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INNOVATION AND ACTION IN PUBLIC HEALTH.**  
—Public Health Agency of Canada

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## EXECUTIVE SUMMARY

In 2013, office-based physicians saw patients for more than 293 million diagnoses, resulting in 23.8 million antimicrobial recommendations (8% of all diagnoses). A total of 22.8 million antimicrobial prescriptions were dispensed through pharmacies representing 202,000 kilograms of active ingredient. Pneumonia and acute sinusitis had the highest percentage of all diagnoses resulting with an antimicrobial recommendation (85% and 84%, respectively). Children between the ages of 3 and 9 years had the highest percentage of diagnoses with an antimicrobial recommendation, consisting mostly of penicillins or macrolides. Over time, the greatest changes in antimicrobial recommendations were observed among pneumonia diagnoses (9% increase), upper urinary tract infection/pyelonephritis (13% decrease), chronic sinusitis (6% decrease) and acne (6% decrease).

Overall levels of prescriptions and costs associated with antimicrobials dispensed through community pharmacies have decreased consistently since 2011. Although the most commonly prescribed antimicrobials for 2013 were amoxicillin, ciprofloxacin and azithromycin, prescription rates for nitrofurantoin, moxifloxacin and azithromycin have shown dramatic changes between 2000 and 2013. Overall prescription rates for oral antimicrobials have not shown dramatic changes between 2010 and 2013 while increases have been seen in the volume of parenteral products dispensed through outpatient pharmacies. However, the volume of antimicrobials for parenteral administration remained low relative to the volume of oral products; in 2013 there were more than 260 oral prescriptions dispensed for each parenteral antimicrobial prescription at the national level. Between 2012 and 2013, total kilograms of active ingredient and costs for parenteral products have increased by 200% and 96%, respectively, driven mainly by increases in cefazolin and piperacillin-tazobactam products.

Over time, patterns in outpatient antimicrobial use decreased with increasing age among children and young adults. In contrast, levels of use increased as age increased among adults. In 2013, antimicrobial use was highest among the youngest (0-5 years) and oldest (65+) age groups with the youngest (0 to 5 years) group having observed the greatest prescription rate decline between 2010 and 2013. However, in 2013, levels of use in children between 0 and 5 years was 30% (230 prescriptions/1,000 inhabitants) more than what was observed in the general population (872 compared to 642 prescriptions/1,000 inhabitant). In contrast, prescriptions for the 12-17 age group was 30% (220 prescriptions/1,000 inhabitants) lower than the overall rate. Levels of use among people 40 years of age or older were found to be slightly higher while those 18 to 39 age group had slightly lower use than the overall national levels.

Regional differences were observed in the diagnoses and antimicrobial recommendation rates, as well as overall levels of use and cost associated with antimicrobial prescriptions. The province of Newfoundland and Labrador displayed the highest levels of use for all measures, with use 30% higher than that reported for the second highest province (Saskatchewan). Prescription rates for parenteral antimicrobials in the provinces of Québec, New Brunswick, and Nova Scotia were more than fifteen times the rates reported in the provinces of Ontario, British Columbia and Manitoba. Looking at specific antimicrobials, Newfoundland and Labrador had the lowest levels of use for vancomycin, while Québec had the highest use for cefadroxil, cefprozil, ertapenem, minocycline, moxifloxacin, penicillin v and vancomycin. In the community setting in all provinces with the exception of New Brunswick and Nova Scotia, the dispensing of oral vancomycin was roughly 50% greater than the dispensing of parenteral vancomycin. In New

Brunswick and Nova Scotia, this was reversed. In the hospital setting, only parenteral vancomycin products were purchased.

Total kilograms of active antimicrobial ingredients purchased by hospitals increased 75% between 2010 and 2013, driven mainly by increased purchases of ceftriaxone and piperacillin and enzyme inhibitor products. In contrast with what was observed with pharmacy dispensations, the volume of parenteral antimicrobials was 9 times that of oral antimicrobials purchased in the hospital. There were large variations in hospital purchasing among the provinces; the proportion of parenteral products purchased ranged from 85% in Saskatchewan to 94% in New Brunswick. The total mass of active ingredient purchased by hospitals was highest in Manitoba and lowest in Québec, while the cost was lowest in Ontario and highest in British Columbia. The higher levels of purchased antimicrobials in Manitoba was due to ceftriaxone purchasing; Manitoba reported purchasing 40% more product than any other province based on defined daily doses/1,000 inhabitant-days. Piperacillin and enzyme inhibitor products ranked high in the total kilogram of active antimicrobial ingredients per 1,000 inhabitants among all provinces with the exception of British Columbia, where ceftriaxone was the highest mass of active ingredient purchased.

Antimicrobial use information is presented in this report for better understanding trends over time at the national and provincial levels. However, it is important when interpreting this information to have full understanding of any changes that have taken place on infectious disease rates as well as formularies at the provincial and hospital levels. These changes could drive some of the trends presented in this report.

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## PREAMBLE

### WHAT'S NEW IN THE 2012/2013 REPORT

- Tables and figures have been simplified by removing the ATC codes and "importance to human medicine" classifications from all three data sets. Results are presented at the national and provincial (or region) levels for all drugs, as well as at the individual drug level.
- Due to small numbers of observations at the individual province level, provincial data were summarized into regions for the physician diagnosis dataset. Data are now presented for Western Canada (British Columbia, Alberta, Saskatchewan, and Manitoba), Central Canada (Ontario and Québec), and Eastern Canada (New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador).
- Updated classification of physician diagnoses has been implemented to provide better granularity on the diseases where antimicrobial recommendations were provided.
- Non-oral drug data have been included for the pharmacy dataset. For 2010-2013, data now include oral and parenteral antimicrobial drugs. As in previous reports, data for 2000 – 2009 detail oral products only.
- Age breakdowns were added for the pharmacy dataset in order to view prescribing differences among groups. These data were available for 2010-2013, and replace the comparisons between prescriptions for liquid and tablet preparations. As the definition of a defined daily dose refers to the mass of active ingredient used per day for treatment in an adult, this measure is not used for children  $\leq 17$  years of age, when data are broken down by age groups. Instead, prescription rates are reported for these age groups. However, when overall data are presented (without age breakdowns), defined daily doses are calculated, and data for prescribing to children are included in these overall measurements (as in previous years.)
- Updates to the census estimates and extensive data cleaning performed for the 2012/2013 report resulted in slight changes from measures displayed in previous reports. This cleaning affected all years of data. Therefore, it is suggested that the 2012/2013 values override those presented in previous reports.

## IMPORTANT NOTES

### ABBREVIATIONS OF 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
West	BC, AB, SK, and MB
Central	ON and QC
East	NB, NS, PEI, and NL

### GENERAL ABBREVIATIONS

ATC	Anatomic Therapeutic Classification (ATC)
DDDs	Defined daily doses
DID	Total number of DDDs per 1,000 inhabitants per day (inhabitant-days)
NR	Not recommended
Rx	Prescription

## 1. 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 (specialists and general practitioners, including those with offices in hospitals). These data are presented over three geographic regions in Canada: West (British Columbia, Alberta, Saskatchewan, and Manitoba); Central (Québec and Ontario), and East (New Brunswick, Newfoundland and Labrador, Nova Scotia, and Prince Edward Island).

The sample of physicians represents all major specialties across Canada. Data from 652 physicians were available in 2013 and projection methods used to extrapolate data to the universe of approximately 55,092 physicians in Canada.

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. These data do not include patient visits to a primary care nurse. Furthermore, 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, the sample size may be considered too small for decision making. However, this information is included in this analysis to provide a view of antimicrobial recommendation practices which may require further studies.

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

## NATIONAL DIAGNOSIS DATA

In 2013, Canadian physicians saw patients for >293 million diagnoses, and provided more than 23.8 million antimicrobial recommendations for these diagnoses (Table 1.1). This reflects approximately 82,800 diagnoses per 10,000 Canadian inhabitants, with 8% of all diagnoses resulting with an antimicrobial recommendation.

### Antimicrobial recommendations by diagnostic class

In 2013, the diagnostic classes with the greatest number of antimicrobial recommendations / 10,000 inhabitants were upper respiratory tract infections (1,061 recommendations / 10,000 inhabitants), lower UTI or cystitis (924 recommendations / 10,000 inhabitants), and diseases of the ear (703 recommendations / 10,000 inhabitants). Although these three diagnostic classes had the greatest number of recommendations, they differ from the diagnostic classes with the highest proportion of recommendations per diagnoses. Pneumonia and acute sinusitis had antimicrobial recommendations for 84.5% and 83.5% of diagnoses, respectively. Acute bronchitis had a recommendation rate of 77.9% (Table 1.1). Similarly, these were also the diagnostic classes with the highest rate of antimicrobial recommendation in 2012 (Table 1.2 and Appendix Table B.1).

Over the 2007 – 2013 time frame, the diagnostic classes with the greatest change in recommendation rates were the upper UTI or pyelonephritis (12.5% reduction), pneumonia

(9.4% increase), chronic sinusitis (6.3% reduction), and acne (6.0% reduction) (Table 1.2) (Figure 1.1).

The particular antimicrobial drug recommended varied by the class of diagnosis made (Table 1.3). These data display that for particular diagnostic classes (e.g., diseases of the ear, upper respiratory tract infections) a single antimicrobial was recommended at a much higher rate than others. Conversely, diagnostic classes such as chronic sinusitis and acute bronchitis have no single "preferred" drug. No major changes were observed in the recommendation rates for the specific diagnosis-drug combinations with the exception of the use of levofloxacin for treating pneumonia. The recommendation rate of levofloxacin dropped from 25 recommendations / 10,000 inhabitants in 2011 to 9 recommendations / 10,000 inhabitants in 2012. In 2013, the rate was 28 recommendations / 10,000 inhabitants.



**Table 1.1: 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, 2013<sup>1</sup>.**

Diagnostic Class	Total diagnoses	Number of diagnoses / 10,000 inhabitants	Antimicrobial recommendations (N)	Number of antimicrobial recommendations / 10,000 individuals	Percentage of diagnoses with antimicrobial recommendations
Acne	2211530	623.97	452240	127.60	20.45
Acute bronchitis	2844550	802.57	2214510	624.81	77.85
Acute sinusitis	1644900	464.10	1373790	387.61	83.52
Chronic bronchitis	1114640	314.49	747200	210.82	67.04
Chronic sinusitis	1176910	332.06	608910	171.80	51.74
Disease of the gastrointestinal system	20372310	5747.93	1178850	327.74	5.79
Diseases of the ear	9686880	2733.10	2497020	702.96	25.78
Injuries and poisonings	13350560	3766.78	438040	123.59	3.28
Lower UTI or Cystitis	4755520	1341.74	3275220	924.08	68.87
Other diseases of the genitourinary system	14781490	4170.51	1467820	414.14	9.93
Other respiratory tract infections	16030240	4522.84	1190590	335.92	7.43
Other skin and soft tissue infections	16391170	4624.67	940590	212.56	5.74
Pneumonia	1258540	355.09	1062970	299.91	84.46
SSTIs	2815660	794.42	1816860	512.62	64.53
Symptoms and ill-defined conditions	21703010	6123.38	346580	92.58	1.60
Upper respiratory tract infections	11538380	3255.49	3760560	1061.02	32.59
<b>TOTAL</b>	<b>293468260</b>	<b>82800.35</b>	<b>23778840</b>	<b>6709.06</b>	<b>8.10</b>

Diagnostic classes were removed from this table if they represented < 1% of antimicrobial mentions in 2013. These classes were: complications of pregnancy, childbirth, and puerperium; congenital anomalies; diseases of the central nervous system; diseases of the circulatory system; diseases of the sense organs; endocrine, nutritional, metabolic, and immunity diseases; musculoskeletal diseases; neoplasms; perinatal conditions; supplementary classifications; and upper UTI or pyelonephritis.

<sup>1</sup> 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 1.2: Percent of diagnoses receiving antimicrobial recommendations provided by office-based physicians in Canada by diagnostic class, by year, 2007–2013<sup>1</sup>.**

Diagnostic Class	2007	2008	2009	2010	2011	2012	2013	Rank*
Acne	26.5	21.0	21.7	25.2	18.3	25.0	20.4	11
Acute bronchitis	78.9	77.3	80.9	85.1	82.1	77.0	77.9	4
Acute sinusitis	86.7	87.6	83.7	81.6	86.7	87.8	83.5	3
Chronic bronchitis	68.7	70.1	68.6	59.5	74.5	71.3	67.0	6
Chronic sinusitis	58.0	58.2	56.7	51.9	48.8	51.3	51.7	8
Complications of pregnancy, childbirth, and puerperal	1.0	2.1	4.5	4.1	4.9	4.1	5.1	16
Disease of the gastrointestinal system	4.6	4.8	5.1	5.3	5.0	5.9	5.7	15
Diseases of the ear	26.8	29.2	27.6	25.5	25.2	26.8	25.7	10
Lower UTI or Cystitis	73.5	73.3	76.0	69.3	68.3	67.3	68.9	5
Other diseases of the genitourinary system	6.4	6.9	6.6	10.3	9.8	9.7	9.9	12
Other respiratory tract infections	8.4	8.5	7.2	8.6	7.1	6.6	7.4	13
Other skin and soft tissue infections	2.7	3.1	2.9	4.4	3.7	4.1	4.6	17
Perinatal conditions	2.4	6.3	4.0	7.4	3.9	2.4	5.8	14
Pneumonia	75.0	80.9	77.3	84.8	76.6	82.1	84.5	2
SSTIs	58.6	59.9	64.9	62.1	60.6	65.2	64.5	7
Upper respiratory tract infections	35.1	32.1	31.2	31.5	33.3	32.8	32.6	9
Upper UTI or Pyelonephritis	97.0	74.0	*	97.6	81.1	77.4	84.5	1

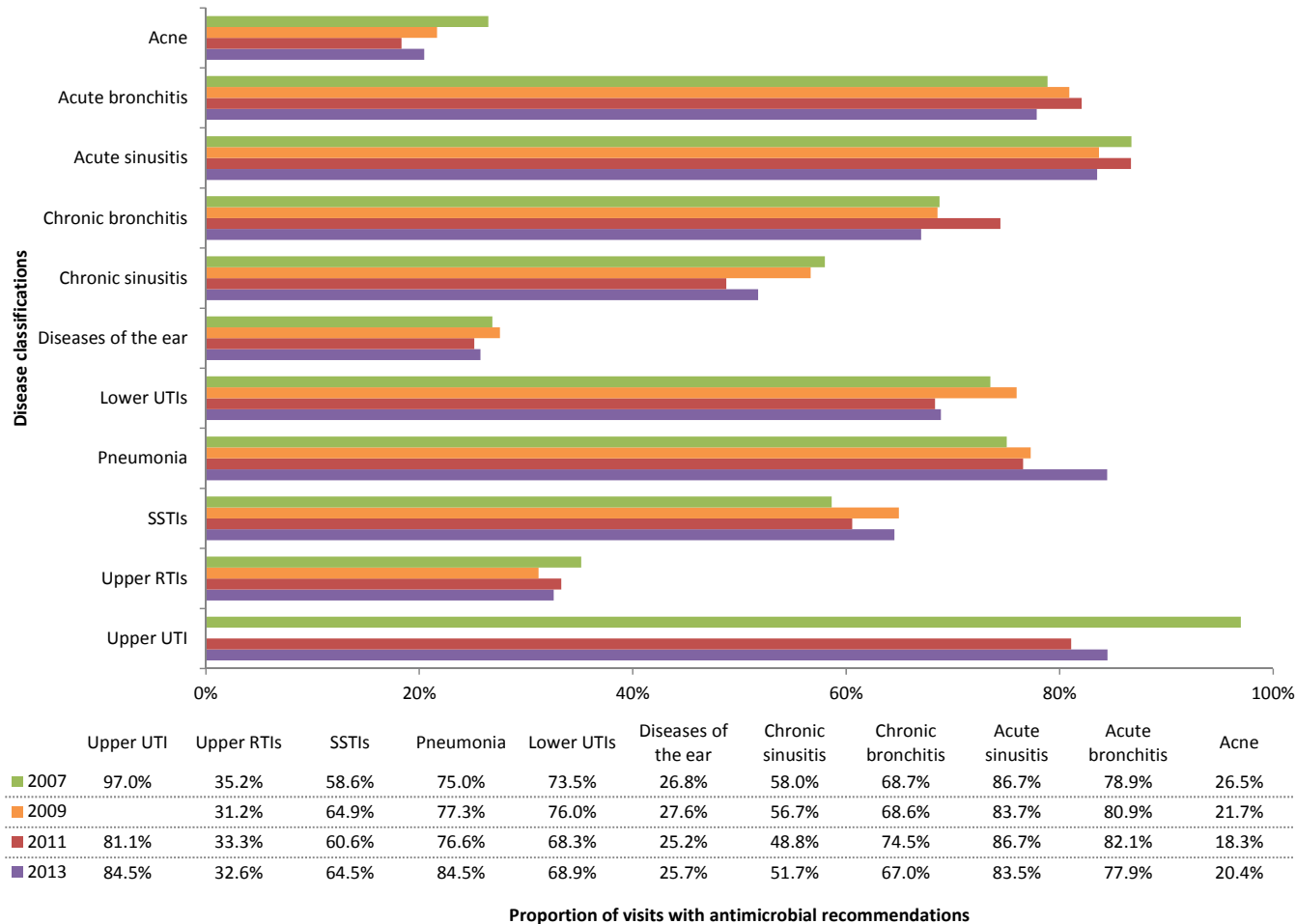
\*Data for Upper UTI or Pyelonephritis in 2009 were removed due to obvious data recording errors

Diagnostic classes were removed from this table if < 5% of visits resulted in an antimicrobial recommendation. These classes were: congenital anomalies; diseases of the central nervous system; diseases of the circulatory system; diseases of the sense organs; endocrine, nutritional, metabolic, and immunity diseases; injuries and poisonings; mental disorders; musculoskeletal diseases; neoplasms; supplementary classifications; and symptoms and ill-defined conditions.

Ranked from highest rate of recommendation to lowest rate in 2013.

<sup>1</sup> 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.

**Figure 1.1. Percent of diagnoses that received an antimicrobial recommendation by office-based physicians in Canada, 2007, 2009, 2011 and 2013<sup>1</sup>.**



\*Data for Upper UTI or Pyelonephritis in 2009 were removed due to obvious data recording errors  
 Classifications were removed from this figure if antimicrobial recommendation occurred in < 5% of visits in 2013. These classifications were: complications of pregnancy, childbirth, and puerperium; congenital anomalies; diseases of the gastrointestinal system; diseases of the central nervous system; diseases of the circulatory system; diseases of the sense organs; endocrine, nutritional, metabolic, and immunity diseases; injuries and poisonings; mental disorders; musculoskeletal diseases; neoplasms; other diseases of the genitourinary system; other respiratory tract infections; other skin and soft tissue infections; perinatal conditions; supplementary classifications; and symptoms and ill-defined conditions

<sup>1</sup> 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 1.3: Number of antimicrobial recommendations by office-based physicians in Canada, by diagnostic class, antimicrobial and year (2007 – 2013)<sup>1</sup>**

Diagnostic Class	Antimicrobial recommended	Number of antimicrobial recommendations / 10,000 inhabitants						
		2007	2008	2009	2010	2011	2012	2013
Acute bronchitis	Amoxicillin	262	249	266	267	277	194	211
	Amoxicillin and enzyme inhibitor	124	124	96	121	139	155	160
	Ampicillin	114	132	102	92	94	87	134
	Azithromycin	69	85	65	72	69	60	52
	Cefaclor	18	17	19	16	17	8	15
	Other antimicrobials	102	71	79	68	58	57	53
	<b>TOTAL</b>	<b>688</b>	<b>679</b>	<b>628</b>	<b>637</b>	<b>653</b>	<b>560</b>	<b>625</b>
Acute sinusitis	Amoxicillin	104	110	110	106	124	120	154
	Clarithromycin	147	175	159	155	137	111	76
	Amoxicillin and enzyme inhibitor	30	34	35	24	42	25	35
	Moxifloxacin	54	45	47	50	49	54	32
	Azithromycin	48	50	38	25	34	40	29
	Other antimicrobials	133	102	122	90	90	59	61
	<b>TOTAL</b>	<b>517</b>	<b>516</b>	<b>511</b>	<b>450</b>	<b>477</b>	<b>407</b>	<b>388</b>
Chronic bronchitis	Clarithromycin	81	83	85	63	70	55	68
	Azithromycin	84	90	60	65	45	56	42
	Amoxicillin	66	64	44	33	31	58	42
	Moxifloxacin	37	39	30	29	42	33	25
	Amoxicillin and enzyme inhibitor	5	8	6	6	7	8	13
	Other antimicrobials	36	52	55	16	42	30	21
	<b>TOTAL</b>	<b>309</b>	<b>336</b>	<b>279</b>	<b>212</b>	<b>237</b>	<b>239</b>	<b>211</b>
Chronic sinusitis	Amoxicillin	51	46	75	51	56	62	44
	Clarithromycin	63	69	72	56	61	44	42
	Azithromycin	46	32	16	19	14	20	22
	Moxifloxacin	30	36	26	10	26	13	19
	Amoxicillin and enzyme inhibitor	31	29	39	19	15	24	19
	Other antimicrobials	45	33	53	38	21	29	26
	<b>TOTAL</b>	<b>266</b>	<b>245</b>	<b>279</b>	<b>192</b>	<b>194</b>	<b>193</b>	<b>172</b>
Diseases of the ear	Amoxicillin	303	390	380	373	362	386	431
	Cefprozil	76	81	60	56	66	71	66
	Clarithromycin	112	122	108	112	110	100	61
	Azithromycin	45	70	70	58	48	59	54
	Amoxicillin and enzyme inhibitor	51	41	33	39	31	44	35
	Other antimicrobials	97	84	84	48	44	31	56
	<b>TOTAL</b>	<b>685</b>	<b>789</b>	<b>736</b>	<b>685</b>	<b>661</b>	<b>692</b>	<b>703</b>

<sup>1</sup> 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 1.3 continued: Antimicrobial recommendation rate by office-based physicians in Canada, by diagnostic class, antimicrobial and year (2007 – 2013)<sup>1</sup>**

Diagnostic Class	Antimicrobial recommended	Number of antimicrobial recommendations / 10,000 inhabitants						
		2007	2008	2009	2010	2011	2012	2013
Lower UTI or Cystitis	Ciprofloxacin	467	460	471	454	437	465	426
	Nitrofurantoin	276	280	287	317	294	321	339
	Amoxicillin	34	38	36	27	33	33	42
	Norfloxacin	67	52	76	36	25	20	41
	Cephalexin	17	11	14	10	19	10	16
	Other antimicrobials	228	210	185	100	66	56	61
	<b>TOTAL</b>	<b>1088</b>	<b>1051</b>	<b>1070</b>	<b>943</b>	<b>874</b>	<b>906</b>	<b>924</b>
Pneumonia	Clarithromycin	113	96	97	115	102	106	93
	Azithromycin	31	59	19	34	31	38	52
	Moxifloxacin	72	72	77	86	87	90	47
	Levofloxacin	25	37	25	13	25	9	28
	Amoxicillin	11	15	23	28	35	34	23
	Other antimicrobials	62	82	76	72	51	62	56
	<b>TOTAL</b>	<b>314</b>	<b>361</b>	<b>317</b>	<b>349</b>	<b>331</b>	<b>338</b>	<b>300</b>
Skin and soft tissue infections	Cephalexin	202	200	205	172	230	200	197
	Cloxacillin	73	91	69	79	59	64	59
	Amoxicillin	26	33	33	50	35	44	50
	Cefadroxil	13	31	33	15	18	36	49
	Clindamycin	26	19	39	46	26	23	38
	Other antimicrobials	168	151	178	158	142	141	121
	<b>TOTAL</b>	<b>508</b>	<b>525</b>	<b>557</b>	<b>519</b>	<b>510</b>	<b>508</b>	<b>513</b>
Upper UTI or Pyelonephritis	Ciprofloxacin	11	12	18	8	11	15	15
	Ceftriaxone	3	3	NR	5	6	4	2
	Amoxicillin	NR	NR	3	NR	NR	1	2
	Nitrofurantoin	NR	NR	NR	<1	NR	NR	2
	Ertapenem	NR	NR	NR	NR	NR	NR	1
	Other antimicrobials	9	2	9	10	3	6	NR
	<b>TOTAL</b>	<b>23</b>	<b>18</b>	<b>30</b>	<b>23</b>	<b>20</b>	<b>26</b>	<b>20</b>
Upper respiratory tract infections	Amoxicillin	596	523	567	520	560	494	537
	Clarithromycin	198	157	175	156	132	119	167
	Azithromycin	144	153	129	114	145	151	120
	Penicillin V	181	168	141	145	127	130	118
	Amoxicillin and enzyme inhibitor	15	29	32	19	28	25	36
	Other antimicrobials	188	154	137	111	137	127	83
	<b>TOTAL</b>	<b>1322</b>	<b>1186</b>	<b>1181</b>	<b>1066</b>	<b>1129</b>	<b>1046</b>	<b>1061</b>

<sup>1</sup> 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.

## Recommendations by age group and gender

The rate of antimicrobial recommendation varied in 2013 by the age and sex of the patient (Table 1.4). Although the number of diagnoses per 10,000 inhabitants was highest in the 65+ age group, this group was the least likely to receive an antimicrobial recommendation. Children aged 0-2 had the highest raw number of recommendations / 10,000 inhabitants, but children aged 3-9 had the highest percentage of diagnoses resulting in an antimicrobial recommendation.

Generally, children had a higher rate of antimicrobial recommendation than adults in 2013, and female patients were more likely to receive an antimicrobial recommendation than male patients (Table 1.4).

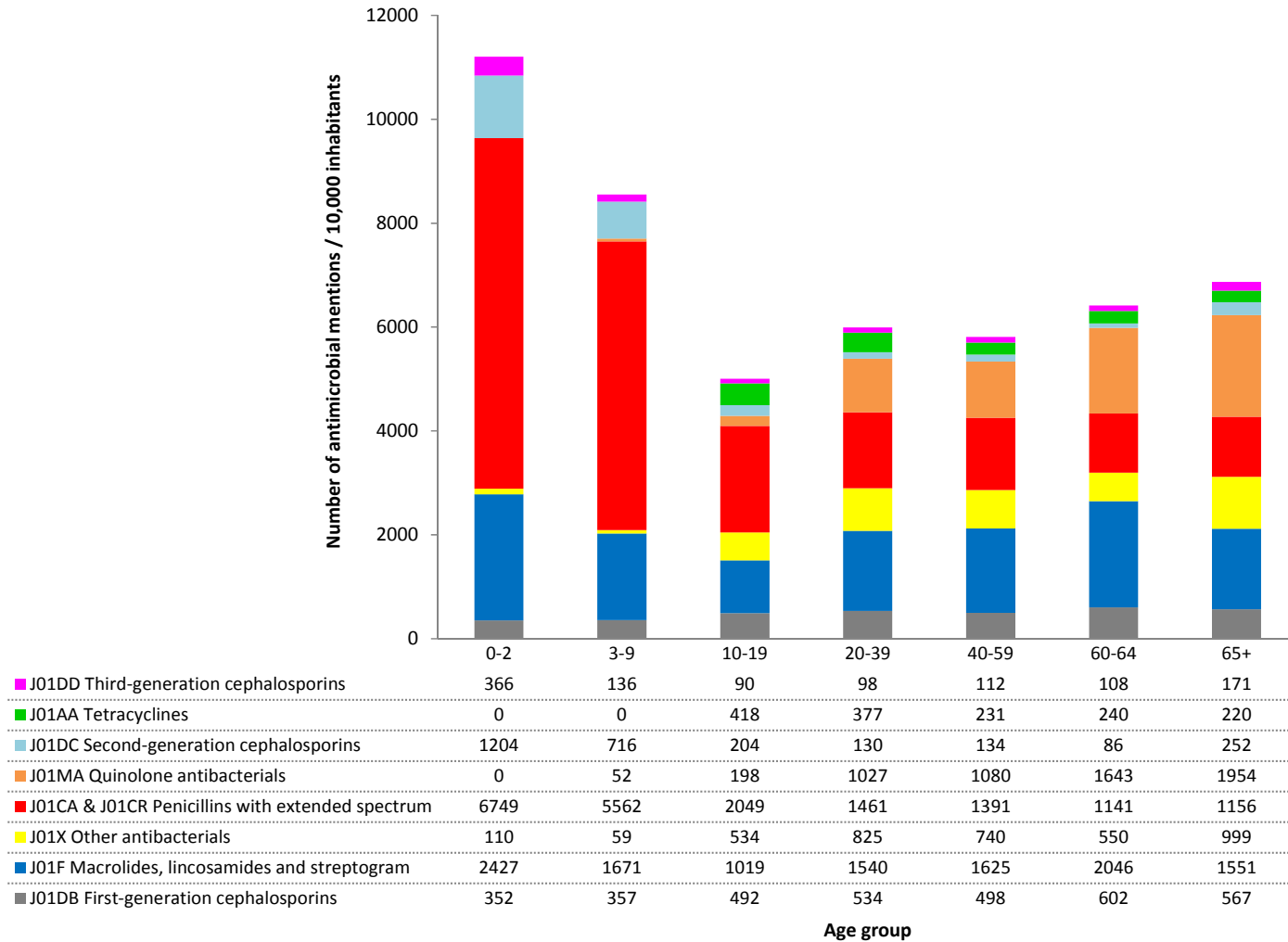
The class of antimicrobial recommended also varied in 2013 by the age of the patient (Figure 1.2). Children (i.e., age groups 0-2, 3-9) were more likely to receive a recommendation for penicillins or second generation cephalosporins than adults, while adults were more likely to receive quinolone or tetracycline recommendations than children. Recommendations for first generation cephalosporins were relatively similar among the age groups.

**Table 1.4: Diagnosis rate, antimicrobial recommendation rate and percentage of diagnosis with antimicrobial recommendation provided by office-based physicians in Canada, by age and by gender, 2013<sup>1</sup>**

Demographic (age or sex)	Number of diagnoses / 10,000 inhabitants	Number of antimicrobial recommendations / 10,000 individuals	Percentage of diagnoses with antimicrobial recommendations
<b>Age group</b>			
0-2	113737.24	12344.61	10.13
3-9	56165.78	8644.25	15.39
10-19	49524.59	5569.25	11.20
20-39	66977.50	6413.98	9.57
40-59	92182.72	6091.54	6.59
60-64	134358.17	6640.77	4.94
65+	155558.50	7206.63	4.52
Unspecified	N/A	N/A	5.25
<b>Sex</b>			
Female	103374.19	8012.90	7.75
Male	80064.97	5348.99	6.68
Unspecified	N/A	N/A	6.40

<sup>1</sup> 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.

**Figure 1.2. Total number of antimicrobial recommendations / 10,000 inhabitants provided by office-based physicians in Canada, by age and antimicrobial classification, 2013<sup>12</sup>.**



<sup>1</sup> 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.

<sup>2</sup> Antimicrobial classifications are displayed in Appendix C, Table C.1



## Recommendations by region

In 2013, the diagnosis rate, antimicrobial recommendation rate and percentage of diagnoses with antimicrobial recommendations varied by region in Canada (Table 1.5). The Eastern region had a higher number of diagnostic classes for which a higher rate of diagnosis and antimicrobial recommendations were provided. However, the Central region had more diagnostic classes with higher percentage of diagnoses with antimicrobial recommendations compared to the other two Canadian regions.

The “preferred” antimicrobial drug recommended for treating the different diagnoses seemed consistent across the regions, with the exception of three diagnoses: acute bronchitis, chronic bronchitis and chronic sinusitis (Table 1.6). Although the West and Central regions primarily recommended the same drug for the treatment of both acute bronchitis (clarithromycin) and chronic sinusitis (amoxicillin), the East region recommended a different drug for these two diagnoses (azithromycin and clarithromycin, respectively). These data display that for particular diagnostic classes (e.g. chronic sinusitis, upper respiratory tract infections, pneumonia and SSTIs) a single antimicrobial is recommended at a much higher rate than others.

**Table 1.5. Diagnosis rate, antimicrobial recommendation rate and percentage of diagnoses with antimicrobial recommendations provided by office-based physicians in Canada, by diagnostic class and region, 2013<sup>1</sup>.**

Diagnostic Class	Region	Number of antimicrobial recommendations / 10,000 individuals	Number of diagnoses / 10,000 inhabitants	Percentage of diagnoses with antimicrobial recommendations
Acne	Central	141	670	21
	East	148	771	19
	West	97	500	19
Acute bronchitis	Central	691	916	75
	East	271	355	76
	West	570	675	84
Acute sinusitis	Central	444	503	88
	East	472	557	85
	West	258	366	71
Chronic bronchitis	Central	198	288	69
	East	323	559	58
	West	212	314	68
Chronic sinusitis	Central	157	282	56
	East	311	583	53
	West	170	377	45
Disease of the gastrointestinal system	Central	326	5389	6
	East	437	8929	5
	West	307	5768	5
Diseases of the ear	Central	810	2761	29
	East	578	4741	12
	West	519	2243	23
Injuries and poisonings	Central	113	3364	3
	East	117	2368	5
	West	147	4866	3
Lower UTI or Cystitis	Central	908	1262	72
	East	885	1459	61
	West	964	1475	65
Other diseases of the genitourinary system	Central	402	4097	10
	East	490	4601	11
	West	422	4223	10
Other respiratory tract infections	Central	284	4579	6
	East	624	5099	12
	West	375	4287	9
Other skin and soft tissue infections	Central	185	4460	4
	East	460	5118	9
	West	213	4844	4
Pneumonia	Central	355	395	90
	East	306	436	70
	West	191	259	74
SSTIs	Central	445	717	62
	East	460	687	67
	West	658	970	68
Upper respiratory tract infections	Central	999	3337	30
	East	1615	3576	45
	West	1064	3025	35

<sup>1</sup> 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 1.6 Antimicrobial recommendation rate provided by office-based physicians in Canada, by diagnostic class, antimicrobial and region, 2013<sup>1</sup>.**

Diagnostic Class	Antimicrobial Recommended	Number of antimicrobial recommendations / 10,000 inhabitants		
		West	Central	East
Acute bronchitis	Amoxicillin	107	155	59
	Clarithromycin	198	238	24
	Azithromycin	186	152	116
	Moxifloxacin	24	69	24
	Cefixime	5	3	48
	Other antimicrobials	49	75	0
	<b>Total</b>	<b>570</b>	<b>691</b>	<b>271</b>
Acute sinusitis	Amoxicillin	114	178	117
	Clarithromycin	42	97	47
	Amoxicillin and enzyme inhibitor	5	43	95
	Cefuroxime	5	26	94
	Azithromycin	31	26	48
	Other antimicrobials	62	74	70
	<b>Total</b>	<b>258</b>	<b>444</b>	<b>472</b>
Chronic bronchitis	Amoxicillin	36	48	12
	Clarithromycin	104	36	189
	Azithromycin	10	55	70
	Moxifloxacin	15	32	NR
	Cefuroxime	10	3	23
	Other antimicrobials	36	23	29
	<b>Total</b>	<b>212</b>	<b>198</b>	<b>323</b>
Chronic sinusitis	Clarithromycin	49	27	143
	Amoxicillin	51	41	36
	Amoxicillin and enzyme inhibitor	26	10	62
	Azithromycin	31	17	23
	Cefuroxime	5	14	24
	Other antimicrobials	8	47	23
	<b>Total</b>	<b>170</b>	<b>157</b>	<b>311</b>
Diseases of the ear	Amoxicillin	341	491	294
	Cefprozil	8	90	119
	Clarithromycin	57	67	23
	Azithromycin	34	65	47
	Amoxicillin and enzyme inhibitor	28	38	36
	Other antimicrobials	50	58	59
	<b>Total</b>	<b>519</b>	<b>810</b>	<b>578</b>
Lower UTI or Cystitis	Amoxicillin	26	52	24
	Ciprofloxacin	446	409	483
	Nitrofurantoin	340	340	319
	Norfloxacin	23	51	36
	Cephalexin	31	11	NR
	Other antimicrobials	99	46	23
	<b>Total</b>	<b>964</b>	<b>908</b>	<b>885</b>
Pneumonia	Clarithromycin	72	96	166
	Azithromycin	21	68	47
	Moxifloxacin	26	61	23
	Levofloxacin	22	32	23
	Amoxicillin	23	26	NR
	Other antimicrobials	27	72	46
	<b>Total</b>	<b>191</b>	<b>355</b>	<b>306</b>
SSTIs	Cephalexin	349	117	223
	Amoxicillin	59	43	67
	Clindamycin	77	17	47
	Cloxacillin	48	69	12
	Clarithromycin	28	24	43
	Other antimicrobials	97	174	69
	<b>Total</b>	<b>658</b>	<b>445</b>	<b>460</b>
Upper UTI or Pyelonephritis	Ciprofloxacin	16	16	NR
	Ceftriaxone	5	NR	NR
	Nitrofurantoin	5	NR	NR
	Amoxicillin	NR	3	NR
	Ertapenem	NR	1	NR
	<b>Total</b>	<b>26</b>	<b>20</b>	<b>0</b>
Upper respiratory tract infections	Amoxicillin	554	481	961
	Azithromycin	72	131	238
	Clarithromycin	238	133	153
	Penicillin V	43	161	72
	Amoxicillin and enzyme inhibitor	47	29	48
	Other antimicrobials	109	63	142
	<b>Total</b>	<b>1064</b>	<b>999</b>	<b>1615</b>

<sup>1</sup> 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.

## 2. PHARMACY DISPENSATION DATA

The Canadian CompuScript (CCS) dataset tracks the number and size of prescriptions dispensed by retail pharmacies in Canada. In 2013, 5,692 pharmacies provided information which was used to project the total number and size of prescriptions dispensed by all 9,140 pharmacies across Canadian provinces. 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, age or age groups, number of prescriptions, units of product in prescription, and dollars spent monthly for each year.

For the 2012/2013 report, antimicrobials for parenteral administration were added for the years 2010, 2011, 2012, and 2013. These data were not available to be added for 2000 – 2009. As such, when comparing data from 2010 – 2013 to previous years, it should be assumed that the data from 2000 – 2009 are a slight under-representation of the total volume dispensed. Therefore, any reductions seen in comparison to data from 2000 - 2009 are expected to be smaller than the actual state, and conversely, increases are expected to be slightly inflated.

## NATIONAL UTILIZATION

### Overall measures of use

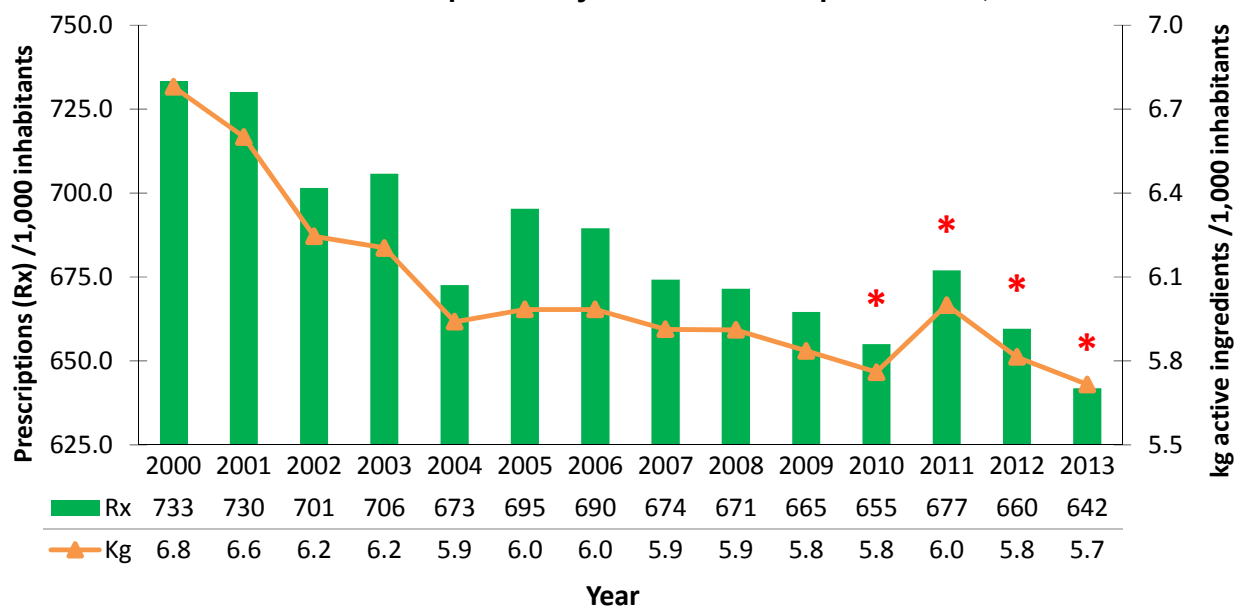
Overall use of antimicrobials in Canada has declined over 2000 – 2013, though a decline was not consistent year over year throughout this time frame. Use by all measures has been declining consistently since 2011 by small amounts (<5% year to year).

#### a. Prescription rates and kilograms of active ingredients

In 2013, the antimicrobial prescription dispensing rate was the lowest it has been since initiation of antimicrobial use surveillance in Canada (642 prescriptions / 1,000 inhabitants). From 2012 to 2013, the prescription rate dropped by 18 prescriptions / 1,000 inhabitants. Over the two year period from 2011 to 2013, the prescribing rate dropped by 35 prescriptions / 1,000 inhabitants (approximately 5.2%) (Figure 2.1).

The mass of active ingredient dispensed was also at its lowest value since the initiation of antimicrobial use surveillance in Canada, with 5.7kg dispensed / 1,000 inhabitants in 2013. There was a decline of 100g / 1,000 inhabitants between 2012 and 2013, and a 200g / 1,000 inhabitants decline from 2011 to 2012 (Figure 2.1 and Appendix C, Table C.2).

**Figure 2.1: Number of prescriptions and kilograms of active ingredient per 1,000 inhabitants of antimicrobials dispensed by Canadian retail pharmacies, 2000 – 2013.**



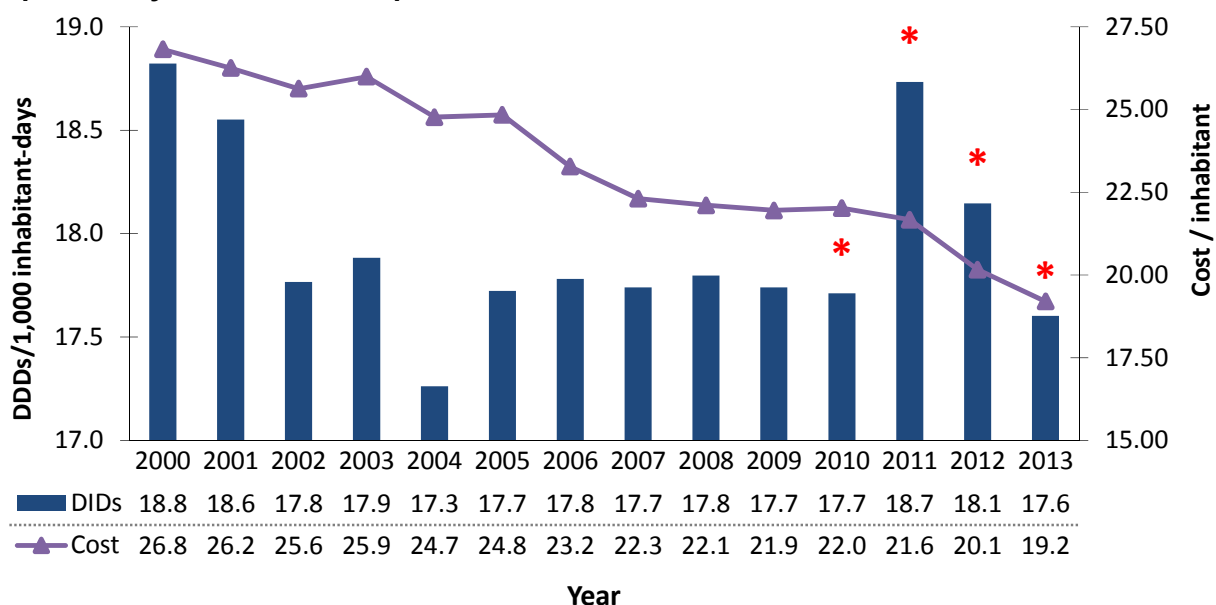
\*Data from 2000 – 2009 include only oral products, 2010 – 2013 data include oral and parenteral drugs

### b. Defined daily doses per 1,000 inhabitant-days (DIDs) and cost per inhabitant

A reduction in the DIDs also occurred over this time frame. In 2013, 17.6 DIDs were dispensed, which was a 2.8% reduction from the 18.1 DIDs dispensed in 2012. Similarly, a 3.2% decline in DIDs was seen from 2011 to 2012 (18.7 to 18.1 DIDs). These reductions return the DID values to those seen in 2010 (Figure 2.2).

Finally, the cost of antimicrobial prescribing in Canada has also been declining. After accounting for the effects of inflation, approximately \$19.20 was spent per inhabitant in Canada in 2013, \$0.90 less than in 2012 (\$20.10), and \$2.40 less than in 2011 (Figure 2.2).

**Figure 2.2: Number of defined daily doses and cost<sup>1</sup> per inhabitant of antimicrobials dispensed by Canadian retail pharmacies, 2000 – 2013.**



\*Data from 2000 – 2009 include only oral products, 2010 – 2013 data include oral and parenteral drugs

<sup>1</sup> Adjusted for inflation, using Bank of Canada reference values: <http://www.bankofcanada.ca/rates/related/inflation-calculator/> Accessed July 2014.

## Use by age groups

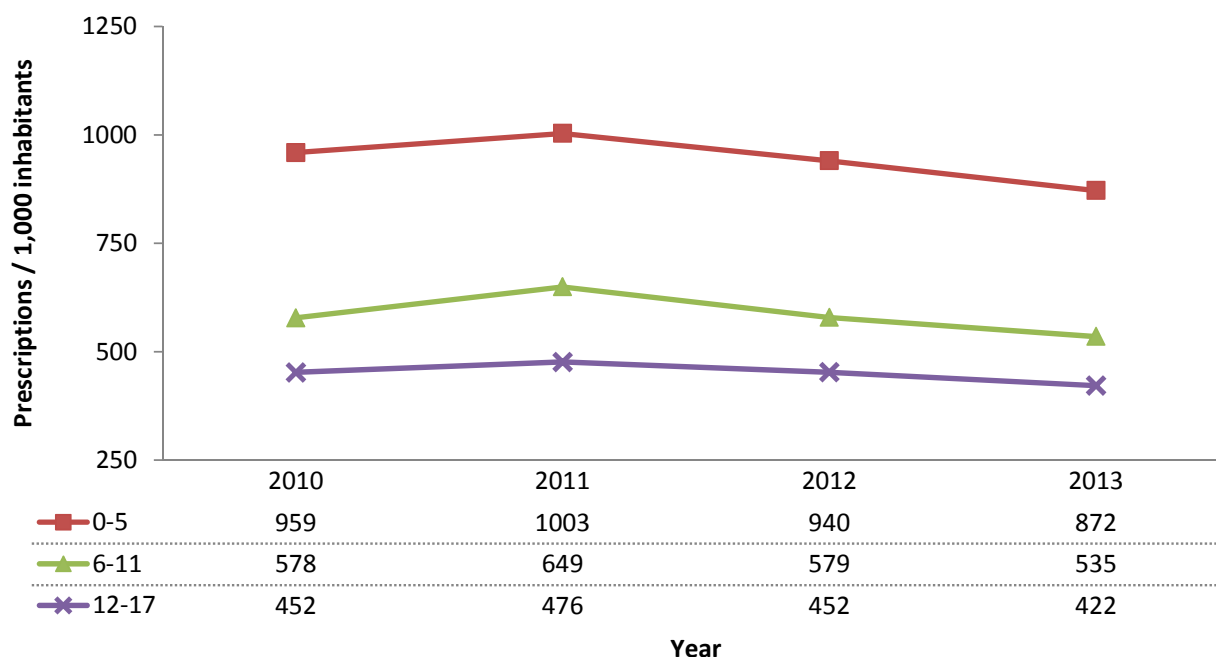
Generally, antimicrobial use was highest among the youngest (0-5) and oldest (65+) age groups in the Canadian population from 2010 – 2013 (Figures 2.3 & 2.4). Use among the groups including 6-39 year olds was slightly below the national measures in 2013, while use in the remaining age groups was above national measures.

### a. Children and young adults ( $\leq 17$ years old)

The trend in prescribing was similar among the three age groups from 2010 – 2013, with an increase from 2010 to 2011, and a decline from 2011 to 2013 (Figure 2.3). Over the time frame, children 0-5 had the greatest prescription rate, followed by the 6-11 age group. Interestingly, the increase from 2010 to 2011 was most dramatic for the 6-11 age group (71 prescriptions / 1,000 inhabitant increase), while the greatest overall reduction 2010 – 2013 occurred for the 0-5 age group (131 prescriptions / 1,000 inhabitant reduction) (Figure 2.3). The least variation over time occurred in the 12-17 age group.

In 2013, children 0-5 received 230 prescriptions / 1,000 inhabitants more than the general population (872 compared to 642 prescriptions / 1,000 inhabitants) (Figure 2.3). In contrast, the prescription rate for children 6-11 was 107 prescriptions / 1,000 inhabitants lower than the overall rate in 2013 (535 compared to 642 prescriptions / 1,000 inhabitants). Even more dramatically, the prescription rate for the 12-17 age group was 220 prescriptions / 1,000 inhabitants lower than the overall rate.

**Figure 2.3: Prescriptions per 1,000 inhabitant-days for oral and parenteral antimicrobials used in Canada 2010 – 2013, by age group.**





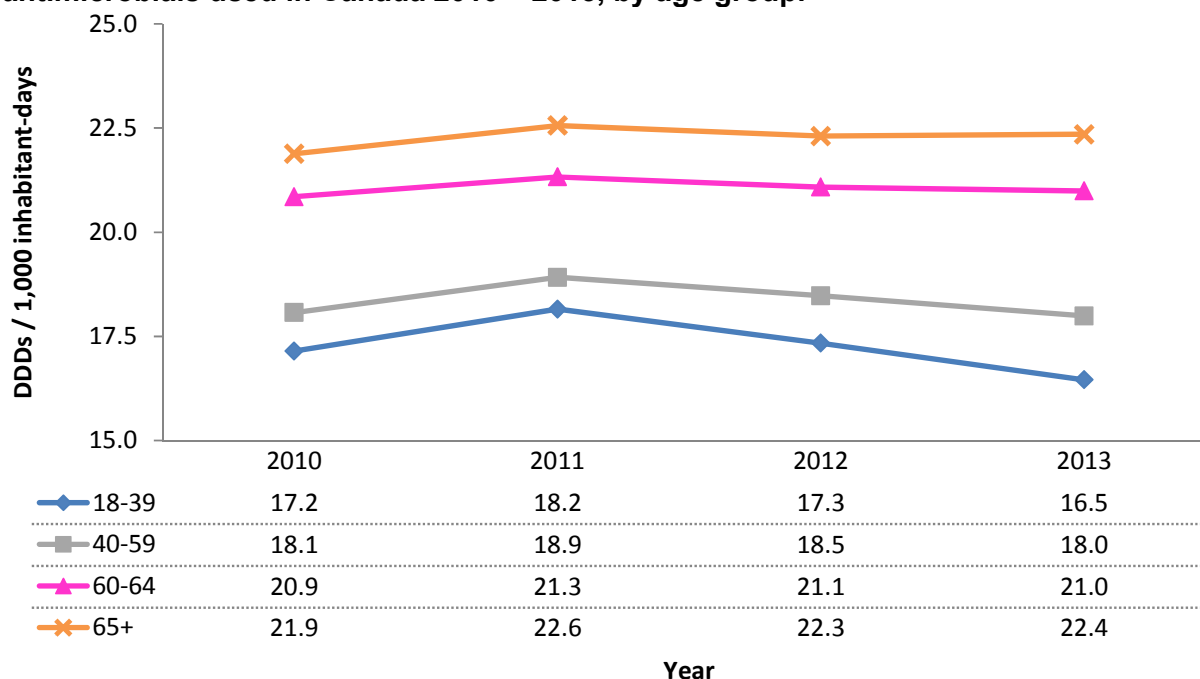
### b. Adults (≥ 18 years old)

In contrast with the decreasing antimicrobial use with increasing age in children and young adults, antimicrobial use increased in Canada from 2010 - 2013 as the age groups increased (Figure 2.4). Defined daily doses per 1,000 inhabitant-days were highest for the 60+ age group over the entire time frame, followed by the 60-64, 40-49, and finally, 18-39 age groups.

The pattern of use from 2010 – 2013 for the 18-39 and 40-59 age groups was similar to the prescribing rates seen in the children and young adult data, with an increase from 2010 – 2011 and subsequent decline. Interestingly, this pattern was not seen for the 60-64 or 65+ age groups. In these groups, an increase from 2010 – 2011 was apparent, followed by a slight decline from 2011 – 2012, and a relative stabilization from 2012 – 2013.

In comparison to the national DID measure in 2013 (17.6 DIDs), the 65+ and 60-64 age groups were 4.8 and 3.4 DIDs greater, respectively (22.4 and 21.0, respectively). The DIDs for the 40-59 age group were slightly higher than the overall measure in 2013 (18.0 DIDs), while the DIDs for the 18-39 age group were slightly lower (16.5 DIDs).

**Figure 2.4: Defined daily doses per 1,000 inhabitant-days for oral and parenteral antimicrobials used in Canada 2010 – 2013, by age group.**

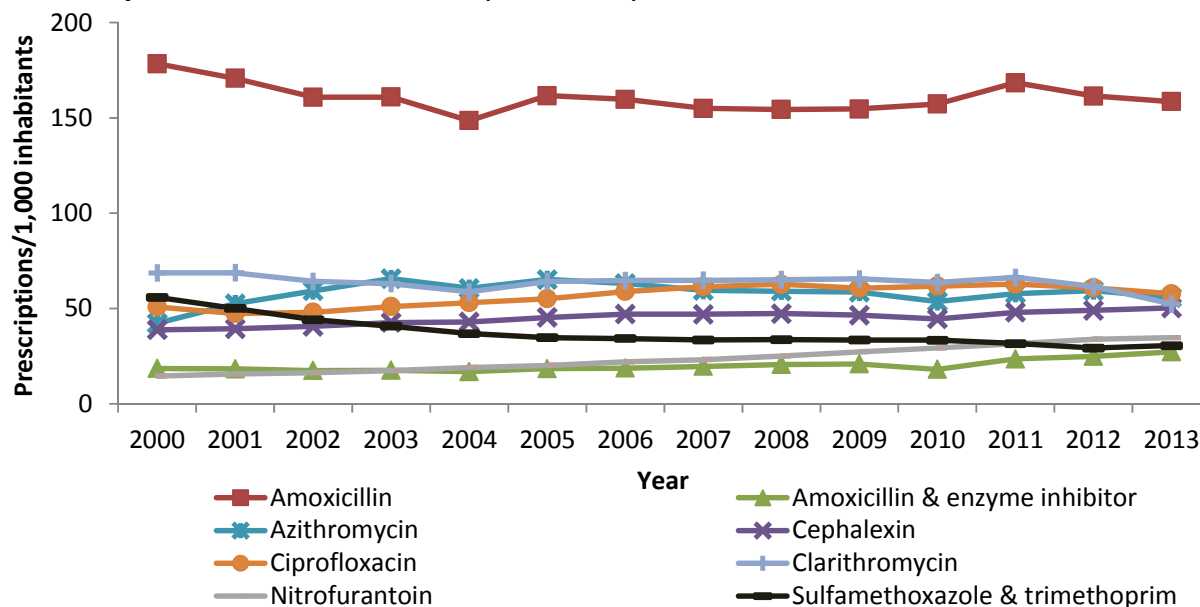


## Use at the individual drug level

### a. Prescriptions per 1,000 inhabitants

The most commonly prescribed antimicrobials in 2013 were amoxicillin (158.6 prescriptions / 1,000 inhabitants), ciprofloxacin (50.3 prescriptions / 1,000 inhabitants), and azithromycin (55.6 prescriptions / 1,000 inhabitants) (Table 2.1, Figure 2.5).

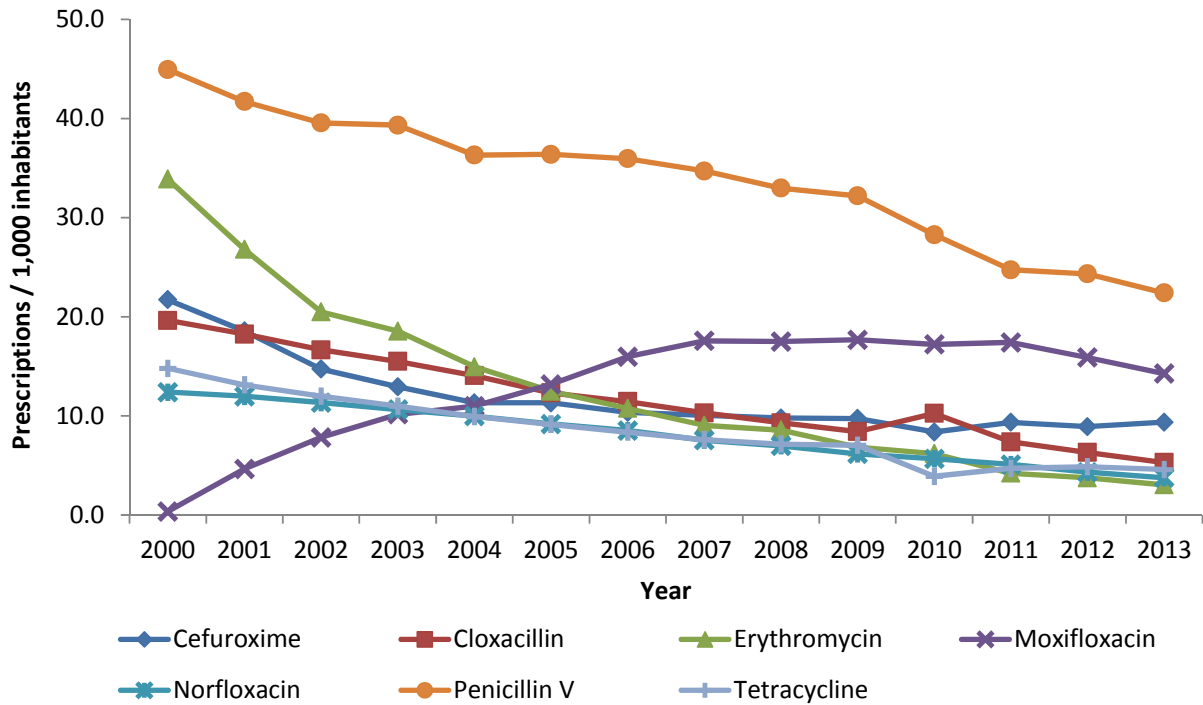
**Figure 2.5: Prescriptions per 1,000 inhabitants for the eight most frequently dispensed antimicrobials in 2013 by retail pharmacies in Canada; oral antimicrobials (2000-2009), oral and parenteral antimicrobials (2010-2013)**



The greatest reductions in prescribing over the 2000 to 2013 time frame occurred for erythromycin (26.2 prescriptions / 1,000 inhabitants), sulfamethoxazole and trimethoprim (25.4 prescriptions / 1,000 inhabitants) and penicillin V (22.5 prescriptions / 1,000 inhabitants) (Table 2.1, Figures 2.5 & 2.6). In contrast, the greatest increases in prescribing over this time frame occurred for nitrofurantoin (20.1 prescriptions / 1,000 inhabitants), moxifloxacin (13.9 prescriptions / 1,000 inhabitants), and azithromycin (13.5 prescriptions / 1,000 inhabitants) (Table 2.1, Figures 2.5 & 2.6).

It should be noted that the largest reductions far outweigh the increases seen during the 2000 to 2013 time frame. Furthermore, increases in the use of some products might be seen as favourable, if these increases reflect attention to prudent use guidelines (e.g., nitrofurantoin for acute uncomplicated cystitis). However, these data are not sufficient to assess the suitability of chosen courses of treatment.

**Figure 2.6: Patterns in prescribing rates (prescriptions per 1,000 inhabitants) from 2000 – 2013 for antimicrobials with the greatest absolute difference in rates from 2000 to 2013\***



\*Excludes antimicrobials previously displayed in Figure 2.5 (amoxicillin, azithromycin, nitrofurantoin, clarithromycin, sulfamethoxazole and trimethoprim), and antimicrobials representing <0.05% of prescribing in 2013.

**Table 2.1: Prescriptions per 1,000 inhabitants of antimicrobials dispensed by retail pharmacies in Canada; oral antimicrobials (2000-2009), oral and parenteral antimicrobials (2010-2013)**

Antimicrobial	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Rank*
Amoxicillin	178.49	170.79	160.87	160.92	148.61	161.62	159.77	155.01	154.48	154.72	157.34	168.47	161.47	158.60	1
Amoxicillin and enzyme inhibitor	18.52	18.27	17.41	17.56	16.85	18.40	18.67	19.58	20.56	20.87	18.01	23.53	24.82	27.19	8
Ampicillin	3.26	2.75	2.20	1.97	1.67	1.34	1.15	0.97	0.86	0.80	0.76	0.68	0.63	0.55	26
Azithromycin	42.16	52.46	59.20	65.67	60.54	65.16	63.07	59.43	59.07	58.52	53.61	57.77	59.33	55.66	3
Cefadroxil	1.93	2.05	2.18	2.34	2.36	2.39	2.68	2.79	2.93	3.02	2.63	2.29	3.05	3.32	22
Cefazolin											0.31	0.30	0.27	0.45	27
Cefixime	5.62	5.24	4.80	4.20	3.65	3.69	3.64	3.96	4.24	4.40	5.23	5.68	5.90	6.30	18
Cefprozil	14.48	16.34	18.37	21.04	22.80	23.49	22.62	19.91	18.97	18.60	17.73	17.81	15.07	13.33	15
Ceftriaxone											0.17	0.20	0.26	0.41	29
Cefuroxime	21.72	18.57	14.72	12.93	11.31	11.32	10.35	10.05	9.77	9.73	8.37	9.35	8.91	9.36	16
Cephalexin	38.79	39.33	40.58	42.56	42.94	45.31	47.00	46.92	47.30	46.46	44.46	47.99	48.99	50.26	5
Ciprofloxacin	50.85	47.34	47.98	50.98	53.04	55.14	58.93	61.47	62.63	60.63	61.73	62.82	60.84	57.74	2
Clarithromycin	68.67	68.69	64.25	63.01	58.65	64.12	64.73	64.76	65.08	65.50	63.55	66.28	61.52	52.37	4
Clindamycin	15.80	16.62	17.50	18.34	18.70	19.46	21.10	21.84	22.13	21.63	23.33	22.96	22.50	22.38	10
Cloxacillin	19.63	18.24	16.66	15.50	14.06	12.32	11.45	10.29	9.31	8.41	10.24	7.39	6.32	5.29	19
Doxycycline	11.70	10.92	10.09	10.00	9.48	9.93	10.54	11.37	12.04	12.36	14.35	15.64	16.49	18.40	12
Ertapenem											0.06	0.09	0.13	0.42	28
Erythromycin	29.16	23.28	18.60	16.94	13.72	11.41	9.92	8.50	7.30	6.42	5.74	4.04	3.69	3.00	23
Levofloxacin	10.27	14.21	13.02	13.26	13.00	11.32	10.15	9.63	9.68	9.27	8.58	8.76	8.55	8.55	17
Metronidazole		16.52	16.59	16.96	17.11	17.17	17.85	17.61	18.08	18.25	19.01	19.06	19.26	19.43	11
Minocycline	16.63	16.77	16.89	17.10	16.97	16.73	16.84	16.41	16.36	15.71	17.12	16.37	14.76	13.94	14
Moxifloxacin	0.35	4.64	7.83	10.15	10.98	13.17	15.97	17.57	17.50	17.67	17.21	17.40	15.89	14.27	13
Nitrofurantoin	14.49	15.64	16.29	17.36	18.98	20.07	21.88	23.08	24.92	27.21	29.23	31.47	33.90	34.61	6
Norfloxacin	12.39	11.97	11.35	10.64	9.98	9.18	8.52	7.54	6.97	6.16	5.67	5.10	4.31	3.76	21
Penicillin V	44.94	41.70	39.54	39.33	36.30	36.38	35.94	34.70	32.97	32.20	28.27	24.73	24.32	22.41	9
Sulfamethoxazole and trimethoprim	55.84	50.05	44.10	40.65	36.77	34.66	34.21	33.51	33.61	33.41	33.32	31.58	29.24	30.43	7
Tetracycline	14.79	13.13	11.99	10.99	9.93	9.13	8.36	7.60	7.15	7.03	3.89	4.71	4.87	4.59	20
Trimethoprim	2.20	2.10	2.12	2.15	2.00	1.82	1.88	1.92	1.87	1.99	2.01	1.97	2.07	2.02	24
Vancomycin	0.14	0.14	0.16	0.19	0.34	0.38	0.36	0.40	0.43	0.47	0.63	0.76	0.81	1.02	25
<b>TOTAL</b>	<b>733.29</b>	<b>730.06</b>	<b>701.49</b>	<b>705.71</b>	<b>672.52</b>	<b>695.34</b>	<b>689.51</b>	<b>674.15</b>	<b>671.50</b>	<b>664.61</b>	<b>655.00</b>	<b>676.98</b>	<b>659.54</b>	<b>641.80</b>	

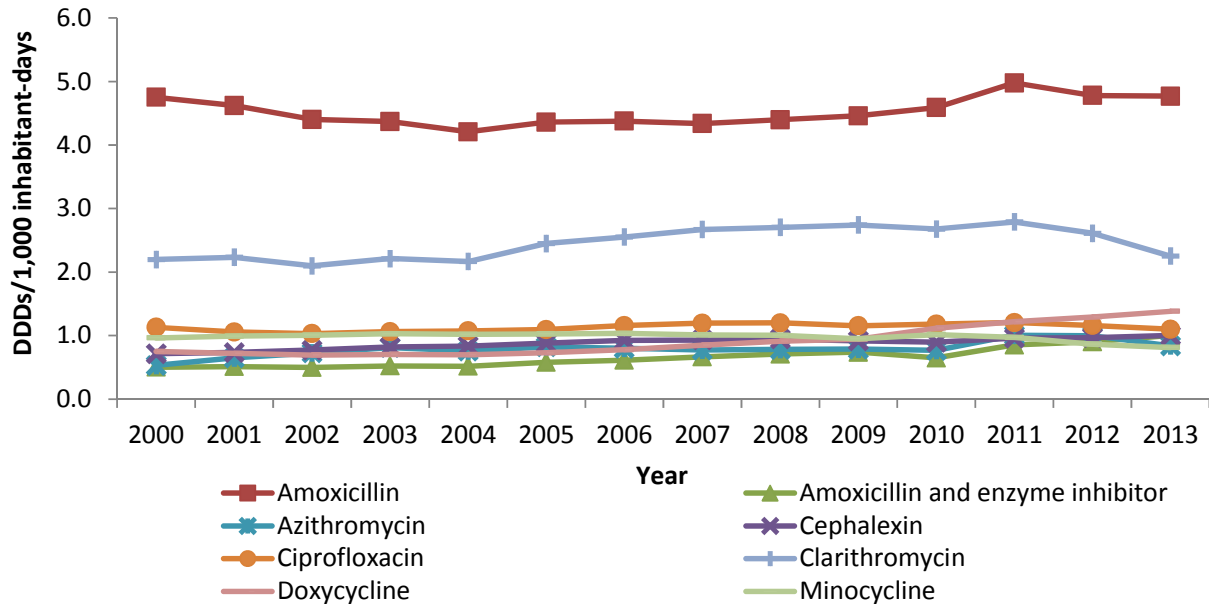
\*Ranked from greatest to least prescribing in 2013

Antimicrobials were removed from this table if they represented <0.05% of prescriptions in 2013. These are: amikacin, bacampicillin, cefaclor, cefepime, cefotaxime, ceftazidime, ceftazidime, ceftibiprole, cephradine, chloramphenicol, colistin, daptomycin, demeclocycline, dicloxacillin, erythromycin ethylsuccinate, fidaxomicin, flucloxacillin, fosfomicin, fusidic acid, gatifloxacin, gemifloxacin, gentamicin, grepafloxacin, imipenem and cilastatin, kanamycin, lincomycin, linezolid, meropenem, methenamine hippurate, methenamine mandelate, neomycin, ofloxacin, oxacillin, penicillin g, piperacillin, piperacillin and tazobactam, pivampicillin, pivmecillinam, spiramycin, streptomycin, sulfadiazine, sulfadiazine and trimethoprim, sulfamethizole, sulfamethoxazole, sulfapyridine, sulfisoxazole, sulfonamides, combinations with other antibacterials (excl. trimethoprim), telithromycin, ticarcillin and clavulanic acid, tigecycline, tobramycin, and trovafloxacin.

### b. Defined daily doses per 1,000 inhabitant-days (DIDs)

The antimicrobials with the greatest DIDs in 2013 were amoxicillin (4.77 DIDs), clarithromycin (2.25 DIDs), and doxycycline (1.38 DIDs) (Table 2.2, Figure 2.7).

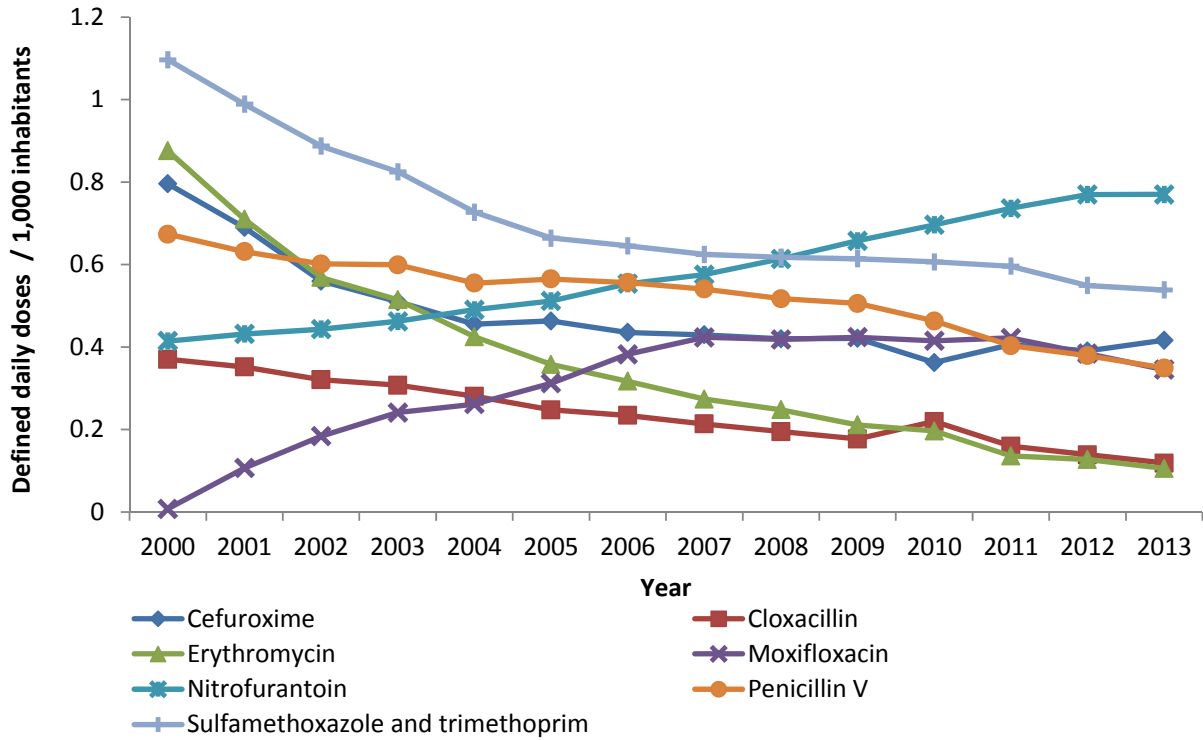
**Figure 2.7: Defined daily doses per 1,000 inhabitant-days for the eight antimicrobials with the highest DDD values in 2013; oral antimicrobials (2000-2009), oral and parenteral antimicrobials (2010-2013)**



The greatest reductions in DIDs over the 2000 – 2013 time frame occurred for erythromycin (0.70 DIDs), tetracycline (0.69 DIDs), and sulfamethoxazole and trimethoprim (0.56 DIDs). In contrast, the greatest increases in DIDs over the same time frame were for doxycycline (0.63 DIDs), amoxicillin and enzyme inhibitor (0.50 DIDs), and nitrofurantoin (0.36 DIDs) (Table 2.2, Figures 2.7 & 2.8).

In comparison to the prescribing rate measure, where declines greatly outweighed increases, the declines in use seen from 2000 to 2013 by DIDs did not outweigh the increases seen over the same time period. This may reflect a move towards prescriptions of higher dose, and/or of longer duration.

**Figure 2.8: Patterns in DID rates (defined daily doses per 1,000 inhabitant-days) from 2000 – 2013 for antimicrobials with the greatest absolute difference in rates from 2000 to 2013\***



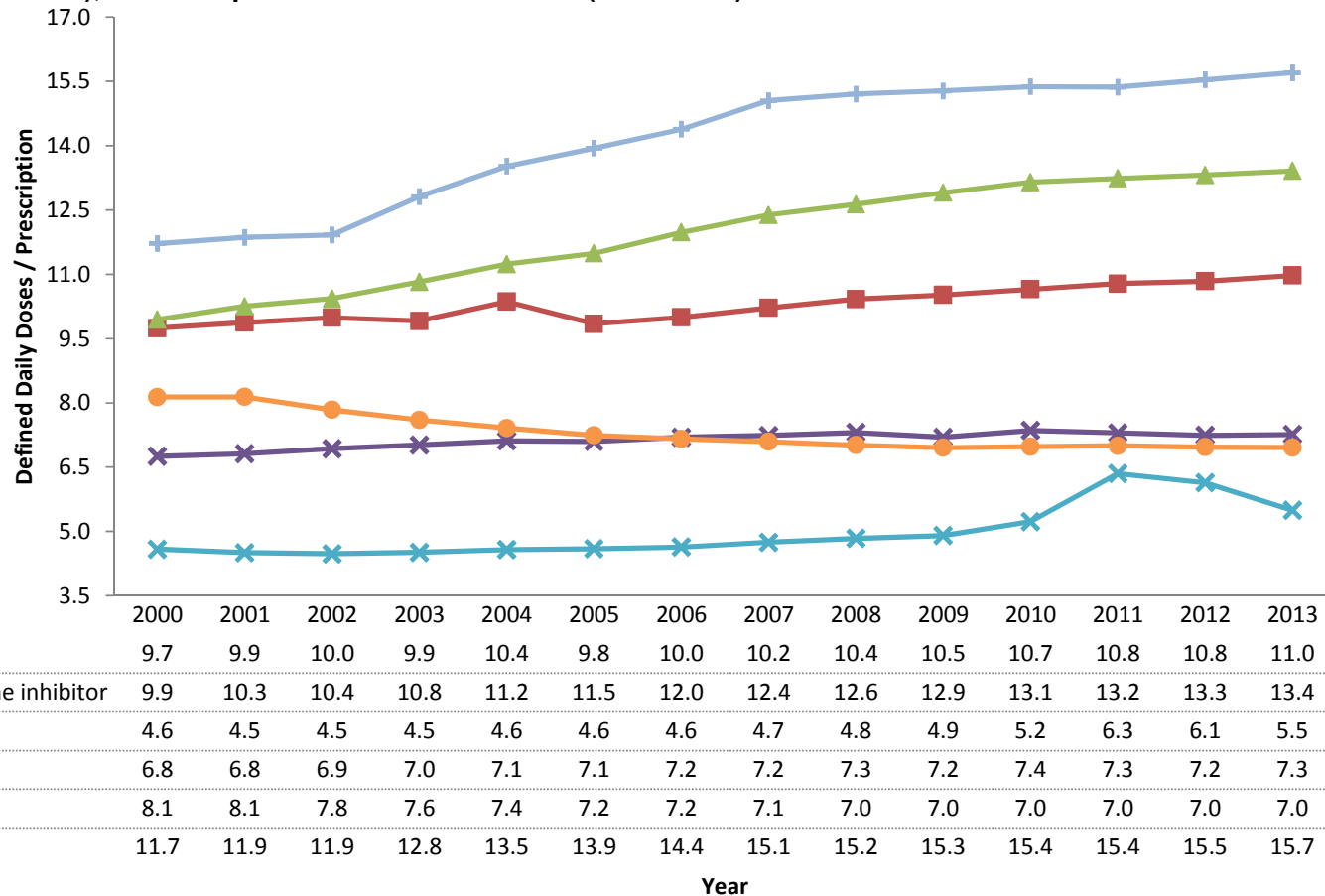
\*Excludes antimicrobials previously displayed in Figure 2.7 (amoxicillin with enzyme inhibitor, azithromycin, cephalexin, and doxycycline), and antimicrobials representing <0.05% of DIDs in 2013.



### c. Defined daily doses per prescription

Changes in the average number of DDDs per prescription dispensed have occurred for a number of antimicrobials over the 2000 – 2013 time frame. Of the antimicrobials included in both of Figures 2.5 and 2.7, these patterns are displayed in Figure 2.9. Slight increases over time were seen for cephalexin, azithromycin, and amoxicillin, while more dramatic (> 25%) increases were seen for amoxicillin and enzyme inhibitor and for clarithromycin.

**Figure 2.9: Defined daily doses per prescriptions for the six antimicrobials with the highest DDD and prescription rates; oral antimicrobials (2000-2009), oral and parenteral antimicrobials (2010-2013)**





## Use by route of administration

The use of oral antimicrobial products has not shown dramatic changes over the 2010 – 2013 time frame. For all measures, year over year changes were < 7% (Table 2.3). In contrast, the use of parenteral antimicrobial products has increased over this time frame, particularly from 2012 to 2013 (Table 2.3). Particularly striking increases in parenteral product use from 2012 to 2013 were seen for the total kilograms of active ingredient and kilograms of active ingredient / 1,000 inhabitants measures, which increased by 200% and 176%, respectively. Accordingly, as the volume of active ingredient dispensed increased, the cost of parenteral treatment also increased from 2012 to 2013, by 96%, equivalent to an increase of \$382 / 1,000 inhabitants.

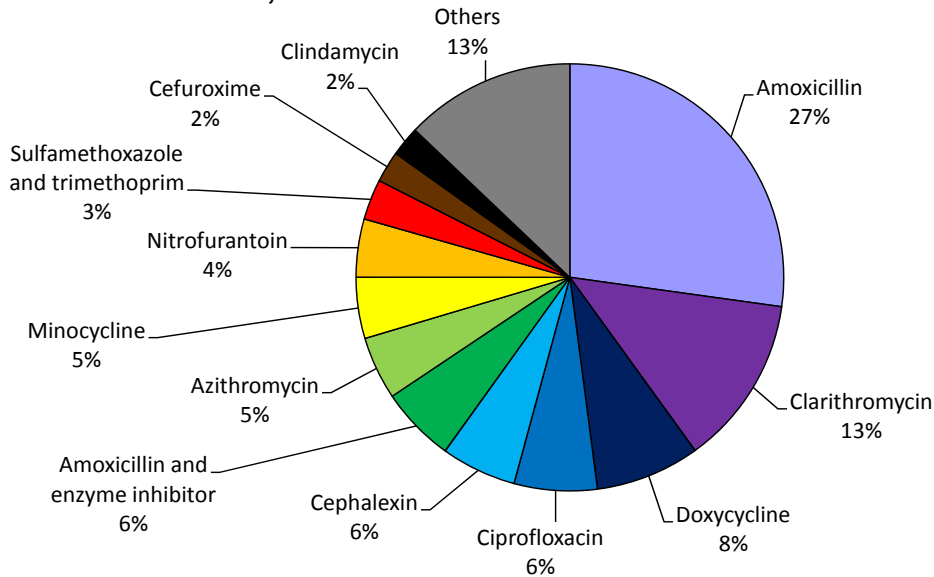
The majority of antimicrobials used in the Canadian outpatient population in 2013 were drugs for oral administration; more than 260 oral prescriptions are dispensed for each parenteral antimicrobial prescription at the national level. Interestingly, the parenteral products that were dispensed from outpatient pharmacies were not products that have an oral format. Figure 2.10 displays the proportion of oral DDDs by individual product, while Figure 2.11 displays the proportion of parenteral DDDs by individual product. No antimicrobial product appears on both of these figures.

**Table 2.3: Overall measures of antimicrobial use as dispensed by retail pharmacies in Canada, by route of administration (2010 – 2013)**

Measure of Use	2010		2011		2012		2013	
	Oral	Parenteral	Oral	Parenteral	Oral	Parenteral	Oral	Parenteral
DIDs	17.67	0.04	18.69	0.04	18.11	0.04	17.53	0.07
Kilograms of active ingredient / 1,000 inhabitants	5.74	0.02	5.97	0.02	5.79	0.02	5.65	0.06
Prescriptions / 1,000 inhabitants	653.45	1.55	675.36	1.62	657.98	1.56	639.19	2.61
Dollars spent / 1,000 inhabitants	21573.34	444.59	21207.23	462.55	19760.70	398.00	18419.68	780.55
Dollars spent / DDD	3.35	29.63	3.11	29.89	2.98	28.72	2.88	31.09
DDDs / prescription	9.87	9.70	10.10	9.54	10.07	8.86	10.01	9.64
Total kilograms of active ingredient	196409.46	775.98	206910.97	862.26	202912.92	806.69	200357.28	2224.00

**a. Oral antimicrobials**

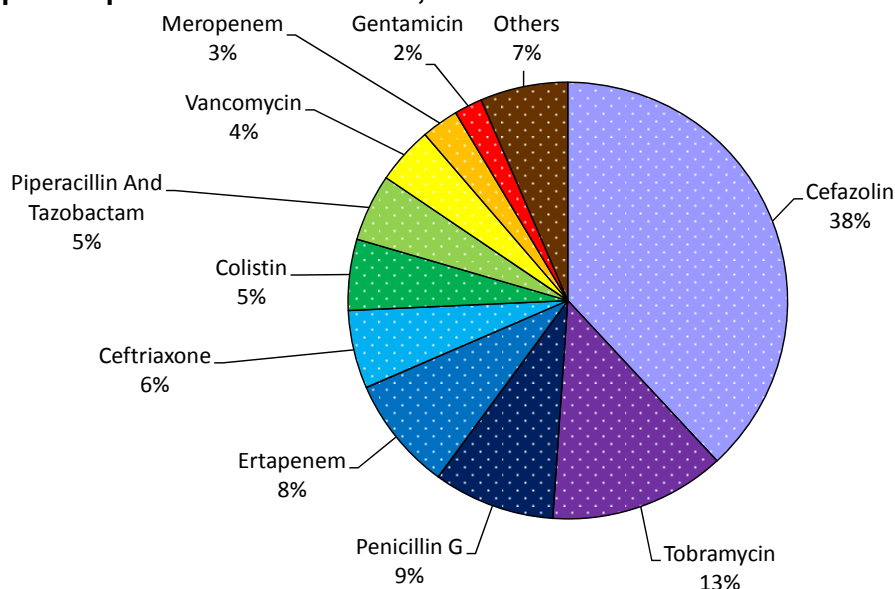
**Figure 2.10: Proportion of oral DDDs by individual antimicrobial dispensed by outpatient pharmacies in Canada, 2013**



\*Other drugs are products with < 2% share in 2013. These drugs (listed in order of greatest to least use) are: penicillin V, moxifloxacin, tetracycline, ceftazidime, metronidazole, levofloxacin, cloxacillin, cefixime, erythromycin, norfloxacin, trimethoprim, cefadroxil, ofloxacin, ampicillin, vancomycin, linezolid, cefaclor, spiramycin, methenamine mandelate, fosfomycin, fidaxomicin, sulfadiazine, fusidic acid, flucloxacillin, sulfamethoxazole, and penicillin g.

**b. Parenteral antimicrobials**

**Figure 2.11: Proportion of parenteral DDDs by individual antimicrobial dispensed by outpatient pharmacies in Canada, 2013**



\*Other drugs are products with < 2% share. These drugs (listed in order of greatest to least use) are: cloxacillin, clindamycin, ceftazidime, daptomycin, ampicillin, amikacin, metronidazole, ciprofloxacin, cefepime, tigecycline, imipenem and cilastatin, ceftazidime, levofloxacin, azithromycin, streptomycin, erythromycin, cefuroxime, cefotaxime, lincomycin, piperacillin, ticarcillin and clavulanic acid, linezolid, chloramphenicol, and sulfamethoxazole and trimethoprim.

## PROVINCIAL VARIATION

### Overall measures of use

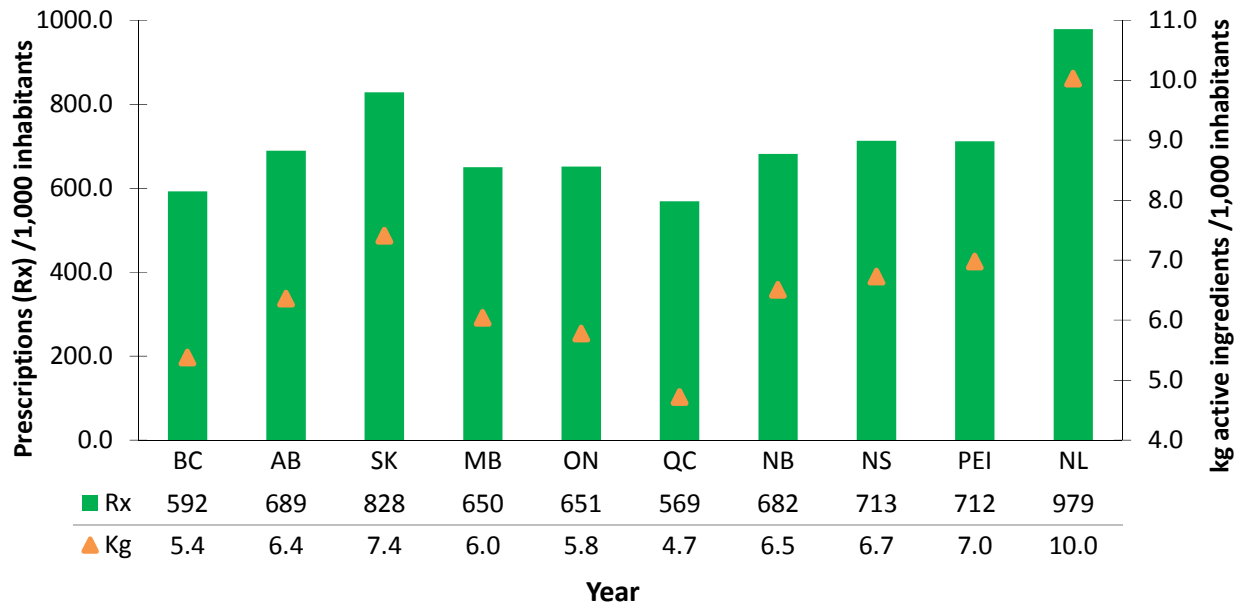
Antimicrobial use continues to vary at the provincial level by all four measures assessed in this use report. In 2013, Newfoundland and Labrador displayed the highest values for all measures, while no single province held the lowest value for all measures.

#### a. Prescription rates and kilograms of active ingredients

In 2013, the prescription rate per 1,000 inhabitants ranged from 569 in Québec to 979 in Newfoundland and Labrador (Figure 2.12). A similar pattern was seen for the kilograms of active ingredient dispensed, with Newfoundland and Labrador dispensing a high of 10.0kg / 1,000 inhabitants, and Québec with a low of 4.7kg / 1,000 inhabitants (Figure 2.12).

Figure 2.12 also shows how the national prescription rate in 2013 (642 prescriptions / 1,000 inhabitants) was greatly driven by the lower-prescribing provinces (Québec, British Columbia, and Ontario). Similarly, at the national level, 5.7 kilograms of active ingredient were dispensed per 1,000 inhabitants; largely driven by the low volume dispensed in the same three provinces.

**Figure 2.12: Number of prescriptions and kilograms of active ingredient per 1,000 inhabitants dispensed by retail pharmacies in 2013, by province.**



### b. Defined daily doses and cost per inhabitant

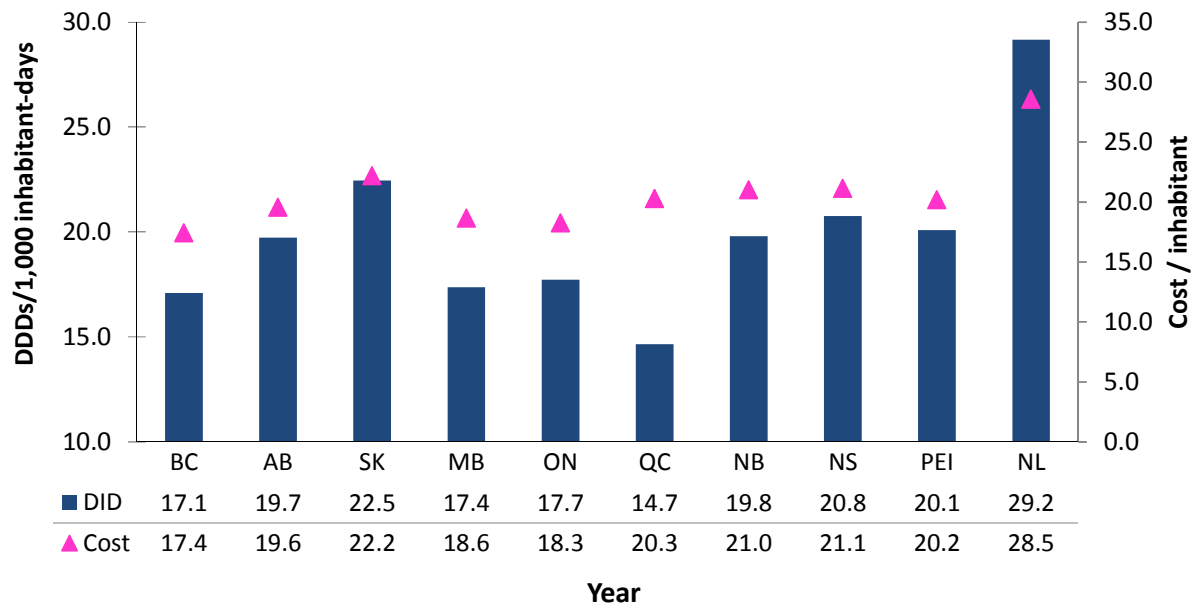
In accordance with the prescription rates and kilograms of active ingredient, Newfoundland and Labrador had the highest DID and cost per inhabitant in 2013 (Figure 2.13 and Appendix C, Figure C.1). DIDs in Newfoundland and Labrador were approximately 30% higher than in the province with the second-highest use by this measure (Saskatchewan). Similarly, cost per inhabitant was \$6.30 higher in Newfoundland and Labrador than in Saskatchewan, which is a >28% gap between these provinces.

Interestingly, although Québec displayed the lowest prescription rate, DIDs, and kilograms of active ingredient dispensed, the cost / inhabitant in Québec was within the median range of costs in 2013. This is also displayed by looking at the overall cost per DDD dispensed, which is highest in Québec (Appendix C, Figure C.2). The province with the lowest cost per inhabitant in 2013 was British Columbia.

In comparison with the national measures, the DIDs for Newfoundland and Labrador were again strikingly high in 2013 (29.2 DIDs compared to the national 17.6 DIDs). With increased use, associated costs were high in Newfoundland and Labrador in 2013 as well, where the cost per inhabitant was approximately \$9.30 higher than the national measure.

In all provinces in 2013, the greatest DIDs dispensed were for the extended spectrum penicillin antimicrobial class, followed by either the macrolide or tetracycline class (Appendix C, Figure C.1).

**Figure 2.13: Defined daily doses per 1,000 inhabitant-days and cost per inhabitant of antimicrobials dispensed by retail pharmacies in 2013, by province.**



## Use at individual drug level

A considerable amount of variation in antimicrobial prescribing occurred among the provinces at the individual drug level. For example, although the prescription rate and DIDs were highest for amoxicillin among all provinces (Table 2.3), the prescription rate varied from a high of 279.9 prescriptions / 1,000 inhabitants in Newfoundland and Labrador to a low of 97.7 prescriptions / 1,000 inhabitants in Québec. Although the overall prescription rate in Québec was lower than the remaining provinces, there were a number of antimicrobials where the use was highest in Québec. Notably, cefadroxil, cefprozil, ertapenem, minocycline, moxifloxacin, penicillin V, and vancomycin (Table 2.3). Interestingly, although Newfoundland and Labrador displays the highest prescription rate overall, their rate of vancomycin prescriptions was the lowest in the country.

Other antimicrobials that displayed a large amount of variation in the prescription rate were cephalexin, with a high of 99.1 prescriptions / 1,000 inhabitants in Saskatchewan and low of 15.6 prescriptions / 1,000 inhabitants in Québec, ciprofloxacin (115.2 prescriptions / 1,000 inhabitants in Newfoundland and Labrador, 46.3 prescriptions / 1,000 inhabitants in Ontario), and azithromycin (91.2 prescriptions / 1,000 inhabitants in Newfoundland and Labrador, 29.5 prescriptions / 1,000 inhabitants in British Columbia) (Table 2.3). Provincial drug-level prescriptions per 1,000 inhabitants data from 2012 can be found in Appendix C, Table C.3)

**Table 2.4: Prescriptions per 1,000 inhabitants of oral and parenteral antimicrobials dispensed by retail pharmacies in Canada, by province (2013)**

Antimicrobial	BC	AB	SK	MB	ON	QC	NB	NS	PEI	NF	Rank*
Amoxicillin	142.38	180.56	243.07	172.61	180.23	97.71	153.03	179.09	159.52	279.88	1
Amoxicillin and enzyme inhibitor	24.00	33.67	24.13	29.36	20.88	33.82	27.37	29.01	66.99	51.62	8
Ampicillin	0.34	0.22	3.43	0.21	0.55	0.15	0.44	0.77	1.85	5.61	26
Azithromycin	29.51	51.66	74.77	83.00	63.80	49.92	63.87	47.20	54.05	91.22	3
Cefadroxil	0.12	0.20	0.01	0.04	0.24	13.59	0.73	0.01	0.10	0.01	22
Cefazolin	0.04	0.05	0.20	0.06	0.04	1.61	0.93	0.70	0.25	0.03	27
Cefixime	7.61	11.27	2.41	3.18	5.55	5.33	4.50	5.18	10.50	10.32	18
Cefprozil	0.51	10.39	3.68	6.79	17.89	18.23	8.05	13.18	3.49	0.73	15
Ceftriaxone	0.11	0.10	0.19	0.01	0.27	0.96	0.90	0.90	1.12	0.04	29
Cefuroxime	11.52	7.81	8.58	4.61	9.55	5.46	30.21	16.36	4.82	29.66	16
Cephalexin	60.49	63.81	99.09	68.42	54.97	15.63	59.52	66.91	64.02	80.60	5
Ciprofloxacin	54.26	56.68	49.02	56.64	45.92	79.79	46.25	47.87	50.95	115.15	2
Clarithromycin	51.10	61.86	42.71	32.58	51.49	52.42	53.65	53.28	54.40	76.46	4
Clindamycin	21.05	27.43	31.85	20.15	21.86	20.36	24.09	22.79	17.92	23.70	10
Cloxacillin	5.24	5.09	9.65	9.59	5.25	3.93	4.07	5.66	8.02	10.50	19
Doxycycline	30.26	22.79	51.54	15.32	12.87	11.77	22.90	36.80	28.39	22.32	12
Ertapenem	0.01	0.02	<0.01	<0.01	<0.01	1.71	0.21	0.32	0.01	<0.01	28
Erythromycin	4.93	2.84	11.12	4.38	2.47	0.94	2.84	5.64	15.93	4.76	23
Levofloxacin	1.41	11.72	2.94	14.87	10.49	8.02	6.06	10.14	6.54	2.58	17
Metronidazole	20.14	22.70	22.64	20.17	19.11	16.44	20.57	22.31	18.60	27.71	11
Minocycline	11.86	19.25	5.94	13.24	7.62	24.34	11.83	15.16	8.70	13.34	14
Moxifloxacin	13.91	8.05	11.11	5.37	12.43	22.81	15.39	9.73	19.92	12.79	13
Nitrofurantoin	44.36	29.65	48.43	22.65	42.24	18.19	34.06	45.11	32.36	28.51	6
Norfloxacin	0.47	2.68	0.20	0.43	7.17	0.62	13.20	2.15	5.28	6.00	21
Penicillin V	21.39	24.67	15.42	20.94	17.74	30.23	26.70	22.72	20.59	24.95	9
Sulfamethoxazole and trimethoprim	28.62	29.19	58.39	39.65	30.51	22.25	41.06	45.78	46.36	52.34	7
Tetracycline	4.18	2.77	4.33	4.24	6.80	2.32	2.67	4.18	8.51	4.02	20
Trimethoprim	0.67	1.06	2.18	0.76	1.81	3.89	2.48	1.04	0.55	1.97	24
Vancomycin	0.60	0.56	0.48	0.35	0.33	2.90	0.86	0.87	0.71	0.25	25
TOTAL	592.26	689.46	828.23	650.25	651.17	569.08	681.58	712.85	711.59	979.10	

\*Ranked from greatest to least prescribing in 2013.

Antimicrobials were removed from this table if they represented <0.05% of prescriptions in 2013. These are: amikacin, cefaclor, cefepime, cefotaxime, ceftazidime, chloramphenicol, colistin, daptomycin, erythromycin ethylsuccinate, fidaxomicin, flucloxacillin, fosfomicin, fusidic acid, gentamicin, imipenem and cilastatin, lincomycin, linezolid, meropenem, methenamine mandelate, ofloxacin, penicillin g, piperacillin, piperacillin and tazobactam, spiramycin, streptomycin, sulfadiazine, sulfamethoxazole, ticarcillin and clavulanic acid, tigecycline, and tobramycin.

Variation in the DIDs is also apparent among the provinces at the individual antimicrobial level. The greatest variation again occurred in the use of amoxicillin (high of 8.77 DIDs in Newfoundland and Labrador, low of 3.24 DIDs in Québec). High variation in use was also seen for doxycycline (3.95 DIDs in Saskatchewan, 0.82 DIDs in Québec), ciprofloxacin (3.03 DIDs in Newfoundland and Labrador, 0.95 DIDs in New Brunswick), and clarithromycin (3.42 DIDs in Newfoundland and Labrador, 1.45 DIDs in Manitoba). Provincial drug-level DID data from 2012 can be found in Appendix C, Table C.4)

**Table 2.5: Defined daily doses per 1,000 inhabitant-days of oral and parenteral antimicrobials dispensed by retail pharmacies in Canada, by province (2013)**

Antimicrobial	BC	AB	SK	MB	ON	QC	NB	NS	PEI	NF	Rank*
Amoxicillin	4.15	5.31	6.81	5.29	5.31	3.24	4.98	5.47	4.71	8.77	1
Amoxicillin and enzyme inhibitor	0.85	1.20	0.79	1.08	0.78	1.26	1.09	1.10	2.23	1.81	6
Ampicillin	0.01	<0.01	0.07	<0.01	0.01	<0.01	0.01	0.02	0.04	0.12	27
Azithromycin	0.53	0.80	0.98	1.15	0.96	0.73	0.94	0.69	0.73	1.42	7
Cefadroxil	<0.01	<0.01	<0.01	<0.01	<0.01	0.18	0.01	<0.01	<0.01	<0.01	24
Cefazolin	<0.01	0.01	0.04	<0.01	<0.01	0.10	0.03	0.01	<0.01	<0.01	25
Cefixime	0.15	0.21	0.03	0.06	0.09	0.07	0.08	0.09	0.21	0.23	20
Cefprozil	0.01	0.20	0.05	0.12	0.33	0.38	0.15	0.26	0.06	0.01	16
Cefuroxime	0.50	0.34	0.35	0.21	0.42	0.25	1.47	0.74	0.20	1.41	11
Cephalexin	1.17	1.27	1.94	1.31	1.10	0.30	1.28	1.45	1.41	1.72	5
Ciprofloxacin	1.05	1.12	1.01	1.11	0.98	1.23	0.95	1.05	1.03	3.03	4
Clarithromycin	2.18	2.73	1.69	1.45	2.18	2.27	2.47	2.41	2.42	3.42	2
Clindamycin	0.37	0.50	0.59	0.38	0.37	0.36	0.47	0.42	0.35	0.46	12
Cloxacillin	0.11	0.11	0.21	0.21	0.12	0.09	0.11	0.13	0.18	0.24	19
Doxycycline	2.14	1.67	3.95	1.40	1.11	0.82	1.36	2.03	1.69	1.54	3
Erythromycin	0.16	0.10	0.30	0.13	0.10	0.04	0.10	0.20	0.48	0.16	21
Levofloxacin	0.04	0.30	0.07	0.35	0.26	0.20	0.16	0.23	0.17	0.07	18
Metronidazole	0.26	0.29	0.29	0.28	0.26	0.22	0.28	0.29	0.26	0.37	17
Minocycline	0.82	1.29	0.30	0.78	0.60	0.97	0.76	1.15	0.64	0.91	8
Moxifloxacin	0.32	0.21	0.25	0.14	0.31	0.54	0.39	0.23	0.49	0.30	14
Nitrofurantoin	0.96	0.71	1.15	0.55	0.93	0.36	0.85	1.11	0.83	0.82	9
Norfloxacin	0.01	0.06	<0.01	0.01	0.15	0.01	0.30	0.06	0.11	0.20	22
Ofloxacin	0.01	0.01	<0.01	0.01	0.02	0.02	0.01	0.04	0.03	0.08	26
Penicillin V	0.35	0.41	0.27	0.31	0.27	0.45	0.43	0.37	0.40	0.43	13
Sulfamethoxazole and trimethoprim	0.60	0.62	0.98	0.71	0.53	0.30	0.73	0.81	0.84	1.14	10
Tetracycline	0.31	0.17	0.24	0.30	0.45	0.10	0.22	0.29	0.54	0.40	15
Tobramycin	<0.01	<0.01	<0.01	0.01	0.01	0.02	0.02	0.03	0.01	0.01	29
Trimethoprim	0.02	0.04	0.07	0.02	0.05	0.05	0.06	0.04	0.01	0.09	23
Vancomycin	<0.01	0.01	<0.01	<0.01	<0.01	0.02	0.01	0.01	<0.01	<0.01	28
TOTAL	17.09	19.73	22.46	17.37	17.73	14.65	19.81	20.76	20.09	29.16	

\*Ranked from greatest to least DDDs at the national level in 2013.

Antimicrobials were removed from this table if they represented <0.05% of DDDs in 2013. These are: amikacin, cefaclor, cefepime, cefotaxime, ceftazidime, ceftriaxone, chloramphenicol, colistin, daptomycin, ertapenem, erythromycin ethylsuccinate, fidaxomicin, flucloxacillin, fosfomicin, fusidic acid, gentamicin, imipenem and cilastatin, lincomycin, linezolid, meropenem, methenamine mandelate, penicillin G, piperacillin, piperacillin and tazobactam, spiramycin, streptomycin, sulfadiazine, sulfamethoxazole, ticarcillin and clavulanic acid, and tigecycline.

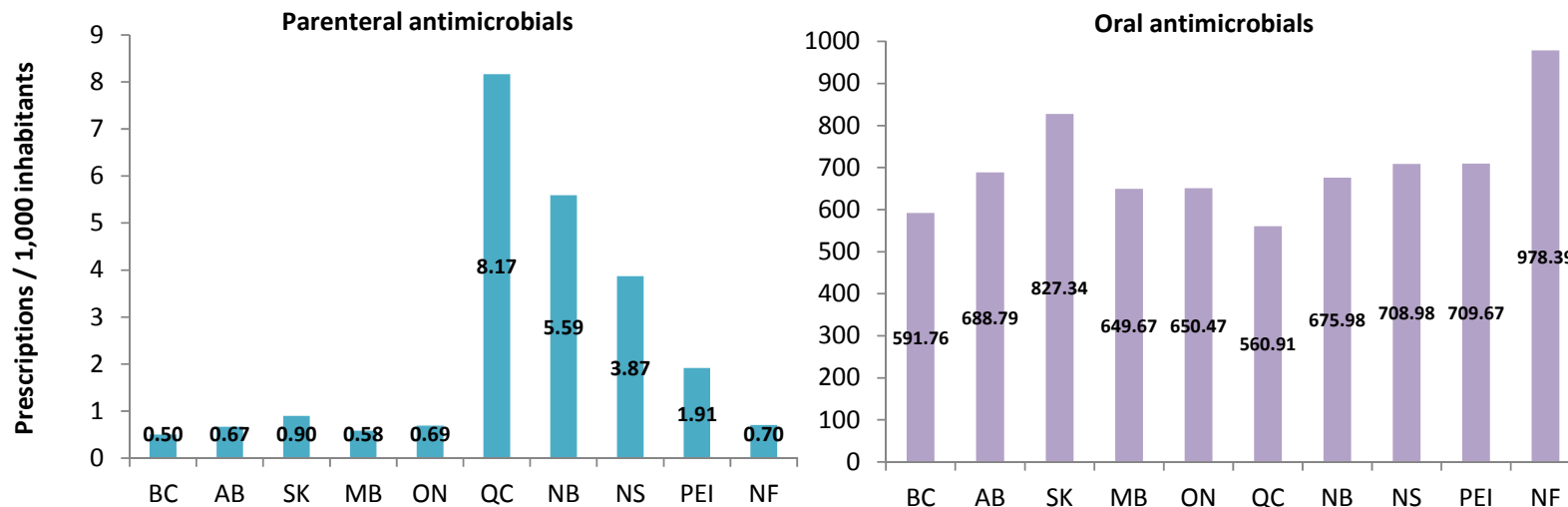


## Use by route of administration

The majority of antimicrobials used in the Canadian outpatient population are drugs for oral administration. In 2013, more than 240 oral prescriptions were dispensed for each parenteral antimicrobial prescription at the national level. However, when viewed at the provincial level, the variation in use of oral and parenteral antimicrobials was quite dramatic (Figure 2.14). The prescription rates for parenteral antimicrobials in Québec, New Brunswick, and Nova Scotia are more than twice the rate of any other province, and are more than fifteen-times the rate in others (British Columbia, Manitoba, and Ontario) (Figure 2.14).

In the community setting in all provinces with the exception of New Brunswick and Nova Scotia, the dispensing of oral vancomycin was roughly 50% greater than the dispensing of parenteral vancomycin. In New Brunswick and Nova Scotia, this was reversed (individual product data not shown due to the small volume of parenteral products dispensed in the community setting).

**Figure 2.14: Provincial level antimicrobial prescriptions per 1,000 inhabitants in 2013, by route of administration.**





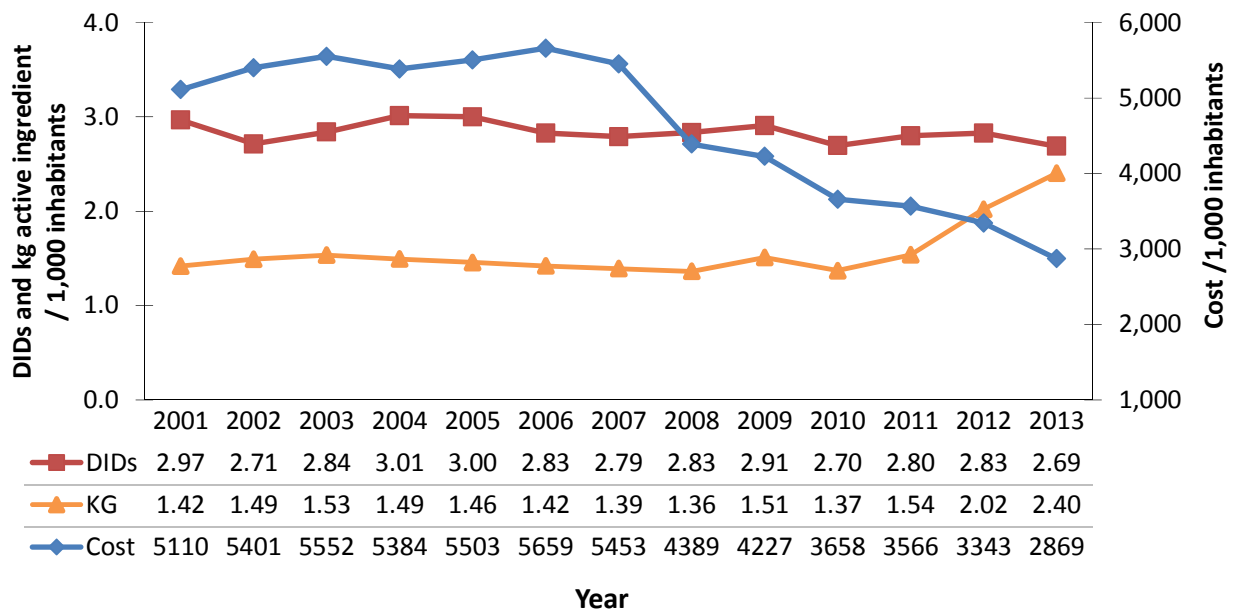
## 3. HOSPITAL PURCHASING DATA

### NATIONAL PURCHASING

#### Overall measures

The three measures of hospital antimicrobial purchasing in Canada displayed different patterns over the period of surveillance 2001 – 2013. A slight decrease in DIDs occurred overall, and the DID value seen in 2013 was lower than in any previous year (2.69 DIDs). A decline in the cost per 1,000 inhabitants has also occurred over the 2001 – 2013 time frame, with a quite dramatic decline from 2007 to 2013 (\$5,659 / 1,000 inhabitants to \$2,869 / 1,000 inhabitants). In contrast, following a period of relative stability 2001 – 2010, the kilograms of active antimicrobial ingredient purchased by hospitals increased dramatically from 2010 to 2013 (1.37 kg / 1,000 inhabitants to 2.40 kg / 1,000 inhabitants, a 75% increase).

**Figure 3.1: DIDs, kilograms of active ingredient, and cost per 1,000 inhabitants of antimicrobials purchased by Canadian hospitals, 2001 – 2013.**



## Individual drug purchasing

### a. Defined daily doses per 1,000 inhabitant-days (DIDs)

The antimicrobials with the greatest DIDs in 2013 were ceftriaxone (0.65 DIDs), penicillin g (0.56 DIDs), and piperacillin with enzyme inhibitor (0.20 DIDs). From 2010 – 2013, there were large increases among the DIDs for ceftriaxone and piperacillin with enzyme inhibitor. In contrast, the use of penicillin g decreased by > 60% between 2009 and 2013 (1.42 to 0.56 DIDs) (Table 3.1, Figure 3.2).

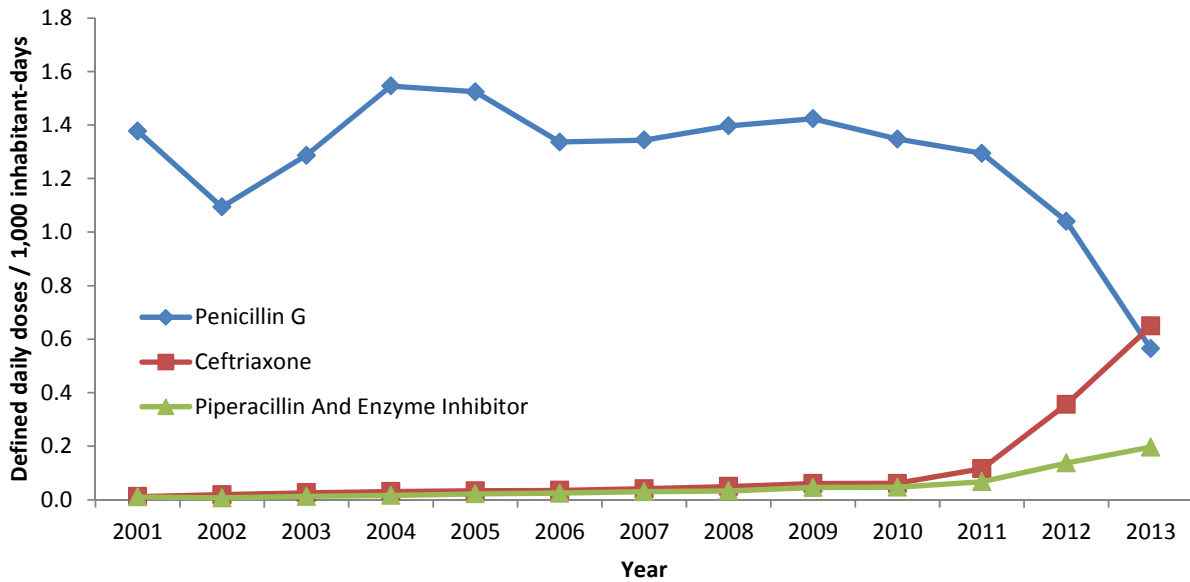
**Table 3.1: DIDs for antimicrobials purchased by hospitals in Canada, 2001 - 2013**

Antimicrobial	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Rank*
Amoxicillin	0.11	0.10	0.10	0.09	0.10	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.10	7
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	0.05	0.05	12
Ampicillin	0.10	0.06	0.06	0.06	0.09	0.09	0.06	0.05	0.04	0.04	0.04	0.04	0.04	17
Azithromycin	0.05	0.05	0.06	0.06	0.06	0.05	0.06	0.07	0.08	0.07	0.08	0.10	0.10	6
Cefadroxil	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	40
Cefazolin	0.12	0.12	0.12	0.12	0.12	0.11	0.12	0.12	0.13	0.12	0.12	0.12	0.10	5
Cefepime	<0.01	<0.01	0.01	0.03	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	42
Cefixime	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	23
Cefotaxime	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	<0.01	<0.01	34
Cefoxitin	0.11	0.16	0.18	0.18	0.14	0.14	0.13	0.12	0.14	0.10	0.10	0.08	0.06	11
Cefprozil	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	33
Ceftazidime	0.01	0.01	0.01	0.01	0.02	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	37
Ceftriaxone	0.01	0.02	0.03	0.03	0.03	0.04	0.04	0.05	0.06	0.06	0.12	0.36	0.65	1
Cefuroxime	0.08	0.06	0.06	0.05	0.05	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	19
Cephalexin	0.05	0.05	0.05	0.05	0.06	0.07	0.05	0.04	0.04	0.04	0.04	0.05	0.05	16
Ciprofloxacin	0.17	0.16	0.16	0.17	0.15	0.16	0.16	0.15	0.15	0.13	0.13	0.13	0.16	4
Clarithromycin	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.03	20
Clindamycin	0.03	0.03	0.03	0.03	0.03	0.04	0.05	0.05	0.05	0.04	0.04	0.04	0.07	9
Cloxacillin	0.07	0.07	0.07	0.06	0.06	0.06	0.05	0.05	0.06	0.05	0.05	0.05	0.05	13
Colistin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	39
Daptomycin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	32
Doxycycline	0.04	0.03	0.04	0.04	0.04	0.04	0.07	0.11	0.07	0.07	0.09	0.08	0.08	8
Ertapenem	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	0.01	0.01	0.01	0.01	25
Erythromycin	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	29
Gentamicin	0.03	0.03	0.02	0.01	0.02	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	24
Imipenem	0.01	0.02	0.02	<0.01	0.01	0.01	0.01	0.01	0.01	<0.01	0.02	0.03	0.02	22
Levofloxacin	0.08	0.08	0.08	0.07	0.06	0.05	0.05	0.05	0.06	0.05	0.05	0.05	0.05	15
Linezolid	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	36
Meropenem	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	21
Metronidazole	0.06	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	30
Minocycline	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	<0.01	<0.01	31
Moxifloxacin	<0.01	0.01	0.02	0.04	0.06	0.07	0.08	0.08	0.08	0.07	0.07	0.06	0.05	14
Nitrofurantoin	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	18
Norfloxacin	0.01	0.01	0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	38
Penicillin G	1.38	1.09	1.29	1.55	1.52	1.34	1.34	1.40	1.42	1.35	1.29	1.04	0.56	2
Penicillin V	0.02	0.03	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.02	0.01	0.01	27
Piperacillin and enzyme inhibitor	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.05	0.05	0.07	0.14	0.20	3
Sulfamethoxazole and trimethoprim	0.09	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	10
Tetracycline	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	35
Tobramycin	0.02	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	26
Trimethoprim	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	41
Vancomycin	0.09	0.14	0.04	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	28
TOTAL	2.97	2.71	2.84	3.01	3.00	2.83	2.79	2.83	2.91	2.70	2.80	2.83	2.69	

\*Ranked from greatest to least DIDs in 2013

Antimicrobials were removed from this table if they represented <0.05% of DIDs in 2013. These are: amikacin, bacampicillin, cefaclor, cefotetan, ceftizoxime, ceftobiprole, cephalothin, chloramphenicol, demeclocycline, doripenem, erythromycin ethylsuccinate, fosfomicin, gatifloxacin, gemifloxacin, lincomycin, methenamine hippurate, methenamine mandelate, nalidixic acid, netilmicin, ofloxacin, piperacillin, pivampicillin, pivmecillinam, quinupristin/dalfopristin, spiramycin, streptomycin, sulfadiazine, sulfadiazine and trimethoprim, sulfonamides, combinations with other antibacterials (excl. trimethoprim), telithromycin, ticarcillin and enzyme inhibitor, tigecycline, and trovafloxacin.

**Figure 3.2: Change in DIDs from 2001 – 2013 for penicillin g, ceftriaxone, and piperacillin and enzyme inhibitor, as purchased by Canadian hospitals.**



### b. Mass (kg) of active ingredient purchased per 1,000 inhabitants

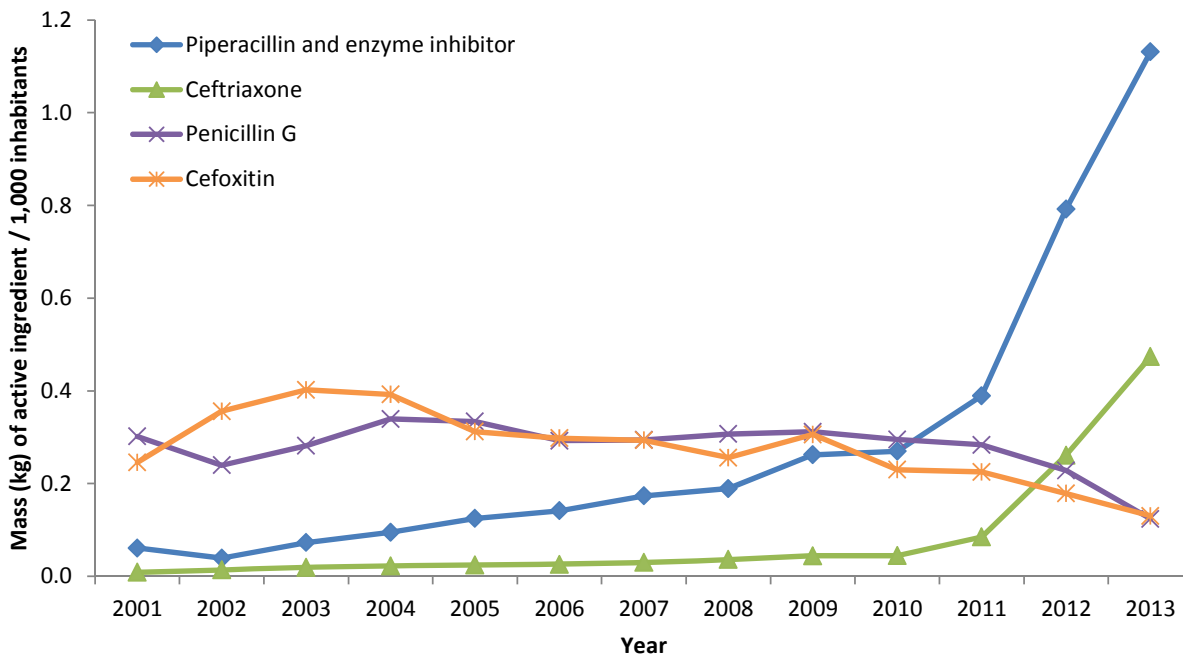
In 2013, the antimicrobial for which the most volume of active ingredient was purchased by Canadian hospitals was piperacillin with enzyme inhibitor (1.13 kg / 1,000 inhabitants) (Table 3.2). Ceftriaxone (0.47 kg / 1,000 inhabitants) and cefoxitin (0.13 kg / 1,000 inhabitants) were ranked second and third, respectively.

The purchasing of piperacillin with enzyme inhibitor has increased more than 18-fold over the 2001 – 2013 time frame, with the most dramatic increases from 2010 - 2013 (Table 3.2, Figure 3.3). Ceftriaxone purchasing has also increased dramatically during this time frame, increasing from < 0.08 kg / 1,000 inhabitants in 2011 to the high of 0.47 kg / 1,000 inhabitants seen in 2013 (Table 3.2, Figure 3.3). The two antimicrobials with the greatest reduction in mass purchased over this time frame were cefoxitin (0.25 kg / 1,000 inhabitants to 0.13kg / 1,000 inhabitants) and penicillin G (0.30 kg / 1,000 inhabitants to 0.12 kg / 1,000 inhabitants) (Table 3.2, Figure 3.3).

**Table 3.2: Mass (kg) of active ingredients purchased by hospitals in Canada, 2001 - 2013**

Antimicrobial	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Rank*
Amoxicillin	0.04	0.04	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	10
Amoxicillin and enzyme inhibitor	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02	14
Ampicillin	0.07	0.04	0.04	0.04	0.06	0.07	0.04	0.03	0.03	0.03	0.03	0.03	0.03	13
Azithromycin	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	16
Cefadroxil	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	37
Cefazolin	0.13	0.13	0.13	0.13	0.13	0.12	0.13	0.14	0.14	0.13	0.13	0.13	0.11	5
Cefixime	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	28
Cefotaxime	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.02	0.01	0.01	0.01	0.01	21
Cefoxitin	0.25	0.36	0.40	0.39	0.31	0.30	0.29	0.26	0.31	0.23	0.23	0.18	0.13	3
Cefprozil	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	31
Ceftazidime	0.01	0.02	0.01	0.01	0.02	0.02	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	25
Ceftriaxone	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.04	0.08	0.26	0.47	2
Cefuroxime	0.03	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	19
Cephalexin	0.03	0.04	0.04	0.04	0.04	0.05	0.03	0.03	0.03	0.03	0.03	0.03	0.03	11
Ciprofloxacin	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.05	6
Clarithromycin	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	23
Clindamycin	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.04	8
Cloxacillin	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	9
Doxycycline	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	27
Ertapenem	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	24
Erythromycin	0.01	0.01	0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	29
Gentamicin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	32
Imipenem	0.01	0.03	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.04	0.03	12
Levofloxacin	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	17
Linezolid	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	33
Meropenem	<0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	15
Metronidazole	0.03	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	26
Moxifloxacin	<0.01	<0.01	<0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	18
Nitrofurantoin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	30
Penicillin G	0.30	0.24	0.28	0.34	0.33	0.29	0.29	0.31	0.31	0.30	0.28	0.23	0.12	4
Penicillin V	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	20
Piperacillin and enzyme inhibitor	0.06	0.04	0.07	0.09	0.12	0.14	0.17	0.19	0.26	0.27	0.39	0.79	1.13	1
Sulfamethoxazole and trimethoprim	0.06	0.05	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04	7
Tetracycline	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	35
Ticarcillin and enzyme inhibitor	0.04	0.08	0.07	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.01	<0.01	<0.01	36
Tobramycin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	34
Vancomycin	0.06	0.10	0.03	0.01	0.01	0.01	<0.01	0.01	0.01	0.01	0.01	0.01	0.01	22
TOTAL	1.42	1.49	1.53	1.49	1.46	1.42	1.39	1.36	1.51	1.37	1.54	2.02	2.40	

**Figure 3.3: Patterns in mass (kg) of active ingredients for antimicrobials with the greatest absolute difference in purchasing from 2001 to 2013\***



### c. Dollars spent per 1,000 inhabitants

In 2013, the antimicrobials with the greatest dollars spent per 1,000 inhabitants by Canadian hospitals were piperacillin and enzyme inhibitor (\$421), meropenem (\$389), and ertapenem (\$264) (Table 3.3). The greatest changes between 2012 and 2013 were reductions in spending; increases were relatively minor in comparison. The antimicrobials for which these decreases occurred were: meropenem (\$554 to \$389 / 1,000 inhabitants), piperacillin and enzyme inhibitor (506 to 421/ 1,000 inhabitants), and ceftriaxone (\$506 to \$421/ 1,000 inhabitants) (Table 3.3, Figure 3.4). The greatest increases from 2012 to 2013 were: ampicillin (\$85 to \$121 / 1,000 inhabitants), ertapenem (\$242 to \$264 / 1,000 inhabitants), and daptomycin (\$129 to \$147 / 1,000 inhabitants) (Table 3.3, Figure 3.4).

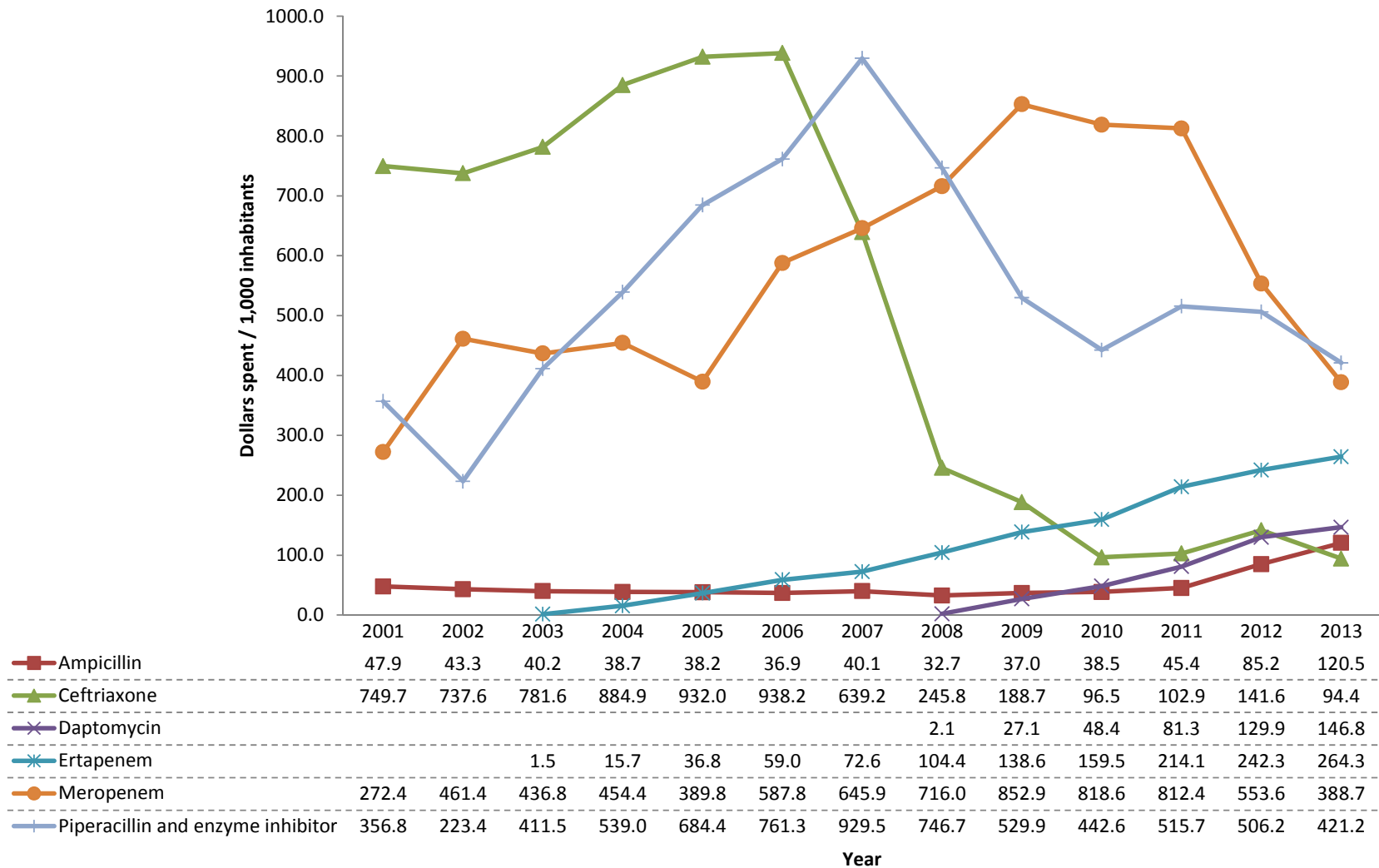
**Table 3.3: Dollars spent per 1,000 individuals for antimicrobials purchased by hospitals in Canada, 2001 - 2013**

Antimicrobial	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Rank*
Amikacin	10.88	10.54	9.36	4.14	14.35	19.24	17.20	16.44	20.65	18.07	14.36	22.26	19.62	28
Amoxicillin	11.98	10.17	9.93	8.78	9.77	8.75	8.99	9.30	10.30	11.30	10.21	11.25	11.94	34
Amoxicillin and enzyme inhibitor	25.59	25.89	25.05	22.50	22.96	22.64	17.49	17.11	20.45	19.88	19.15	18.05	16.51	31
Ampicillin	47.89	43.29	40.17	38.69	38.20	36.93	40.09	32.70	37.02	38.54	45.40	85.19	120.51	7
Azithromycin	192.39	217.68	246.89	229.99	234.73	161.00	143.54	146.04	160.31	80.09	67.02	68.18	61.26	14
Cefazolin	200.25	210.37	203.68	181.72	181.10	160.96	191.11	159.83	163.92	222.04	176.81	130.84	90.21	10
Cefepime	0.77	2.59	17.43	30.56	16.53	13.67	12.36	11.29	12.43	10.05	11.21	10.33	10.08	35
Cefixime	12.20	12.85	11.32	7.28	8.37	8.49	10.62	11.90	15.12	15.91	19.28	24.75	25.22	24
Cefotaxime	135.83	155.17	172.68	174.54	175.92	183.87	173.79	112.56	107.15	60.60	51.22	40.74	26.11	23
Cefoxitin	55.96	60.37	70.54	74.26	65.57	70.44	66.42	51.40	48.69	30.71	30.30	22.24	21.47	26
Cefprozil	9.11	9.76	12.65	14.67	11.22	10.02	9.72	6.18	6.45	5.74	4.26	3.91	3.03	39
Ceftazidime	168.02	186.79	142.96	114.00	81.20	50.19	42.31	39.33	42.00	37.96	33.44	37.95	37.41	21
Ceftriaxone	749.69	737.63	781.56	884.94	932.02	938.22	639.22	245.78	188.65	96.52	102.90	141.61	94.39	9
Cefuroxime	203.05	148.83	111.91	70.03	63.76	41.58	36.61	27.85	28.15	31.94	28.73	23.87	20.45	27
Cephalexin	15.96	15.83	18.62	17.52	18.43	21.65	15.24	14.75	14.18	13.88	15.27	17.20	16.80	30
Chloramphenicol	1.46	1.18	0.99	1.60	1.26	1.68	0.41	1.89	1.19	2.27	1.38	0.59	1.87	40
Ciprofloxacin	940.18	977.78	1023.96	956.55	887.59	912.49	703.04	287.30	94.21	75.44	61.93	48.60	54.90	15
Clarithromycin	90.28	84.09	75.79	70.85	71.50	66.53	62.45	36.52	28.76	23.68	23.63	19.14	13.72	32
Clindamycin	102.77	91.53	77.61	65.30	63.98	116.74	122.17	119.18	122.28	105.90	104.35	120.60	114.47	8
Cloxacillin	44.38	45.28	47.29	48.36	50.47	52.38	59.20	57.28	81.72	78.73	86.82	70.86	52.94	16
Colistin	21.86	25.60	22.68	19.45	16.09	22.17	23.04	22.63	17.24	25.37	23.84	23.62	30.72	22
Daptomycin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	2.14	27.11	48.39	81.25	129.89	146.82	6
Doxycycline	7.95	4.79	6.42	5.48	4.82	4.68	7.42	8.70	4.50	4.56	6.96	3.73	3.70	38
Ertapenem	<0.01	<0.01	1.55	15.66	36.85	58.98	72.58	104.41	138.59	159.54	214.07	242.25	264.35	3
Erythromycin	14.91	14.81	29.23	20.06	16.08	18.93	19.21	19.02	13.85	11.25	18.44	18.78	17.11	29
Gentamicin	51.29	41.68	29.48	20.66	32.93	68.65	94.38	87.20	87.17	83.19	73.35	79.57	83.59	12
Imipenem	222.20	237.75	228.00	193.93	258.29	224.58	230.59	203.19	204.75	179.16	57.16	72.64	42.93	17
Levofloxacin	379.28	393.82	353.33	306.20	208.24	147.40	145.46	152.60	158.58	118.36	124.41	68.52	24.78	25
Linezolid	20.33	55.15	63.57	74.63	117.13	124.05	150.41	171.58	189.89	161.76	163.81	189.63	174.48	4
Meropenem	272.35	461.38	436.81	454.39	389.77	587.77	645.89	716.05	852.92	818.61	812.41	553.58	388.66	2
Metronidazole	29.31	42.07	14.97	15.21	12.99	12.47	14.98	10.93	8.39	8.90	11.40	9.56	9.73	36
Moxifloxacin	11.43	24.95	50.76	131.75	224.14	299.36	329.84	336.74	315.97	214.35	205.34	185.65	155.18	5
Nitrofurantoin	4.97	6.62	7.19	9.00	9.61	9.58	9.92	9.99	10.61	10.98	12.53	13.26	12.54	33
Penicillin G	22.78	21.79	23.91	22.65	21.94	20.42	21.34	21.22	48.21	23.89	27.99	40.26	37.72	19
Piperacillin	81.55	8.85	35.58	28.60	17.39	9.80	7.32	3.79	3.77	2.54	4.14	4.28	1.61	41
Piperacillin and enzyme inhibitor	356.84	223.41	411.52	539.00	684.43	761.33	929.53	746.74	529.89	442.58	515.70	506.24	421.16	1
Sulfamethoxazole and trimethoprim	29.04	32.20	35.67	37.65	36.57	37.49	34.98	34.90	38.23	32.38	32.00	37.47	39.05	18
Ticarcillin and enzyme inhibitor	167.52	312.81	260.46	106.65	98.58	105.83	93.98	96.76	73.39	67.71	28.01	11.31	3.95	37
Tigecycline	0.00	0.00	0.00	0.00	0.00	0.00	12.73	31.13	60.98	59.34	45.13	44.32	37.64	20
Tobramycin	95.31	86.93	66.22	60.56	71.49	97.16	95.80	94.72	98.36	86.86	80.07	79.24	64.24	13
Vancomycin	113.18	155.33	134.90	148.88	165.45	119.34	121.66	92.74	118.92	106.00	110.09	102.78	89.33	11
<b>TOTAL</b>	<b>5110.38</b>	<b>5401.04</b>	<b>5552.30</b>	<b>5383.86</b>	<b>5503.24</b>	<b>5658.81</b>	<b>5453.15</b>	<b>4388.97</b>	<b>4226.61</b>	<b>3657.82</b>	<b>3566.17</b>	<b>3342.82</b>	<b>2868.88</b>	

\*Ranked from greatest to least costs in 2013

Antimicrobials were removed from this table if they represented <0.05% of costs in 2013. These are: bacampicillin, cefaclor, cefadroxil, cefotetan, ceftizoxime, ceftobiprole, cephalothin, demeclocycline, doripenem, erythromycin ethylsuccinate, fosfomicin, gatifloxacin, gemifloxacin, lincomycin, methenamine hippurate, methenamine mandelate, minocycline, nalidixic acid, netilmicin, norfloxacin, ofloxacin, penicillin v, pivampicillin, pivmecillinam, quinupristin/dalfopristin, spiramycin, streptomycin, sulfadiazine, sulfadiazine and trimethoprim, sulfonamides, combinations with other antibacterials (excl. trimethoprim), telithromycin, tetracycline, trimethoprim, and trovafloxacin.

**Figure 3.4: Patterns in spending on antimicrobials by Canadian hospitals for antimicrobials with the greatest change in spending from 2001 to 2013.**



## Purchasing by route of administration

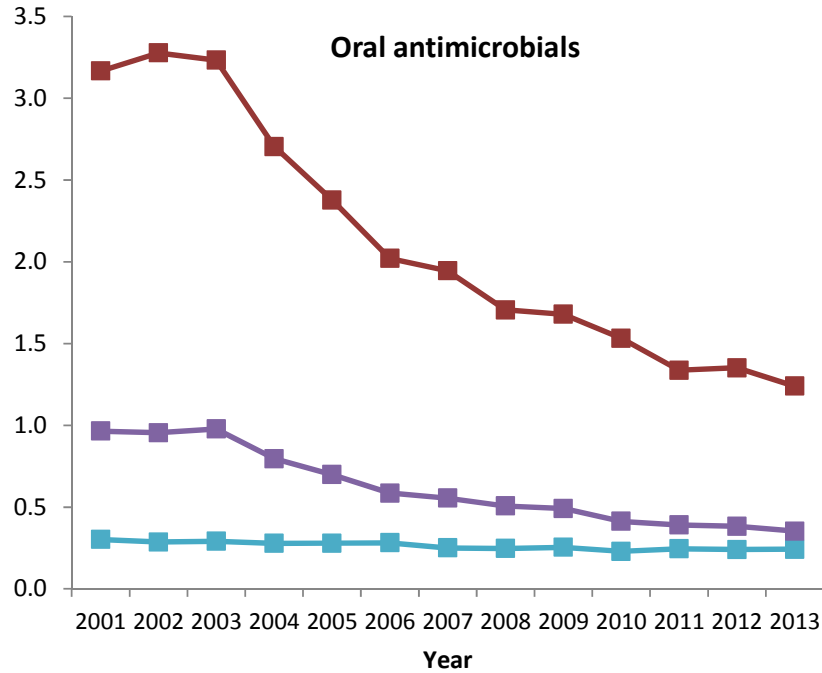
In contrast with use in the community as displayed in the pharmacy dispensation data (Table 2.3), the volume of parenteral antimicrobials outweighed the volume of oral antimicrobials in the hospital purchasing data. By mass (kg) of active ingredient, parenteral antimicrobials were purchased at a rate 9 times higher than oral antimicrobials in 2013 (Table 3.4, Figure 3.5). Similarly, overall spending for parenteral products was 7.2 times the spending on oral products, and parenteral DIDs were 2.9 times the oral DIDs in 2013 (Table 3.4, Figure 3.5).

**Table 3.4: Overall measures of antimicrobial drug purchasing by Canadian hospitals 2001 – 2013, by route of administration**

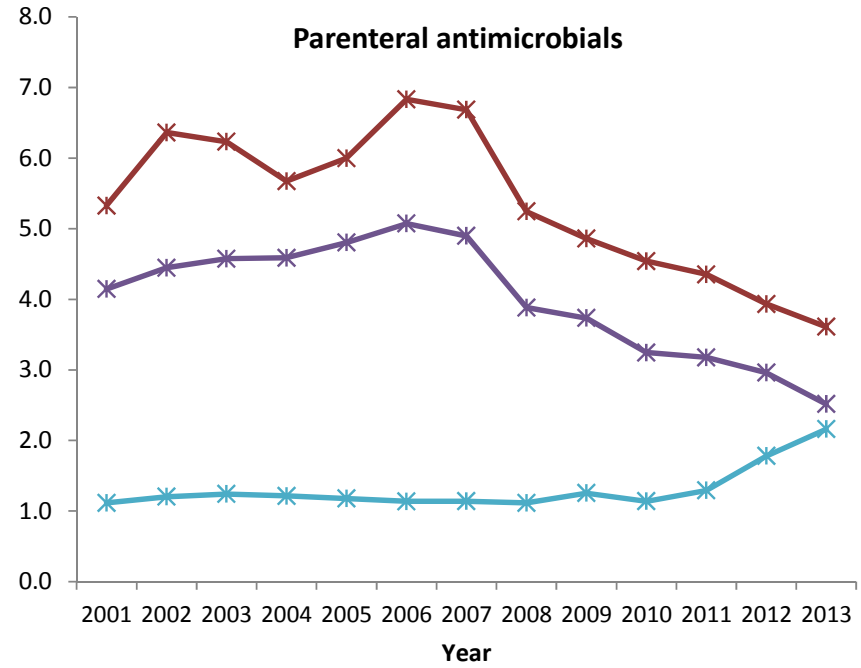
Route of administration	Measure	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Oral	DIDs	3.17	3.28	3.23	2.70	2.38	2.02	1.95	1.71	1.68	1.53	1.34	1.35	1.24
	KG / 1,000 inhabitants	0.30	0.29	0.29	0.28	0.28	0.28	0.25	0.25	0.25	0.23	0.25	0.24	0.24
	Cost (000's) / 1,000 inhabitants	0.97	0.95	0.98	0.80	0.70	0.59	0.56	0.51	0.49	0.41	0.39	0.38	0.35
Parenteral	DIDs	5.33	6.36	6.23	5.67	6.00	6.83	6.68	5.24	4.86	4.54	4.35	3.93	3.61
	KG / 1,000 inhabitants	1.11	1.20	1.24	1.21	1.18	1.14	1.14	1.11	1.25	1.14	1.29	1.78	2.16
	Cost (000's) / 1,000 inhabitants	4.15	4.45	4.57	4.59	4.80	5.07	4.90	3.88	3.74	3.25	3.18	2.96	2.52



**Figure 3.5: Kilograms of active ingredients, defined daily doses, and dollars per 1,000 inhabitants for antimicrobials purchased by Canadian hospitals 2001 – 2013, by route of administration**



- KG active ingredients / 1,000 inhabitants
- DDDs / 1,000 inhabitant-days
- Dollars (000's) / 1,000 inhabitants



- \* KG active ingredients / 1,000 inhabitants
- \* DDDs / 1,000 inhabitant-days
- \* Dollars (000's) / 1,000 inhabitants

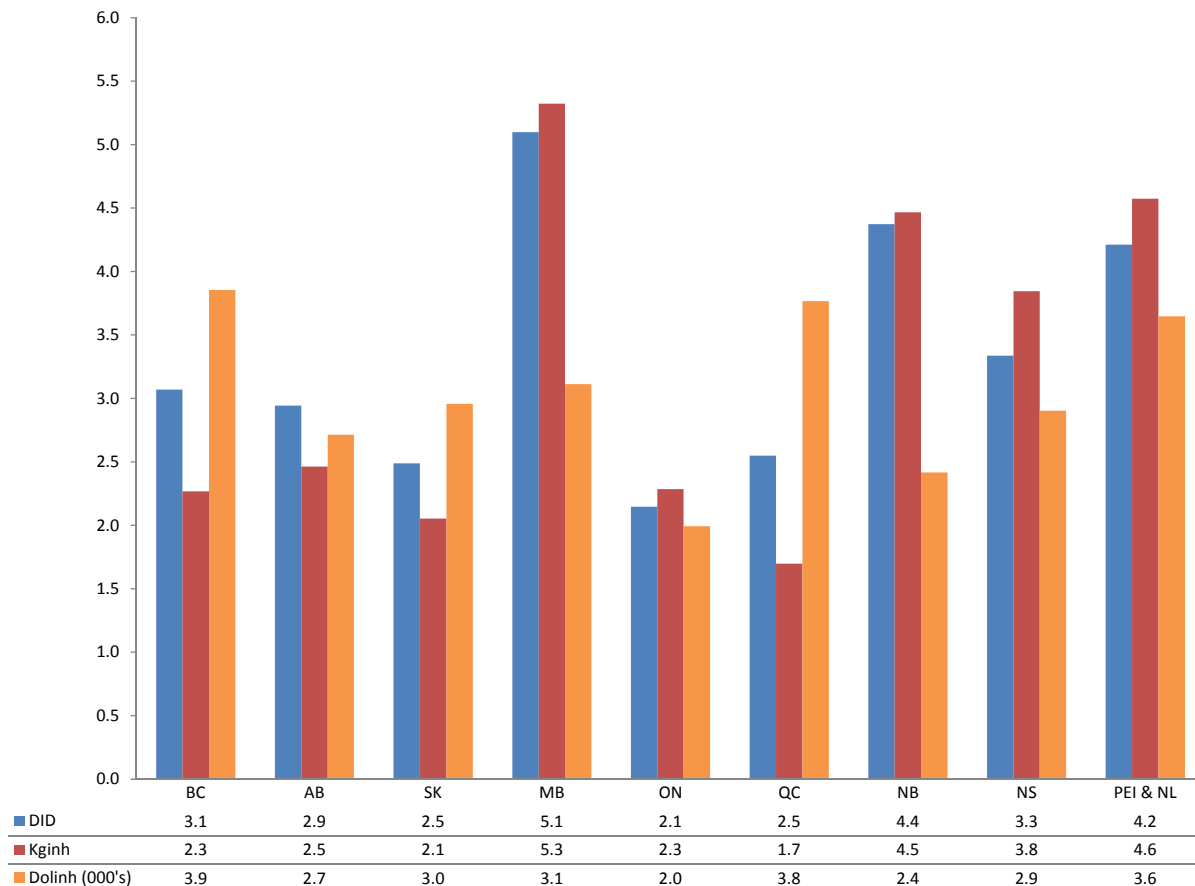
## PROVINCIAL PURCHASING

### Overall measures

Similar to the variation seen in the pharmacy dispensing data, there was a large amount of variation in hospital purchasing of antimicrobials in 2013 among the provinces. As in 2012, the province with the highest DIDs was Manitoba (5.1 DID) and lowest was Ontario (2.1 DID) (Figure 3.6).

Kilograms of active ingredient purchased per 1,000 inhabitants ranged from 1.7 in Québec to 5.3 in Manitoba. Interestingly, although DID and kilograms of active ingredient were highest in Manitoba, cost per 1,000 inhabitants was highest in British Columbia (\$3,856), and lowest in Ontario (\$1,994) (Figure 3.6).

**Figure 3.6: DID, kilograms of active ingredient, and cost per 1,000 inhabitants of antimicrobials purchased by hospitals in Canada, by province (2013).**



## Individual drug purchasing

### a. Defined daily doses per 1,000 inhabitant-days

Ceftriaxone was the antimicrobial with the largest number of DIDs purchased by hospitals in the majority of provinces in 2013. Interestingly however, this was not true of Ontario, Québec, or New Brunswick, where penicillin G held the highest DID ranking (Table 3.5) (ceftriaxone was the second highest rank in Ontario and New Brunswick, third highest in Québec).

The use of ceftriaxone in Manitoba appears to be driving the high DID values seen for this province; DIDs for ceftriaxone in Manitoba were 40% higher than in any other province. The use of this product ranged from 0.15 DIDs in Québec to 2.11 DIDs in Manitoba (Table 3.5). Penicillin G purchasing ranged from 0.07 DIDs purchased in British Columbia to 0.96 DIDs in Québec (Table 3.5).

### b. Mass of active ingredient (kg / 1,000 inhabitants)

By mass of active ingredient purchased (kg / 1,000 inhabitants), piperacillin and enzyme inhibitor was the antimicrobial with the most variation among the provinces (minimum 0.62 in Québec to maximum of 2.65 in New Brunswick) (Table 3.6). This product was the highest ranked drug in all provinces in 2013 with the exception of British Columbia, where ceftriaxone held the highest mass of active ingredient purchased. Ceftriaxone was among the top 3 ranked products among all provinces in 2013 with the exception of Québec (Table 3.6).

## Purchasing by route of administration

In all provinces in 2013, the majority of antimicrobials were purchased for parenteral administration in the hospital setting (Tables 3.7 and 3.8). However, the proportion of oral and parenteral products purchased among the provinces varied dramatically.

### a. Defined daily doses per 1,000 inhabitants

In Saskatchewan in 2013, DIDs for parenteral products accounted for 56% of hospital purchasing (Table 3.7). In contrast, purchasing in New Brunswick was more heavily weighted towards parenteral products, with 84% of antimicrobials purchased for parenteral administration by this measure. Provincial drug-level DID data from 2012 can be found in Appendix D, Table D.2.

### b. Mass (kg) of active ingredient per 1,000 inhabitants

The kilograms of active ingredient per 1,000 inhabitants displayed a similar pattern to the DIDs for the proportion of oral and parenteral products, though the variation was less dramatic (Table 3.8). Again, the lowest proportion of parenteral products was seen in Saskatchewan for 2013 (85%) and highest in New Brunswick (94%). Provincial drug-level mass of active ingredient data from 2012 can be found in Appendix D, Table D.3.

**Table 3.5: DIDs for antimicrobials purchased by hospitals in Canadian provinces, 2013**

Antimicrobial	BC	AB	SK	MB	ON	QC	NB	NS	PEI & NL	Rank*
Amoxicillin	0.15	0.08	0.14	0.48	0.07	0.05	0.07	0.08	0.28	7
Amoxicillin and enzyme inhibitor	0.06	0.05	0.04	0.12	0.03	0.08	0.06	0.05	0.09	12
Ampicillin	0.03	0.03	0.04	0.03	0.04	0.04	0.03	0.04	0.02	17
Azithromycin	0.14	0.06	0.21	0.17	0.10	0.10	0.08	0.05	0.11	6
Cefadroxil	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	40
Cefazolin	0.01	0.16	0.02	0.13	0.10	0.13	0.21	0.16	0.14	5
Cefepime	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	42
Cefixime	0.03	0.04	0.08	0.02	0.01	0.01	0.01	0.01	0.01	23
Cefotaxime	0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	34
Cefoxitin	0.07	0.04	0.10	0.29	0.03	0.07	0.07	0.08	0.03	11
Cefprozil	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	33
Ceftazidime	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	0.01	<0.01	37
Ceftriaxone	1.37	1.14	0.75	2.11	0.35	0.15	0.88	0.79	1.51	1
Cefuroxime	0.04	0.03	0.04	0.03	0.02	0.02	0.07	0.06	0.08	19
Cephalexin	0.06	0.05	0.06	0.22	0.04	0.02	0.04	0.06	0.09	16
Ciprofloxacin	0.10	0.11	0.10	0.14	0.12	0.24	0.17	0.36	0.25	4
Clarithromycin	0.04	0.03	0.03	0.03	0.02	0.03	0.04	0.04	0.07	20
Clindamycin	0.07	0.08	0.09	0.13	0.05	0.05	0.14	0.12	0.16	9
Cloxacillin	0.09	0.04	0.05	0.08	0.04	0.04	0.07	0.06	0.06	13
Colistin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	39
Daptomycin	0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	32
Doxycycline	0.25	0.08	0.10	0.06	0.06	0.03	0.05	0.07	0.04	8
Ertapenem	0.03	0.02	0.01	0.01	0.01	0.02	<0.01	0.01	0.03	25
Erythromycin	0.02	0.01	0.03	0.02	<0.01	<0.01	<0.01	<0.01	0.01	29
Gentamicin	0.01	0.02	0.02	0.01	0.01	0.02	0.01	0.02	0.02	24
Imipenem	0.01	<0.01	<0.01	<0.01	<0.01	0.03	<0.01	0.50	<0.01	22
Levofloxacin	0.02	0.08	0.03	0.10	0.05	0.03	0.08	0.07	0.01	15
Linezolid	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	36
Meropenem	0.03	0.02	0.02	0.02	0.02	0.04	0.01	0.01	0.02	21
Metronidazole	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	0.05	<0.01	30
Minocycline	0.01	<0.01	0.02	0.01	<0.01	0.01	<0.01	<0.01	0.01	31
Moxifloxacin	0.07	0.01	0.08	0.02	0.04	0.08	0.03	0.06	0.14	14
Nitrofurantoin	0.06	0.03	0.06	0.07	0.02	0.02	0.03	0.03	0.07	18
Norfloxacin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	38
Penicillin G	0.07	0.46	0.11	0.08	0.59	0.96	1.67	0.12	0.28	2
Penicillin V	0.02	<0.01	0.01	0.05	0.01	0.01	<0.01	0.01	0.02	27
Piperacillin and enzyme inhibitor	0.11	0.16	0.14	0.36	0.25	0.11	0.46	0.29	0.43	3
Sulfamethoxazole and trimethoprim	0.07	0.06	0.07	0.26	0.04	0.04	0.04	0.05	0.14	10
Tetracycline	0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	0.01	35
Tobramycin	<0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.02	26
Trimethoprim	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	41
Vancomycin	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	<0.01	0.01	<0.01	28
<b>TOTAL</b>	<b>3.07</b>	<b>2.94</b>	<b>2.49</b>	<b>5.10</b>	<b>2.15</b>	<b>2.55</b>	<b>4.37</b>	<b>3.34</b>	<b>4.21</b>	

\*Ranked from greatest to least DDDs at the national level in 2013

Antimicrobials were removed from this table if they represented <0.05% of DDDs in 2013. These are: amikacin, cefaclor, chloramphenicol, fosfomycin, lincomycin, methenamine mandelate, ofloxacin, piperacillin, spiramycin, streptomycin, ticarcillin and enzyme inhibitor, and tigecycline.

**Table 3.6: Mass of active ingredient purchased by hospitals in Canadian provinces, by antimicrobial, 2013**

Antimicrobial	BC	AB	SK	MB	ON	QC	NB	NS	PEI & NL	Rank*
Amoxicillin	0.05	0.03	0.05	0.18	0.02	0.02	0.02	0.03	0.10	10
Amoxicillin and enzyme inhibitor	0.03	0.02	0.02	0.05	0.01	0.04	0.03	0.02	0.04	14
Ampicillin	0.02	0.02	0.03	0.02	0.03	0.03	0.02	0.03	0.01	13
Azithromycin	0.02	0.01	0.02	0.02	0.01	0.02	0.01	0.01	0.01	16
Cefadroxil	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	37
Cefazolin	0.01	0.18	0.02	0.15	0.11	0.14	0.23	0.17	0.16	5
Cefixime	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	28
Cefotaxime	0.01	0.01	0.02	0.01	<0.01	0.01	0.01	0.01	0.01	21
Cefoxitin	0.14	0.09	0.22	0.63	0.06	0.16	0.16	0.17	0.07	3
Cefprozil	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	31
Ceftazidime	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	0.01	<0.01	25
Ceftriaxone	1.00	0.83	0.55	1.54	0.26	0.11	0.64	0.58	1.10	2
Cefuroxime	0.01	0.01	0.01	0.01	<0.01	0.01	0.02	0.01	0.02	19
Cephalexin	0.04	0.03	0.04	0.16	0.03	0.01	0.03	0.04	0.06	11
Ciprofloxacin	0.04	0.04	0.03	0.05	0.04	0.06	0.05	0.08	0.09	6
Clarithromycin	0.01	0.01	0.01	0.01	<0.01	0.01	0.01	0.01	0.01	23
Clindamycin	0.04	0.05	0.05	0.08	0.03	0.03	0.09	0.08	0.10	8
Cloxacillin	0.06	0.03	0.03	0.06	0.03	0.03	0.05	0.04	0.05	9
Doxycycline	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	27
Ertapenem	0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	<0.01	0.01	24
Erythromycin	0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	29
Gentamicin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	32
Imipenem	0.01	<0.01	<0.01	<0.01	<0.01	0.04	<0.01	0.73	<0.01	12
Levofloxacin	<0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.01	<0.01	17
Linezolid	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	33
Meropenem	0.02	0.01	0.02	0.01	0.01	0.03	0.01	0.01	0.01	15
Metronidazole	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.03	<0.01	26
Moxifloxacin	0.01	<0.01	0.01	<0.01	0.01	0.01	<0.01	0.01	0.02	18
Nitrofurantoin	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	0.01	30
Penicillin G	0.02	0.10	0.02	0.02	0.13	0.21	0.37	0.03	0.06	4
Penicillin V	0.01	<0.01	0.01	0.04	<0.01	<0.01	<0.01	<0.01	0.02	20
Piperacillin and enzyme inhibitor	0.62	0.90	0.78	2.06	1.44	0.62	2.65	1.65	2.49	1
Sulfamethoxazole and trimethoprim	0.05	0.04	0.05	0.18	0.03	0.03	0.03	0.04	0.10	7
Tetracycline	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	35
Ticarcillin and enzyme inhibitor	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	36
Tobramycin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	34
Vancomycin	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	0.01	<0.01	22
<b>TOTAL</b>	<b>2.27</b>	<b>2.46</b>	<b>2.05</b>	<b>5.32</b>	<b>2.29</b>	<b>1.70</b>	<b>4.47</b>	<b>3.85</b>	<b>4.57</b>	

\*Ranked from greatest to least mass at the national level in 2013

Antimicrobials were removed from this table if they represented <0.05% of mass in 2013. These are: amikacin, cefaclor, cefepime, chloramphenicol, colistin, daptomycin, fosfomycin, lincomycin, methenamine mandelate, minocycline, norfloxacin, ofloxacin, piperacillin, spiramycin, streptomycin, tigecycline, and trimethoprim..

**Table 3.7.: Defined daily doses per 1,000 inhabitants for antimicrobials purchased by Canadian pharmacies, by antimicrobial and province, 2013.**

Antimicrobial	Route of administration	BC	AB	SK	MB	ON	QC	NB	NS	PEI & NL
Amoxicillin	Oral	0.15	0.08	0.14	0.48	0.07	0.05	0.07	0.08	0.28
Amoxicillin and enzyme inhibitor	Oral	0.06	0.05	0.04	0.12	0.03	0.08	0.06	0.05	0.09
Ampicillin	Oral	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Parenteral	0.03	0.03	0.04	0.03	0.04	0.04	0.03	0.04	0.01
Azithromycin	Oral	0.14	0.05	0.20	0.16	0.09	0.03	0.06	0.05	0.09
	Parenteral	0.01	0.01	0.01	0.01	0.01	0.06	0.02	<0.01	0.01
Cefazolin	Parenteral	0.01	0.16	0.02	0.13	0.10	0.13	0.21	0.16	0.14
Cefoxitin	Parenteral	0.07	0.04	0.10	0.29	0.03	0.07	0.07	0.08	0.03
Ceftriaxone	Parenteral	1.37	1.14	0.75	2.11	0.35	0.15	0.88	0.79	1.51
Cefuroxime	Oral	0.04	0.03	0.04	0.03	0.02	0.02	0.07	0.06	0.08
	Parenteral				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cephalexin	Oral	0.06	0.05	0.06	0.22	0.04	0.02	0.04	0.06	0.09
Ciprofloxacin	Oral	0.10	0.11	0.10	0.14	0.11	0.11	0.10	0.09	0.23
	Parenteral	<0.01		<0.01	<0.01	0.02	0.13	0.07	0.27	0.02
Clarithromycin	Oral	0.04	0.03	0.03	0.03	0.02	0.03	0.04	0.04	0.07
Clindamycin	Oral	0.02	0.02	0.02	0.05	0.01	0.01	0.01	0.01	0.03
	Parenteral	0.04	0.06	0.07	0.09	0.03	0.04	0.13	0.11	0.14
Cloxacillin	Oral	0.01	0.01	0.01	0.03	<0.01	<0.01	0.01	0.03	0.02
	Parenteral	0.08	0.04	0.04	0.05	0.04	0.03	0.06	0.03	0.05
Doxycycline	Oral	0.25	0.08	0.10	0.06	0.06	0.03	0.05	0.07	0.04
Levofloxacin	Oral	0.02	0.08	0.03	0.10	0.05	0.03	0.08	0.07	0.01
	Parenteral	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Moxifloxacin	Oral	0.05	0.01	0.05	0.02	0.03	0.07	0.02	0.04	0.10
	Parenteral	0.02	<0.01	0.03	<0.01	0.01	0.01	0.01	0.02	0.05
Nitrofurantoin	Oral	0.06	0.03	0.06	0.07	0.02	0.02	0.03	0.03	0.07
Penicillin G	Parenteral	0.07	0.46	0.11	0.08	0.59	0.96	1.67	0.12	0.28
Piperacillin and enzyme inhibitor	Parenteral	0.11	0.16	0.14	0.36	0.25	0.11	0.46	0.29	0.43
Sulfamethoxazole and trimethoprim	Oral	0.07	0.06	0.07	0.26	0.04	0.04	0.04	0.05	0.13
	Parenteral	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
<b>TOTAL</b>	Oral	1.14	0.75	1.10	1.87	0.62	0.60	0.70	0.77	1.43
	Parenteral	1.93	2.19	1.39	3.23	1.52	1.95	3.67	2.57	2.78

Antimicrobials were removed from this table if they represented <1% of DIDs in 2013. These are: amikacin, cefaclor, cefadroxil, cefepime, cefixime, cefotaxime, ceftazidime, ertapenem, gentamicin, imipenem, lincomycin, linezolid, meropenem, methenamine mandelate, metronidazole, minocycline, norfloxacin, ofloxacin, penicillin v, streptomycin, trimethoprim, and vancomycin

**Table 3.8.: Kilograms of active ingredient per 1,000 inhabitants for antimicrobials purchased by Canadian pharmacies, by antimicrobial and province, 2013.**

Antimicrobial	Route of administration	BC	AB	SK	MB	ON	QC	NB	NS	PEI & NL
Amoxicillin	Oral	0.05	0.03	0.05	0.18	0.02	0.02	0.02	0.03	0.10
Ampicillin	Oral	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Parenteral	0.02	0.02	0.03	0.02	0.03	0.03	0.02	0.03	0.01
Cefazolin	Parenteral	0.01	0.18	0.02	0.15	0.11	0.14	0.23	0.17	0.16
Cefoxitin	Parenteral	0.14	0.09	0.22	0.63	0.06	0.16	0.16	0.17	0.07
Ceftriaxone	Parenteral	1.00	0.83	0.55	1.54	0.26	0.11	0.64	0.58	1.10
Cephalexin	Oral	0.04	0.03	0.04	0.16	0.03	0.01	0.03	0.04	0.06
Ciprofloxacin	Oral	0.04	0.04	0.03	0.05	0.04	0.04	0.04	0.03	0.09
	Parenteral	<0.01		<0.01	<0.01	<0.01	0.02	0.01	0.05	<0.01
Clindamycin	Oral	0.01	0.01	0.01	0.02	0.01	<0.01	0.01	0.01	0.01
	Parenteral	0.03	0.04	0.05	0.06	0.02	0.03	0.09	0.07	0.09
Cloxacillin	Oral	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.02	0.01
	Parenteral	0.06	0.03	0.03	0.04	0.03	0.02	0.05	0.02	0.03
Imipenem	Parenteral	0.01	0.00		0.00	0.00	0.04		0.73	
Penicillin G	Parenteral	0.02	0.10	0.02	0.02	0.13	0.21	0.37	0.03	0.06
Piperacillin and enzyme inhibitor	Parenteral	0.62	0.90	0.78	2.06	1.44	0.62	2.65	1.65	2.49
Sulfamethoxazole and trimethoprim	Oral	0.05	0.04	0.05	0.18	0.03	0.03	0.03	0.03	0.09
	Parenteral	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
<b>TOTAL</b>	Oral	0.30	0.23	0.30	0.77	0.19	0.19	0.21	0.25	0.50
	Parenteral	1.97	2.23	1.75	4.55	2.10	1.50	4.25	3.60	4.07

Antimicrobials were removed from this table if they represented <1% of mass in 2013. These are: amikacin, amoxicillin and enzyme inhibitor, azithromycin, cefaclor, cefadroxil, cefepime, cefixime, cefotaxime, cefprozil, ceftazidime, cefuroxime, chloramphenicol, clarithromycin, colistin, daptomycin, doxycycline, ertapenem, erythromycin, fosfomycin, gentamicin, levofloxacin, lincomycin, linezolid, meropenem, methenamine mandelate, metronidazole, minocycline, moxifloxacin, nitrofurantoin, norfloxacin, ofloxacin, penicillin v, piperacillin, spiramycin, streptomycin, tetracycline, ticarcillin and enzyme inhibitor, tigecycline, tobramycin, trimethoprim, and vancomycin.



## APPENDIX A

### METHODS FOR DATA COLLECTION AND ANALYSIS

#### Physician Diagnosis Data

The Canadian Disease and Therapeutic Index (CDTI) is a 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). These data are presented over three geographic regions in Canada: West (British Columbia, Alberta, Saskatchewan, and Manitoba), Central (Québec and Ontario), and East (New Brunswick, Newfoundland and Labrador, Nova Scotia, and Prince Edward Island).

The sample of physicians represents all major specialties across Canada. Data from 652 physicians were available in 2013, and projection methods were used to extrapolate data to a universe of approximately 55,092 physicians in Canada. Data on physician prescription/recommendations were extracted from the IMS Health Canada database.

For four consecutive quarters, each physician in the CDTI group maintains a practice diary describing information on every patient visit during a randomly selected 48-hour period within the quarter. 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. 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 diagnoses, defined by the International Classification of Diseases Ninth Revision System (ICD-9), and associated with antimicrobial drug mentions for sampled physicians.

The total number of antimicrobial recommendations and number of diagnoses per 10,000 individuals for a given year, age or region was obtained by dividing by the size of the population in thousands during that year, age group and region (Table A.1 and Table A.2).

Some limitations and caveats should be considered for assessing data from 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.
- Although diagnoses are listed for each visit, diagnoses are not necessarily made at the visit in question, as previous diagnoses are recorded for chronic conditions.
- The data does not include patient visits to primary care nurses.
- Visit counts do not translate into number of patients (multiple visits per individual are possible, as well as multiple diagnoses per individual)
- Drug recommendations are not necessarily tied to a prescription, as samples may be given by the practitioner. Similarly, patients may choose not to fill a prescription.
- 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).
- 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, age group, the number of prescriptions dispensed, units of product dispensed, and dollars spent monthly for each year.

The sampling frame (or “universe”) for this dataset in 2013 consisted of 5,692 pharmacies, covering approximately 62% all retail pharmacies in the Canadian provinces. IMS Health Canada uses a method of geospatial projection that creates projection factors for application to all non-participating stores. Projection is performed on the basis of the number of stores in the area, distance between stores, and store size. The projection factor was used to extrapolate the number of prescriptions and units dispensed in the stores actually sampled to that of the “universe” (9,140 pharmacies).

In previous reports (2011 and earlier), antimicrobials administered by non-oral routes were excluded from analyses. In the 2012/2013 report, these data were included and classified retrospectively back to January 2010. Consequently, the 2012/2013 report describes orally administered drugs for the years 2000-2009, and oral and parenteral drug formulations for 2010-2013. Information for antimicrobials for systemic use (those in the ATC group J01) are included in this report.

The use of metronidazole was added in 2005. Data for metronidazole could not be extracted at the time of analysis for year 2000. Therefore, metronidazole data are missing from tables and totals for 2000.

Defined daily doses (DDDs) were determined according to the World Health Organization's Collaborating Centre for Drug Statistics Methodology. 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). 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. Where a DDD was not available for both routes of administration, the available DDD was used (e.g., for benzylpenicillin, kanamycin).

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 antimicrobial drug 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 2011 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 six 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 2,750 retail pharmacy outlets, and over 650 hospitals. A method of geographical projection was used to create projection factors for a “universe” of approximately 9,000 drugstores and over 750 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 as pharmacy information was presented using the CompuScript data.

Only information regarding antimicrobials for systemic use was included in the analysis. Defined daily doses (DDDs) were determined according to the World Health Organization's Collaborating Centre for Drug Statistics Methodology. 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.

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<sup>1</sup> Bank of Canada. Inflation calculator.: <http://www.bankofcanada.ca/rates/related/inflation-calculator/> Accessed July 2014.

Where a DDD was not available for both routes of administration, the available DDD was used (e.g., for benzylpenicillin, kanamycin).

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 antimicrobial drug 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 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 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.: <http://www.bankofcanada.ca/rates/related/inflation-calculator/> Accessed July 2014..

## Population sizes used for analysis of all datasets.

**Table A.1: Population values for Canadian provinces in 2013**

Province	Population (000's)	
	2012	2013
British Columbia	4,599.8	4,638.2
Alberta	3,924.6	4,061.0
Saskatchewan	1,098.6	1,119.5
Manitoba	1,263.5	1,278.2
Ontario	13,564.0	13,688.6
Québec	8,182.6	8,255.5
New Brunswick	767.5	766.6
Nova Scotia	958.4	953.6
Prince Edward Island	147.2	147.3
Newfoundland and Labrador	534.3	534.3
Canada	35,040.5	35,442.9

**Table A.2: Population values for age groups, by province in 2013**

Province	Population (thousands)						
	0-5	6-11	12-17	18-39	40-59	60-64	65+
British Columbia	267.2	268.7	302.8	1351.3	1345.6	294.0	808.6
Alberta	315.6	281.1	280.9	1373.0	1126.1	199.2	485.2
Saskatchewan	87.8	80.3	82.8	342.4	294.2	60.8	171.3
Manitoba	95.6	92.7	99.3	381.0	343.8	70.3	195.5
Ontario	864.3	873.9	958.5	4027.0	3966.7	789.6	2208.5
Québec	535.6	480.0	504.3	2392.7	2365.7	521.8	1455.4
New Brunswick	43.5	44.0	49.0	201.9	230.9	53.7	143.5
Nova Scotia	52.6	52.7	60.9	257.4	284.8	65.6	179.7
Prince Edward Island	8.9	9.2	10.3	38.4	43.2	10.1	27.1
Newfoundland and Labrador	29.4	30.8	33.0	138.7	164.8	40.0	97.6
Canada	2300.5	2213.4	2381.8	10503.8	10165.7	2105.2	5772.5

## APPENDIX B – ADDITIONAL PHYSICIAN DIAGNOSIS DATA

**Table B.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, 2012<sup>1</sup>.**

Diagnostic Class	Total diagnoses	Number of diagnoses / 10,000 inhabitants	Antimicrobial recommendations (N)	Number of antimicrobial recommendations / 10,000 individuals	Percentage of diagnoses with antimicrobial recommendations
Acne	2137030	609.87	535210	152.74	25.04
Acute bronchitis	2547010	726.88	1961240	559.71	77.00
Acute sinusitis	1626800	464.26	1427640	407.43	87.76
Chronic bronchitis	1175000	335.33	837670	239.06	71.29
Chronic sinusitis	1319090	376.45	676670	193.11	51.30
Disease of the gastrointestinal system	19616280	5598.18	1163000	331.90	5.93
Diseases of the ear	9054310	2583.96	2425050	692.07	26.78
Injuries and poisonings	13093100	3736.56	419120	119.61	3.20
Lower UTI or Cystitis	4715880	1345.84	3173210	905.58	67.29
Other diseases of the genitourinary system	14987530	4277.20	1451450	414.22	9.68
Other respiratory tract infections	16063670	4584.32	1059120	302.26	6.59
Other skin and soft tissue infections	15835440	4519.19	644330	183.88	4.07
Pneumonia	1443120	411.84	1184910	338.15	82.11
SSTIs	2731830	779.62	1780290	508.07	65.17
Symptoms and ill-defined conditions	21925630	6257.23	401270	114.52	1.83
Upper respiratory tract infections	11172760	3188.53	3664680	1045.84	32.80
<b>TOTAL</b>	<b>289219210</b>	<b>82538.61</b>	<b>23543270</b>	<b>6718.88</b>	<b>8.14</b>

Diagnostic classes were removed from this table if they represented < 1% of antimicrobial mentions in 2012. These classes were: complications of pregnancy, childbirth, and puerperal; congenital anomalies; diseases of the central nervous system; diseases of the circulatory system; diseases of the sense organs; endocrine, nutritional, metabolic, and immunity diseases; musculoskeletal diseases; neoplasms; perinatal conditions; supplementary classifications; and upper UTI or pyelonephritis.

<sup>1</sup> 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.

## APPENDIX C – ADDITIONAL PHARMACY DISPENSATION DATA

**Table C.1: Anatomical Therapeutic Group (ATC) classification of antimicrobials used in Canada 2000 – 2013.**

Therapeutic Group	ATC Class	Antimicrobials	Therapeutic Group	ATC Class	Antimicrobials
Aminoglycosides	J01GA & J01GB	amikacin	Other cephalosporins and penems	J01DD & J01DE	cefepime
		gentamicin			cefixime
		streptomycin			cefotaxime
		tobramycin			ceftazidime
Amphenicols	J01BA	chloramphenicol			ceftriaxone
Beta-lactamase sensitive & resistant penicillins	J01CE & J01CF	cloxacillin	Penicillins with extended spectrum	J01CA	amoxicillin
		flucloxacillin			amoxicillin and enzyme inhibitor
		penicillin g			ampicillin
		penicillin v			piperacillin
Carbapenems	J01DH	ertapenem			piperacillin and tazobactam
		imipenem and cilastatin			ticarcillin and clavulanic acid
		meropenem			
First-generation cephalosporins	J01DB	cefadroxil	Quinolone antibacterials	J01MA	ciprofloxacin
		cefazolin			levofloxacin
		cephalexin			moxifloxacin
Macrolides, lincosamides and streptogramins	J01FA & J01FF	azithromycin			ofloxacin
		clarithromycin	Second-generation cephalosporins	J01DC	cefaclor
		clindamycin			cefoxitin
		erythromycin			cefprozil
		lincomycin			cefuroxime
		spiramycin			sulfadiazine
		sulfamethoxazole			
Methenamine	J01XX	methenamine mandelate	Sulfonamides	J01EC	sulfamethoxazole and trimethoprim
Other antibacterials	J01X	colistin	Tetracyclines	J01AA	doxycycline
	J01XX	daptomycin			minocycline
	A07AA	fidaxomicin			tetracycline
	J01XX	fosfomicin			tigecycline
	J01XC	fusidic acid	Trimethoprim	J01EA	trimethoprim
	J01XX	linezolid			
	J01XD	metronidazole			
	J01XE	nitrofurantoin			
J01XA	vancomycin				





**Table C.3: Prescriptions per 1,000 inhabitants of oral and parenteral antimicrobials dispensed by retail pharmacies in Canada, by province. 2012**

Antimicrobial	BC	AB	SK	MB	ON	QC	NB	NS	PEI	NF	Rank*
Amoxicillin	141.35	178.84	236.37	186.62	188.57	99.12	150.73	168.80	161.62	262.68	1
Amoxicillin and enzyme inhibitor	21.37	30.36	21.48	26.70	18.78	31.74	24.96	25.42	71.68	49.54	8
Ampicillin	0.38	0.24	4.54	0.25	0.59	0.15	0.52	0.63	2.15	6.38	26
Azithromycin	29.81	52.17	73.27	84.93	70.44	52.08	76.48	57.36	65.04	83.07	4
Cefadroxil	0.09	0.19	0.01	0.05	0.19	12.53	0.66	0.09	0.00	0.02	23
Cefixime	6.42	8.62	2.34	3.39	5.78	5.20	4.05	5.79	11.92	9.73	19
Cefprozil	0.57	12.09	4.37	7.72	20.06	20.82	7.35	15.03	4.87	0.49	14
Cefuroxime	10.62	8.34	8.46	4.96	8.65	5.57	25.78	16.82	7.13	28.60	16
Cephalexin	59.57	62.16	98.50	65.44	53.21	15.90	57.65	64.12	62.76	77.14	5
Ciprofloxacin	59.12	61.70	52.36	59.02	48.81	80.99	50.25	50.74	57.23	122.44	3
Clarithromycin	55.32	71.73	40.38	36.78	63.73	61.51	67.14	51.90	66.98	93.65	2
Clindamycin	21.74	28.76	32.90	19.53	22.05	19.67	23.91	22.58	18.61	22.57	10
Cloxacillin	6.25	6.11	11.82	12.86	6.16	4.53	5.01	6.84	12.01	12.56	18
Doxycycline	26.91	19.21	52.74	14.13	11.66	10.66	18.46	28.68	28.19	21.80	12
Erythromycin	5.87	3.79	16.83	5.60	2.83	1.02	3.26	6.51	21.87	5.74	22
Levofloxacin	1.55	11.53	2.55	14.33	10.83	7.96	2.53	10.03	7.62	2.83	17
Metronidazole	19.41	22.06	22.53	19.74	19.49	16.21	20.24	21.24	18.03	25.85	11
Minocycline	12.58	21.14	6.06	14.49	8.68	24.41	12.98	15.27	9.81	14.48	15
Moxifloxacin	13.88	10.11	12.58	6.43	13.95	25.05	20.50	10.53	25.84	13.85	13
Nitrofurantoin	43.75	27.91	48.00	21.72	41.49	17.96	33.64	44.77	27.83	26.93	6
Norfloxacin	0.64	3.22	0.26	0.60	8.07	0.72	15.37	2.59	7.62	7.03	21
Penicillin V	23.57	26.54	15.87	24.55	19.26	32.44	29.54	24.49	26.50	27.12	9
Sulfamethoxazole and trimethoprim	28.04	30.12	52.33	38.60	29.04	20.92	38.14	44.97	50.62	49.15	7
Tetracycline	4.58	3.20	4.94	4.63	7.08	2.35	2.90	4.35	10.08	4.36	20
Trimethoprim	0.73	1.05	2.63	0.78	1.90	3.84	2.19	0.89	0.63	2.12	24
Vancomycin	0.66	0.36	0.36	0.27	0.34	2.11	0.66	0.70	0.46	0.22	25
TOTAL	595.63	702.33	825.61	674.84	683.00	579.78	700.15	704.22	779.58	972.23	

\*Ranked from greatest to least prescribing in 2012

Antimicrobials were removed from this table if they represented <0.05% of prescribing in 2012. These are: amikacin, cefaclor, cefazolin, cefepime, cefotaxime, ceftazidime, ceftiofur, chloramphenicol, colistin, daptomycin, ertapenem, erythromycin ethylsuccinate, fidaxomicin, fosfomicin, fusidic acid, gentamicin, imipenem and cilastatin, lincomycin, linezolid, meropenem, methenamine mandelate, ofloxacin, penicillin G, piperacillin, piperacillin and tazobactam, spiramycin, streptomycin, sulfadiazine, sulfamethoxazole, ticarcillin and clavulanic acid, tigecycline, and tobramycin.



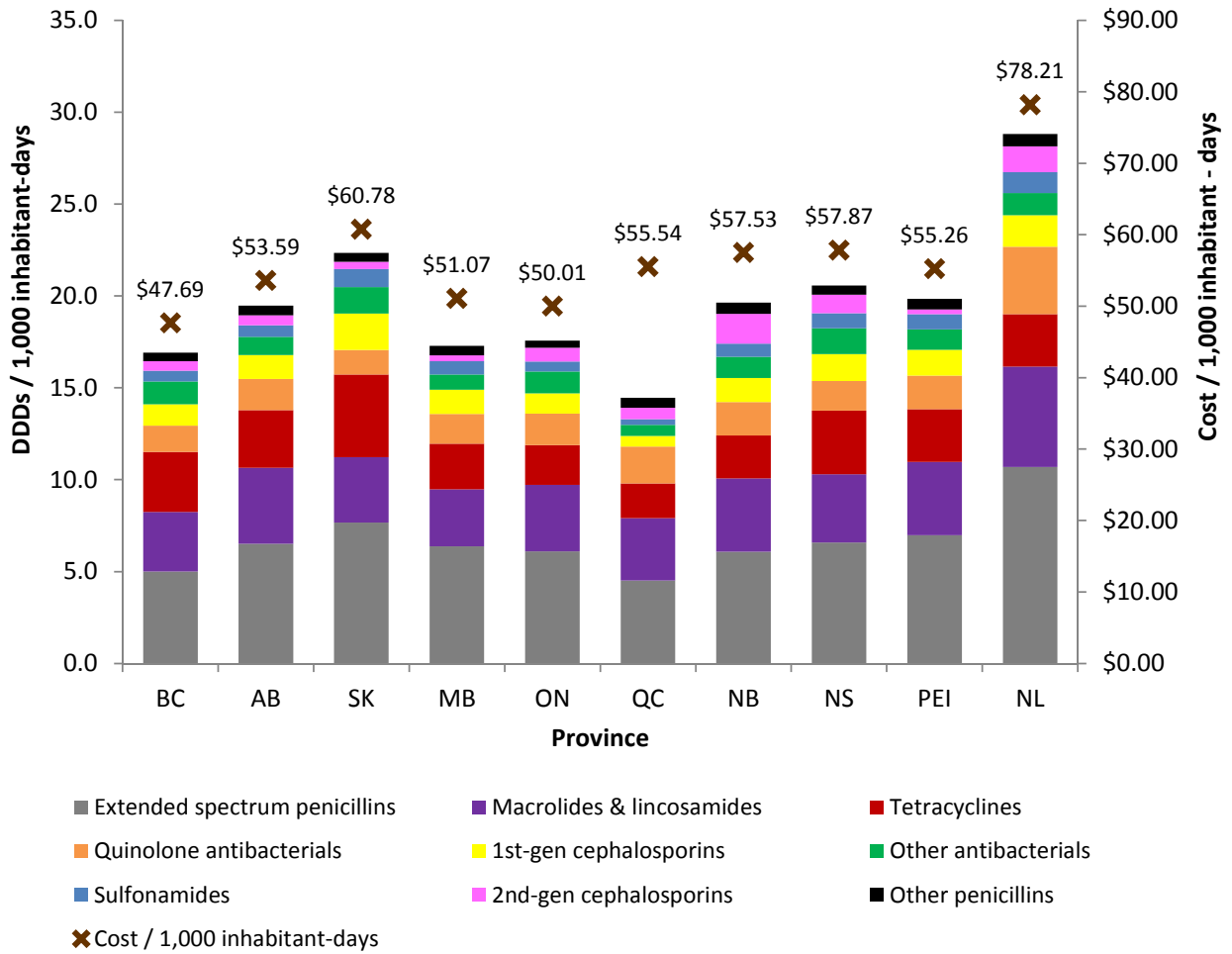
**Table C.4: Defined daily doses per 1,000 inhabitants of oral and parenteral antimicrobials dispensed by retail pharmacies in Canada, by province, 2012**

Antimicrobial	BC	AB	SK	MB	ON	QC	NB	NS	PEI	NF	Rank*
Amoxicillin	4.03	5.17	6.62	5.62	5.44	3.28	4.92	5.13	4.84	8.11	1
Amoxicillin and enzyme inhibitor	0.76	1.05	0.70	0.99	0.70	1.17	0.99	0.96	2.28	1.74	7
Ampicillin	0.01	0.01	0.09	0.00	0.01	0.00	0.01	0.01	0.04	0.14	26
Azithromycin	0.72	0.98	1.16	1.33	1.20	0.74	1.13	0.86	0.79	1.24	5
Cefadroxil	<0.01	<0.01	<0.01	<0.01	<0.01	0.16	0.01	<0.01	<0.01	<0.01	24
Cefixime	0.12	0.15	0.03	0.06	0.09	0.07	0.07	0.09	0.24	0.21	21
Cefprozil	0.01	0.23	0.06	0.14	0.37	0.43	0.14	0.29	0.08	0.01	16
Cefuroxime	0.45	0.36	0.33	0.21	0.37	0.25	1.26	0.76	0.29	1.36	12
Cephalexin	1.13	1.23	1.89	1.24	1.07	0.31	1.23	1.38	1.33	1.62	6
Ciprofloxacin	1.13	1.22	1.07	1.17	1.04	1.23	1.01	1.12	1.10	3.24	4
Clarithromycin	2.32	3.11	1.59	1.58	2.66	2.64	3.07	2.32	2.91	4.27	2
Clindamycin	0.38	0.52	0.60	0.37	0.38	0.35	0.47	0.41	0.36	0.42	11
Cloxacillin	0.13	0.13	0.25	0.28	0.14	0.10	0.14	0.15	0.25	0.28	19
Doxycycline	1.97	1.52	4.06	1.32	1.06	0.76	1.17	1.67	1.63	1.53	3
Erythromycin	0.18	0.14	0.45	0.17	0.11	0.04	0.11	0.21	0.64	0.20	20
Levofloxacin	0.04	0.29	0.06	0.34	0.27	0.19	0.07	0.23	0.18	0.08	18
Metronidazole	0.25	0.28	0.29	0.28	0.26	0.21	0.28	0.28	0.26	0.34	17
Minocycline	0.86	1.39	0.31	0.83	0.68	0.97	0.80	1.16	0.69	0.93	8
Moxifloxacin	0.32	0.26	0.27	0.16	0.35	0.59	0.50	0.26	0.65	0.33	13
Nitrofurantoin	0.96	0.69	1.18	0.55	0.93	0.36	0.86	1.11	0.80	0.78	9
Norfloxacin	0.01	0.07	0.01	0.02	0.17	0.01	0.35	0.07	0.16	0.21	22
Ofloxacin	0.01	0.01	<0.01	0.01	0.02	0.02	0.02	0.04	0.06	0.08	25
Penicillin V	0.38	0.44	0.28	0.36	0.30	0.48	0.48	0.40	0.54	0.47	14
Sulfamethoxazole and trimethoprim	0.61	0.67	0.95	0.73	0.53	0.32	0.73	0.83	1.02	1.11	10
Tetracycline	0.34	0.21	0.28	0.32	0.48	0.10	0.24	0.30	0.71	0.39	15
Trimethoprim	0.03	0.04	0.09	0.02	0.06	0.05	0.05	0.03	0.01	0.11	23
<b>TOTAL</b>	<b>17.20</b>	<b>20.21</b>	<b>22.63</b>	<b>18.12</b>	<b>18.70</b>	<b>14.96</b>	<b>20.24</b>	<b>20.15</b>	<b>21.88</b>	<b>29.24</b>	

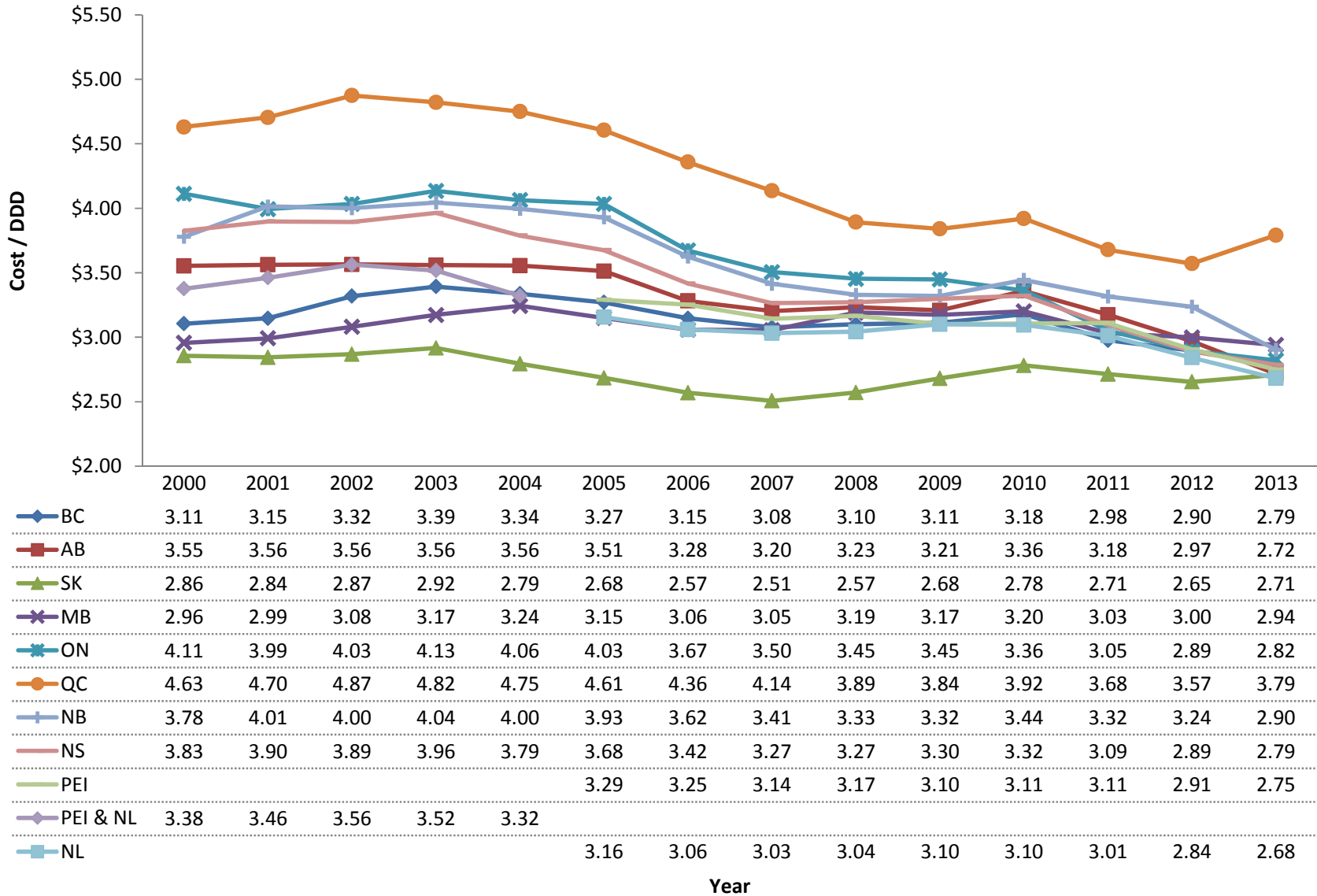
\*Ranked from greatest to least DDDs in 2012

Antimicrobials were removed from this table if they represented <0.05% of DDDs in 2012. These are: amikacin, cefaclor, cefazolin, cefepime, cefotaxime, cefoxitin, ceftazidime, ceftriaxone, chloramphenicol, colistin, daptomycin, ertapenem, erythromycin ethylsuccinate, fidaxomicin, fosfomycin, fusidic acid, gentamicin, imipenem and cilastatin, lincomycin, linezolid, meropenem, methenamine mandelate, penicillin g, piperacillin, piperacillin and tazobactam, spiramycin, streptomycin, sulfadiazine, sulfamethoxazole, ticarcillin and clavulanic acid, tigecycline, tobramycin, and vancomycin.

**Figure C.1. Defined daily doses and cost per 1,000 inhabitant-days, by antimicrobial class and province, 2013**



**Figure C.2. Cost per DDD dispensed by retail pharmacies in Canada, by province (oral antimicrobials 2000 – 2009, oral and parenteral antimicrobials 2010 – 2013)**



## APPENDIX D – ADDITIONAL HOSPITAL PURCHASING DATA

**Table D.1: Kilograms of active ingredient purchased by hospitals in Canada, 2001- 2013.**

Antimicrobial	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Rank*
Amoxicillin	1262.73	1167.00	1103.41	1066.42	1173.60	1013.37	971.34	973.26	1044.73	1100.21	1159.93	1197.41	1263.35	10
Amoxicillin and enzyme inhibitor	272.44	328.61	406.08	451.77	540.86	620.94	478.72	503.34	586.48	590.87	722.51	819.71	830.83	14
Ampicillin	2275.11	1341.79	1295.13	1318.27	2050.84	2210.65	1357.88	1118.16	1056.24	988.52	982.71	953.45	947.68	13
Azithromycin	159.98	189.22	228.95	213.18	226.51	193.11	239.10	261.23	296.26	281.07	330.47	414.45	462.08	16
Cefadroxil	12.45	14.20	17.80	23.45	22.55	25.60	28.60	32.35	40.55	31.35	35.25	37.70	42.70	37
Cefazolin	3927.45	4228.99	4278.14	4128.03	4151.53	3896.28	4428.73	4570.26	4864.67	4589.91	4575.73	4691.44	4060.75	5
Cefixime	36.78	39.46	35.86	24.04	28.32	29.68	37.16	42.55	53.93	57.10	72.61	95.15	97.04	28
Cefotaxime	593.37	628.39	731.14	765.77	782.82	847.58	838.68	567.25	545.93	317.48	286.02	255.05	195.22	21
Cefoxitin	7653.08	11208.45	12789.57	12594.00	10113.11	9756.92	9705.48	8560.82	10350.01	7870.20	7797.13	6257.71	4614.48	3
Cefprozil	37.45	40.56	55.23	66.29	51.42	46.98	50.41	52.04	68.47	60.29	55.28	52.39	49.75	31
Ceftazidime	410.93	567.86	457.12	455.27	716.59	512.58	155.81	157.84	151.19	153.87	149.39	156.56	142.80	25
Ceftriaxone	272.36	438.53	615.62	722.56	789.33	843.65	999.33	1215.56	1499.93	1528.40	2942.70	9146.01	16794.88	2
Cefuroxime	1089.74	916.64	730.68	616.70	554.66	386.42	347.27	298.97	297.41	226.61	257.25	232.23	223.04	19
Cephalexin	1077.73	1123.48	1226.69	1239.41	1362.13	1664.34	1094.83	1084.37	1097.21	1003.52	1101.53	1160.27	1212.72	11
Ciprofloxacin	1741.41	1598.12	1653.27	1702.93	1538.76	1631.67	1643.50	1636.99	1617.46	1433.96	1453.08	1507.31	1710.37	6
Clarithromycin	355.57	333.38	311.45	300.86	304.33	294.18	298.57	301.95	317.24	265.43	275.68	248.88	192.19	23
Clindamycin	604.30	588.49	556.90	515.76	547.73	866.25	919.12	907.78	919.97	857.34	882.35	867.61	1413.53	8
Cloxacillin	1626.03	1550.90	1517.02	1454.70	1413.03	1336.41	1311.96	1256.98	1396.81	1243.30	1329.25	1329.24	1292.02	9
Doxycycline	47.45	34.43	43.96	49.59	44.68	48.50	80.55	131.47	86.95	93.17	116.76	97.32	106.73	27
Ertapenem			0.80	8.38	20.35	33.89	43.04	64.27	86.45	102.15	143.79	167.09	183.08	24
Erythromycin	263.94	276.17	297.10	201.32	208.89	184.92	179.84	162.23	149.82	115.86	133.60	98.43	82.77	29
Gentamicin	88.41	72.14	53.52	34.70	49.82	91.12	88.95	78.21	68.12	63.98	59.54	57.36	47.85	32
Imipenem	301.09	936.85	1083.44	215.78	296.05	265.70	278.19	254.51	261.83	242.36	793.08	1359.70	1103.93	12
Levofloxacin	458.34	484.23	456.58	412.38	366.77	315.89	312.81	317.94	349.00	302.70	337.08	319.98	307.28	17
Linezolid	3.97	10.73	13.22	15.39	24.60	27.18	33.57	39.74	44.07	39.22	41.07	48.22	44.41	33
Meropenem	142.66	246.43	243.12	261.20	227.46	355.53	400.38	457.76	548.19	538.70	558.06	546.10	591.24	15
Metronidazole	1018.43	399.58	151.55	147.95	134.03	131.81	129.19	119.69	93.22	99.37	138.97	117.30	122.68	26
Moxifloxacin	22.13	49.42	83.88	174.51	260.60	351.58	374.02	375.16	378.35	331.27	329.58	307.01	257.35	18
Nitrofurantoin	50.21	57.58	58.91	67.74	70.77	71.73	69.92	66.99	67.81	77.14	85.07	85.83	81.50	30
Penicillin G	9399.67	7545.75	8955.94	10892.43	10820.07	9585.90	9734.76	10263.17	10550.84	10101.52	9816.04	8005.56	4382.57	4
Penicillin V	502.00	595.70	618.66	544.61	505.85	534.06	292.51	315.65	359.91	220.94	403.77	239.56	218.07	20
Piperacillin and enzyme inhibitor	1898.13	1230.91	2312.65	3043.18	4046.54	4636.79	5741.59	6324.86	8862.18	9234.08	13477.90	27751.54	40097.01	1
Sulfamethoxazole and trimethoprim	1991.11	1672.59	1758.77	1627.06	1670.46	1719.65	1602.25	1559.30	1611.91	1496.04	1525.65	1522.47	1509.31	7
Tetracycline	107.75	104.65	89.23	77.08	75.10	73.30	89.73	87.58	95.03	40.45	49.53	46.43	43.28	35
Ticarcillin and enzyme inhibitor	1106.35	2490.13	2209.10	925.15	876.93	1003.16	920.27	967.73	757.74	717.90	310.54	122.69	42.82	36
Tobramycin	62.26	57.53	27.23	18.54	27.94	58.29	62.04	57.01	54.45	51.30	47.53	47.16	43.78	34
Vancomycin	1982.13	3237.72	859.70	235.89	266.05	188.14	164.14	175.93	227.34	228.61	304.30	262.04	194.94	22
TOTAL	44156.45	46947.12	48747.87	47897.84	47211.50	46488.19	45997.73	45558.15	51053.92	46866.71	53255.74	70792.27	85148.84	

\*Ranked from greatest to least mass of active ingredient purchased in 2013

Antimicrobials were removed from this table if they represented <0.05% of mass of active ingredient purchased in 2013. These are: amikacin, bacampicillin, cefaclor, cefepime, cefotetan, ceftizoxime, ceftibiprole, cephalothin, chloramphenicol, colistin, daptomycin, demeclocycline, doripenem, fosfomicin, gatifloxacin, gemifloxacin, lincomycin, methenamine hippurate, methenamine mandelate, minocycline, nalidixic acid, netilmicin, norfloxacin, ofloxacin, piperacillin, pivampicillin, pivmecillinam, quinupristin/dalfopristin, spiramycin, streptomycin, sulfadiazine, sulfadiazine and trimethoprim, sulfonamides, combinations with other antibacterials (excl. trimethoprim), telithromycin, tigecycline, trimethoprim, and trovafloxacin.

**Table D.2: Defined daily doses per 1,000 inhabitants antimicrobials purchased by Canadian hospitals in 2012.**

Antimicrobial	BC	AB	SK	MB	ON	QC	NB	NS	PEI & NL	Rank*
Amoxicillin	0.13	0.07	0.22	0.45	0.06	0.06	0.07	0.08	0.25	7
Amoxicillin and enzyme inhibitor	0.05	0.06	0.04	0.11	0.03	0.09	0.05	0.04	0.08	12
Ampicillin	0.03	0.03	0.03	0.04	0.04	0.05	0.03	0.04	0.01	18
Azithromycin	0.09	0.06	0.20	0.21	0.10	0.07	0.14	0.07	0.15	6
Cefadroxil		<0.01			<0.01	<0.01	<0.01			39
Cefazolin	0.13	0.17	0.18	0.14	0.09	0.13	0.10	0.15	0.14	5
Cefixime	0.03	0.03	0.08	0.02	0.02	<0.01	<0.01	<0.01	0.01	24
Cefotaxime	0.01	0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	31
Cefoxitin	0.09	0.02	0.09	0.40	0.05	0.11	0.07	0.09	0.06	8
Cefprozil	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	33
Ceftazidime	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	37
Ceftriaxone	0.36	0.73	0.16	0.67	0.29	0.24	0.61	0.26	0.55	2
Cefuroxime	0.04	0.03	0.04	0.03	0.02	0.03	0.07	0.06	0.06	21
Cephalexin	0.05	0.04	0.05	0.21	0.04	0.02	0.04	0.05	0.08	15
Ciprofloxacin	0.10	0.12	0.11	0.14	0.10	0.21	0.20	0.22	0.19	4
Clarithromycin	0.06	0.05	0.05	0.04	0.02	0.04	0.04	0.04	0.09	17
Clindamycin	0.05	0.05	0.06	0.07	0.03	0.04	0.06	0.04	0.07	16
Cloxacillin	0.09	0.05	0.05	0.09	0.04	0.04	0.07	0.06	0.05	13
Daptomycin	0.01	0.00	0.00	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	35
Doxycycline	0.27	0.08	0.12	0.06	0.04	0.03	0.04	0.06	0.05	9
Ertapenem	0.03	0.02	0.01	0.01	<0.01	0.02	0.01	0.01	0.01	26
Erythromycin	0.02	0.01	0.03	0.03	<0.01	<0.01	<0.01	<0.01	0.02	29
Gentamicin	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.03	0.02	23
Imipenem	<0.01	<0.01	<0.01	<0.01	<0.01	0.05	<0.01	0.49	0.14	20
Levofloxacin	0.02	0.09	0.03	0.11	0.05	0.03	0.04	0.09	0.02	14
Linezolid	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	36
Meropenem	0.03	0.01	0.02	0.02	0.02	0.03	0.02	0.01	0.02	22
Metronidazole	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	0.04	<0.01	30
Minocycline	0.00	0.00	0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	32
Moxifloxacin	0.07	0.03	0.10	0.02	0.04	0.09	0.09	0.07	0.14	11
Nitrofurantoin	0.07	0.03	0.06	0.09	0.02	0.02	0.02	0.03	0.06	19
Norfloxacin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	38
Penicillin G	1.45	1.17	1.18	1.21	1.11	0.68	0.94	0.70	0.50	1
Penicillin V	0.02	<0.01	0.01	0.05	<0.01	<0.01	<0.01	<0.01	0.02	28
Piperacillin and enzyme inhibitor	0.08	0.06	0.09	0.15	0.18	0.13	0.32	0.15	0.19	3
Sulfamethoxazole and trimethoprim	0.09	0.06	0.07	0.19	0.04	0.05	0.04	0.08	0.11	10
Tetracycline	<0.01	<0.01	0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	34
Vancomycin	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	0.00	0.03	0.11	27
<b>TOTAL</b>	<b>3.51</b>	<b>3.16</b>	<b>3.17</b>	<b>4.65</b>	<b>2.50</b>	<b>2.42</b>	<b>3.15</b>	<b>3.06</b>	<b>3.27</b>	

\*Ranked from greatest to least DDDs at the national level in 2012

Antimicrobials were removed from this table if they represented <0.05% of DDDs in 2012. These are: amikacin, cefaclor, cefepime, chloramphenicol, colistin, doripenem, fosfomycin, lincomycin, methenamine mandelate, ofloxacin, piperacillin, spiramycin, streptomycin, ticarcillin and enzyme inhibitor, tigecycline, and trimethoprim.

**Table D.3: Mass of active ingredient (kg) per 1,000 inhabitants of antimicrobials purchased by Canadian hospitals in 2012.**

Antimicrobial	BC	AB	SK	MB	ON	QC	NB	NS	PEI & NL	Rank*
Amoxicillin	0.05	0.03	0.08	0.16	0.02	0.02	0.03	0.03	0.09	10
Amoxicillin and enzyme inhibitor	0.02	0.02	0.02	0.05	0.01	0.04	0.02	0.02	0.04	14
Ampicillin	0.02	0.02	0.02	0.03	0.03	0.03	0.02	0.03	<0.01	12
Azithromycin	0.01	<0.01	0.02	0.02	0.01	0.01	0.02	<0.01	0.02	16
Cefadroxil		<0.01			<0.01	<0.01	<0.01			38
Cefazolin	0.14	0.19	0.20	0.16	0.10	0.14	0.11	0.17	0.16	5
Cefepime	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.01	39
Cefixime	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	30
Cefotaxime	<0.01	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	0.01	0.01	20
Cefoxitin	0.19	0.03	0.21	0.88	0.11	0.24	0.16	0.21	0.12	4
Cefprozil	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	33
Ceftazidime	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.02	<0.01	25
Ceftriaxone	0.26	0.53	0.12	0.49	0.21	0.17	0.45	0.19	0.41	2
Cefuroxime	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.02	0.01	23
Cephalexin	0.04	0.03	0.04	0.16	0.03	0.02	0.03	0.04	0.06	11
Ciprofloxacin	0.04	0.04	0.04	0.05	0.03	0.06	0.06	0.06	0.06	7
Clarithromycin	0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.02	21
Clindamycin	0.03	0.03	0.04	0.04	0.02	0.03	0.03	0.03	0.04	13
Cloxacillin	0.06	0.03	0.03	0.06	0.03	0.03	0.05	0.04	0.03	9
Doxycycline	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	29
Ertapenem	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	24
Erythromycin	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	28
Gentamicin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	32
Imipenem	0.01	<0.01	<0.01	<0.01	<0.01	0.06	<0.01	0.72	0.20	8
Levofloxacin	<0.01	0.02	<0.01	0.02	<0.01	<0.01	<0.01	0.02	<0.01	17
Linezolid	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	35
Meropenem	0.02	0.01	0.01	0.02	0.01	0.02	0.01	<0.01	0.01	15
Metronidazole	0.00	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.02	<0.01	27
Moxifloxacin	0.01	<0.01	0.02	<0.01	<0.01	0.01	0.01	0.01	0.02	18
Nitrofurantoin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.00	<0.01	31
Penicillin G	0.32	0.26	0.26	0.27	0.24	0.15	0.21	0.15	0.11	3
Penicillin V	0.01	<0.01	0.01	0.03	<0.01	<0.01	<0.01	<0.01	0.02	22
Piperacillin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	34
Piperacillin and enzyme inhibitor	0.43	0.35	0.50	0.89	1.02	0.72	1.85	0.84	1.09	1
Sulfamethoxazole and trimethoprim	0.06	0.04	0.05	0.13	0.03	0.04	0.03	0.06	0.08	6
Ticarcillin and enzyme inhibitor	<0.01	<0.01			<0.01	0.01	<0.01	<0.01	<0.01	26
Vancomycin	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	0.02	0.08	19
<b>TOTAL</b>	<b>1.82</b>	<b>1.72</b>	<b>1.76</b>	<b>3.54</b>	<b>1.97</b>	<b>1.91</b>	<b>3.18</b>	<b>2.74</b>	<b>2.74</b>	

\*Ranked from greatest to least mass of active ingredient purchased at the national level in 2012.

Antimicrobials were removed from this table if they represented <0.05% of mass of active ingredient purchased in 2012. These are: amikacin, cefaclor, chloramphenicol, colistin, daptomycin, doripenem, fosfomycin, lincomycin, methenamine mandelate, minocycline, norfloxacin, ofloxacin, spiramycin, streptomycin, tigecycline, and trimethoprim.