

# Antibiotic recommendations of office-based physicians, 2007–2011

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## Abstract

**Objective:** To describe patterns of antibiotic recommendations by office-based physicians from five regions in Canada between 2007 and 2011.

**Methods:** Values were estimated based on quarterly data from a sample of approximately 652 physicians stratified by region and specialty. For four consecutive quarters, each physician maintained a practice diary describing information on every patient visit during a randomly selected 48-hour period. This information was then extrapolated using a projection factor to estimate prescriptions by all physicians across Canada.

**Results:** Over the five-year surveillance period, physicians saw patients for almost 1.5 billion diagnoses with approximately 120 million antimicrobial recommendations. In 2011 alone, 289 million clinical diagnoses were made of which 8% resulted in an antimicrobial being recommended. The majority of these (51%) were for the treatment of diseases of the respiratory system, 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 0–2, 3–9, and 65 or older. Antimicrobial recommendation rates generally decreased between 2007 and 2011 except for diseases of the genitourinary system and diseases of the ear that remained stable. Overall, the most commonly recommended antimicrobials included macrolides, penicillins with extended spectrum, and fluoroquinolones. Although not as common, there was a 42% increase in the number of physician recommendations for third generation cephalosporins.

**Conclusion:** With the exception of third generation cephalosporins, the percentage of antimicrobial recommendations by office-based physicians in Canada remained stable or decreased between 2007 and 2011. Provincial differences were observed in the antimicrobial recommendations and rates, with the Atlantic region and Québec having higher rates of antimicrobial recommendations compared to the overall national level.

## Introduction

The Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) monitors trends in antimicrobial use and antimicrobial resistance in selected bacterial organisms from human, animal and food sources across Canada. The Program is based on several representative and methodologically unified surveillance components that can be linked to examine the relationship between antimicrobials used in food animals and humans, and the associated health impacts. This information supports: (i) the creation of evidence-based policies to control antimicrobial use in hospital, community, and agricultural settings, and thus prolong the effectiveness of these drugs; and (ii) the identification of appropriate

measures to contain the emergence and spread of resistant bacteria between animals, food, and people in Canada.

The human antimicrobial use surveillance reports are published on a regular basis to provide a national overview of current antimicrobial use practices in Canada annually, to enable comparisons and to support formulary and stewardship development. The objective of this paper is to summarize the most recent [CIPARS report](#) that describes patterns of antibiotic recommendations by office-based physicians from five regions in Canada between 2007 and 2011 (1).

## Methods

The Canadian Disease and Therapeutic Index (CDTI) dataset is purchased by the Public Health Agency of Canada from IMS Health Canada Inc. This 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 antimicrobials 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 patients visited 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 study.

## Results

Over the five-year surveillance period (2007–2011) physicians saw patients for almost 1.5 billion diagnoses and provided a total of approximately 121 million antimicrobial recommendations(1). In 2011, a total of 289 million clinical diagnoses were made of which 8% resulted in an antimicrobial recommendation (**Table 1**). During that year, out of all the antimicrobials recommended by office-based physicians, 51.3% were for treatment of diseases of the respiratory system followed by infections of the urinary tract (14.5%) and diseases of the skin and subcutaneous tissue (11.3%)

**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, 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>

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

**TABLE 2. Diagnosis rate, antimicrobial recommendation rate and percentage of diagnosis with antimicrobial recommendation provided by office-based physicians in Canada, by age group and by gender, 2011**

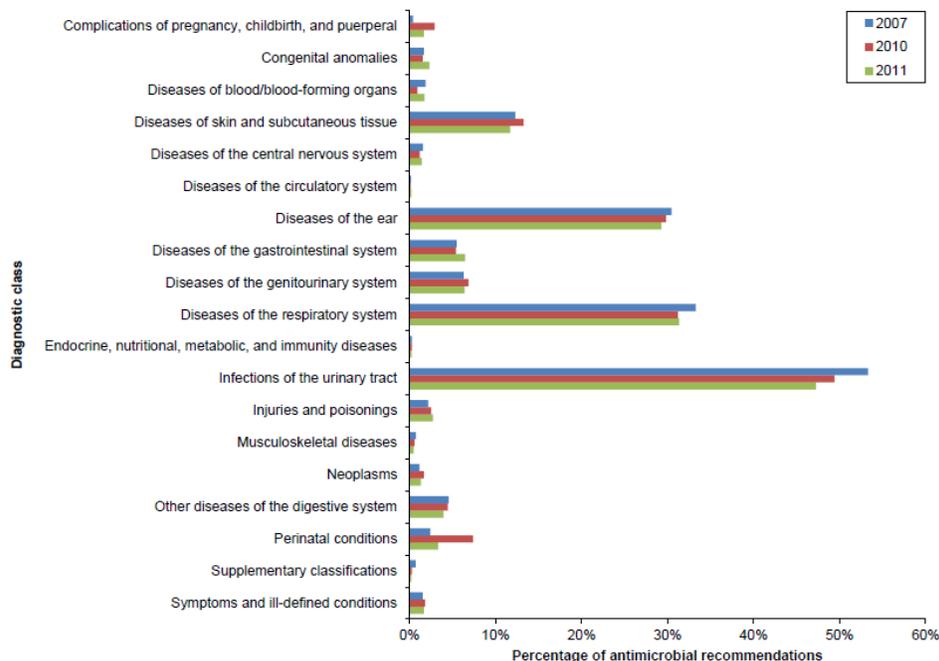
Demographics: age (year) or gender	Number of diagnoses / 10 inhabitants <sup>1</sup>	Antimicrobial recommendations / 10 inhabitants <sup>2</sup>	Percentage of diagnoses with antimicrobial recommendations
<b>Age</b>			
0 to 2	123	12	9.7
3 to 9	52	9	16.5
10 to 19	42	6	13.0
20 to 39	59	6	10.7
40 to 59	81	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

<sup>1</sup>Diagnosis does not represent the number of times a person visits, but represents every time a diagnosis is provided; if a person presents multiple diseases each individual disease/diagnosis is recorded separately.

<sup>2</sup>Data does not represent actual prescriptions dispensed by pharmacists or products consumed by the patient, as information on patient compliance was not available.

For the most part, the percentage of antimicrobial recommendations by office-based physicians in Canada remained stable or decreased between 2007 and 2011 (**Figure 1**). Slight increases were seen related to complications of pregnancy, childbirth, and puerperal; congenital anomalies; diseases of the gastrointestinal system; injuries and poisonings; and perinatal conditions.

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



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

Provincial variation in the total number of antimicrobial recommendations per 10,000 inhabitants was observed, with the Atlantic region (7,101 recommendations per 10,000 inhabitants) and Québec (8,268 recommendations per 10,000 inhabitants) having the highest rates compared to the overall national level. Rates of diagnoses and antimicrobial recommendations per 10,000 inhabitants varied depending upon the province and disease of treatment. Provincial preferences for antimicrobial of choice for treatment of disease were also observed (**Table 3**).

**TABLE 3. Diagnosis rate, antimicrobial recommendation rate and percentage of diagnoses with antimicrobial recommendations provided by office-based physicians in Canada, by diagnostic class and by province/region, 2011**

Diagnostic class	Province / region	Number of diagnoses / 10,000 inhabitants <sup>1</sup>	Antimicrobial recommendations / 10,000 inhabitants <sup>2</sup>	Percentage of diagnoses with antimicrobial recommendations
Complications of pregnancy, childbirth, and puerperal	British Columbia	350	NAS <sup>3</sup>	NAS
	Prairies <sup>4</sup>	303	3	1.1
	Ontario	271	NAS	NAS
	Quebec	330	19	5.7
	Atlantic <sup>5</sup>	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

<sup>1</sup>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.

<sup>2</sup>Data does not represent actual prescriptions dispensed by pharmacists or products consumed by the patient, as information on patient compliance was not available.

<sup>3</sup>NAS = no antimicrobials suggested (recommended).

<sup>4</sup>The Prairies include the provinces of Alberta, Saskatchewan, and Manitoba.

<sup>5</sup>The Atlantic region includes the provinces of New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador.

**TABLE 3 (continued). Diagnosis rate, antimicrobial recommendation rate and percentage of diagnoses with antimicrobial recommendations provided by office-based physicians in Canada, by diagnostic class and by province/region, 2011**

Diagnostic class	Province / region	Number of diagnoses / 10,000 inhabitants <sup>1</sup>	Antimicrobial recommendations / 10,000 inhabitants <sup>2</sup>	Percentage of diagnoses with antimicrobial recommendations
Diseases of the ear	British Columbia	2,285	349	15.3
	Prairies <sup>4</sup>	1,628	460	28.2
	Ontario	1,708	514	30.1
	Quebec	3,123	1,168	37.4
	Atlantic <sup>5</sup>	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 <sup>3</sup>	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

<sup>1</sup>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.

<sup>2</sup>Data does not represent actual prescriptions dispensed by pharmacists or products consumed by the patient, as information on patient compliance was not available.

<sup>3</sup>NAS = no antimicrobials suggested (recommended).

<sup>4</sup>The Prairies include the provinces of Alberta, Saskatchewan, and Manitoba.

<sup>5</sup>The Atlantic region includes the provinces of New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador.

**TABLE 3 (continued). Diagnosis rate, antimicrobial recommendation rate and percentage of diagnoses with antimicrobial recommendations provided by office-based physicians in Canada, by diagnostic class and by province/region, 2011**

Diagnostic class	Province / region	Number of diagnoses / 10,000 inhabitants <sup>1</sup>	Antimicrobial recommendations / 10,000 inhabitants <sup>2</sup>	Percentage of diagnoses with antimicrobial recommendations
Injuries and poisonings	British Columbia	5,400	99	1.8
	Prairies <sup>4</sup>	3,446	93	2.7
	Ontario	2,864	94	3.3
	Quebec	3,221	90	2.8
	Atlantic <sup>5</sup>	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 <sup>3</sup>	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	British Columbia	6,427	97	1.5

conditions	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

<sup>1</sup>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.

<sup>2</sup>Data does not represent actual prescriptions dispensed by pharmacists or products consumed by the patient, as information on patient compliance was not available.

<sup>3</sup>NAS = no antimicrobials suggested (recommended).

<sup>4</sup>The Prairies include the provinces of Alberta, Saskatchewan, and Manitoba.

<sup>5</sup>The Atlantic region includes the provinces of New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador.

## Discussion

Eight percent of clinical diagnoses provided by office-based physicians resulted in an antimicrobial being recommended in 2011. Of these, 51% 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 0–2 years, 3–9 years, and 65 years or older. Antimicrobial recommendation rates decreased between 2007 and 2011 for diseases of the ear, 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 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.

There are several limitations and caveats within the CDTI dataset. 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 do not include patient visits to a primary care nurse, and diagnosis visits do not translate into number of patients as some patients may have visited multiple times for the same reason or were 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. In addition, 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 and 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 are only available at the regional level, where fluctuations may be more or less obvious and specific information for individual provinces could not be determined.

Antimicrobial resistance will continue to challenge the health of Canadians and those around the world for some time to come. Antibiotic use surveillance will help document the progress we have made in curbing it and the impact these changes might have had on overall antibiotic resistance.

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## Conflict of interest

None.

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## Disclaimer

This article was prepared using data from IMS Health Canada Inc. The analyses, conclusions, opinions, and statements expressed are those of the authors and not those of IMS Health Canada Inc.

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