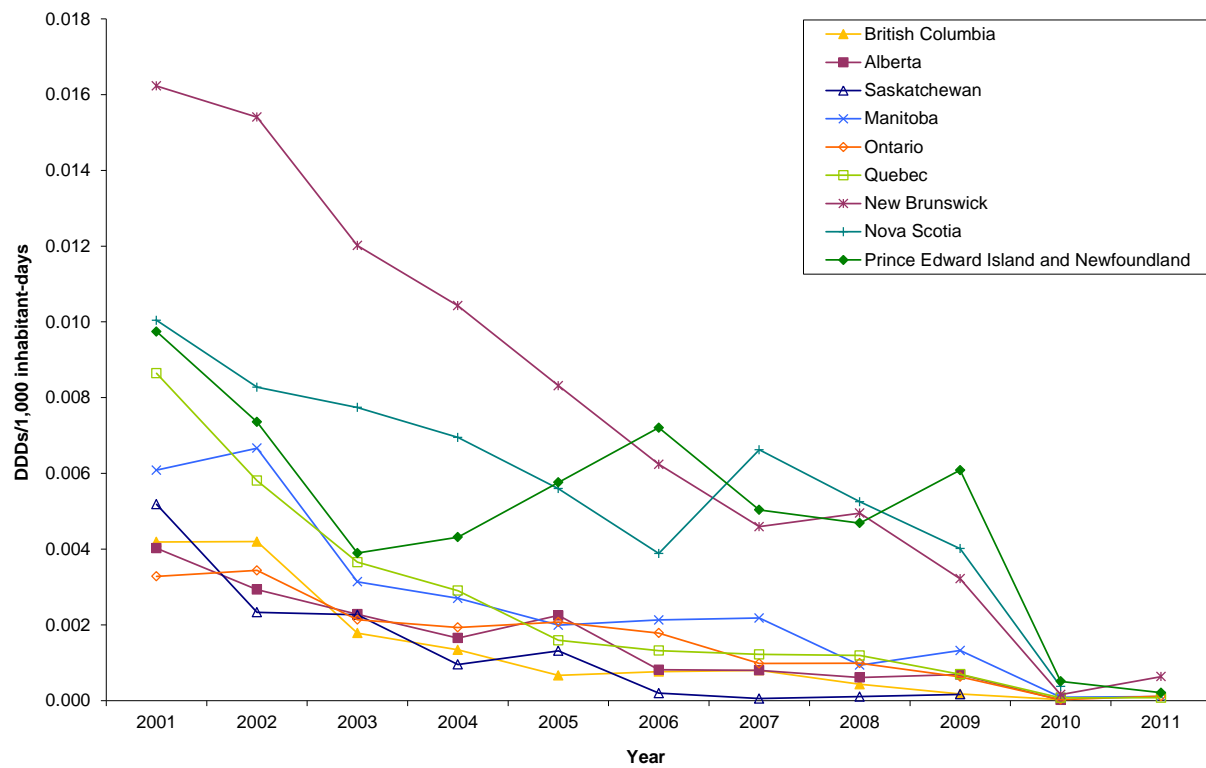
DDDs = Defined daily doses.

**Figure 28. Total consumption (DDDs/1,000 inhabitant-days) of cefprozil (J01DC10) purchased by hospitals in Canada, 2001–2011.**



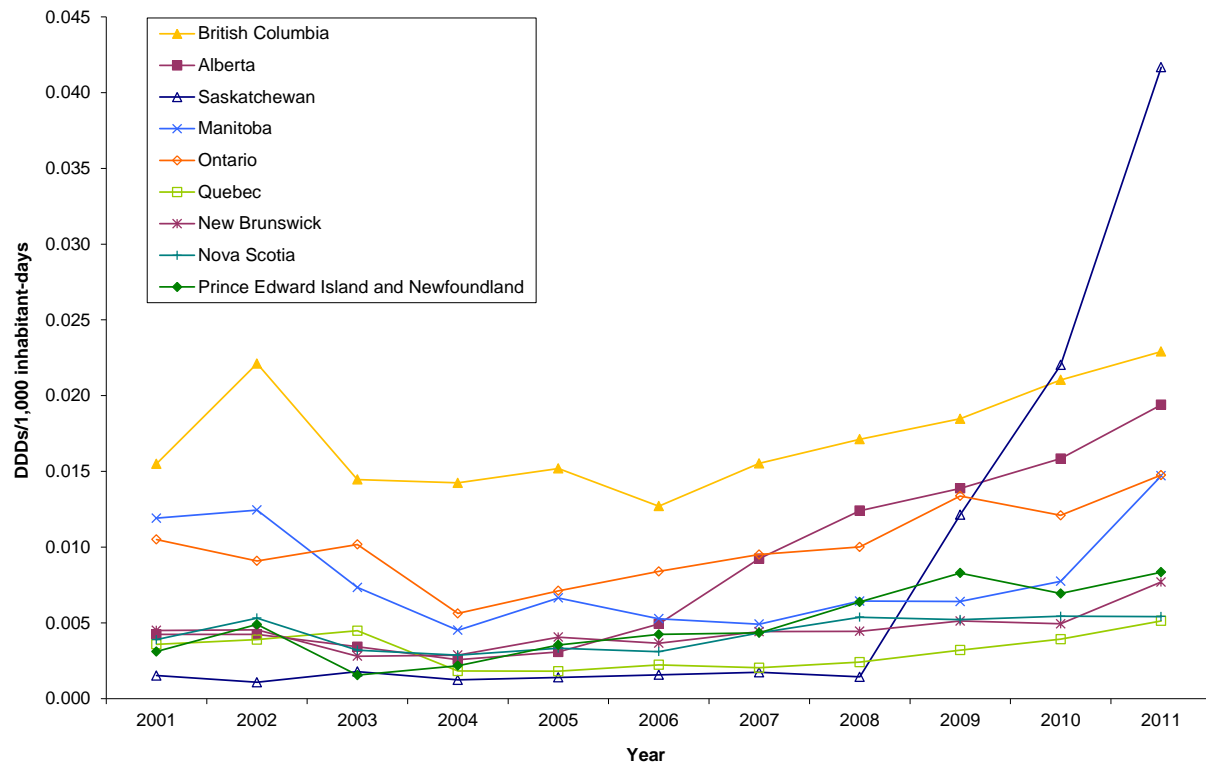
DDDs = Defined daily doses.

**Figure 29. Total consumption (DDDs/1,000 inhabitant-days) of cefaclor (J01DC04) purchased by hospitals in Canada, 2001–2011.**



DDDs = Defined daily doses.

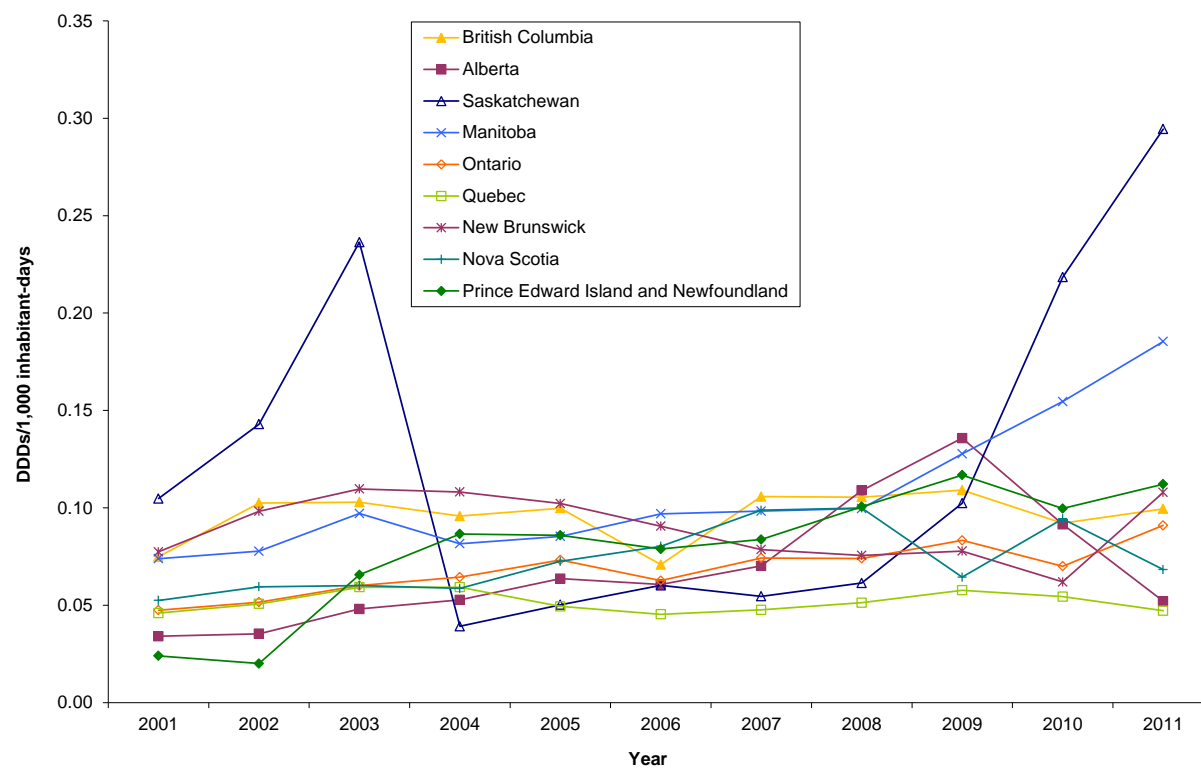
**Figure 30. Total consumption (DDDs/1,000 inhabitant-days) of cefixime (J01DD08) purchased by hospitals in Canada, 2001–2011.**



DDDs = Defined daily doses.

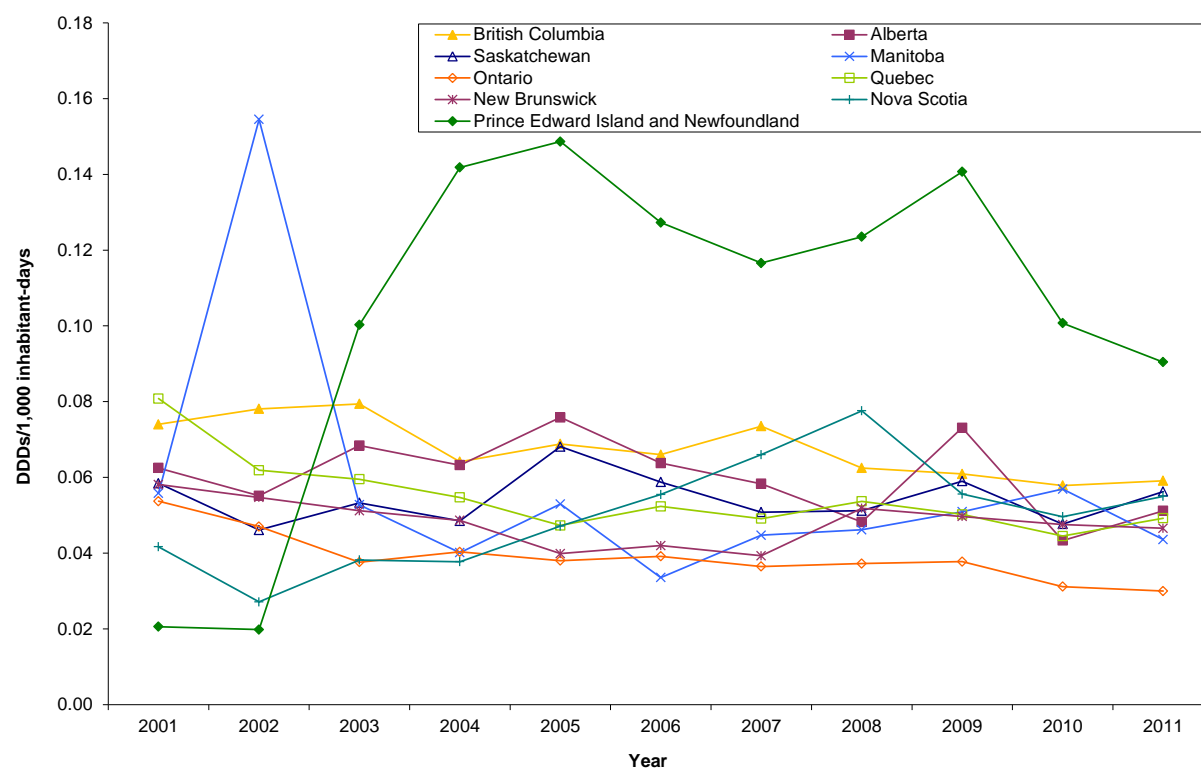


**Figure 31. Total consumption (DDDs/1,000 inhabitant-days) of azithromycin (J01FA10) purchased by hospitals in Canada, 2001–2011.**



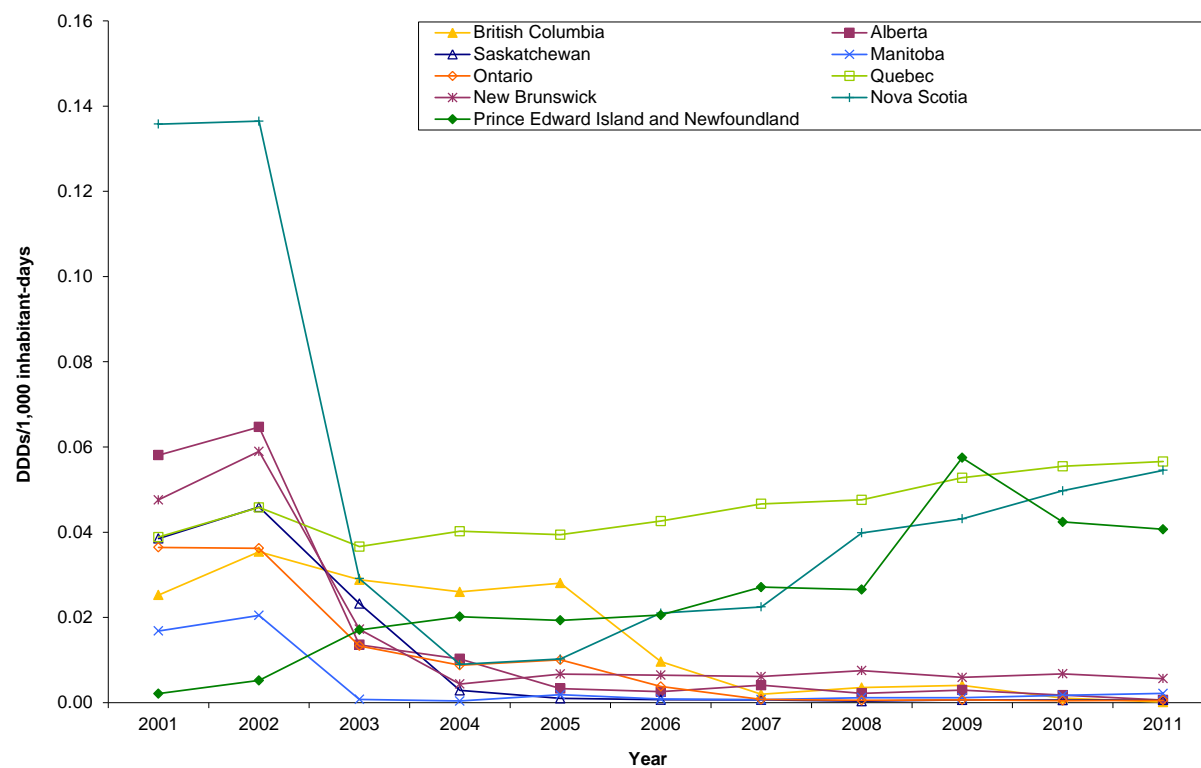
DDDs = Defined daily doses.

**Figure 32. Total consumption (DDDs/1,000 inhabitant-days) of clarithromycin (J01FA09) purchased by hospitals in Canada, 2001–2011.**



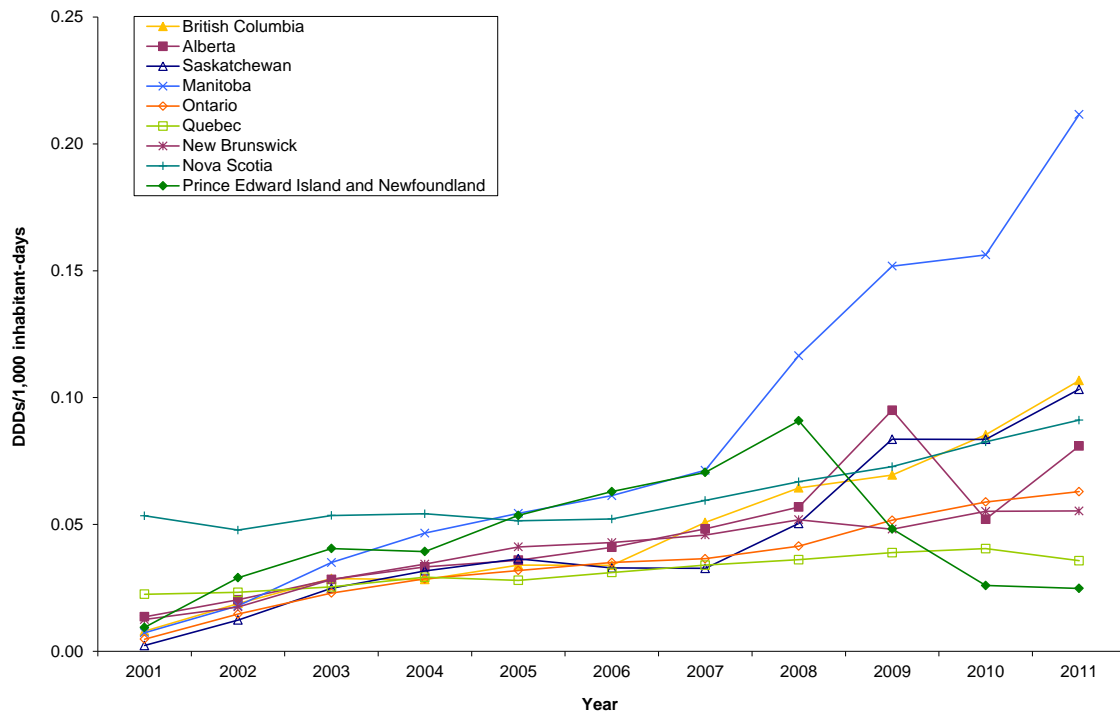
DDDs = Defined daily doses.

**Figure 33. Total consumption (DDD/1,000 inhabitant-days) of vancomycin (J01XA01) purchased by hospitals in Canada, 2001–2011.**



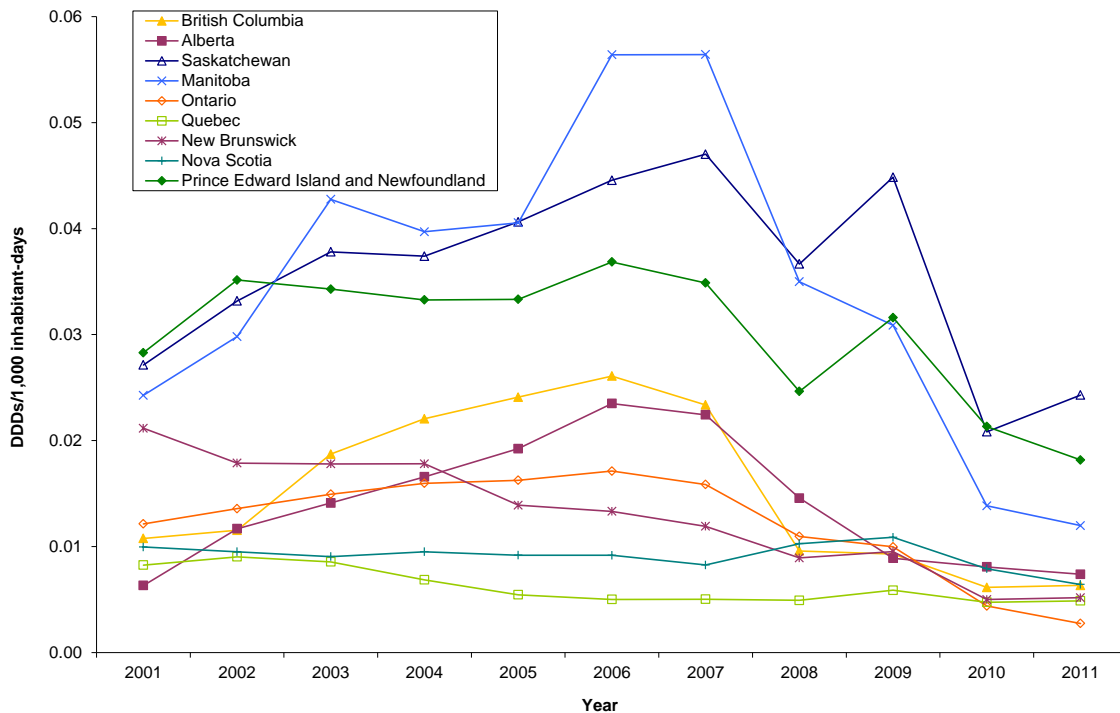
DDDs = Defined daily doses.

**Figure 34. Total consumption (DDDs/1,000 inhabitant-days) of ceftriaxone (J01DD04) purchased by hospitals in Canada, 2001–2011.**



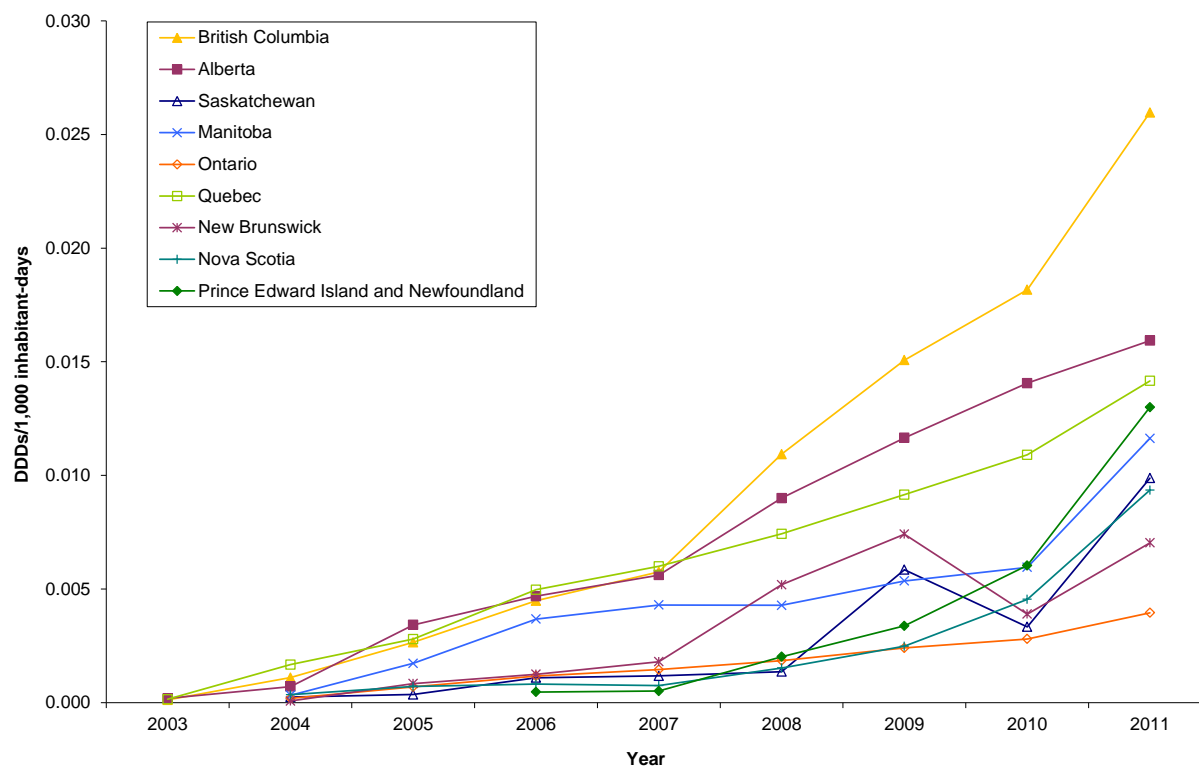
DDDs = Defined daily doses.

**Figure 35. Total consumption (DDDs/1,000 inhabitant-days) of cefotaxime (J01DD01) purchased by hospitals in Canada, 2001–2011.**



DDDs = Defined daily doses.

**Figure 36. Total consumption (DDDs/1,000 inhabitant-days) of ertapenem (J01DH03) purchased by hospitals in Canada, 2003–2011.**



DDDs = Defined daily doses.

## Appendix A – Methods

### Data Collection and Analysis

#### Physician Diagnosis Data

The Canadian Disease and Therapeutic index (CDTI) is quarterly profile that provides information about the patterns and treatments of disease encountered by office-based physicians (specialists and general practitioners, including those with offices in hospitals) from five regions [the Maritimes (New Brunswick, Newfoundland and Labrador, Nova Scotia, and Prince Edward Island), Québec, Ontario, the Prairies (Alberta, Manitoba, and Saskatchewan), and British Columbia].

The sample of physicians represents all major specialties across Canada and they are selected using a two-stage sampling process: first by region and specialty and second by each 48-hour period in the quarter. Values are estimated based on quarterly data from a sample of approximately 652 physicians stratified by region and specialty. Projection was then used to create projection factors for a “universe” comprised of approximately 52,959 physicians, that roughly represents all Canadian data. Quarterly data on physician prescription/recommendations were extracted from the IMS Health Canada database.

For four consecutive quarters, each physician maintains a practice diary describing information on every patient visit during a randomly selected 48-hour period. Information includes patient age and gender, reason for visit, diagnosis, name(s) of the treatment(s) recommended or discussed (including drugs, referrals, environmental, behavioural, or dietary changes, etc.) desired therapeutic effect(s), and the presence of concomitant therapies. If a patient presents to a doctor’s office for multiple “diseases”, the practitioner will generate one form for each disease. Similarly, if a person visits multiple times for the same “disease”, it is counted in the system separately every time. CDTI data were used to determine the most common diagnosis, defined by the International Classification of Diseases Ninth Revision System (ICD-9), and associated with antimicrobial drug mentions for sampled physicians. Drugs were classified to the Anatomical Therapeutic Chemical (ATC) classification system (Table A.1).

During the data cleaning process some diagnostic codes were rearranged into new ICD-9 diagnostic classes including: “Disorders of the Urinary Tract”, “Disorders of the Ear”, and “Disorders of the Genitourinary System”. Other classifications such as “Infective Parasitic Diseases” and “Diseases of the Genito/Urinary System” were removed as the diagnostic codes were allocated into other diagnostic classes. Select members of the diagnostic classes “Central Nervous System”, “Symptoms, Signs & Ill-Defined Conditions”, “Supplementary Classification” and “Injured and Poisonings” were reclassified into other existing diagnostic classes, where they were deemed a better fit. The “Mental Disorders” diagnostic class was removed due to the low number of values and resulting unstable analysis. Only oral, community level antimicrobials were used in analysis therefore the IV- and hospital-only antimicrobials were removed. The gender-unspecified and age-unspecified entries were also removed from the age and gender datasets, but not from the antimicrobial and diagnosis datasets, as these values were too low and were unstable in the analysis.

The limitations and caveats that should be considered within the CDTI dataset include the following:

- The drugs listed are those that the physician has written or recommended and do not represent actual prescriptions dispensed by pharmacists or products consumed by the patient, as information on patient compliance was not available.
- The data does not include patient visits to a primary care nurse.
- Diagnosis visits do not translate into number of patients as some patients may visit multiple times for the same reason or where diagnosed with multiple diseases.

- The appearance of a drug may include samples that do not necessarily tie to a prescription dispensed as physicians list all suggested treatments.
- Physicians also record drugs ‘previously ordered and continued’ for the diagnosis, which would not necessarily tie to a prescription dispensed.
- Some drug therapy and diagnosis is under-represented due to self-medication (i.e. over-the-counter products).
- Sample size is sometimes considered too small for decision making, however these have been included for information purposes only (i.e. Diseases of the Gastrointestinal System).
- Reliability of the data is dependent on sampling error, so caution should be taken when interpreting those disease categories with a small sample size.

Data is only available at the regional level, where fluctuations may be more or less obvious and specific information for individual provinces could not be determined.

### Pharmacy Dispensation Data

Canadian CompuScript (CCS) tracks the number and size of prescriptions dispensed by retail pharmacies in Canada. Data fields include product name (including manufacturer), form, strength, province, the number of prescriptions, units of product, and dollars spent monthly for each year.

The sampling frame (or “universe”) for this dataset in 2011 consisted of approximately 8,700 pharmacies, covering nearly all retail pharmacies in Canada and excluding those in the Yukon, Northwest Territories, and Nunavut. IMS Health Canada uses a method of geospatial projection that creates projection factors for application to all non-participating stores on the basis of the number of stores in the area, distance between stores, and store size. In 2011, an average of 5,595 stores was included. The projection factor was used to extrapolate the number of prescriptions dispensed in the stores actually sampled to that of the “universe” (8,700 pharmacies).

Although no hospital pharmacies participated in the CCS program, CCS data included a small volume of antimicrobials administered in non-oral forms such as parenteral drugs or products administered by inhalation. Inconsistencies related to non-oral drugs, which represent a very small volume of the CCS data, were judged too common to include these drugs in the CIPARS analysis. Consequently, the 2011 report only describes orally administered drugs dispensed only by retail pharmacies consisting of tablets, and liquid forms. Only information regarding drugs of ATC group J01 (antimicrobials for systemic use) were retained in the analysis. Information regarding orally administered vancomycin (ATC group A07AA) was included in the analysis under class J01XA.

In the 2002 and 2003 CIPARS reports, methenamine and linezolid were classified under “other antimicrobials.” As of 2004, they have been reported separately to harmonize with reports from other surveillance programs such as the Danish Integrated antimicrobial Resistance Monitoring and Research Program. The use of metronidazole (under J01XD imidazole) was added in 2005. Data from metronidazole could not be extracted at the time of analysis for year 2000. That information is therefore missing from the tables and is not included in any totals for year 2000.

Drugs were classified and defined daily doses (DDDs) were determined according to the Anatomical Therapeutic Chemical (ATC) classification system (Table A.1). Temporary DDDs (not yet approved but posted on the World Health Organization website) were used when available. For erythromycin ethylsuccinate, all tablets were classified as erythromycin ethylsuccinate tablets (2 g) and all forms other than tablets were classified as erythromycin (1 g). The DDDs for sulfonamides, combinations with other antibacterials (excluding trimethoprim) (2 g) was used for pediazole. For oral administration of penicillin G, the DDDs for benzylpenicillin by parenteral route (3.6 g) was used. Drugs with no DDDs were excluded, including trisulfaminic (drug discontinued in 2001; a total of 832,384 extended units were dispensed in 2000).

The total amount of active ingredient was obtained by multiplying the number of extended units (real or corrected) by the strength of the product in grams. For combination drugs, the active ingredients of all

antimicrobial components were summed to obtain the total number of active ingredients. However, the amount of active ingredient used in the calculation of the total number of DDDs for combination drugs included only the compounds from which the DDDs were derived. For example, for drugs composed of trimethoprim-sulfamethoxazole, only the total number of grams of sulfamethoxazole was used to compute the number of DDDs.

The total number of DDDs per 1,000 inhabitant-days for a given year was obtained by summing all DDDs for each ATC class and each year. This number was further divided by the size of the population in thousands during that year, divided by the number of days in that year (365 or 366). The total number of prescriptions and total cost per 1,000 inhabitants was obtained by dividing the total number of prescriptions or the total cost by the population size in thousands for each year. The cost was then adjusted for inflation using the Bank of Canada Inflation Calculator<sup>1</sup>. Population data were obtained from updated and preliminary post-census estimates based on the results of the 2001 Census.

The limitations and caveats that should be considered with the Canadian CompuScript dataset include the following:

- CompuScript only includes products with Health Canada identification numbers (Drug Identification Number, DIN, some but not all Natural Product Number, NPN and some but not all Product Pin Number, PIN).
- Product data is tracked by its DIN therefore two products with the same DIN are reported together.
- Hospital dispensaries are not included.
- Yukon, Northwest Territories and Nunavut are not included due to their very low volumes and distinct prescribing trends.
- Changes made to the databases are made to the last 72 months only and outside the five year period it is considered a closed dataset as updates cannot be made.

### Hospital Purchasing Data

The Canadian Drugstore and Hospital Purchases Audit (CDH) measures the dollar value and unit volume of pharmaceutical and diagnostic products purchased by nearly all Canadian retail pharmacy outlets and hospitals excluding those in the Yukon, Northwest Territories, and Nunavut. Information was collected from a representative sample of over 2,700 retail pharmacy outlets, and over 700 hospitals and a method of geographical projection was used to create projection factors for a “universe” of approximately 8,700 drugstores and over 800 hospitals to reflect all Canadian purchases (including non-participating stores). Data on drug purchases were extracted from the IMS Health Canada database, which included sales from manufacturers and wholesalers. For the purposes of this report, only data on hospital purchases were included in the analyses.

Only information regarding systemic drugs (ATC group J01) were included in analysis. Information regarding orally administered vancomycin (ATC group A07AA) was included in the analysis under class J01XA. For erythromycin ethylsuccinate, all tablets were classified as erythromycin ethylsuccinate tablets (2g) and all forms other than tablets were classified as erythromycin (1g). For oral pediazole, the DDD for sulfonamides, combinations with other antibacterials (excl. trimethoprim) (2 g) was used. For oral administration of penicillin G, the DDD for benzylpenicillin by parenteral route (3.6 g) was used.

Drugs were classified and defined daily doses (DDDs) were determined according to the Anatomical Therapeutic Chemical (ATC) classification system (Table A.1). Temporary DDDs (not yet approved but posted on the World Health Organization website) were used when available.

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<sup>1</sup> Bank of Canada. Inflation Calculator. Available at: [www.bankofcanada.ca/rates/related/inflation-calculator/](http://www.bankofcanada.ca/rates/related/inflation-calculator/). Accessed November 2013.



The total amount of active ingredient was obtained by multiplying the number of extended units (real or corrected) by the strength of the product in grams. For combination drugs, the active ingredients of all antimicrobial components were summed to obtain the total number of active ingredients. However, the amount of active ingredient used in the calculation of the total number of DDDs for combination drugs included only the compounds from which the DDDs were derived. For example, for drugs composed of trimethoprim-sulfamethoxazole, only the total number of grams of sulfamethoxazole was used to compute the number of DDDs.

The total number of DDDs per 1,000 inhabitant-days for a given year was obtained by summing all DDDs for each ATC class and each year for oral and parenteral antimicrobials separately. This number was further divided by the size of the population in thousands during that year, divided by the number of days in that year (365 or 366). The total number of active ingredients (kg) and total cost per 1,000 inhabitants (for oral and parenteral antimicrobials combined) was obtained by dividing the total number of active ingredients or the total cost by the population size in thousands for each year. The cost was then adjusted for inflation using the Bank of Canada Inflation Calculator<sup>1</sup>. Population data were obtained from updated and preliminary post-census estimates based on the results of the 2001 Census.

The use of metronidazole (under J01XD imidazole) was added in 2005.

The limitations and caveats that should be considered with the CDH dataset include the following:

- The data is estimated and is not census data.
- Limited tracking of specific niche markets (due to low volume and/or unique distribution).
- A small number of products may be excluded due to confidentiality (if they are only sold in one outlet).
- Some data may be excluded to reflect true market trends (i.e. large stockpiling transactions that occur prior to a potential epidemic).
- Direct sales for a specific manufacturer may not be available leading to underestimation of a product (higher incidence in the hospital than in drug store purchases).
- The provinces of Prince Edward Island and Newfoundland and Labrador were grouped due to the small volume within each province.
- Changes made to the databases are made to the last 72 months only and outside the five year period it is considered a closed dataset as updates cannot be made.
- Hospital patient days or number of hospital beds was not available for this data; general population information was used for developing rates of purchasing.

Data for CCS, CDH, and CDTI datasets were analyzed using SAS v. 9.3 (SAS Institute Inc., Cary, NC, USA) and Microsoft Excel 2010 (Microsoft Cor., Redmond, WA, USA).

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<sup>1</sup> Bank of Canada. Inflation Calculator. Available at: [www.bankofcanada.ca/rates/related/inflation-calculator/](http://www.bankofcanada.ca/rates/related/inflation-calculator/). Accessed November 2013.

## Categorization of Antimicrobials Based on Importance in Human Medicine

Categories of antimicrobials used in this report were taken from the document Categorization of Antimicrobial Drugs Based on Importance in Human Medicine<sup>1</sup> by Health Canada's Veterinary Drugs Directorate (Table A.1).

Antimicrobials are considered to be of Very High Importance in Human Medicine (Category I) when they are essential for the treatment of serious bacterial infections and there is no or limited availability of alternative antimicrobials for effective treatment. Antimicrobials of High Importance in Human Medicine (Category II) consist of those that can be used to treat a variety of infections, including serious infections, and for which alternatives are generally available. Bacteria resistant to antimicrobials of this category are generally susceptible to Category I antimicrobials, which could be used as alternatives. Antimicrobials of Medium Importance in Human Medicine (Category III) are used in the treatment of bacterial infections for which alternatives are generally available. Infections caused by bacteria resistant to these antimicrobials can, in general, be treated with Category II or I antimicrobials. Antimicrobials of Low Importance in Human Medicine (Category IV) are currently not used in human medicine.

**Table A.1. Categorization of antimicrobials based on importance in human medicine.**

Category of importance in human medicine	Antimicrobial class
<b>I</b> Very High Importance	Carbapenems
	Cephalosporins – the third and fourth-generations
	Fluoroquinolones
	Glycopeptides
	Glycylcyclines
	Ketolides
	Lipopeptides
	Monobactams
	Nitroimidazoles (metronidazole)
	Oxazolidinones
	Penicillin-β-lactamase inhibitor combinations
<b>II</b> High Importance	Polymyxins (colistin)
	Therapeutic agents for tuberculosis (e.g. ethambutol, isoniazid, pyrazinamide, and rifampin)
	Aminoglycosides (except topical agents)
	Cephalosporins – the first and second-generations (including cephamycins)
	Fusidic acid
	Lincosamides
	Macrolides
	Penicillins
	Quinolones (except fluoroquinolones)
	Streptogramins
	Trimethoprim-sulfamethoxazole

<sup>1</sup> Version April, 2009. Available at: [www.hc-sc.gc.ca/dhp-mps/vet/antimicrob/amr\\_ram\\_hum-med-rev-eng.php](http://www.hc-sc.gc.ca/dhp-mps/vet/antimicrob/amr_ram_hum-med-rev-eng.php). Accessed on May 2013.

**Table A.1 (continued). Categorization of antimicrobials based on importance in human medicine.**

Category of importance in human medicine		Antimicrobial class
III	Medium Importance	Aminocyclitols
		Aminoglycosides (topical agents)
		Bacitracins
		Fosfomycin
		Nitrofurans
		Phenicals
		Sulfonamides
		Tetracyclines
IV	Low Importance	Trimethoprim
		Flavophospholipols
		Ionophores

## Anatomical Therapeutic Chemical Classification System

**Table A.2. List of antimicrobials from the pharmacy dispensation database for each ATC<sup>1</sup> class.**

Antimicrobial	ATC Class
Amoxicillin and enzyme inhibitor (J01CR02), ticarcillin and enzyme inhibitor (J01CR03), piperacillin and enzyme inhibitor (J01CR05)	Combinations of penicillins, including $\beta$ -lactamase inhibitors (J01CR)
Cefotaxime (J01DD01), ceftazidime (J01DD02), ceftriaxone (J01DD04), ceftizoxime (J01DD07), cefixime (J01DD08)	Third-generation cephalosporins (J01DD)
Cefepime (J01DE01)	Fourth-generation cephalosporins (J01DE)
Meropenem (J01DH02), ertapenem (J01DH03), imipenem (J01DH51)	Carbapenems (J01DH)
Quinupristin/dalfopristin (J01FG02)	Streptogramins (J01FG)
Ofloxacin (J01MA01), ciprofloxacin (J01MA02), norfloxacin (J01MA06), levofloxacin (J01MA12), moxifloxacin (J01MA14), gatifloxacin (J01MA16)	Fluoroquinolones (J01MA)
Vancomycin (J01XA01)	Glycopeptides (J01XA)
Colistin (J01XB01)	Polymixins (J01XB)
Metronidazole (J01XD01)	Imidazole (J01XD)
Linezolid (J01XX08)	Linezolid (J01XX)
Ampicillin (J01CA01), pivampicillin (J01CA02), amoxicillin (J01CA04), bacampicillin (J01CA06), pivmecillinam (J01CA08), piperacillin (J01CA12)	Penicillins with extended spectrum (J01CA)
Penicillin G (J01CE01), penicillin V (J01CE02)	$\beta$ -lactamase sensitive penicillins (J01CE)
Cloxacillin (J01CF02)	$\beta$ -lactamase resistant penicillins (J01CF)
Cephalexin (J01DB01), cefazolin (J01DB04), cefadroxil (J01DB05)	First-generation cephalosporins (J01DB)
Cefoxitin (J01DC01), cefuroxime (J01DC02), cefaclor (J01DC04), cefotetan (J01DC05), cefprozil (J01DC10)	Second-generation cephalosporins (J01DC)
Sulfamethoxazole and trimethoprim (J01EE01), sulfadiazine and trimethoprim (J01EE02)	Combinations of sulfonamides and trimethoprim, including derivatives (J01EE)
Erythromycin (J01FA01), spiramycin (J01FA02), clarithromycin (J01FA09), azithromycin (J01FA10), telithromycin (J01FA15)	Macrolides (J01FA)
Clindamycin (J01FF01)	Lincosamides (J01FF)
Nalidixic acid (J01MB02)	Other quinolones, excluding fluoroquinolones (J01MB)
Erythromycin-sulfisoxazole (J01RA02)	Sulfonamide combinations, excluding trimethoprim (J01RA)
Fusidic acid (J01XC01)	Steroid antibacterials (J01XC)

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

ATC = Anatomical Therapeutic Chemical.

<sup>1</sup> World Health Organization Collaborating Center for Drug Statistics Methodology. Available at: [www.whocc.no/atc\\_ddd\\_index/](http://www.whocc.no/atc_ddd_index/). Accessed November 2013.

**Table A.2 (continued). List of antimicrobials from the pharmacy dispensation database for each ATC<sup>1</sup> class.**

Antimicrobial	ATC Class
Demeclocycline (J01AA01), doxycycline (J01AA02), tetracycline (J01AA07), minocycline (J01AA08), tigecycline (J01AA12)	Tetracyclines (J01AA)
Chloramphenicol (J01BA01)	Amphenicols (J01BA)
Trimethoprim (J01EA01)	Trimethoprim and derivatives (J01EA)
III Sulfamethizole (J01EB02), sulfapyridine (J01EB04), sulfisoxazole (J01EB05)	Short-acting sulfonamides (J01EB)
Sulfadiazine (J01EC02), sulfamethoxazole (J01EC04)	Intermediate-acting sulfonamides (J01EC)
Nitrofurantoin (J01XE01)	Nitrofurans derivatives (J01XE)
Fosfomycin (J01XX01)	Fosfomycin (J01XX)
NC Methenamine (J01XX05)	Methenamine (J01XX)

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

ATC = Anatomical Therapeutic Chemical. NC = Not classified.

<sup>1</sup> World Health Organization Collaborating Center for Drug Statistics Methodology. Available at: [www.whocc.no/atc\\_ddd\\_index/](http://www.whocc.no/atc_ddd_index/). Accessed November 2013.

## Appendix B – Additional Tables

### Physician Diagnosis Data

**Table B.1. Total number of diagnoses, total number of diagnoses in which a treatment was recommended, and total number of diagnoses consisting of antimicrobials recommended by office-based physicians in Canada, by diagnostic class, 2011.**

Diagnostic class	Total diagnoses	Total diagnoses / 10,000 inhabitants	Antimicrobial recommendations (N)	Total antimicrobial recommendations / 10,000 inhabitants	Percentage diagnoses with antimicrobial recommendations
Complications of pregnancy, childbirth, and puerperal	1,044,850	302	17,180	5	1.6
Congenital anomalies	925,330	267	21,290	6	2.3
Diseases of blood/blood-forming organs	2,593,490	749	45,160	13	1.7
Diseases of skin and subcutaneous tissue	21,784,200	6,295	2,551,830	737	11.7
Diseases of the central nervous system	10,591,580	3,061	148,900	43	1.4
Diseases of the circulatory system	33,884,750	9,791	62,510	18	0.2
Diseases of the ear	7,627,370	2,204	2,232,080	645	29.3
Diseases of the gastrointestinal system	1,674,160	484	107,900	31	6.4
Diseases of the genitourinary system	12,878,470	3,721	821,180	237	6.4
Diseases of the respiratory system	37,079,860	10,715	11,628,520	3,360	31.4
Endocrine, nutritional, metabolic, and immunity diseases	28,537,420	8,246	62,310	18	0.2
Infections of the urinary tract	6,951,220	2,009	3,285,390	949	47.3
Injuries and poisonings	11,575,360	3,345	317,020	92	2.7
Musculoskeletal diseases	28,086,920	8,116	136,030	39	0.5
Neoplasms	7,124,130	2,059	93,740	27	1.3
Other diseases of the digestive system	17,401,060	5,028	684,730	198	3.9
Perinatal conditions	438,380	127	14,540	4	3.3
Supplementary classifications	37,076,290	10,714	77,420	22	0.2
Symptoms and ill-defined conditions	21,771,660	6,291	359,500	104	1.7
<b>Total</b>	<b>289,046,500</b>	<b>83,524</b>	<b>22,667,230</b>	<b>6,550</b>	<b>7.8</b>

Data does not represent actual prescriptions dispensed by pharmacists or products consumed by the patient, as information on patient compliance was not available. Diagnosis does not represent the number of times a person visits, but represents every time a diagnosis is provided; if a person presents with multiple diseases each individual disease/diagnosis is recorded separately.

## Pharmacy Dispensation Data

**Table B.2. Quantity of active ingredients of oral antimicrobials dispensed by Canadian retail pharmacies, 2000–2011.**

ATC Class and antimicrobial	Total active ingredients (kg)											
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>Combinations of penicillins, including <math>\beta</math>-lactamase inhibitors (J01CR)</b>												
Amoxicillin and enzyme inhibitor	6,943.80	7,111.36	6,953.47	7,328.95	7,354.77	8,276.17	8,829.72	9,653.61	10,431.01	10,911.14	9,622.95	12,843.61
<b>Third-generation cephalosporins (J01DD)</b>												
Cefixime	441.47	412.56	372.50	321.45	275.37	282.37	274.85	303.43	321.94	338.16	422.10	457.61
<b>Fluoroquinolones (J01MA)</b>												
Ofloxacin, ciprofloxacin, norfloxacin, levofloxacin, moxifloxacin	17,387.35	17,569.37	17,718.15	18,469.28	18,738.69	18,781.31	19,348.63	19,806.00	19,937.45	19,297.71	19,545.35	19,925.39
<b>Glycopeptides (J01XA)</b>												
Vancomycin	25.90	28.25	32.23	40.56	70.36	79.17	75.77	84.10	84.89	88.17	100.72	121.33
<b>Imidazole (J01XD)</b>												
Metronidazole	NPD	4,808.34	4,927.11	5,126.54	5,237.51	5,311.07	5,563.92	5,587.82	5,788.75	5,921.42	6,344.69	6,430.43
<b>Linezolid (J01XX)</b>												
Linezolid	NPD	1.55	4.91	10.82	17.29	23.26	22.44	25.34	25.92	27.33	29.36	28.16
<b>Penicillins with extended spectrum (J01CA)</b>												
Ampicillin, amoxicillin, pivampicillin	57,566.37	56,004.37	53,404.23	53,132.75	51,471.46	53,138.73	53,534.54	53,445.95	54,493.64	55,482.47	57,748.23	63,277.75
<b><math>\beta</math>-lactamase sensitive penicillins (J01CE)</b>												
Penicillin G, penicillin V	15,079.86	14,253.92	13,722.26	13,802.13	12,916.80	13,174.54	13,139.46	12,881.10	12,391.33	12,249.18	11,011.37	9,755.95
<b><math>\beta</math>-lactamase resistant penicillins (J01CF)</b>												
Cloxacillin	8,351.00	8,004.27	7,376.34	7,135.18	6,596.38	5,861.06	5,604.72	5,159.05	4,774.68	4,378.22	5,426.41	3,980.87
<b>I First-generation cephalosporins (J01DB)</b>												
Cephalexin, cefadroxil	16,693.30	17,295.99	18,358.43	19,683.24	20,312.94	21,585.02	22,980.74	23,353.79	24,048.77	23,617.99	23,258.77	25,016.70
<b>Second-generation cephalosporins (J01DC)</b>												
Cefaclor, cefprozil, cefuroxime axetil	11,099.40	9,857.59	8,712.26	8,570.41	8,277.23	8,410.81	7,937.34	7,424.93	7,214.71	7,143.74	6,451.46	6,768.20
<b>Combinations of sulfonamides and trimethoprim, including derivatives (J01EE)</b>												
Sulfamethoxazole and trimethoprim, sulfadiazine and trimethoprim	29,783.84	27,065.80	24,548.61	23,018.83	20,511.55	18,858.59	18,519.88	18,102.01	18,154.38	18,208.33	18,187.55	17,987.58

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.  
 ATC = Anatomical Therapeutic Chemical. NPD = No prescriptions dispensed.

**Table B.2 (continued). Quantity of active ingredients of oral antimicrobials dispensed by Canadian retail pharmacies, 2000–2011.**

ATC Class and antimicrobial		Total active ingredients (kg)											
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
II	<b>Macrolides (J01FA)</b>												
	Azithromycin, clarithromycin, erythromycin	25,163.98	23,844.04	21,665.44	22,138.28	21,168.11	22,746.49	22,646.72	22,517.46	22,775.91	22,593.78	22,215.30	23,208.11
	<b>Lincosamides (J01FF)</b>												
	Clindamycin	3,289.35	3,590.12	3,896.00	4,272.26	4,441.95	4,499.59	4,976.64	5,303.74	5,551.38	5,562.55	6,135.78	6,140.36
	<b>Other quinolones, excluding fluoroquinolones (J01MB)</b>												
	Nalidixic acid	76.31	62.19	52.12	45.35	41.87	1.05	0.26	0.01	NPD	0.01	NPD	NPD
	<b>Sulfonamide combinations, excluding trimethoprim (J01RA)</b>												
	Erythromycin-sulfisoxazole (J01RA02)	2,745.17	1,910.05	1,251.28	843.14	548.87	494.05	418.86	305.33	102.70	0.07	NPD	0.04
	<b>Steroid antimicrobials (J01XC)</b>												
	Fusidic acid	34.79	39.06	35.54	37.27	36.64	41.91	42.73	34.22	30.08	13.05	0.82	0.78
	<b>Tetracyclines (J01AA)</b>												
	Doxycycline, minocycline, tetracycline	14,112.37	13,169.24	12,595.12	11,902.77	11,050.90	10,709.61	10,280.96	9,691.69	9,415.40	9,250.68	7,058.85	7,899.56
	<b>Amphenicols (J01BA)</b>												
	Chloramphenicol	0.78	0.99	0.20	NPD	0.06	0.01	NPD	NPD	NPD	NPD	0.01	NPD
	<b>Trimethoprim and derivatives (J01EA)</b>												
	Trimethoprim	315.71	297.29	310.34	307.34	288.32	265.98	265.88	261.01	242.45	256.72	256.69	254.79
	<b>Short-acting sulfonamides (J01EB)</b>												
	Sulfamethizole, sulfapyridine, sulfisoxazole	105.38	13.45	0.88	1.04	1.02	0.26	0.13	0.03	0.03	NPD	NPD	NPD
	<b>Intermediate-acting sulfonamides (J01EC)</b>												
	Sulfadiazine, sulfamethoxazole	28.08	4.48	4.77	5.55	4.51	2.93	2.27	2.36	1.33	0.05	0.10	0.25
	<b>Nitrofurantoin derivatives (J01XE)</b>												
	Nitrofurantoin	935.24	981.97	1,019.51	1,073.19	1,152.40	1,210.89	1,323.74	1,390.41	1,503.01	1,624.94	1,740.21	1,852.07
	<b>Fosfomycin (J01XX)</b>												
	Fosfomycin	64.76	74.26	48.00	35.71	26.28	20.78	17.78	11.00	1.90	5.57	3.70	0.37
NC	<b>Methenamine (J01XX)</b>												
	Methenamine	389.51	356.69	350.35	296.88	282.20	253.34	249.14	261.99	163.26	217.10	245.16	247.81
	<b>Total (J01)</b>	<b>210,633.72</b>	<b>206,757.23</b>	<b>197,360.06</b>	<b>197,598.93</b>	<b>190,823.45</b>	<b>194,029.00</b>	<b>196,057.10</b>	<b>195,606.41</b>	<b>197,454.92</b>	<b>197,188.39</b>	<b>195,805.58</b>	<b>206,197.72</b>

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.  
ATC = Anatomical Therapeutic Chemical. NC = Not classified. NPD = No prescriptions dispensed.



## Hospital Purchasing Data

**Table B.3. Defined daily doses per 1,000 inhabitant-days ( $\times 10^{-2}$ ) for oral and parenteral antimicrobials purchased by hospitals in Canada, 2000–2011.**

ATC Class and antimicrobial	DDDs/1,000 inhabitant-days ( $\times 10^{-2}$ )										
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>Combinations of penicillins, including <math>\beta</math>-lactamase inhibitors (J01CR)</b>											
Amoxicillin and enzyme inhibitor (J01CR02)	1.92	2.30	2.84	3.15	3.78	4.40	3.29	3.39	3.89	3.92	4.75
Ticarcillin and enzyme inhibitor (J01CR03)	0.64	1.43	1.26	0.52	0.49	0.57	0.50	0.52	0.40	0.38	0.16
Piperacillin and enzyme inhibitor (J01CR05)	1.07	0.68	1.27	1.66	2.20	2.55	3.03	3.27	4.55	4.71	5.76
<b>Third-generation cephalosporins (J01DD)</b>											
Cefotaxime (J01DD01)	1.19	1.37	1.59	1.64	1.68	1.84	1.74	1.16	1.10	0.64	0.57
Ceftazidime (J01DD02)	0.94	1.30	1.22	1.27	1.68	1.22	0.45	0.44	0.38	0.34	0.33
Ceftriaxone (J01DD04)	1.21	1.92	2.67	3.10	3.38	3.66	4.16	4.96	6.07	6.14	7.07
Ceftizoxime (J01DD07)	0.03	0.07	0.09	0.05	0.03	< 0.01	NAP	NAP	NAP	NAP	NAP
Cefixime (J01DD08)	0.81	0.86	0.78	0.52	0.61	0.64	0.77	0.87	1.09	1.15	1.44
<b>Fourth-Generation Cephalosporins (J01DE)</b>											
Cefepime (J01DE01)	0.05	0.18	1.26	2.86	1.52	1.45	1.13	0.12	0.12	0.12	0.14
Ceftobiprole (J01DIP01)	NAP	NAP	NAP	NAP	NAP	NAP	NAP	< 0.01	0.01	< 0.01	NAP
<b>Carbapenems (J01DH)</b>											
Meropenem (J01DH02)	0.63	1.08	1.06	1.12	0.97	1.54	1.67	1.87	2.22	2.16	2.21
Ertapenem (J01DH03)	NAP	NAP	0.01	0.07	0.17	0.29	0.36	0.52	0.70	0.82	1.14
Imipenem (J01DH51)	0.67	2.05	2.35	0.46	0.63	0.58	0.58	0.52	0.53	0.49	0.20
<b>Streptogramins (J01FG)</b>											
Quinupristin-dalfopristin (J01FG02)	0.01	< 0.01	< 0.01	0.01	0.01	< 0.01	< 0.01	< 0.01	NAP	NAP	NAP

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.  
 ATC = Anatomical Therapeutic Chemical. DDDs = Defined daily doses. NAP = No antimicrobials purchased.

**Table B.3 (continued). Defined daily doses per 1,000 inhabitant-days ( $\times 10^{-2}$ ) for oral and parenteral antimicrobials purchased by hospitals in Canada, 2000–2011.**

ATC Class and antimicrobial	DDDs/1,000 inhabitant-days ( $\times 10^{-2}$ )										
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>Fluoroquinolones (J01MA)</b>											
Ofloxacin (J01MA01)	0.13	0.13	0.11	0.13	0.07	0.11	0.06	0.09	0.11	0.07	0.06
Ciprofloxacin (J01MA02)	17.01	15.81	16.34	16.82	15.56	16.73	15.61	15.02	14.57	12.81	12.59
Norfloxacin (J01MA06)	0.82	0.80	0.83	0.87	0.74	0.75	0.52	0.48	0.49	0.39	0.33
Levofloxacin (J01MA12)	8.12	8.48	7.93	7.08	6.29	5.48	5.21	5.19	5.65	4.86	5.35
Moxifloxacin (J01MA14)	0.49	1.08	1.82	3.74	5.58	7.62	7.78	7.65	7.65	6.65	6.53
Gatifloxacin (J01MA16)	0.16	1.33	2.75	2.46	1.83	0.35	< 0.01	NAP	NAP	NAP	NAP
<b>Glycopeptides (J01XA)</b>											
I Vancomycin (J01XA01)	3.95	4.39	2.14	1.83	1.82	1.44	1.32	1.38	1.58	1.58	1.59
<b>Polymixins (J01XB)</b>											
Colistin (J01XB01)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	< 0.01	< 0.01
<b>Imidazole (J01XD)</b>											
Metronidazole (J01XD01)	9.57	5.67	4.57	5.03	4.68	4.79	4.84	4.28	3.99	3.96	3.80
<b>Linezolid (J01XX)</b>											
Linezolid (J01XX08)	0.03	0.08	0.10	0.11	0.18	0.20	0.23	0.27	0.30	0.26	0.27
<b>Daptomycin (J01XX)</b>											
Daptomycin (J01XX09)	NAP	NAP	NAP	NAP	NAP	NAP	NAP	0.01	0.07	0.13	0.23
<b>Penicillins with extended spectrum (J01CA)</b>											
Ampicillin (J01CA01)	6.86	5.82	5.19	5.35	5.34	5.31	4.91	4.56	4.27	3.97	3.89
Pivampicillin (J01CA02)	0.11	0.18	0.08	0.05	0.03	0.02	0.02	< 0.01	NAP	NAP	NAP
Amoxicillin (J01CA04)	11.19	10.22	9.58	9.15	10.06	8.78	8.08	7.94	8.45	8.84	9.21
II Piperacillin (J01CA12)	0.36	0.04	0.17	0.14	0.09	0.06	0.05	0.03	0.02	0.02	0.02
<b><math>\beta</math>-lactamase sensitive penicillins (J01CE)</b>											
Penicillin G (J01CE01)	21.01	18.75	22.46	27.00	27.99	27.69	26.00	26.75	26.16	25.12	25.38
Penicillin V (J01CE02)	2.22	2.61	2.69	2.34	2.17	2.31	1.22	1.29	1.46	0.89	1.61
<b><math>\beta</math>-lactamase resistant penicillins (J01CF)</b>											
Cloxacillin (J01CF02)	7.20	6.79	6.58	6.24	6.05	5.79	5.46	5.13	5.65	4.99	5.15

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.  
 ATC = Anatomical Therapeutic Chemical. DDDs = Defined daily doses. NAP = No antimicrobials purchased.

**Table B.3 (continued). Defined daily doses per 1,000 inhabitant-days ( $\times 10^{-2}$ ) for oral and parenteral antimicrobials purchased by hospitals in Canada, 2000–2011.**

ATC Class and antimicrobial		DDDs/1,000 inhabitant-days (x10 <sup>-2</sup> )										
		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
First-generation cephalosporins (J01DB)												
	Cephalexin (J01DB01)	4.77	4.92	5.32	5.32	5.84	7.21	4.55	4.42	4.44	4.04	4.38
	Cefazolin (J01DB04)	11.60	12.35	12.38	11.81	11.86	11.26	12.28	12.42	13.12	12.29	12.02
	Cefadroxil (J01DB05)	0.06	0.06	0.08	0.10	0.10	0.11	0.12	0.13	0.16	0.13	0.14
Second-generation cephalosporins (J01DC)												
	Cefoxitin (J01DC01)	0.40	0.43	0.50	0.50	0.42	0.44	0.39	0.33	0.33	0.29	0.27
	Cefuroxime axetil (J01DC02)	8.01	6.34	5.67	4.94	4.78	4.04	4.12	3.57	3.59	2.81	3.31
	Cefaclor (J01DC04)	0.56	0.47	0.29	0.25	0.21	0.17	0.13	0.12	0.09	0.01	0.01
	Cefotetan (J01DC05)	0.90	1.43	0.96	0.06	0.11	< 0.01	NAP	NAP	NAP	NAP	NAP
	Cefprozil (J01DC10)	0.33	0.36	0.48	0.57	0.44	0.41	0.42	0.42	0.55	0.48	0.44
II	Combinations of sulfonamides and trimethoprim, including derivatives (J01EE)											
	Sulfamethoxazole and trimethoprim (J01EE01)	9.19	7.63	7.95	7.27	7.45	7.76	6.94	6.62	6.79	6.26	6.31
	Sulfadiazine and trimethoprim (J01EE02)	0.01	< 0.01	0.01	< 0.01	< 0.01	NAP	NAP	NAP	NAP	NAP	NAP
Macrolides (J01FA)												
	Erythromycin (J01FA01)	2.31	2.35	2.54	1.72	1.79	1.59	1.49	1.32	1.21	0.93	1.06
	Spiramycin (J01FA02)	< 0.01	0.02	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
	Clarithromycin (J01FA09)	6.30	5.84	5.41	5.16	5.22	5.10	4.97	4.92	5.13	4.27	4.40
	Azithromycin (J01FA10)	5.26	6.10	7.25	6.73	7.08	6.19	7.27	7.81	8.84	8.01	8.73
	Telithromycin (J01FA15)	NAP	NAP	< 0.01	0.02	0.03	0.04	0.01	< 0.01	< 0.01	< 0.01	NAP
Lincosamides (J01FF)												
	Clindamycin (J01FF01)	3.44	3.33	3.17	2.91	3.04	4.64	4.78	4.62	4.66	4.31	4.38
Streptomycin (J01GA)												
	Streptomycin (J01GA01)	< 0.01	< 0.01	< 0.01	< 0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01

Roman numerals I to III indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.

ATC = Anatomical Therapeutic Chemical. DDDs = Defined daily doses. NAP = No antimicrobials purchased.

**Table B.3 (continued). Defined daily doses per 1,000 inhabitant-days ( $\times 10^{-2}$ ) for oral and parenteral antimicrobials purchased by hospitals in Canada, 2000–2011.**

ATC Class and antimicrobial		DDDs/1,000 inhabitant-days (x10 <sup>-2</sup> )										
		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
II	<b>Aminoglycosides (J01GB)</b>											
	Tobramycin (J01GB01)	2.19	1.94	0.75	0.39	0.70	1.87	1.94	1.72	1.62	1.56	1.41
	Gentamicin (J01GB03)	3.27	2.66	1.95	1.25	1.79	3.30	3.09	2.66	2.30	2.15	1.97
	Amikacin (J01GB06)	0.04	0.05	0.05	0.02	0.07	0.11	0.10	0.09	0.11	0.10	0.08
	Netilmicin (J01GB07)	0.13	0.03	NAP	NAP	NAP	NAP	NAP	NAP	NAP	NAP	NAP
	<b>Sulfonamide combinations, excluding trimethoprim (J01RA)</b>											
	Erythromycin-sulfisoxazole (J01RA02)	0.25	0.33	0.19	0.08	0.10	0.05	0.08	0.01	NAP	NAP	NAP
	<b>Steroid antimicrobials (J01XC)</b>											
	Fusidic acid (J01XC01)	0.06	0.06	0.06	0.06	0.04	0.05	0.05	0.04	0.01	NAP	NAP
III	<b>Tetracyclines (J01AA)</b>											
	Demeclocycline (J01AA01)	0.14	0.14	0.12	0.11	0.11	0.11	0.05	NAP	NAP	NAP	NAP
	Doxycycline (J01AA02)	4.20	3.02	3.82	4.26	3.83	4.20	6.70	10.72	7.03	7.48	9.25
	Tetracycline (J01AA07)	0.95	0.92	0.77	0.66	0.64	0.64	0.75	0.71	0.77	0.33	0.39
	Minocycline (J01AA08)	0.72	0.66	0.63	0.55	0.56	0.64	0.52	0.64	0.45	0.54	0.54
	Tigecycline (J01AA12)	NAP	NAP	NAP	NAP	NAP	NAP	0.02	0.05	0.09	0.09	0.07
	<b>Amphenicols (J01BA)</b>											
	Chloramphenicol (J01BA01)	0.03	0.02	0.02	0.03	0.02	0.01	< 0.01	0.01	0.01	0.01	0.01
	<b>Trimethoprim and derivatives (J01EA)</b>											
	Trimethoprim (J01EA01)	0.23	0.23	0.34	0.22	0.24	0.26	0.21	0.16	0.16	0.15	0.15
NC	<b>Nitrofuran derivatives (J01XE)</b>											
	Nitrofurantoin (J01XE01)	2.22	2.52	2.56	2.91	3.03	3.11	2.91	2.73	2.74	3.10	3.37
	<b>Methenamine (J01XX)</b>											
	Methenamine (J01XX05)	0.11	0.10	0.10	0.10	0.07	0.06	0.05	0.02	0.04	0.04	0.03
	<b>Total (x10<sup>2</sup>) (J01)</b>	<b>1.66</b>	<b>1.60</b>	<b>1.63</b>	<b>1.63</b>	<b>1.65</b>	<b>1.70</b>	<b>1.63</b>	<b>1.64</b>	<b>1.66</b>	<b>1.55</b>	<b>1.62</b>

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ATC = Anatomical Therapeutic Chemical. DDDs = Defined daily doses. NAP = No antimicrobials purchased. NC = Not classified.

## Demographics

**Table B.4. Canadian population<sup>1</sup> demographics, 2000–2011.**

	Population (thousands)											
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>Province / territory</b>												
Canada	30,784.0	31,129.3	31,446.7	31,734.1	32,038.4	32,353.0	32,690.2	33,047.5	33,447.6	33,857.8	34,256.4	34,606.4
British Columbia	4,049.3	4,085.1	4,106.5	4,132.7	4,167.4	4,212.6	4,263.4	4,334.7	4,409.2	4,483.7	4,551.0	4,595.8
Alberta	3,016.9	3,078.7	3,145.0	3,198.5	3,261.2	3,346.9	3,453.0	3,531.3	3,614.6	3,687.2	3,737.5	3,798.0
Saskatchewan	1,006.0	999.3	996.4	996.7	997.2	993.4	992.7	1,005.0	1,018.5	1,033.8	1,048.5	1,063.5
Manitoba	1,148.2	1,152.2	1,157.4	1,165.8	1,174.7	1,179.1	1,185.3	1,196.8	1,208.1	1,224.0	1,240.2	1,255.6
Ontario	11,748.3	11,961.7	12,143.2	12,289.2	12,436.0	12,577.9	12,708.8	12,838.5	12,981.1	13,121.3	13,280.9	13,415.8
Quebec	7,368.8	7,411.6	7,455.5	7,503.5	7,553.5	7,598.8	7,650.9	7,705.7	7,773.0	7,851.2	7,928.8	8,000.2
New Brunswick	750.3	749.4	749.4	749.4	749.2	747.6	745.0	746.1	747.8	751.1	754.1	755.6
Nova Scotia	934.5	933.4	935.8	938.6	939.8	938.8	937.2	936.4	938.8	943.1	947.4	949.2
Prince Edward Island	136.4	136.9	137.1	137.4	137.7	138.1	138.1	138.5	140.4	141.9	144.2	146.1
Newfoundland and Labrador	526.7	521.6	519.5	518.8	516.9	513.8	509.4	506.9	507.6	510.7	512.1	513.6
Northwest Territories	40.6	41.2	41.8	42.8	43.3	43.5	43.2	43.5	43.7	43.4	43.9	43.9
Nunavut	27.7	28.2	28.9	29.4	29.8	30.4	30.8	31.4	31.7	32.4	33.0	33.6
Yukon	30.3	30.1	30.3	31.2	31.7	32.1	32.4	32.7	33.3	34.0	34.8	35.6
<b>Age</b>												
0 to 2	1,034.6	1,027.9	1,014.6	1,009.0	1,017.2	1,032.6	1,053.6	1,076.6	1,109.2	1,135.7	1,148.9	1,152.7
3 to 9	2,781.3	2,737.3	2,689.8	2,641.0	2,589.3	2,541.6	2,511.5	2,501.6	2,506.9	2,524.6	2,556.2	2,600.4
10 to 19	4,164.3	4,212.9	4,252.4	4,277.0	4,294.1	4,308.1	4,309.1	4,293.5	4,263.2	4,214.6	4,156.2	4,090.8
20 to 39	9,084.4	9,061.6	9,025.4	8,969.5	8,934.7	8,922.5	8,953.3	9,030.7	9,138.4	9,269.2	9,399.1	9,502.3
40 to 59	8,584.4	8,846.0	9,097.9	9,332.7	9,554.7	9,751.4	9,875.1	9,939.8	10,008.2	10,074.9	10,134.6	10,175.6
60 to 64	1,261.9	1,301.2	1,354.4	1,417.8	1,483.2	1,548.0	1,631.6	1,738.7	1,828.0	1,909.1	1,988.0	2,045.7
65 or older	3,873.1	4,012.1	4,012.1	4,087.0	4,165.1	4,248.8	4,356.0	4,466.6	4,593.6	4,729.6	4,873.5	5,038.8
<b>Sex</b>												
Male	15,245.6	15,424.3	15,582.9	15,725.7	15,878.2	16,037.4	16,207.4	16,386.1	16,588.1	16,794.9	16,995.4	17,172.6
Female	15,538.4	15,705.0	15,863.8	16,008.3	16,160.2	16,315.6	16,482.9	16,661.4	16,859.5	17,062.8	17,260.9	17,433.7

Population data were obtained from updated and preliminary post-census estimates based on the results of the 2006 Census. Census counts were adjusted for net under-coverage.

<sup>1</sup> Statistics Canada. Demography Division, Demographic Estimates Section, July Population Estimates, 2012 Final Intercensal Estimate.