BC Centre for Disease Control
An agency of the Provincial Health Services Authority

655 West 12th Avenue
Vancouver, BC V5Z 4R4
Tel 604.707.2400
Fax 604.707.2441
www.bccdc.ca

Antibiotic Utilization in the Province of British Columbia

2013

Prepared by:
The *Do Bugs Need Drugs?* Program

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Contributors:

Sophie Wang, Masters of Public Health Practicum Student, Simon Fraser University

Diana George, Epidemiologist, Communicable Disease Prevention and Control Services, BCCDC

Dr. David Patrick, Medical Epidemiology Lead, Antimicrobial Resistance, Communicable Disease Prevention and Control Services, BCCDC

Dr. Fawziah Marra, Professor, Faculty of Pharmaceutical Services, University of British Columbia

Mei Chong, Biostatistician, Communicable Disease Prevention and Control Services, BCCDC

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Foreword

Antibiotics have had a profound impact on health by improving our ability to prevent, cure and reduce transmission of many infectious diseases. Unfortunately, the increasing prevalence and spread of resistant organisms threaten this progress. Antibiotic resistance is a naturally occurring evolutionary response, which has been exacerbated by selective pressure caused by the use and misuse of antimicrobials. Numerous studies have confirmed the strong association between antimicrobial utilization and microbial resistance. Importantly, it has been estimated that antibiotic use is unnecessary or inappropriate in up to 50% of prescriptions in the United States and Canada (1;2) and that this is driven largely by prescribing for upper respiratory tract infections (3).

In 2000, a report from the Office of the Provincial Health Officer on “Antimicrobial Resistance: Recommended Action Plan for British Columbia” suggested three priorities for action with respect to decreasing antibiotic resistance: (1) to raise public awareness about the risks of antimicrobial resistance and the importance of appropriate use; (2) to continue to raise awareness among prescribers about the risks of resistance and the importance of appropriate prescribing; and (3) to meet specific education and training requirements through collaboration with professional organizations and by providing input to curricula for various disciplines (4).

In the fall of 2005, funding was graciously provided by the Pharmaceutical Services Division, Ministry of Health for British Columbia to adopt the *Do Bugs Need Drugs?* (DBND) program from the neighboring province of Alberta. Since that time, the DBND program has been addressing the priorities for action, education and awareness through the use of three key program messages focusing on handwashing, the differences between bacteria and viruses, and using antibiotics wisely.

The DBND program provides healthcare professionals with evidence-based treatment options for common infections. Accredited courses for physicians and pharmacists have been offered each year. We continue to see improvement in the knowledge and prescribing practices of physicians who participate in the accredited courses.

Educational programs incorporate teaching the three key messages to children in preschool and Grade 2, as well as their parents. A parent survey completed in 2007 and 2008 demonstrated that the Grade 2 Program not only impacts the knowledge of children who receive the program in their classroom, but also contributes to increasing knowledge of their parents and other family members. In addition, an educational program targets adults residing in assisted living facilities, their caregivers and families. Activities in this program raise awareness about the importance of handwashing in a group setting where many objects are shared.

In addition to the audience-specific education programs, a comprehensive media campaign targets the general public through advertisements on television and public transit. As well, children initiatives target children and their parents through children’s festivals, children’s magazines, parenting magazines and children’s websites. These campaigns are an important and effective means of reaching the general population.

An important component of program evaluation – now that we are in the 10th year of the program – is surveillance of antibiotic consumption. Thus, this report has been generated to determine trends in antibiotic use in BC and the impact of the DBND program on these temporal trends. The report shows that the stewardship program on prudent antibiotic use has a substantial impact on the use of antibiotics and therefore the prevalence of antimicrobial resistance at a provincial level.

The BC Centre for Disease Control would like to thank the Pharmaceutical Services Division, Ministry of Health, and Office of the Provincial Health Officer for their steadfast support.

Thank you,

David Patrick, MD, FRCPC, MHSc
Medical Epidemiology Lead, Antimicrobial Resistance,
BC Centre for Disease Control and
Professor and Director, School of Population and Public Health
University of British Columbia

Fawziah Marra, BSc (Pharm), Pharm.D., FCSHP
Professor, Faculty of Pharmaceutical Sciences
University of British Columbia

Executive Summary

Objectives

Antibiotic utilization is one of the main causes of the development and spread of antibiotic resistance. Antibiotic resistance is becoming a serious public health threat as there are very few new antibiotics in the development pipeline. Moreover, a large proportion of antibiotic prescriptions are inappropriate; thus, efforts are needed to reduce the misuse and overuse of these important resources. Monitoring trends in utilization can inform therapy guidelines and assess the consequence of resistance, in addition to evaluating the impact of interventions aimed at curbing antibiotic utilization. As part of the evaluation of the *Do Bugs Need Drugs?* program, which started in 2005 in British Columbia, this report provides a comprehensive review of the antibiotic utilization trends in BC between 1996 and 2013.

Methods

Data on oral antibiotic consumption were collected for the community (primary care sector) and were obtained from the BC PharmaNet database, which includes all prescriptions dispensed in retail and internet pharmacies in BC. Antibiotic consumption rates were converted into a standardized measure of *daily defined dose (DDD) per 1000 inhabitants per day* in adults, and *total number of prescriptions per 1000 inhabitants per day* in children. Consumption rates were further analyzed by antibiotic class and sub-class, year, age, gender, health authority (HA), and health services delivery area (HSDA).

Results

- Overall antibiotic consumption decreased by 13.2% from 1996 to 2002, but increased by 9.1% through to 2005. Since that year, overall consumption has decreased slightly and is reported to be at 16.0 DDD/1000 population/day in 2013 (an overall decrease of 12.7% compared to 1996).
- In 2013, antibiotic consumption by class was highest for penicillins, followed by macrolides, tetracyclines, cephalosporins, quinolones and lastly the sulfonamides and trimethoprim.
- Between 1996 and 2013, overall consumption rates showed a declining trend for penicillins, tetracyclines, sulfonamides and trimethoprim. An increasing trend was observed for quinolones during this same time period; in contrast, cephalosporin and macrolide consumption remains relatively unchanged.
- The rate of overall antibiotic prescriptions decreased among all age groups among children (less than 15 years of age), with children less than 1 year of age experiencing the largest decrease and children aged 10 to 14 experiencing the smallest decrease between 1996 and 2013.
- Overall antibiotic consumption rates among adults (aged 15 years and older) experienced a lesser degree of decrease between 1996 and 2013.
- Among children, those aged 1 to 4 years of age consistently had the highest rate of prescriptions between 1996 and 2013, while those aged 10 to 14 consistently had the lowest rate of prescriptions.
- Among adults, those 60 years and older had the highest rate of antibiotic consumption while those aged 25 to 29 had the lowest rate of antibiotic consumption in 2013.
- Antibiotic consumption among females consistently exceeded consumption among males across all antibiotic classes and within all years between 1996 and 2013.
- In 2013, antibiotic consumption rates in BC were highest in the Fraser Health Authority (6.8% above the provincial average); while Vancouver Coast Health had the lowest antibiotic consumption rate (lower than the provincial average by 11.8%).

- In 2013, Richmond had the lowest antibiotic consumption among all HSDAs (13.3 DDD/1000 population/day; 16.6% below the provincial average); while Fraser East had the highest antibiotic consumption among all HSDAs (18.3 DDD/1000 population/day; 14.7% the above provincial average).

Conclusions

While many factors contribute to antibiotic prescribing practices, efforts to promote their judicious use via the *Do Bugs Need Drugs?* campaign have likely contributed to some of the decrease in utilization since 2005. The current report provides insight into the geographical and temporal trends of antibiotic consumption in BC. Continued surveillance and reporting is important to identify areas to target future efforts and guide decision making.

Methods

BC PharmaNet is a provincial network that links all BC pharmacies, including internet pharmacy stores, to a central data system. This secure computer network is managed by the BC Ministry of Health. PharmaNet provides information on all prescription medications dispensed to an individual in BC and allows pharmacists to identify and caution patients about potentially harmful medication interactions. In 2007, over 47 million prescription claims were processed through the system.

Data on oral antibiotic consumption in the community (primary care sector) were obtained from BC PharmaNet. The database provided to the BC Centre for Disease Control contains an anonymous study identifier, patient age, gender and drug information detailing generic name, brand name, form, strength, quantity and date dispensed. Drugs are classified based on the Anatomical Therapeutic Chemical (ATC) classification system and utilization is represented as total daily defined dose (DDD) developed by World Health Organization Collaborating Centre for Drug Statistics Methodology which provides a standardized measure of comparison internationally (5). In this report, antibiotic consumption and antibiotic utilization is used interchangeably

Population estimates and projections were taken from P.E.O.P.L.E. Projection 35 (Population Extrapolation for Organizational Planning with Less Error – 35). In general, antibiotic consumption rates are presented in DDD per 1000 population per day. For children under 15 years of age, antibiotic dosing may be highly variable due to weight-based dosing. Therefore, antibiotic consumption rates for this age group are calculated as the total number of prescriptions per 1000 population per day. In this report, the consumption rate is broken down by year, age group, gender, health authority (HA) and health services delivery area (HSDA). Where appropriate, the antibiotic utilization trend over time was tested for significance using the Spearman rank test. Please note, that the y-axis used for graphical representation may not always begin at zero.

There are some limitations to the current antibiotics utilization report. These are inherent to the limitations of the PharmaNet system to capture prescribing data. For example, antibiotic usage in the acute care setting (i.e. hospitals), particularly for parenteral antibiotics, is not documented on the PharmaNet database; however, this usage accounts for a small percentage of overall antibiotic utilization. PharmaNet excludes antibiotics provided as samples by the prescriber. In addition, this report does not include information on compliance and adverse effects. Although data are presented as daily consumption rates, they merely reflect the dispensing rates for the antimicrobial agents.

Please note, the data in this report was based on a re-extraction of the entire dataset from 1996 to 2013. Thus, values presented in this report may differ from those presented in earlier reports. In addition, medical billing data was unavailable at the time of report preparation; indication-specific trends will be released at a later date.

Overall Utilization

1. Over-Time Trend

The trend in the consumption of antibiotics for systemic use (ATC group J01) in the community from 1996 to 2013 is shown in Figure 1. Following a high rate (18.26 DDD/1000 population/day) of overall antibiotic utilization in 1996, the consumption rate has dropped and shows an overall decreasing trend and is at 15.96 DDD/1000 population/day in 2013 (p=0.034) (Figure 1). Similarly, as shown in Figure 2, prescription rate over the years show a clear decreasing trend from 1.98 in 1996 to 1.52 prescription/1000 population/day in 2013 (p<0.001).

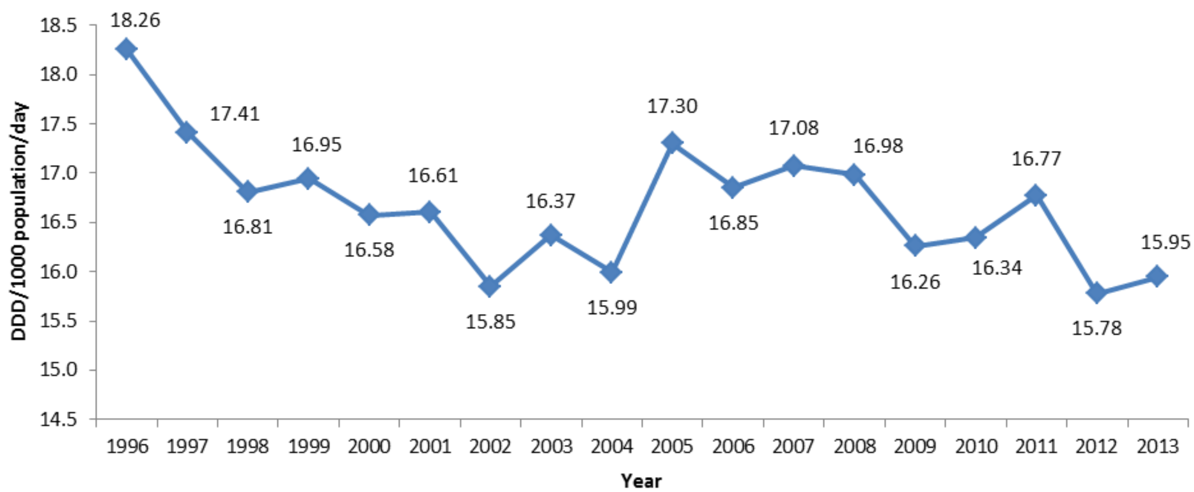


Figure 1: Overall antibiotic (J01) daily consumption rates from 1996 to 2013

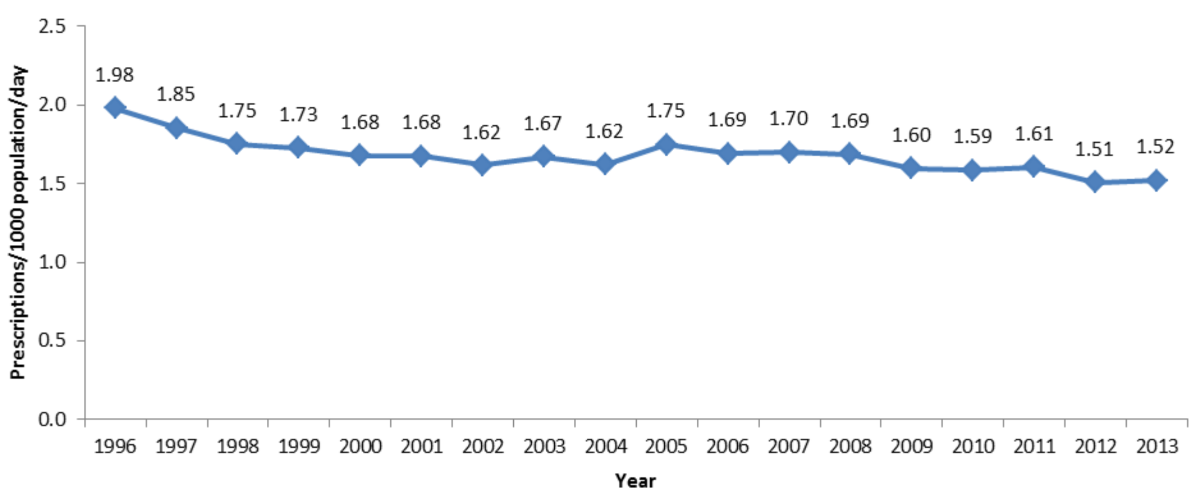
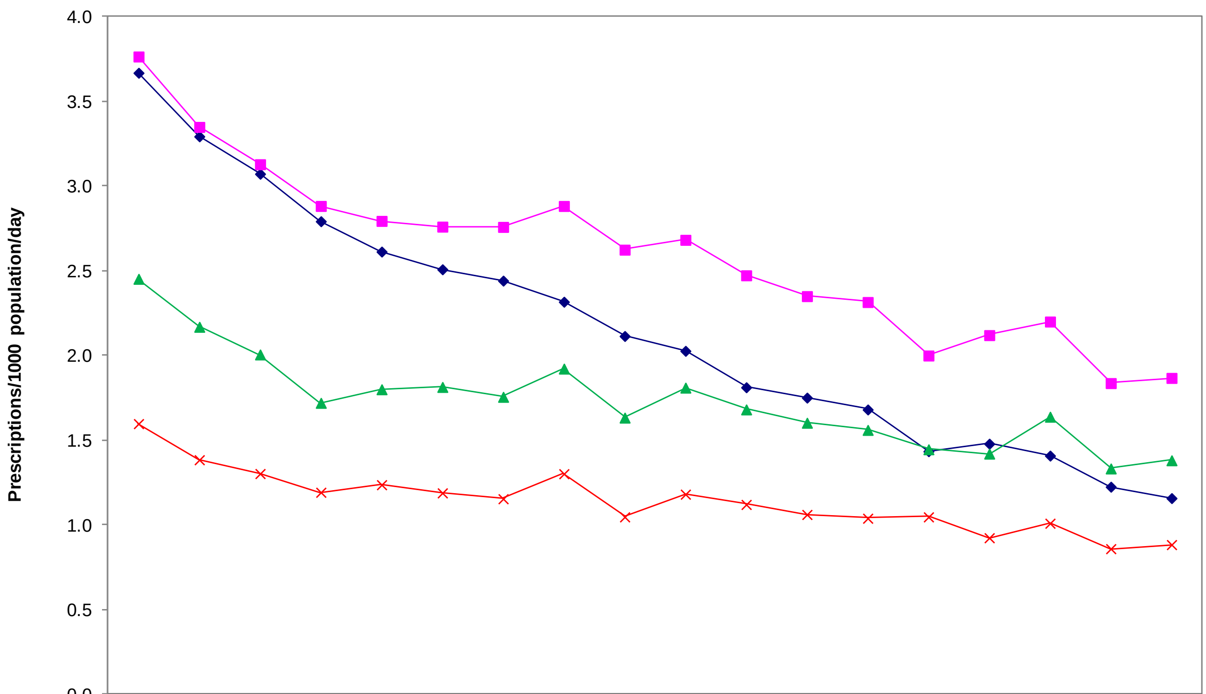


Figure 2: Overall antibiotic (J01) daily prescription rates from 1996 to 2013

2. By Age

a. Children (< 15 years)

In 2013, children 1 to 4 years of age had the highest overall antibiotic prescription rate at 1.87 prescriptions/1000 population/day, followed by those 5 to 9 years (1.38 prescriptions/1000 population/day), under 1 year (1.16 prescriptions/1000 population/day), then 10 to 14 years (0.88 prescriptions/1000 population/day) (Figure 3). All pediatric age groups exhibited consistent decline in daily prescription rates from 1996 to 2013. Of note, there were slight increases in 2003 and 2011 in all groups except those under 1 year of age (Figure 3). The greatest percentage drop from 1996 to 2013 was seen in children under 1 year (68% decrease from 3.67 to 1.16 prescriptions/1000 population/day) followed by 1 to 4 years (50% decrease from 4.08 to 1.87 prescriptions/1000 population/day) (Figure 3).

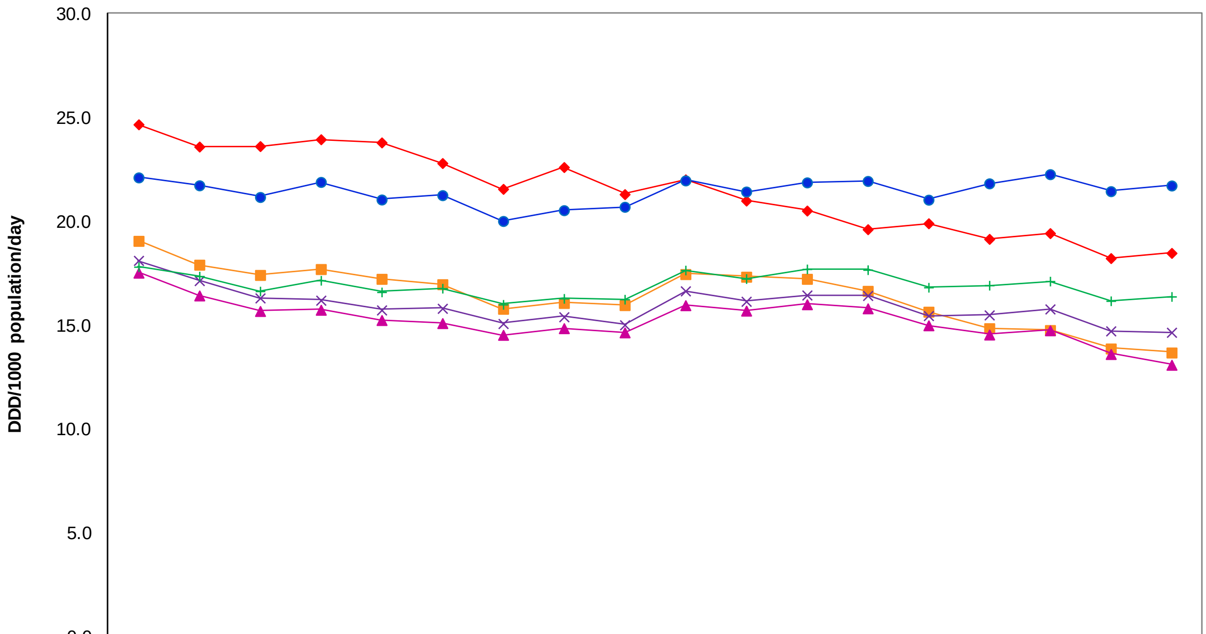


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
<1	3.67	3.29	3.07	2.79	2.61	2.51	2.44	2.32	2.11	2.03	1.81	1.75	1.68	1.43	1.48	1.41	1.22	1.16
1-4	3.76	3.35	3.13	2.88	2.79	2.76	2.76	2.88	2.62	2.68	2.47	2.35	2.31	2.00	2.12	2.20	1.84	1.87
5-9	2.45	2.17	2.01	1.72	1.80	1.81	1.76	1.92	1.63	1.81	1.68	1.60	1.56	1.45	1.42	1.64	1.33	1.38
10-14	1.60	1.38	1.30	1.19	1.24	1.19	1.15	1.30	1.05	1.18	1.12	1.06	1.04	1.05	0.92	1.01	0.86	0.88

Figure 3: Overall antibiotic (J01) daily prescription rates in children from 1996 to 2013

b. Adults (≥ 15 years)

While teens 15 to 19 years of age had been the highest adult consumers of antibiotics from 1996 to 2005, they have been surpassed by those 60 years and older since then. In 2013, the latter group had an overall antibiotic consumption rate of 21.71 DDD/1000 population/day, which exceeded the consumption rate of the former group by 18%. Utilization rates for all other adult age groups fluctuated between 13.10 and 16.40 DDD/1000 population/day (Figure 4). The greatest percentage drop was observed in the 20-24 age group (28% decrease from 19.05 to 13.67 DDD/1000 population/day) followed by the 15 to19 age group (25% decrease from 24.66 to 18.47 DDD/1000 population/day) (Figure 4). All other adult age groups experienced decreases in antibiotic consumption rates during this time period as well (Figure 4).

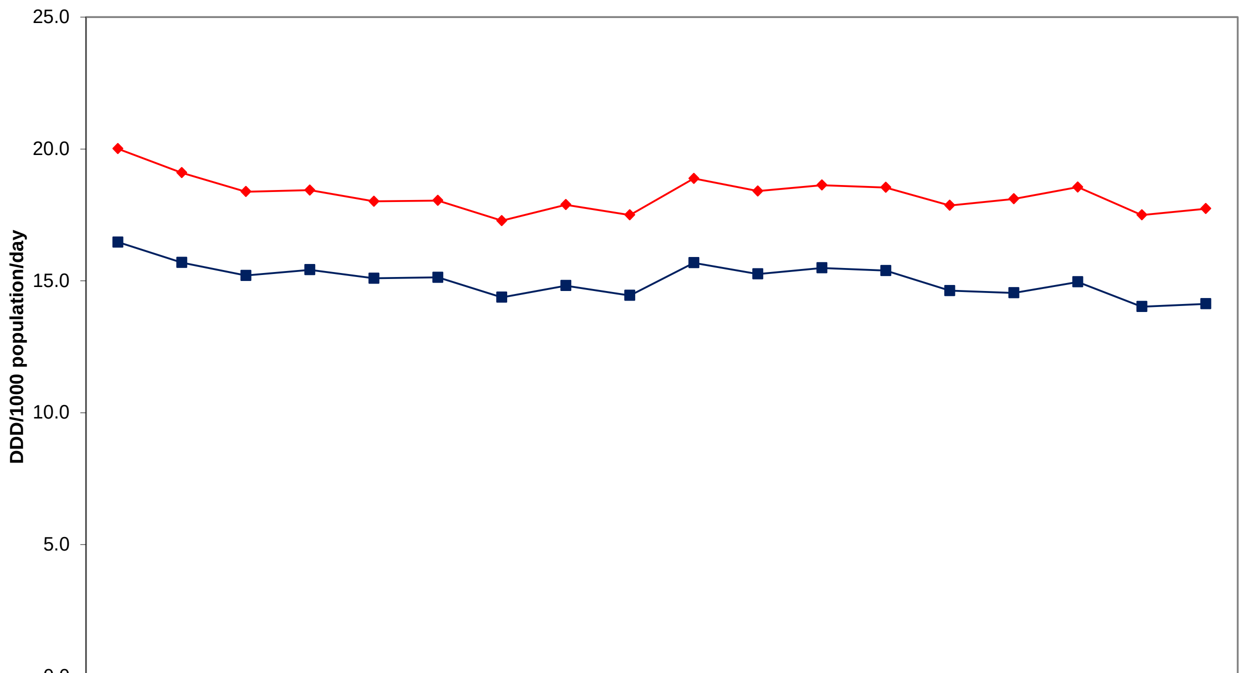


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
15-19	24.66	23.59	23.61	23.94	23.79	22.79	21.55	22.60	21.30	22.01	20.99	20.50	19.61	19.89	19.14	19.42	18.22	18.47
20-24	19.05	17.90	17.41	17.69	17.22	16.96	15.78	16.06	15.95	17.45	17.32	17.22	16.64	15.64	14.84	14.75	13.86	13.67
25-29	17.51	16.42	15.67	15.73	15.23	15.09	14.52	14.84	14.64	15.95	15.69	15.99	15.80	14.98	14.54	14.74	13.60	13.08
30-39	18.11	17.13	16.30	16.19	15.72	15.80	15.07	15.39	15.00	16.64	16.14	16.44	16.42	15.45	15.48	15.77	14.71	14.64
40-59	17.80	17.35	16.63	17.15	16.59	16.77	15.99	16.28	16.24	17.64	17.23	17.69	17.66	16.81	16.91	17.11	16.16	16.37
60+	22.10	21.72	21.16	21.88	21.04	21.25	20.00	20.52	20.69	21.96	21.42	21.86	21.93	21.03	21.81	22.26	21.44	21.71

Figure 4: Overall antibiotic (J01) daily consumption rates in adults (≥15) from 1996 to 2013

3. By Gender

Over the years, female antibiotic consumption has consistently exceeded male consumption by approximately 20% (Figure 5). Both genders showed an overall decrease in usage from 1996 to 2013, with a drop of 11% (from 20.01 to 17.74 DDD/1000 population/day) among females and 14% (from 16.47 to 14.13 DDD/1000 population/day) among males (Figure 5).

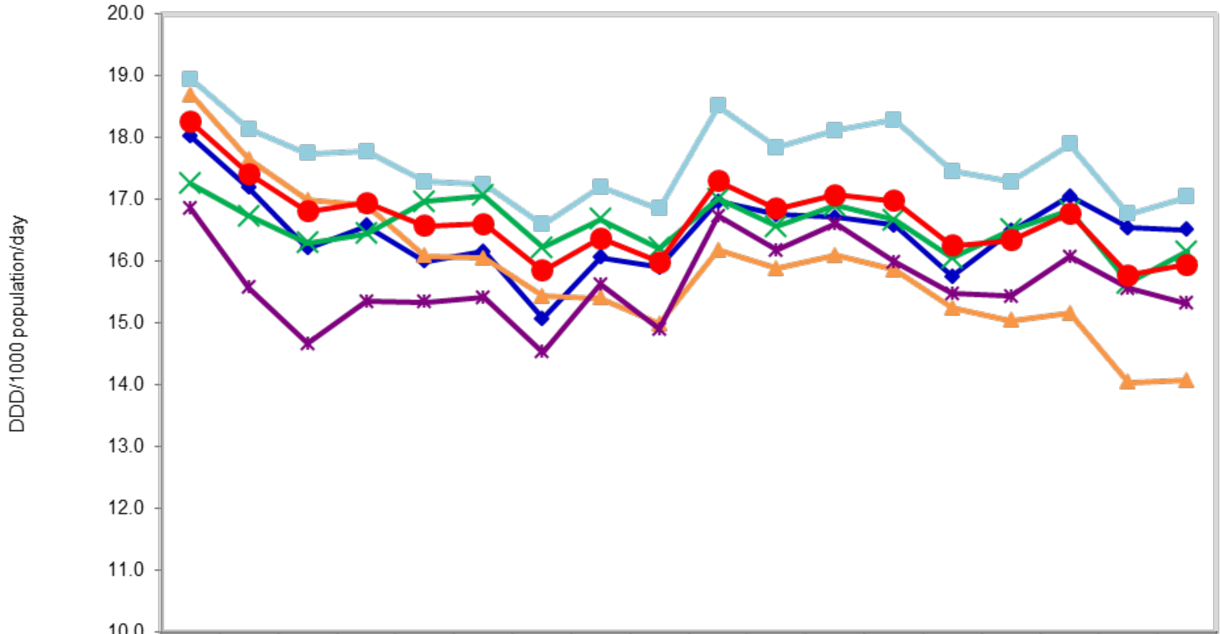


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
F	20.01	19.10	18.38	18.44	18.01	18.05	17.28	17.89	17.50	18.88	18.41	18.63	18.54	17.86	18.11	18.55	17.50	17.74
M	16.47	15.69	15.20	15.42	15.10	15.13	14.38	14.82	14.45	15.68	15.26	15.49	15.39	14.63	14.55	14.96	14.02	14.13

Figure 5: Overall antibiotic (J01) daily consumption rates by gender from 1996 to 2013

4. By Health Authority & Health Services Delivery Area

Temporal trends in antibiotic consumption were similar across all five Health Authorities (HAs) in BC, with significant declines seen from 1996 to 2002, and a rise in usage through 2005, followed by stabilization or gradual decline. The greatest drop in antibiotic consumption was in Vancouver Coastal from 18.69 DDD/1000 population/day in 1996 to 14.07 DDD/1000 population/day in 2013, representing a 25% decrease; relative declines ranged from 6% to 13% for the other HAs. In 2013, overall consumption rates were highest in Fraser Health Authority (FHA), followed by Interior Health Authority (IHA), Island Health Authority (VIHA), Northern Health Authority (NHA), and lastly Vancouver Coastal Health Authority (VCHA) (see Table A-2 in the Appendix for definitions of Health Authorities and Health Service Delivery Areas).



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1-IHA	18.02	17.19	16.21	16.58	16.00	16.16	15.07	16.07	15.91	16.97	16.76	16.72	16.59	15.75	16.49	17.05	16.55	16.51
2-FHA	18.95	18.15	17.75	17.78	17.29	17.25	16.60	17.21	16.85	18.51	17.85	18.12	18.29	17.46	17.29	17.89	16.77	17.04
3-VCHA	18.69	17.65	16.99	16.90	16.09	16.06	15.44	15.40	14.99	16.18	15.89	16.09	15.86	15.24	15.04	15.16	14.04	14.07
4-VIHA	17.26	16.74	16.29	16.45	16.97	17.07	16.23	16.69	16.22	17.01	16.57	16.91	16.67	16.06	16.51	16.82	15.65	16.16
5-NHA	16.85	15.58	14.67	15.36	15.34	15.41	14.53	15.63	14.91	16.74	16.18	16.61	15.99	15.48	15.43	16.08	15.56	15.32
BC	18.26	17.41	16.81	16.95	16.58	16.61	15.85	16.37	15.99	17.30	16.85	17.08	16.98	16.26	16.34	16.77	15.78	15.95

Figure 6: Overall antibiotic (J01) daily consumption rates by health authority from 1996 to 2013

Within Interior, the consumption rate in Okanagan was the highest among the four Health Service Delivery Areas (HSDAs) for most years and was reported to be at 17.53 DDD/1000 population/day in 2013. The largest percentage decrease in consumption since 1996 was found in East Kootenay with a 15% drop from 18.26 to 15.44 DDD/1000 population/day. The relative decreases in all other HSDAs ranged from 6% to 17%. (Table 1).

For Fraser, overall antibiotic consumption decreased from 18.95 in 1996 to 17.04 DDD/1000 population/day in 2013. The reduction was driven by consumption rates in Fraser North, which decreased 20%, whereas the decrease was only 7% in Fraser South. Conversely, a 4% increase in antibiotic consumption rates was seen in Fraser East (Table 1).

Within Vancouver Coastal, the lowest antibiotic utilization occurred in Richmond, followed by Vancouver and North Shore/Coast Garibaldi. From 1996 to 2013, usage dropped by 31%, 24%, and 11% in Vancouver, Richmond, and North Shore/Coast Garibaldi, respectively (Table 1).

The overall consumption rates in Vancouver Island dropped by 6% from 1996 to 2013, which was primarily driven by consumption rates in South Vancouver Island where rates decreased by 8% from 17.61 to 16.20 DDD/1000 population/day (Table 1).

In Northern, a decrease of 14% and 10% in antibiotics consumption was observed for Northern Interior and Northeast respectively while an increase of 2% was observed for Northwest during the time frame between 1996 and 2013. The consumption rate was reported to be at 15.64, 15.23, and 15.17 DDD/1000 population/day for Northwest, Northern Interior and Northeast respectively (Table 1).

Table 1: Overall antibiotic (J01) daily consumption rates by health authority (HA) and health services delivery area (HSDA) from 1996 to 2013

HA/HSDA	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	% Change
IHA	18.02	17.19	16.21	16.58	16.00	16.16	15.07	16.07	15.91	16.97	16.76	16.72	16.59	15.75	16.49	17.05	16.55	16.51	-8.37
11-EK	18.26	16.86	16.28	16.66	16.34	17.03	16.49	16.77	16.44	17.11	16.50	17.00	16.52	15.36	15.55	16.42	15.32	15.44	-15.42
12-KB	16.97	17.31	16.33	16.19	15.39	15.60	14.30	14.57	14.35	15.07	14.99	14.73	14.36	13.67	14.13	14.13	14.24	14.10	-16.94
13-OK	18.57	17.72	16.35	16.46	16.08	16.23	15.03	16.26	16.17	17.21	17.01	17.06	17.08	16.20	17.34	18.02	17.40	17.53	-5.64
14-TCS	17.56	16.54	15.95	16.86	15.98	15.96	14.90	16.07	15.90	17.25	17.09	16.78	16.64	15.92	16.35	16.79	16.46	16.14	-8.12
FHA	18.95	18.15	17.75	17.78	17.29	17.25	16.60	17.21	16.85	18.51	17.85	18.12	18.29	17.46	17.29	17.89	16.77	17.04	-10.03
21-FE	17.74	17.25	17.27	17.22	17.42	17.29	16.57	17.48	17.20	18.65	18.06	18.22	19.22	18.14	18.43	19.53	18.27	18.35	3.45
22-FN	19.08	18.16	17.59	17.55	16.64	16.74	16.07	16.31	15.92	17.50	16.98	17.10	16.77	16.01	15.77	16.24	15.16	15.29	-19.87
23-FS	19.34	18.51	18.09	18.21	17.82	17.69	17.07	17.89	17.53	19.34	18.52	18.96	19.21	18.42	18.13	18.65	17.53	18.02	-6.85
VCHA	18.69	17.65	16.99	16.90	16.09	16.06	15.44	15.40	14.99	16.18	15.89	16.09	15.86	15.24	15.04	15.16	14.04	14.07	-24.71
31-RMD	17.41	16.00	15.60	15.02	13.97	13.93	13.27	13.45	13.15	14.13	13.88	14.21	13.60	13.27	13.63	13.91	13.02	13.29	-23.65
32-VAN	19.74	18.57	17.84	17.72	16.60	16.50	15.78	15.61	15.02	16.13	15.83	15.93	15.76	15.19	14.89	14.92	13.69	13.73	-30.44
33-NSCG	17.22	16.69	16.03	16.36	16.35	16.48	16.11	16.26	16.18	17.67	17.37	17.77	17.66	16.72	16.35	16.56	15.57	15.41	-10.49
VIHA	17.26	16.74	16.29	16.45	16.97	17.07	16.23	16.69	16.22	17.01	16.57	16.91	16.67	16.06	16.51	16.82	15.65	16.16	-6.33
41-SVI	17.61	16.85	16.89	16.93	17.74	17.76	16.95	17.20	16.48	16.88	16.73	16.96	16.74	16.00	16.50	16.67	15.51	16.20	-8.04
42-CVI	17.08	16.59	15.82	16.15	16.35	16.58	15.59	16.41	16.27	17.47	16.67	16.99	16.54	16.06	16.67	17.15	15.79	16.33	-4.37
43-NVI	16.58	16.72	15.54	15.64	15.99	15.96	15.36	15.70	15.28	16.39	15.84	16.55	16.75	16.24	16.18	16.55	15.75	15.67	-5.47
NHA	16.85	15.58	14.67	15.36	15.34	15.41	14.53	15.63	14.91	16.74	16.18	16.61	15.99	15.48	15.43	16.08	15.56	15.32	-9.10
51-NW	15.39	14.31	13.52	14.03	14.49	14.21	13.97	15.62	14.25	16.13	15.76	16.72	15.72	15.37	15.36	15.75	15.56	15.64	1.63
52-NI	17.69	15.81	14.67	15.64	15.25	15.36	14.56	15.19	14.96	16.82	16.29	16.86	16.43	15.56	15.45	16.15	15.32	15.23	-13.92
53-NE	16.88	16.78	16.30	16.48	16.69	17.14	15.18	16.66	15.58	17.27	16.43	15.93	15.34	15.42	15.47	16.28	16.05	15.17	-10.12
BC	18.26	17.41	16.81	16.95	16.58	16.61	15.85	16.37	15.99	17.30	16.85	17.08	16.98	16.26	16.34	16.77	15.78	15.95	-12.64

5. Comparison of Antimicrobial Utilization in British Columbia, Other Provinces and Europe

When compared to that of several European nations, the 2011 (most recent year with comparable data available) overall utilization rate in BC was lower than most (i.e. 7 countries with comparatively less utilization and 15 countries with more) (Figure 7). BC held a similar position (among the countries reported in 2011) in 2005 when the overall utilization rate was 17.30 DDD/1000 population/day. In 2011, BC had a similar overall rate to Norway. When compared to other Canadian provinces, BC had the second lowest rate in 2011 (second to Québec) and the lowest cost of antimicrobials (Figure 8).

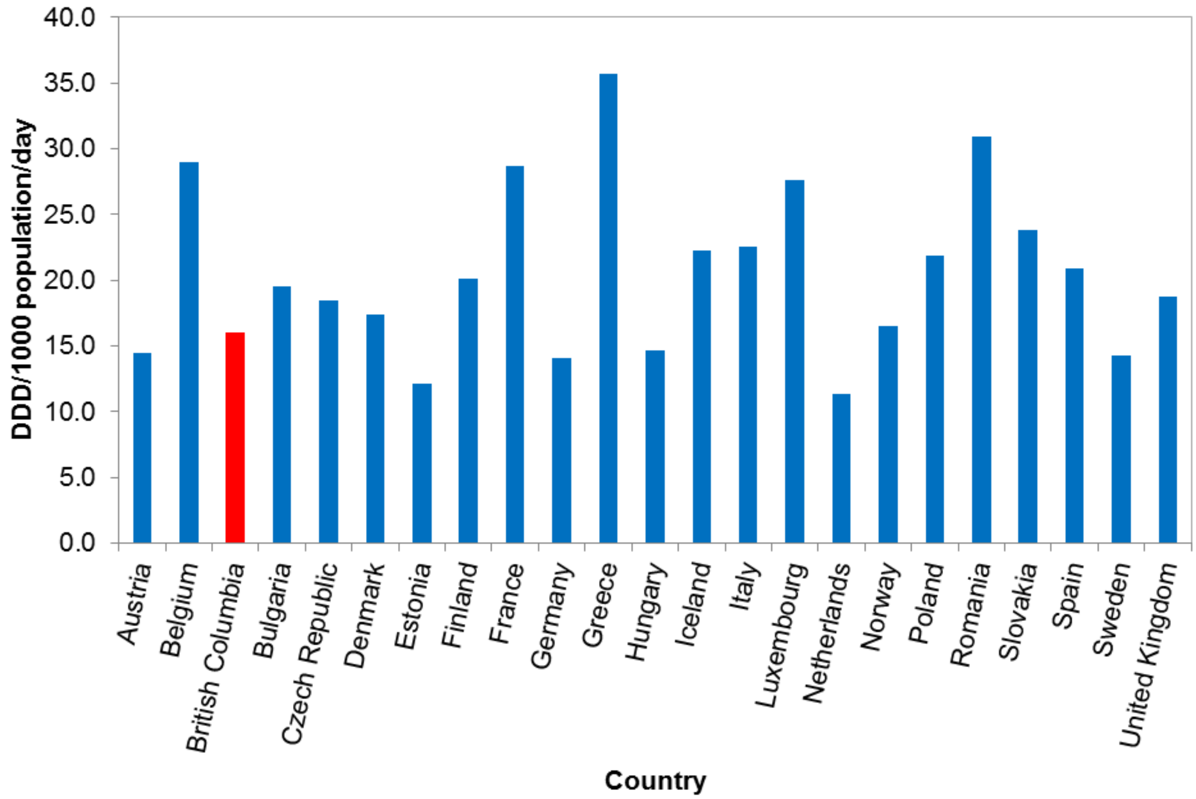


Figure 7: Defined daily rate of all antimicrobials for systematic use (J01) in BC and several European nations in 2011
Source: PharmaNet (BC data); European Surveillance of Antimicrobial Consumption (ESAC) (6)

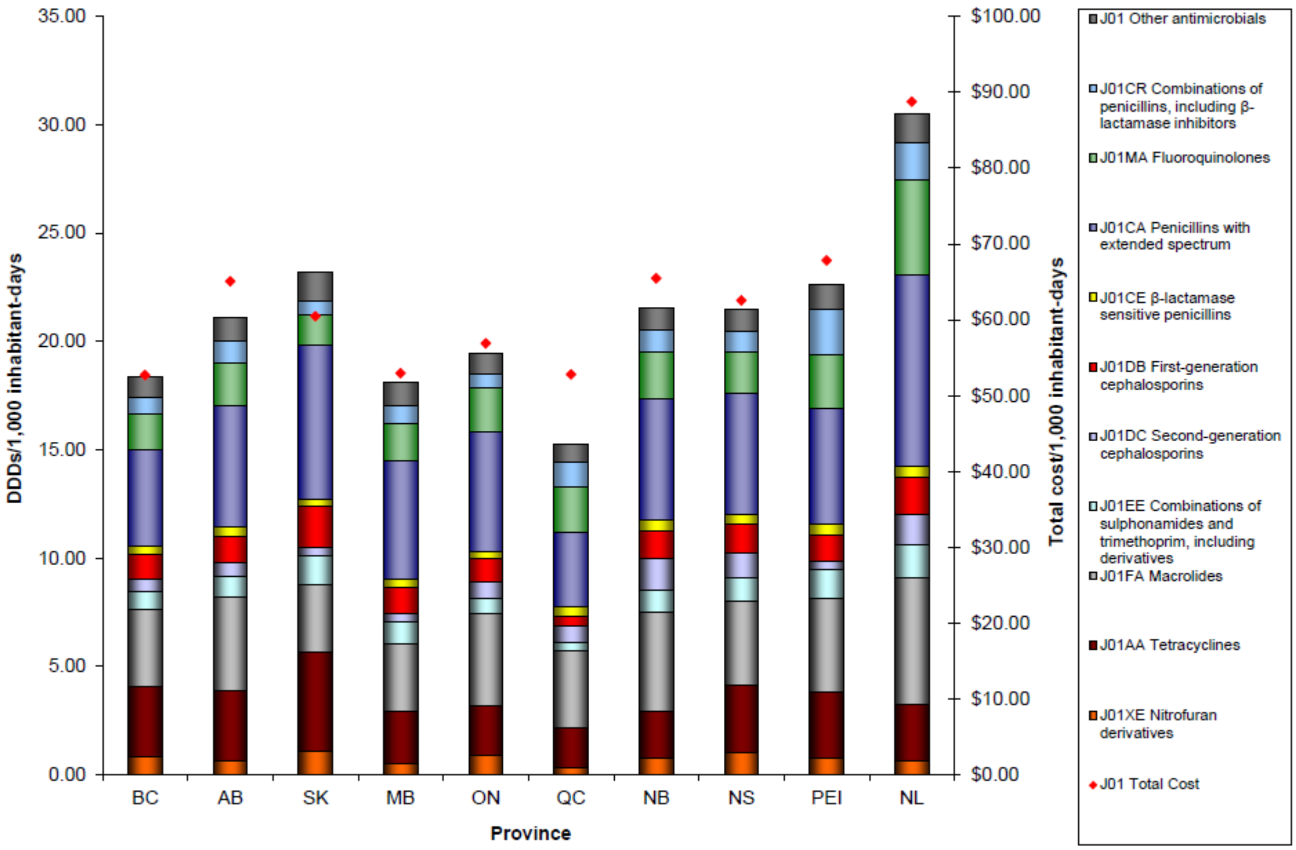


Figure 8: Total consumption (DDD/1,000 inhabitant-days) and total cost of oral antimicrobials dispensed by retail pharmacies in Canadian provinces, 2011
Source: CIPARS Human Antimicrobial Use Short Report 2011 (7)

6. By Drug Class

The penicillins remain the most highly utilized antibiotic class for BC. In 2013, the daily consumption rate of penicillins was 5.36 DDD/1000 population/day, a slight decrease since 1996 (6.69 DDD/1000 population/day). In contrast, following a peak in 2005 at 3.87 DDD/1000 population/day, a decreasing trend was observed in the consumption of the macrolide/lincosamides/streptogramin class and was reported to be at 3.04 DDD/1000 population/day in 2013. Consumption of tetracyclines and cephalosporins has remained relatively stable over the years and was reported to be at 2.28 and 1.68 DDD/100 population/day in 2013 compared to 3.34 and 1.69 in 1996. Consumption of sulfonamides/trimethoprim has experienced the largest decrease at 68% from 2.17 in 1996 to 0.70 DDD/1000 population/day in 2013. On the other hand, consumption of quinolones has increased by 46% from 0.94 in 1996 to 1.38 DDD/1000 population/day in 2013 (Figure 9). However, rates of quinolone and macrolide/lincosamides/streptogramin utilization have been declining slightly in BC since the inception of the *Do Bugs Need Drugs?* program in 2005.

A substantial rise in the use of drugs belonging to the J01X class has also been noted since 1996, and has surpassed sulphonamides and trimethoprim utilization since 2011. This is driven primarily by increased use of nitrofurantoin, which has replaced ciprofloxacin as the recommended treatment for UTIs.

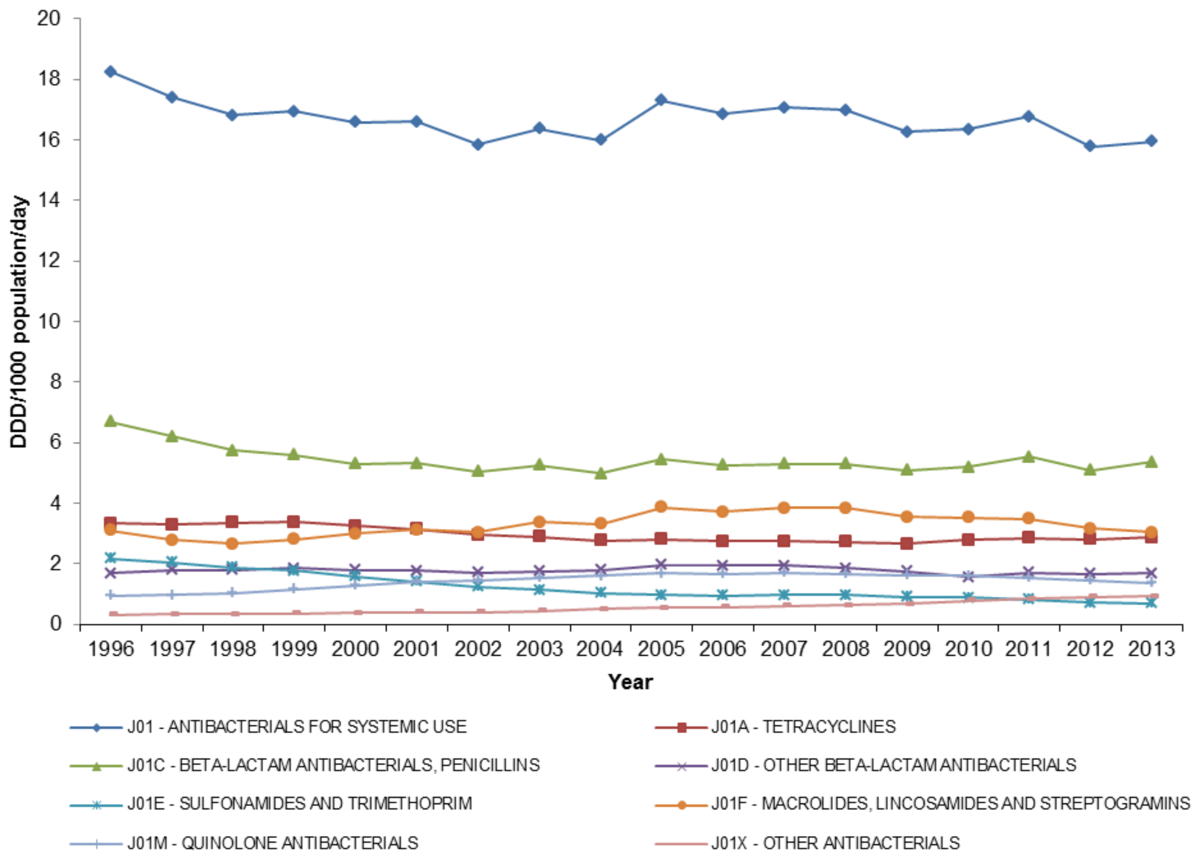
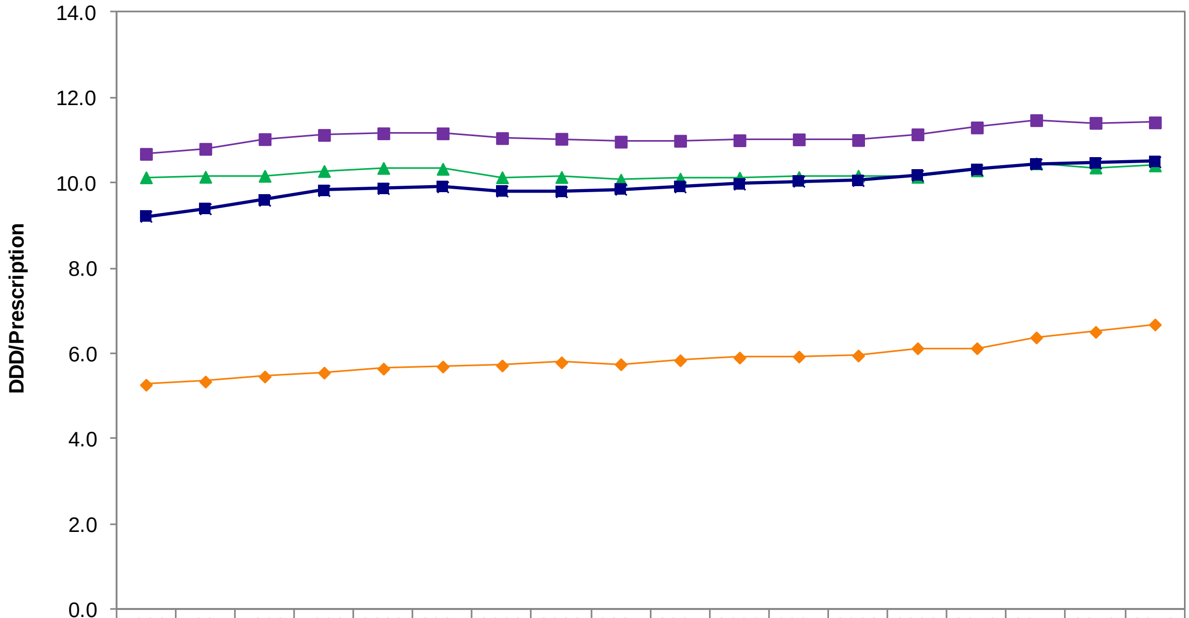


Figure 9: Antibiotic utilization rates (DDD/1000 population/day) by drug class from 1996 to 2013

7. By Prescription

As shown in Figure 10, the trend of DDD per prescription over the years has been generally increasing from 1996 to 2013, which suggests that antibiotics are being prescribed for longer durations and/or at higher doses when compared to previous years (Figure 10). This increase in prescription of antibiotics could be reflective of the aging population structure in Canada with seniors (65 years and older) making up the fastest growing age group (8). A study found that although most common infectious diseases could be effectively treated with a course of seven or fewer days, almost half of all antibiotic treatment course in long term care facilities extend beyond a week (9).

The 15 to 59 age group consistently experiences the highest DDD per prescription estimates, which may be driven by the high tetracycline prescription rate for acne vulgaris in youth aged 15 to 19, as shown in Figure 14. Total prescription per DDD was reported to be 10.41 in 2013 for the 60+ age group (Figure 10). The 0 to 14 age group experienced the largest percent increase (27%) over this time period from 5.27 in 1996 to 6.68 DDD per prescription in 2013 (Figure 10). This may be attributed to the increase in average dose of amoxicillin (penicillin class) during the last few years among children for acute otitis media and community-acquired pneumonia as recommended by the IDSA guidelines for Community Acquired Infections in Children in 2012.



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
0-14	5.27	5.35	5.46	5.55	5.65	5.70	5.72	5.80	5.75	5.84	5.91	5.93	5.95	6.13	6.13	6.38	6.51	6.68
15-59	10.68	10.80	11.03	11.13	11.16	11.16	11.05	11.03	10.97	10.99	11.00	11.02	11.01	11.14	11.30	11.47	11.41	11.42
60+	10.13	10.14	10.17	10.28	10.35	10.33	10.13	10.14	10.08	10.10	10.12	10.14	10.17	10.14	10.29	10.46	10.36	10.41
Total	9.22	9.40	9.59	9.82	9.87	9.91	9.81	9.79	9.85	9.91	9.97	10.04	10.06	10.18	10.31	10.44	10.46	10.50

Figure 10: Total DDDs per prescription of oral antimicrobials (J01) by age groups from 1996 to 2013

By Drug Class

J01A – Tetracyclines

1. Over-Time Trend

The tetracyclines were first discovered in the 1940s and were used for a number of infections due to their broad spectrum of antimicrobial activity. These bacteriostatic agents are classified as short-acting (i.e. tetracycline), intermediate-acting (i.e. demeclocycline) and long-acting (i.e. minocycline and doxycycline). All members of this class share a similar antibacterial spectrum against pathogens such as *Rickettsia*, *Chlamydia*, and *Mycoplasma* (10). As a result, they are indicated for a large array of infections including Chlamydia and urinary tract infections (UTIs) (11).

The tetracyclines act by inhibiting bacterial protein synthesis via binding of the 30S ribosomal subunit (10). Widespread resistance has limited the use of these agents over time. Resistance occurs through the expression of the *tet* genes, which encode for an efflux pump to enhance the exportation of the tetracycline agent, an altered target site that prevents binding of the drug, and the production of modifying enzymes that inactivate the drug (10).

From 1996 to 2009, the consumption rate of the tetracyclines class steadily declined from 3.34 to 2.66 DDD/1000 population/day (a total percentage drop of 20%). However, an increase of 8% was observed from 2.66 in 2009 to 2.88 DDD/1000 population/day in 2013. Upon examination of the trend among individual antibiotic agents, it is clear that doxycycline usage is the major contributor for this increase. Doxycycline usage decreased from 1.27 in 1996 to 1.06 DDD/1000 population/day in 2003, followed by a steady increase to 1.78 DDD/1000 population/day in 2013, which is likely related to MRSA and treatment of skin and soft tissue infections. Consumption of minocycline experienced an increase as well from 0.43 DDD/1000 population/day in 1996 to 0.82 DDD/1000 population/day in 2013 (Figure 11).

Similar overall trends were observed in the tetracycline antibiotic prescription rate as shown in Figure 12.

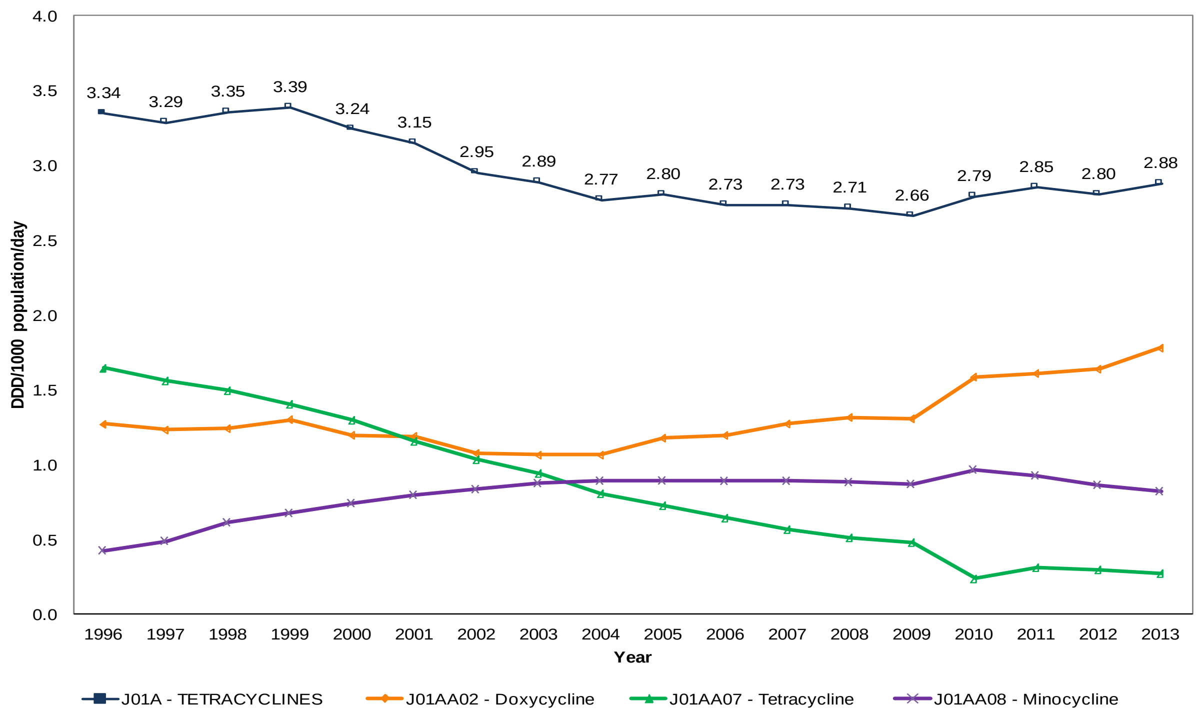


Figure 11: Daily consumption rates for tetracyclines (J01A) and subclass agents from 1996 to 2013

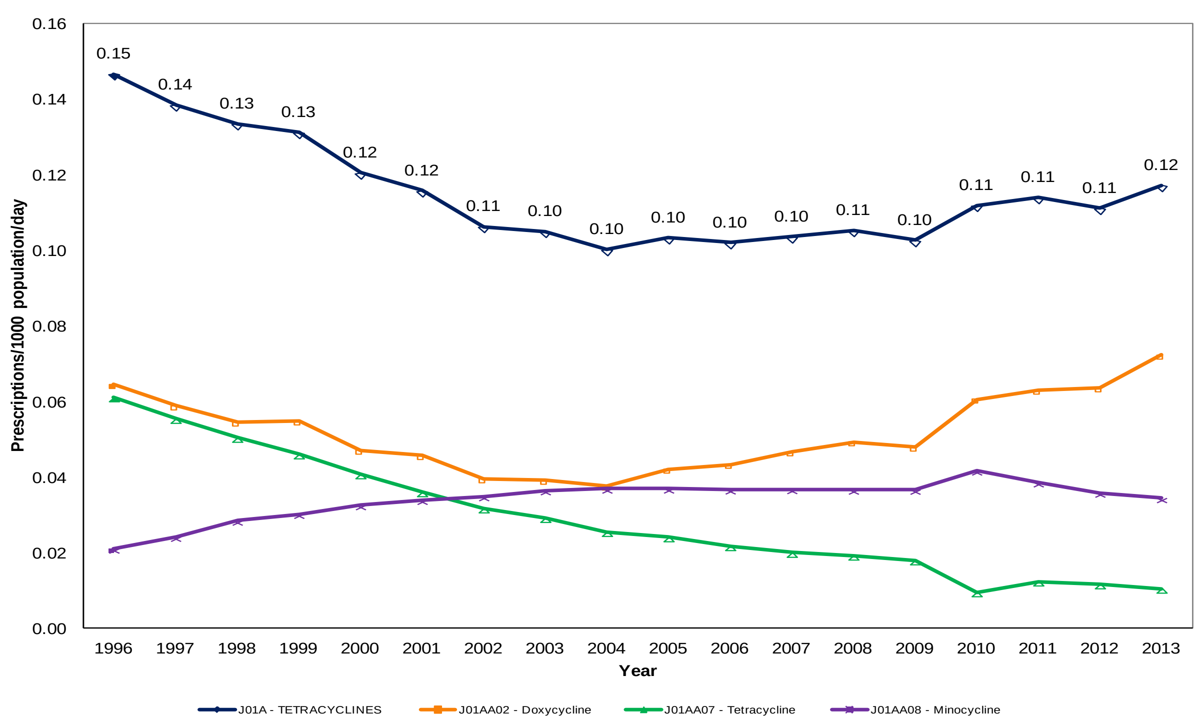
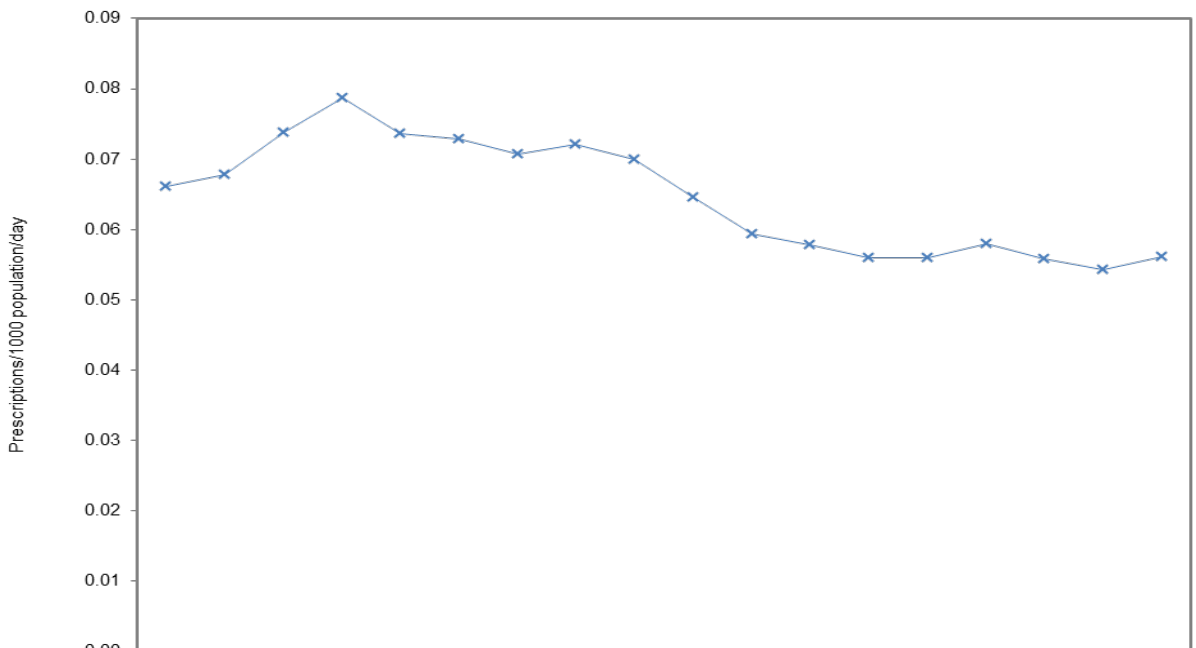


Figure 12: Daily prescription rates for tetracyclines (J01A) and subclass agents from 1996 to 2013

2. By Age

a. Children (< 15 years)

Because the use of tetracyclines during the tooth development stage of a child may lead to permanent tooth discoloration, these agents are contraindicated in children eight years of age and younger (10;11). As such, there were limited prescription data in these age groups (data not shown). A peak of 0.08 prescriptions/1000 population/day was observed in 1999 in the 10 to 14 age group, after which a decreasing trend was observed. The prescription rate for this age group was reported to be at 0.06 prescriptions/1000 population/day in 2013. As mentioned previously, the higher rate of prescription for tetracycline in this age group may be due to the prescriptions for acne vulgaris among teenagers (Figure 13).

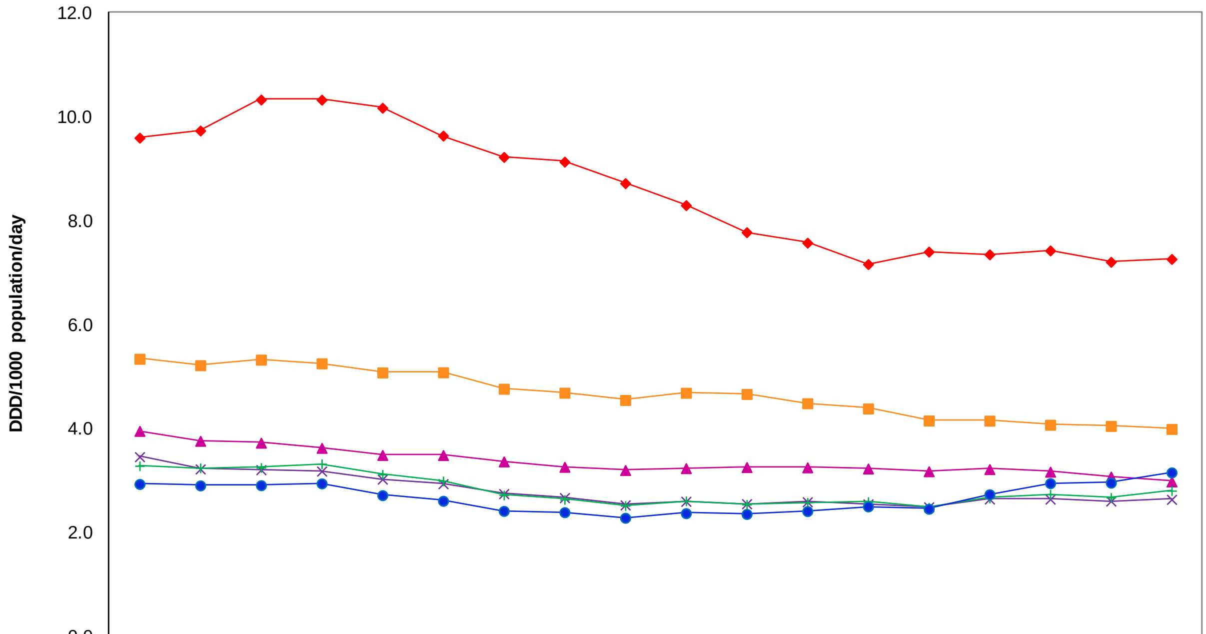


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
10-14	0.07	0.07	0.07	0.08	0.07	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.06

Figure 13: Tetracyclines (J01A) daily prescription rate for children between 10 to 14 years of age from 1996 to 2013

b. Adults (≥ 15 years)

Adults 15 to 19 years of age showed higher rates of tetracycline consumption consistently across the years, followed by those 20 to 24 years of age. With the exception of the 60+ age group, all other age groups experienced drops between 14% to 25% from 1996 to 2013. In 2013, adults in the 15 to 19 age group had the highest consumption rate at 7.25 DDD/1000 population/day, followed by the 20 to 24 age group with a rate of 3.98 DDD/1000 population/day. Conversely, the tetracycline consumption rate of the 60+ age group increased to 3.15 DDD/1000 population/day in 2013 (Figure 14), likely reflecting the use of this class for skin and soft tissue and community-acquired pneumonia infections.

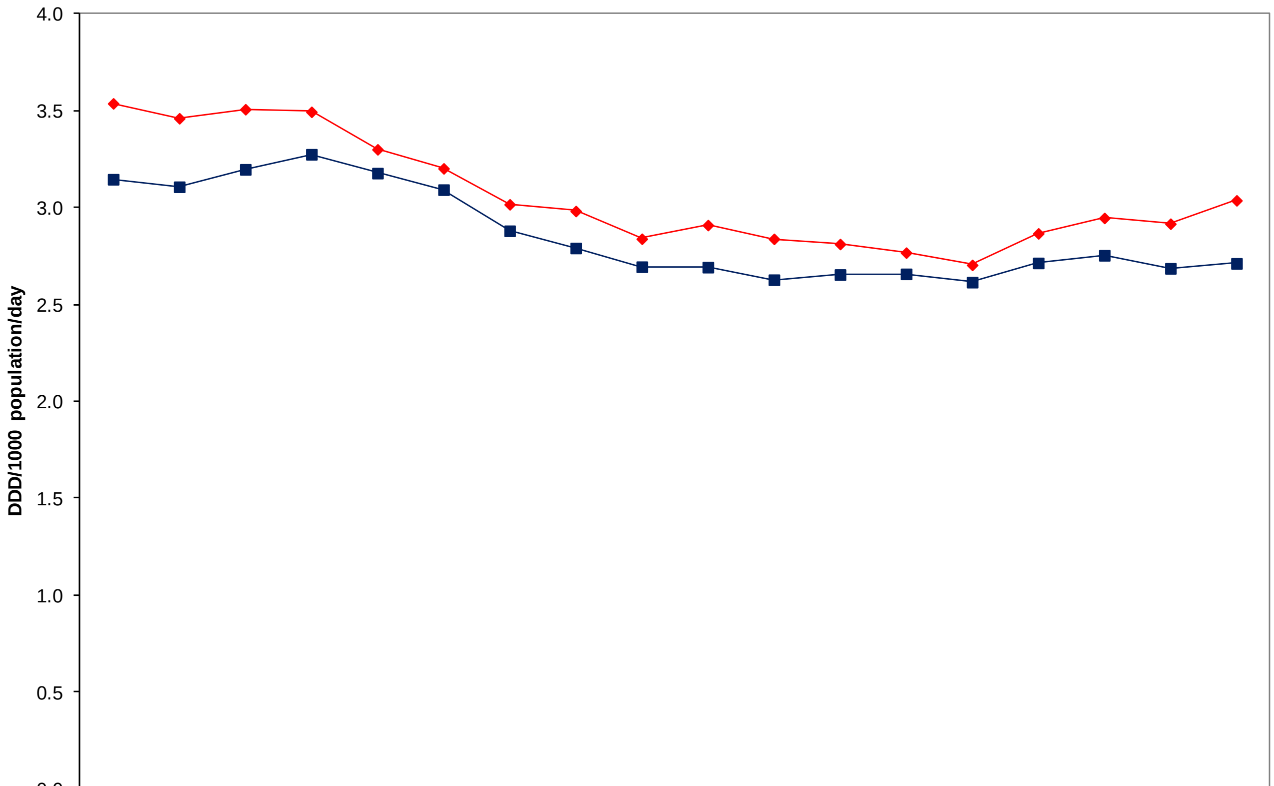


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
15-19	9.59	9.73	10.32	10.32	10.16	9.63	9.22	9.13	8.71	8.29	7.77	7.57	7.16	7.40	7.34	7.42	7.20	7.25
20-24	5.33	5.21	5.32	5.25	5.07	5.07	4.76	4.68	4.54	4.68	4.66	4.48	4.38	4.15	4.14	4.06	4.04	3.98
25-29	3.95	3.75	3.72	3.62	3.48	3.48	3.36	3.25	3.19	3.23	3.25	3.24	3.22	3.17	3.21	3.16	3.07	2.97
30-39	3.45	3.21	3.20	3.17	3.02	2.93	2.74	2.66	2.52	2.59	2.54	2.58	2.54	2.48	2.64	2.63	2.60	2.63
40-59	3.27	3.23	3.24	3.31	3.11	2.98	2.71	2.63	2.51	2.60	2.53	2.57	2.58	2.48	2.66	2.73	2.66	2.80
60+	2.92	2.90	2.90	2.94	2.71	2.60	2.41	2.38	2.27	2.36	2.35	2.40	2.49	2.45	2.73	2.94	2.95	3.15

Figure 14: Tetracyclines (J01A) daily consumption rates in adults by age group from 1996 to 2013

3. By Gender

From 1996 to 2013, consumption of tetracyclines among females consistently exceeded consumption among males by 3% to 12%. These differences are relatively small in magnitude compared to those observed for the sulfonamides/trimethoprim, macrolides and quinolones. Despite a noticeable increase since 2009, utilization has declined for both females and males when compared to the rate in 1996, with a total reduction in consumption by 14% in both sexes (Figure 15).

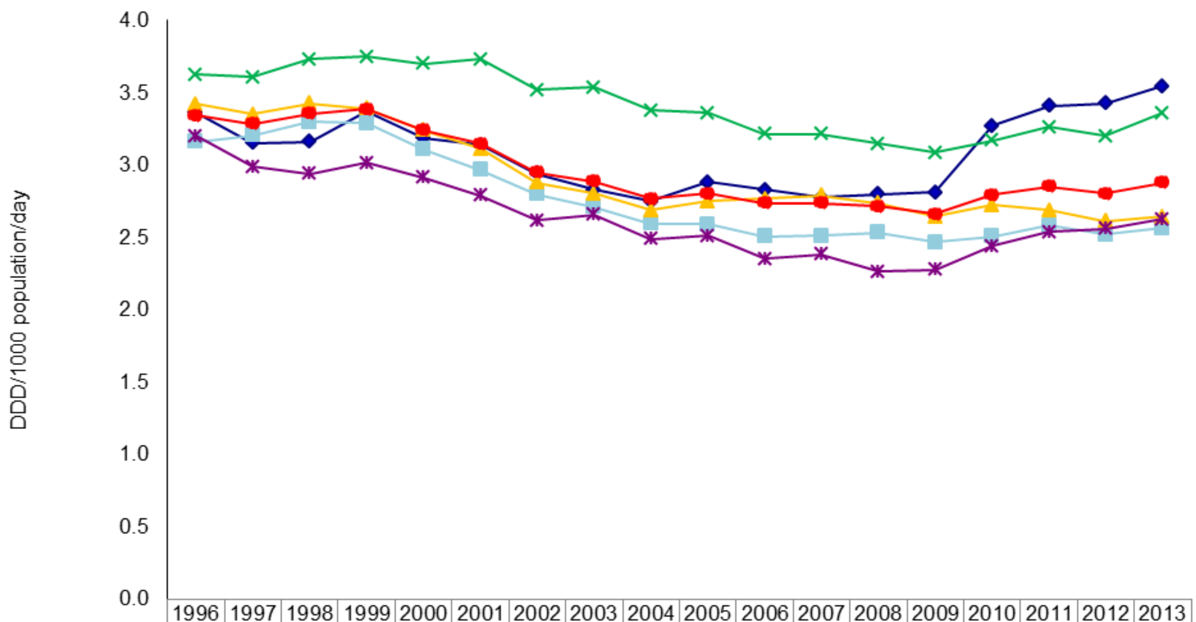


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
F	3.54	3.46	3.51	3.49	3.30	3.20	3.02	2.98	2.84	2.91	2.84	2.81	2.77	2.70	2.87	2.95	2.92	3.04
M	3.15	3.11	3.20	3.27	3.18	3.09	2.88	2.79	2.69	2.69	2.63	2.65	2.66	2.62	2.71	2.75	2.69	2.71

Figure 15: Tetracyclines (J01A) daily consumption rates by gender from 1996 to 2013

4. By Health Authority & Health Services Delivery Area

There was a downward trend in tetracyclines utilization from 1996 to 2009 in all BC HAs. However, in 2010 an increase of utilization was observed, particularly in Interior and Northern where rates jumped 27% and 16%, respectively. Consumption rates in Vancouver Island were traditionally the highest, ranging from 8% to 20% above the provincial average until 2010, at which time the highest consumption rates were observed in Interior. Consumption rates in Fraser and Northern Health remained below the provincial average since 1996, with the lowest consumption rate consistently observed in Northern over the years except in 2012 and 2013. In 2013, tetracycline consumption rate was observed to be at 3.54, 3.36, 2.63, 2.64 and 2.56 for Interior, Island, Northern, Vancouver Coastal, and Fraser, respectively (Figure 16).



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1-IHA	3.36	3.15	3.16	3.37	3.19	3.14	2.94	2.83	2.75	2.88	2.83	2.78	2.80	2.81	3.27	3.41	3.42	3.54
2-FHA	3.16	3.21	3.30	3.29	3.11	2.97	2.80	2.71	2.59	2.59	2.51	2.51	2.53	2.47	2.50	2.58	2.52	2.56
3-VCHA	3.42	3.35	3.43	3.39	3.24	3.11	2.88	2.80	2.69	2.75	2.77	2.79	2.74	2.64	2.72	2.69	2.61	2.64
4-VIHA	3.62	3.61	3.73	3.75	3.70	3.73	3.52	3.54	3.38	3.36	3.21	3.21	3.15	3.09	3.17	3.26	3.20	3.36
5-NHA	3.20	2.99	2.94	3.02	2.91	2.79	2.62	2.66	2.49	2.51	2.35	2.38	2.26	2.28	2.44	2.54	2.56	2.63
BC	3.34	3.29	3.35	3.39	3.24	3.15	2.95	2.89	2.77	2.80	2.73	2.73	2.71	2.66	2.79	2.85	2.80	2.88

Figure 16: Tetracyclines (J01A) daily consumption rates by health authority from 1996 to 2013

Tetracycline utilization within the Interior experienced an overall increasing trend from 3.36 in 1996 to 3.54 in 2013. This may be mostly attributed to the 13% increase of tetracycline usage in the Okanagan region. The largest decrease was observed in the Kootenay Boundary region from 3.55 in 1996 to 3.05 DDD/1000 population/day in 2013 (Table 2).

In Fraser, tetracycline consumption rate was similar across all three HSDAs. Fraser North experienced the largest percent decrease (28%) from 3.48 DDD/1000 population/day to 2.52 DDD/1000 population/day in 2013. This was followed by a 14% decrease in tetracycline usage in Fraser South and an 8.33% decrease in Fraser East (Table 2).

An overall decreasing trend in tetracycline consumption was observed in all three HSDAs within the Vancouver Coastal Health region. The consumption rate was highest in North Shore/Coast Garibaldi at 2.90 DDD/1000 population/day in 2013. This exceeded the average rate in Vancouver Coastal by 10%. Utilization rates were 2.71 and 2.04 DDD/1000 population/day for Vancouver and Richmond, respectively (Table 2).

Within Vancouver Island, the greatest drop in tetracyclines utilization occurred in Northern Vancouver Island from 1996 to 2013 a total percentage drop of 21% from 3.30 to 2.60 DDD/1000 population/day. Consumption rate in Central Vancouver Island also dropped to 3.12 DDD/1000 population/day in 2013 while rates in South Vancouver Island remained relatively unchanged at 3.78 DDD/1000 population/day in 2013 (Table 2).

Lastly, Northern Health tetracycline consumption rate experienced an overall decreasing trend over the years for all three HSDAs with Northern Interior experiencing the largest percentage drop (27%) from

3.49 to 2.53 DDD/1000 population/day in 2013. A rate of 2.43 and 3.01 DDD/1000 population/day was reported in 2013 for tetracycline usage in Northwest and Northeast, respectively (Table 2).

Table 2: Tetracyclines (J01A) daily consumption rates by health authority and health services delivery area from 1996 to 2013

HA/HSDA	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	% Change
1-IHA	3.36	3.15	3.16	3.37	3.19	3.14	2.94	2.83	2.75	2.88	2.83	2.78	2.80	2.81	3.27	3.41	3.42	3.54	5.43
11-EK	3.15	3.01	2.78	2.74	2.70	2.71	2.80	2.56	2.63	2.53	2.53	2.56	2.61	2.52	2.85	3.24	3.15	3.27	3.93
12-KB	3.55	3.57	3.34	3.27	3.18	2.94	2.89	2.70	2.62	2.91	2.87	2.59	2.78	2.56	2.91	2.82	2.91	3.05	-14.08
13-OK	3.55	3.29	3.31	3.57	3.41	3.42	3.15	3.08	3.01	3.11	3.06	3.03	3.05	3.18	3.81	3.96	3.90	4.01	12.98
14-TCS	3.11	2.87	3.03	3.35	3.04	2.96	2.70	2.60	2.46	2.66	2.56	2.52	2.47	2.42	2.71	2.81	2.95	3.07	-1.13
2-FHA	3.16	3.21	3.30	3.29	3.11	2.97	2.80	2.71	2.59	2.59	2.51	2.51	2.53	2.47	2.50	2.58	2.52	2.56	-18.83
21-FE	2.79	2.84	2.85	2.93	2.87	2.60	2.54	2.58	2.48	2.40	2.34	2.34	2.42	2.30	2.35	2.52	2.52	2.56	-8.33
22-FN	3.48	3.52	3.63	3.61	3.30	3.20	2.93	2.78	2.67	2.75	2.70	2.67	2.62	2.60	2.60	2.65	2.54	2.52	-27.66
23-FS	3.03	3.08	3.19	3.16	3.03	2.90	2.78	2.70	2.57	2.53	2.41	2.44	2.50	2.43	2.48	2.55	2.50	2.61	-13.91
3-VCHA	3.42	3.35	3.43	3.39	3.24	3.11	2.88	2.80	2.69	2.75	2.77	2.79	2.74	2.64	2.72	2.69	2.61	2.64	-22.78
31-RMD	3.09	2.94	3.14	3.04	2.86	2.73	2.56	2.45	2.32	2.31	2.35	2.33	2.20	2.09	2.23	2.09	1.99	2.04	-34.03
32-VAN	3.50	3.43	3.43	3.35	3.21	3.09	2.81	2.72	2.60	2.69	2.72	2.73	2.72	2.69	2.78	2.77	2.67	2.71	-22.59
33-NSCG	3.45	3.44	3.60	3.70	3.56	3.42	3.24	3.22	3.14	3.19	3.16	3.22	3.15	2.93	2.93	2.91	2.90	2.90	-16.07
4-IH	3.62	3.61	3.73	3.75	3.70	3.73	3.52	3.54	3.38	3.36	3.21	3.21	3.15	3.09	3.17	3.26	3.20	3.36	-7.27
41-SVI	3.82	3.78	4.09	4.06	4.24	4.26	4.04	4.16	3.96	3.85	3.68	3.68	3.60	3.51	3.64	3.64	3.54	3.78	-0.97
42-CVI	3.51	3.50	3.47	3.56	3.14	3.28	3.01	2.97	2.80	2.94	2.84	2.85	2.73	2.75	2.79	3.02	3.02	3.12	-11.17
43-NVI	3.30	3.34	3.23	3.23	3.25	3.08	3.01	2.82	2.84	2.74	2.62	2.59	2.66	2.51	2.57	2.62	2.56	2.60	-21.37
5-NHA	3.20	2.99	2.94	3.02	2.91	2.79	2.62	2.66	2.49	2.51	2.35	2.38	2.26	2.28	2.44	2.54	2.56	2.63	-17.92
51-NW	2.69	2.47	2.30	2.48	2.68	2.54	2.37	2.69	2.44	2.58	2.57	2.62	2.38	2.27	2.36	2.26	2.37	2.43	-9.45
52-NI	3.49	3.24	3.26	3.34	3.06	2.98	2.78	2.78	2.58	2.55	2.35	2.42	2.36	2.28	2.37	2.53	2.49	2.53	-27.35
53-NE	3.23	3.09	3.06	2.97	2.87	2.67	2.54	2.32	2.34	2.35	2.12	2.06	1.93	2.28	2.68	2.85	2.89	3.01	-6.66
BC	3.34	3.29	3.35	3.39	3.24	3.15	2.95	2.89	2.77	2.80	2.73	2.73	2.71	2.66	2.79	2.85	2.80	2.88	-13.98

5. Comparison of Antimicrobial Utilization in British Columbia, Other Provinces and Europe

When compared to that of several European nations, the 2011 tetracycline utilization rate in BC was lower than most countries (7 countries reported less utilization and 16 countries reported more) (Figure 17). In 2011, BC had a similar tetracycline consumption rate to Norway, Germany, and Ireland (Figure 17). When compared to other Canadian provinces, BC had medial tetracycline use in 2011 (Figure 8).

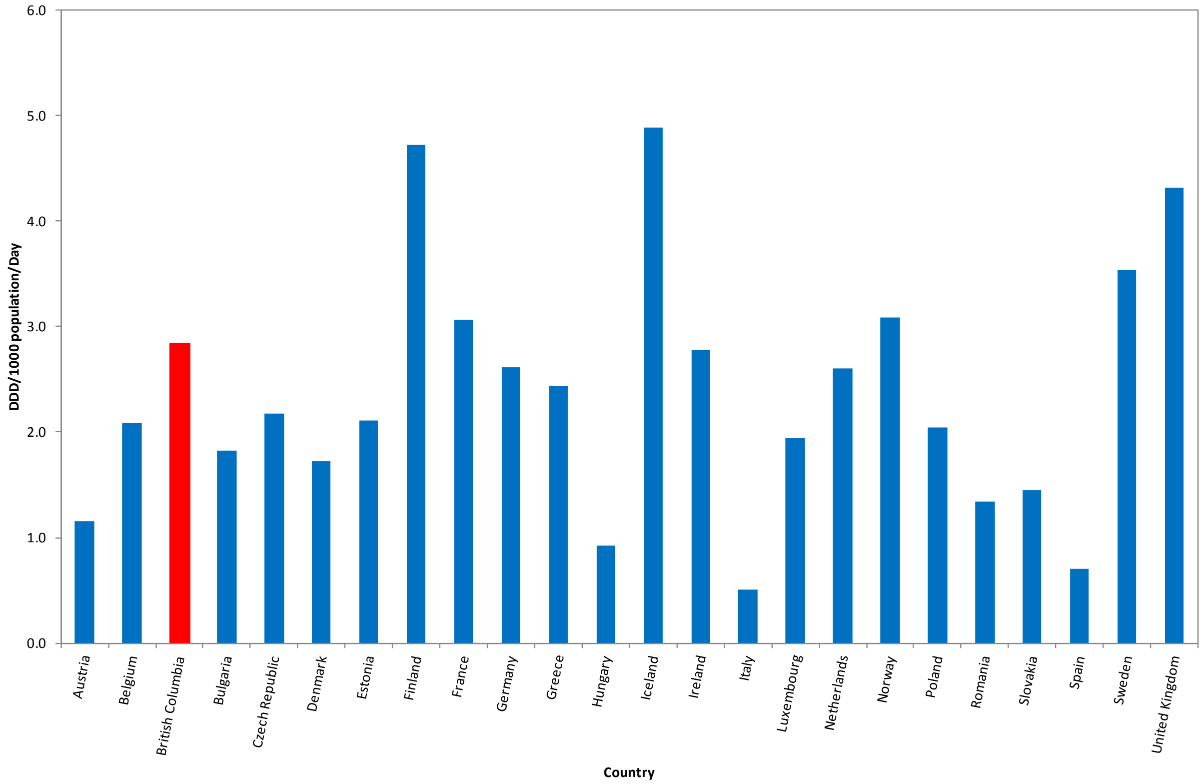


Figure 17: Defined daily rate of tetracycline (J01A) use in BC and several European nations for 2011

Source: PharmaNet (BC data); European Surveillance of Antimicrobial Consumption (ESAC) (6;12)
See Table for the list of antimicrobials included in this class

J01C- Penicillins

1. Over-Time Trend

The penicillins are bactericidal agents that belong to the larger beta-lactam (β-lactam) family of antimicrobials. These agents have a common functional group, the β-lactam ring, which binds to an enzyme that facilitates the peptidoglycan cross-linkage in bacterial cell wall, inhibiting cell wall biosynthesis (10). They encompass a large array of agents with varying degrees of antibacterial activity. The β-lactamase sensitive penicillins (e.g. penicillin V) have a relatively narrow gram-positive antibacterial spectrum against *Staphylococci, Streptococci* and *Pneumococci* (10). Those with extended spectrum (e.g. amoxicillin, ampicillin) have greater activity against gram-negative pathogens including *Neisseria meningitides, E. coli* and *P. mirabilis* (10). As a result, penicillins are indicated for a variety of infections.

Resistance is conferred through two main mechanisms: (1) production of β-lactamase, an enzyme that cleaves and inactivates the active moiety of penicillins, the β-lactam ring, and (2) altered expression of the penicillin-binding protein (PBP) to reduce the binding affinity to the antimicrobial agent (10). Several subclasses of the penicillin family have been designed to circumvent the growing resistance. These include the β-lactamase resistant penicillin (e.g. cloxacillin) and penicillins with β-lactamase inhibitors (e.g. amoxicillin-clavulanate, piperacillin-tazobactam).

The use of penicillins with extended spectrum of activity has dominated the overall usage of the penicillin antimicrobials overall the past decade. In 2013, the use of J01CA (penicillins with extended spectrum) made up 77.6% of the overall penicillin consumption. From 1996 to 2000, consumption rates for this subclass dropped by 23.1%; usage has remained relatively stable since then and was reported to be at 5.36 DDD/1000 population/day in 2013. Consumption rates for β-lactamase-sensitive penicillins and β-lactamase resistant penicillins have consistently dropped by a respective total of 62.1% and 78.8% from 1996 to 2013. During the same time period, consumption rates for penicillins with β-lactamase inhibitors have increased substantially by 176.9% (Figure 18). These drugs now appear more frequently recommended for several infections and their use may also be driven by observed patterns of resistance to simpler compounds.

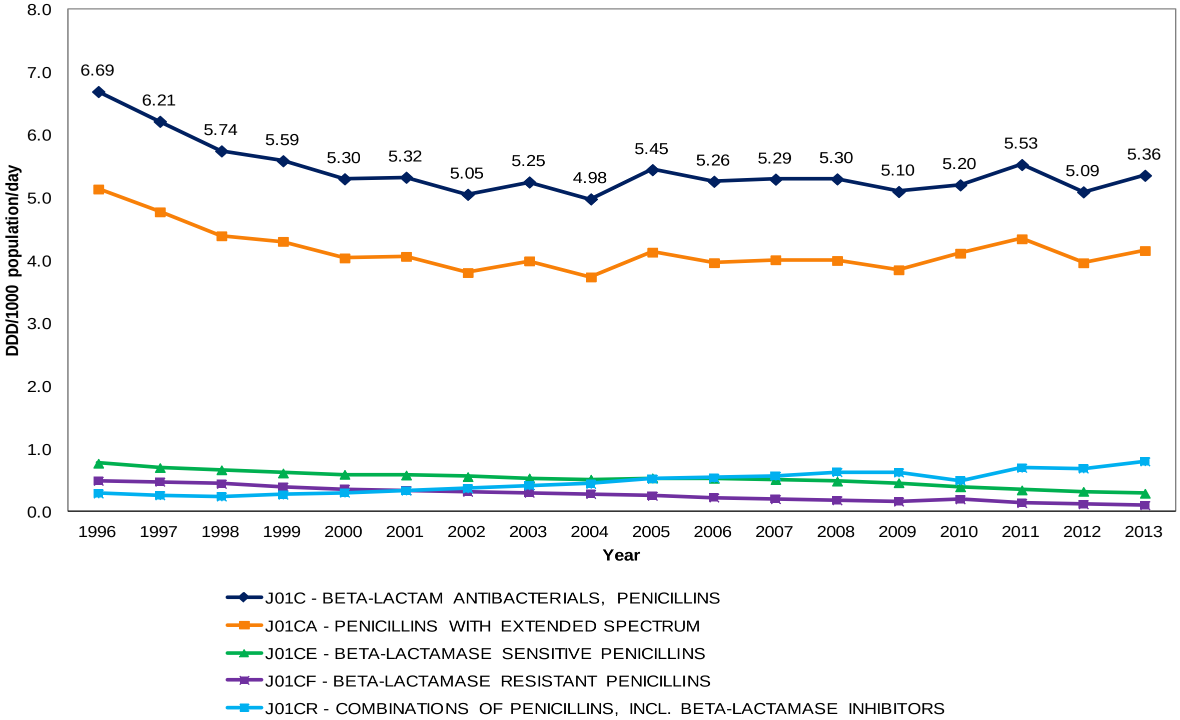


Figure 18: Daily consumption rates for penicillins (J01C) and the subclass agents from 1996 to 2013

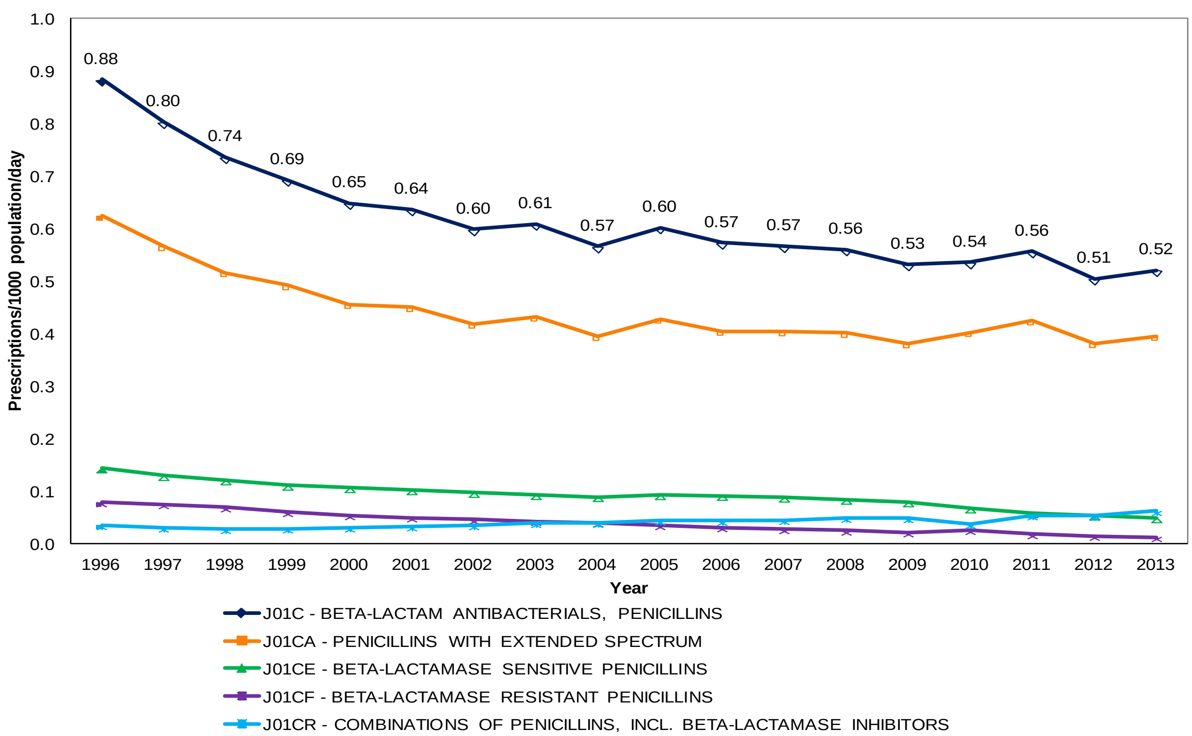


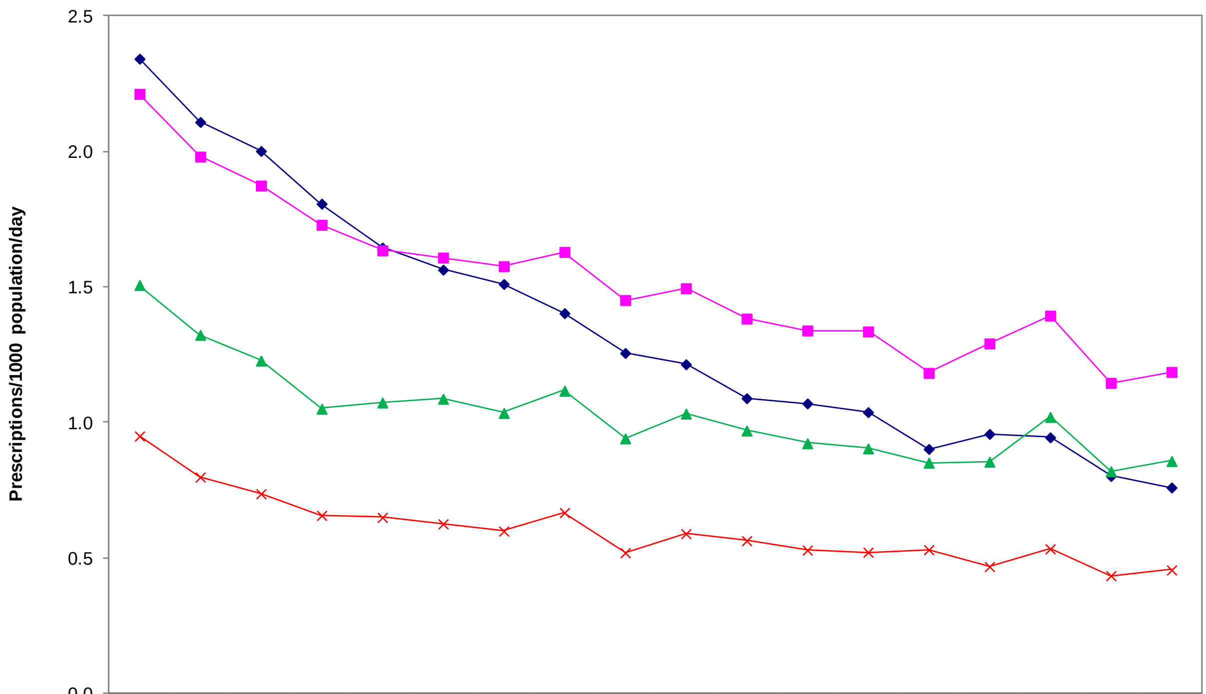
Figure 19: Daily prescription rates for penicillins (J01C) and the subclass agents from 1996 to 2013

2. By Age

a. Children (< 15 years)

Penicillins are the most commonly prescribed class of antimicrobial agents in the paediatric population. They possess several key characteristics that make them suitable agents for this population: (1) they are compatible with pregnancy and lactation, (2) they are indicated for common pediatric infectious diseases (e.g., otitis media, some bacterial meningitis), and (3) many agents are available in suspension formulations that improve the ease of administration (11).

The penicillin prescription utilization rate showed a decreasing trend throughout the years from 1996 to 2013 across all pediatric age groups. In 2013, children 1 to 4 years of age were the largest consumers of penicillin at a rate of 1.19 prescriptions/1000 population/day, followed by children aged 5 to 9, less than 1, and 10 to 14 with prescription rates of 0.86, 0.76 and 0.46 prescriptions/1000 population/day, respectively (Figure 20).

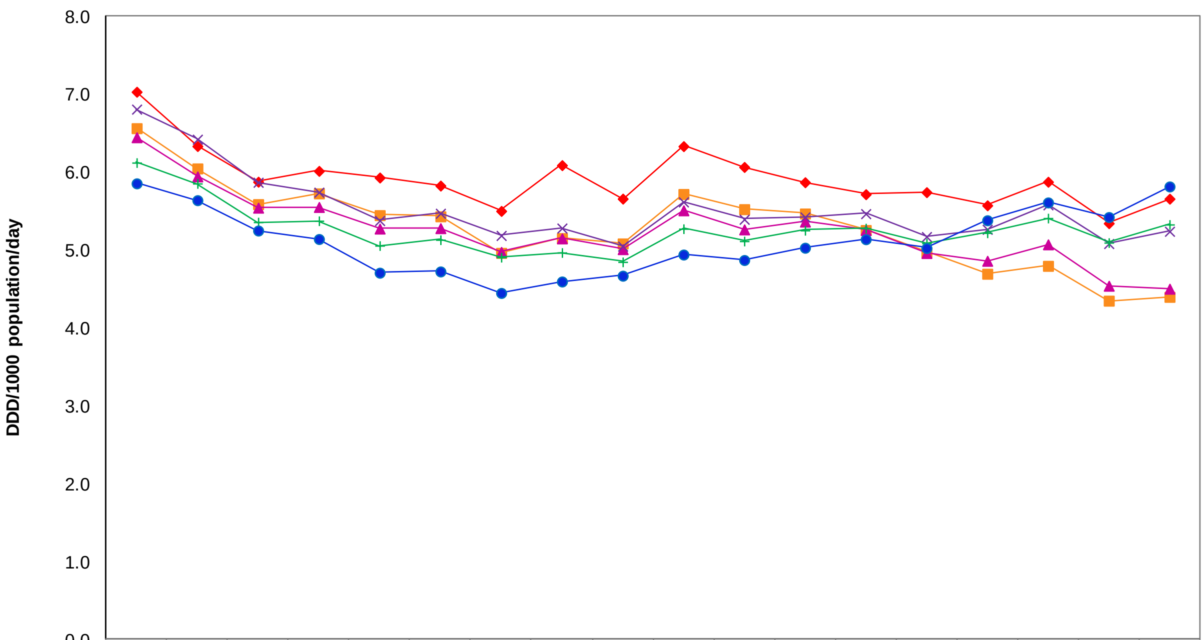


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
<1	2.34	2.11	2.00	1.81	1.65	1.56	1.51	1.40	1.26	1.21	1.09	1.07	1.04	0.90	0.96	0.94	0.80	0.76
1-4	2.21	1.98	1.87	1.73	1.63	1.61	1.58	1.63	1.45	1.50	1.38	1.34	1.34	1.18	1.29	1.39	1.15	1.19
5-9	1.51	1.32	1.23	1.05	1.07	1.09	1.03	1.12	0.94	1.03	0.97	0.92	0.90	0.85	0.85	1.02	0.82	0.86
10-14	0.95	0.80	0.74	0.66	0.65	0.63	0.60	0.67	0.52	0.59	0.56	0.53	0.52	0.53	0.47	0.53	0.43	0.46

Figure 20: Penicillins (J01C) daily prescription rates in children from 1996 to 2013

b. Adults (≥ 15 years)

Penicillin utilization showed similar trends across all adult age groups over the years 1996 to 2013 with those 15 to 19 years of age showing the highest rate up until 2012 and 2013. For all years prior to 2009, patients over the age of 60 years had the lowest penicillin utilization rate; however, following a sharp increase in 2002, utilization of penicillins has steadily increased such that utilization is at 5.82 DDD/1000 population/day in 2013. This is followed by the 15 to 19 years age group, which has a utilization rate of 5.66 DDD/1000 population/day. Those 20 to 24 and 25 to 29 years of age experienced the largest percentage decline in utilization by approximately 30% since 1996 and were reported to be at 4.4 and 4.5 DDD/1000 population/day, respectively, in 2013. Consumption rates for those 30 to 39 and 40 to 59 showed similar rates in 2013 at 5.24 and 5.33 DDD/1000 population/day (Figure 21).

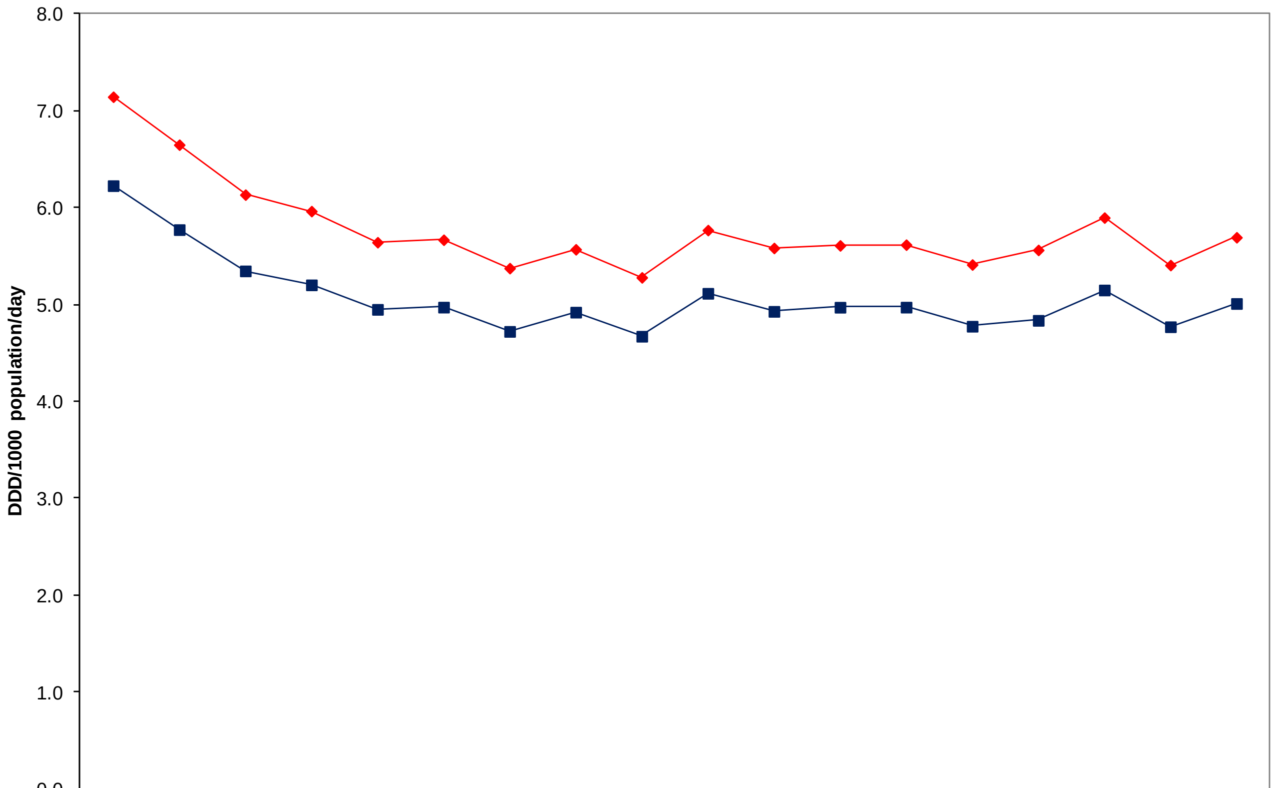


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
15-19	7.03	6.33	5.88	6.02	5.93	5.83	5.50	6.09	5.66	6.33	6.07	5.87	5.72	5.74	5.57	5.88	5.34	5.66
20-24	6.56	6.05	5.59	5.73	5.45	5.43	4.96	5.15	5.08	5.72	5.52	5.47	5.26	4.97	4.70	4.80	4.35	4.40
25-29	6.45	5.94	5.54	5.55	5.27	5.28	4.98	5.15	5.01	5.51	5.26	5.36	5.26	4.96	4.86	5.07	4.54	4.50
30-39	6.81	6.42	5.87	5.74	5.38	5.47	5.19	5.28	5.05	5.62	5.39	5.42	5.47	5.17	5.27	5.58	5.08	5.24
40-59	6.12	5.85	5.36	5.38	5.06	5.13	4.91	4.97	4.85	5.27	5.12	5.25	5.28	5.09	5.22	5.41	5.10	5.33
60+	5.86	5.64	5.25	5.14	4.71	4.72	4.45	4.60	4.67	4.94	4.87	5.03	5.14	5.03	5.38	5.61	5.42	5.82

Figure 21: Penicillins (J01C) daily consumption rates in adults from 1996 to 2013

3. By Gender

Consistent with other classes of antimicrobial agents, consumption of penicillins among females was approximately 13% above consumption among males over the years from 1996 to 2013. Both females and males experienced a similar trend in penicillin utilization, decreasing until 2002, after which both rates stabilized (Figure 22).

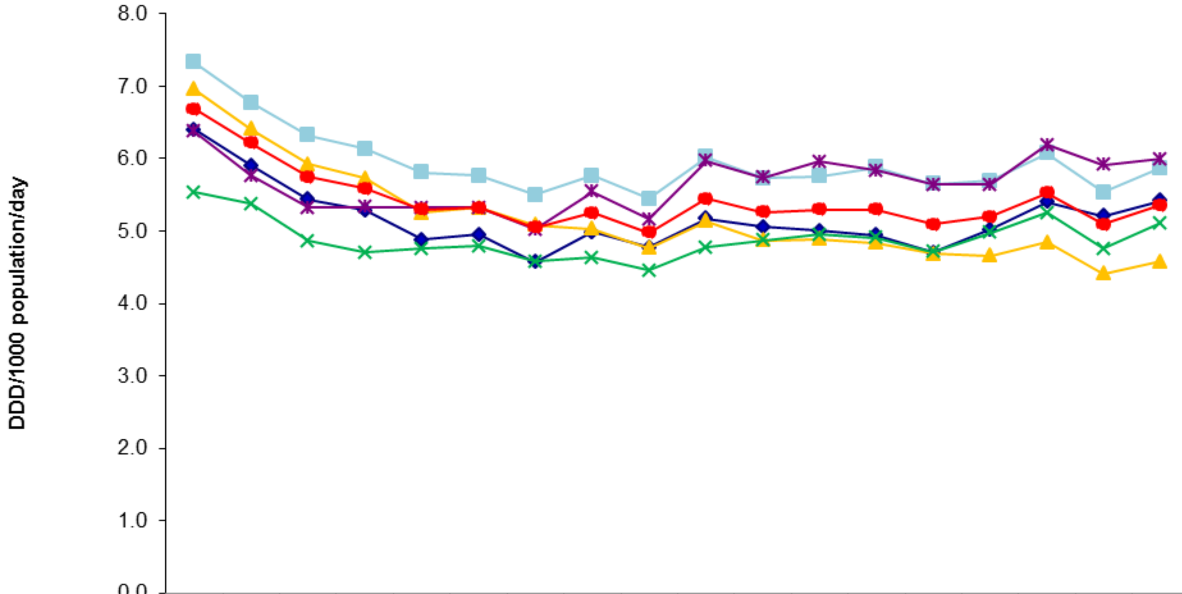


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
F	7.14	6.65	6.13	5.96	5.64	5.67	5.37	5.57	5.28	5.77	5.58	5.61	5.62	5.41	5.56	5.90	5.41	5.69
M	6.23	5.77	5.35	5.20	4.95	4.97	4.72	4.92	4.67	5.12	4.93	4.97	4.97	4.78	4.84	5.15	4.77	5.01

Figure 22: Penicillins (J01C) daily consumption rates by gender from 1996 to 2013

4. By Health Authority & Health Services Delivery Area

In 2013, the lowest prescribing rates for penicillin antibiotics occurred in Vancouver Coastal at 14.5% below the provincial average with 4.6 DDD/1000 population/day. The next lowest consumption rate of 5.11 and 5.42 DDD/1000 population/day occurred in Island and Interior, respectively. Consumption rates in Fraser were 5.87 DDD/1000 population/day, while the highest consumption rate occurred in Northern at 6.0 DDD/1000 population/day (11.9% above the provincial average) (Figure 23).



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1-IHA	6.40	5.91	5.43	5.29	4.88	4.95	4.57	4.99	4.77	5.18	5.06	5.00	4.94	4.71	5.03	5.40	5.20	5.42
2-FHA	7.33	6.78	6.32	6.14	5.81	5.77	5.50	5.77	5.44	6.02	5.73	5.76	5.88	5.65	5.70	6.08	5.54	5.87
3-VCHA	6.96	6.42	5.92	5.73	5.26	5.32	5.08	5.03	4.77	5.13	4.87	4.89	4.83	4.69	4.66	4.84	4.41	4.58
4-VIHA	5.54	5.37	4.86	4.71	4.75	4.79	4.58	4.64	4.46	4.77	4.87	4.95	4.91	4.71	4.98	5.25	4.75	5.11
5-NHA	6.38	5.77	5.32	5.33	5.32	5.32	5.03	5.54	5.17	5.96	5.74	5.96	5.84	5.64	5.64	6.19	5.92	6.00
BC	6.69	6.21	5.74	5.59	5.30	5.32	5.05	5.25	4.98	5.45	5.26	5.29	5.30	5.10	5.20	5.53	5.09	5.36

Figure 23: Penicillins (J01C) daily consumption rates by health authority from 1996 to 2013

From 1996 to 2013 the only continuous reduction in utilization of the class of penicillins for HAs in BC was observed in Vancouver Coastal (from 7.21 to 4.73 DDD/1000 population/day). Although there was a decline in usage in all other HAs from 1996 to 2002, utilization rates reverted to an upward trend until 2005 and (with the exception of Vancouver Island) have subsequently either stabilized or decreased slightly (Table 3).

During 2013, within Interior, the first and second highest ranked consumption rates were in Okanagan and Thompson Cariboo Shuswap at 5.63 and 5.43 DDD/1000 population/day, respectively. Rates in East Kootenay ranked third at 5.33 DDD/1000 population/day, while rates in Kootenay Boundary were lowest at 4.49 DDD/1000 population/day. Rates in all HDSAs demonstrated similar decreasing trend since 1996, with the highest percent decrease occurring in Thompson Cariboo Shuswap (22%), followed by Kootenay Boundary (21%), East Kootenay (18%), and Okanagan (9%) (Table 3).

In Fraser, the most dramatic drop in consumption rates occurred in Fraser North from 7.50 DDD/1000 population/day in 1996 to 5.37 DDD/1000 population/day in 2013 (total percentage drop of 28%). This was followed by Fraser East then Fraser North with a consumption rate at 5.76 and 5.37 DDD/1000 population/day in 2013 (Table 3). All three HSDAs showed similar trends in penicillin consumption with a decreasing rate until 2004, which then stabilized for the following years (Table 3).

A substantial decreasing trend was observed in penicillin consumption in Vancouver Coastal with the Vancouver region experiencing the largest percentage decrease of 41% followed by Richmond (29%) and North Shore/Coast Garibaldi (21%) from 1996 to 2013. The consumption rate reported for 2013 was 4.83, 4.60 and 4.50 DDD/1000 population/day for Richmond, North Shore/Coast Garibaldi, and Vancouver, respectively (Table 3).

For the three HSDAs within Vancouver Island, the trend in penicillins class consumption rates mirrored that of other BC HAs. In 2013, the highest usage occurred in Northern Vancouver Island and Central Vancouver Island at 5.51 and 5.39 DDD/1000 population/day, respectively. The lowest consumption rates were seen in South Vancouver Island at 4.79 DDD/1000 population/day. While there was an overall drop in penicillins utilization in South Vancouver Island and Central Vancouver Island from 1996 to 2013 of 14% and 5%, respectively, there was an overall increase in North Vancouver Island of 6%.

Lastly, the consumption rate in Northern had an overall decreasing trend, with Northern Interior and Northeast decreasing by approximately 9%. Conversely, penicillin consumption increased by 3% in Northwest from 1996 to 2013. When observing the trends from 1996 to 2013, the smallest reduction in penicillin utilization rates among BC HAs occurred in Northern Health (6% decrease in utilization) (Table 3).

Table 3: Penicillins (J01C) daily consumption rates by health authority and health services delivery area from 1996 to 2013

HA/HSDA	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	% Change
1-IHA	6.40	5.91	5.43	5.29	4.88	4.95	4.57	4.99	4.77	5.18	5.06	5.00	4.94	4.71	5.03	5.40	5.20	5.42	-15.42
11-EK	6.48	5.74	5.46	5.44	5.63	5.76	5.55	5.69	5.41	5.85	5.74	5.65	5.43	4.97	5.02	5.58	5.14	5.33	-17.69
12-KB	5.67	5.62	5.03	4.95	4.61	4.71	4.17	4.25	4.12	4.26	4.25	4.21	4.00	3.81	4.18	4.27	4.26	4.49	-20.81
13-OK	6.18	5.64	5.20	4.80	4.51	4.60	4.25	4.78	4.61	5.12	4.92	4.96	4.96	4.74	5.30	5.66	5.37	5.63	-8.89
14-TCS	6.96	6.45	5.90	6.06	5.24	5.26	4.84	5.32	5.03	5.35	5.31	5.13	5.07	4.89	4.89	5.33	5.30	5.43	-21.99
2-FHA	7.33	6.78	6.32	6.14	5.81	5.77	5.50	5.77	5.44	6.02	5.73	5.76	5.88	5.65	5.70	6.08	5.54	5.87	-19.89
21-FE	6.43	6.25	5.97	5.65	5.62	5.50	5.25	5.52	5.17	5.60	5.43	5.39	5.87	5.54	5.72	6.15	5.44	5.76	-10.44
22-FN	7.50	6.80	6.28	6.13	5.64	5.65	5.32	5.38	5.08	5.66	5.38	5.38	5.39	5.21	5.25	5.60	5.12	5.37	-28.32
23-FS	7.57	6.98	6.51	6.34	6.03	5.99	5.76	6.21	5.87	6.50	6.17	6.24	6.31	6.08	6.08	6.45	5.92	6.34	-16.23
3-VCHA	6.96	6.42	5.92	5.73	5.26	5.32	5.08	5.03	4.77	5.13	4.87	4.89	4.83	4.69	4.66	4.84	4.41	4.58	-34.17
31-RMD	6.78	6.09	5.65	5.21	4.74	4.75	4.49	4.55	4.48	4.86	4.67	4.78	4.61	4.58	4.71	5.01	4.61	4.83	-28.81
32-VAN	7.56	6.96	6.42	6.28	5.60	5.61	5.28	5.20	4.86	5.21	4.93	4.98	4.89	4.77	4.70	4.83	4.32	4.50	-40.45
33-NSCG	5.78	5.44	5.03	4.88	4.85	5.07	5.03	4.98	4.76	5.15	4.87	4.77	4.85	4.57	4.53	4.77	4.47	4.60	-20.49
4-IH	5.54	5.37	4.86	4.71	4.75	4.79	4.58	4.64	4.46	4.77	4.87	4.95	4.91	4.71	4.98	5.25	4.75	5.11	-7.66
41-SVI	5.57	5.28	4.88	4.72	4.69	4.77	4.63	4.57	4.33	4.56	4.79	4.79	4.76	4.57	4.81	5.02	4.49	4.79	-14.02
42-CVI	5.66	5.56	4.96	4.73	4.88	4.85	4.48	4.82	4.69	5.06	5.00	5.17	5.09	4.85	5.24	5.55	4.95	5.39	-4.76
43-NVI	5.21	5.24	4.62	4.64	4.69	4.71	4.62	4.46	4.36	4.80	4.81	4.97	4.96	4.84	4.94	5.33	5.16	5.51	5.88
5-NHA	6.38	5.77	5.32	5.33	5.32	5.32	5.03	5.54	5.17	5.96	5.74	5.96	5.84	5.64	5.64	6.19	5.92	6.00	-5.96
51-NW	6.27	5.62	5.37	5.25	5.28	5.25	5.25	5.90	5.14	6.04	5.74	6.04	5.68	5.51	5.48	6.10	6.04	6.43	2.55
52-NI	6.16	5.28	4.71	4.90	4.87	4.85	4.68	5.07	4.94	5.54	5.43	5.74	5.68	5.44	5.33	5.83	5.41	5.56	-9.71
53-NE	7.03	7.14	6.72	6.48	6.45	6.55	5.55	6.18	5.72	6.80	6.40	6.35	6.36	6.21	6.44	7.02	6.82	6.40	-8.97
BC	6.69	6.21	5.74	5.59	5.30	5.32	5.05	5.25	4.98	5.45	5.26	5.29	5.30	5.10	5.20	5.53	5.09	5.36	-19.94

5. Comparison of Antimicrobial Utilization in British Columbia, Other Provinces and Europe

When compared to that of several European nations, the 2011 utilization rate in BC for the class of penicillins was much lower than most countries (3 countries reported less utilization and 20 countries reported more) (Figure 24). When compared to other Canadian provinces, BC had the second lowest penicillins use in 2011 (second to Québec) (Figure 8).

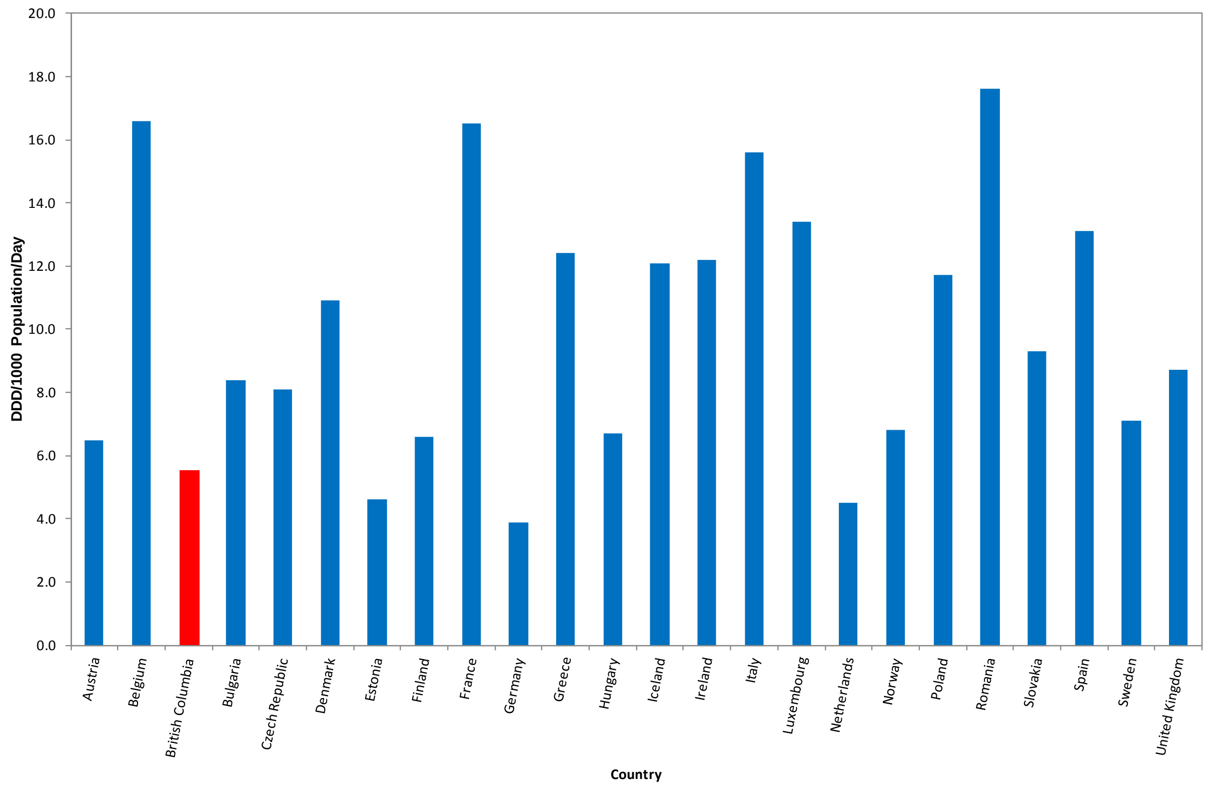


Figure 24: Defined daily rate of penicillins (J01C) use in BC and several European nations for 2011
Source: PharmaNet (BC data); European Surveillance of Antimicrobial Consumption (ESAC) (6)
See Table for the list of antimicrobials included in this class

J01D – Cephalosporins

1. Over-Time Trend

Cephalosporins belong to the beta-lactam antibiotic class along with penicillins and carbapenems and are characterized by the four-membered β-lactam ring. Production of β-lactamase is the main mechanism of resistance against all β-lactam antibiotics and is shared amongst Gram negative bacteria. Thus, due to similar mechanisms of action, cross-reactivity among penicillin and cephalosporins is observed (13).

The first-generation cephalosporins (e.g. cephalexin, cefadroxil) have strong gram-positive activity against various *Streptococcus* species and sensitive strains of *Staphylococcus aureus*; however, they possess only moderate gram-negative activity against *E. coli, Klebsiella,* and *Proteus* (11). Second generation cephalosporins exhibit more prominent gram-negative activity including *E. coli, H. influenzae, Klebsiella,* and *Proteus* (10). The higher the generation, the more gram-negative coverage the agent provides. For example, ceftriaxone (a third-generation cephalosporin), has broad activity against most gram-positive, gram-negative, and some anaerobic pathogens; therefore, this class of agents can be prescribed for a wide variety of indications (10;14).

The overall consumption of cephalosporins was at its highest in 2005 at 1.97 DDD/1000 population/day, decreasing to 1.56 DDD/1000 population/day. It has since stabilized and was at a rate of 1.68 DDD/1000 population/day in 2013. The upward trend before 2005 was primarily driven by the increased consumption of first-generation cephalosporins, which had multiplied by approximately 1.6-fold from 1996. Utilization of second-generation cephalosporins declined from 0.86 in 1996 to 0.45 in 2013 (a decrease of 48%). The prescribing of third-generation cephalosporins increased by 40%, but remained low at 0.14 DDD/1000 population/day in 2013. Increased use is likely driven by UTIs, where third generation cephalosporins are frequently used to manage infections resistant to other classes. However, several of the third-generation agents (e.g. ceftazidime, cefotaxime, ceftriaxone, ceftobiprole) are administered parenterally. Therefore, the daily consumption rates as reported here likely significantly underestimate the current utilization of these agents (Figure 25). As shown in Figure 26, the daily prescription rates show similar trend with the daily consumption rate peaking at 0.24 prescriptions/1000 population/day in 2005 and stabilizing at approximately 0.20 prescriptions/1000 population/day in 2013.

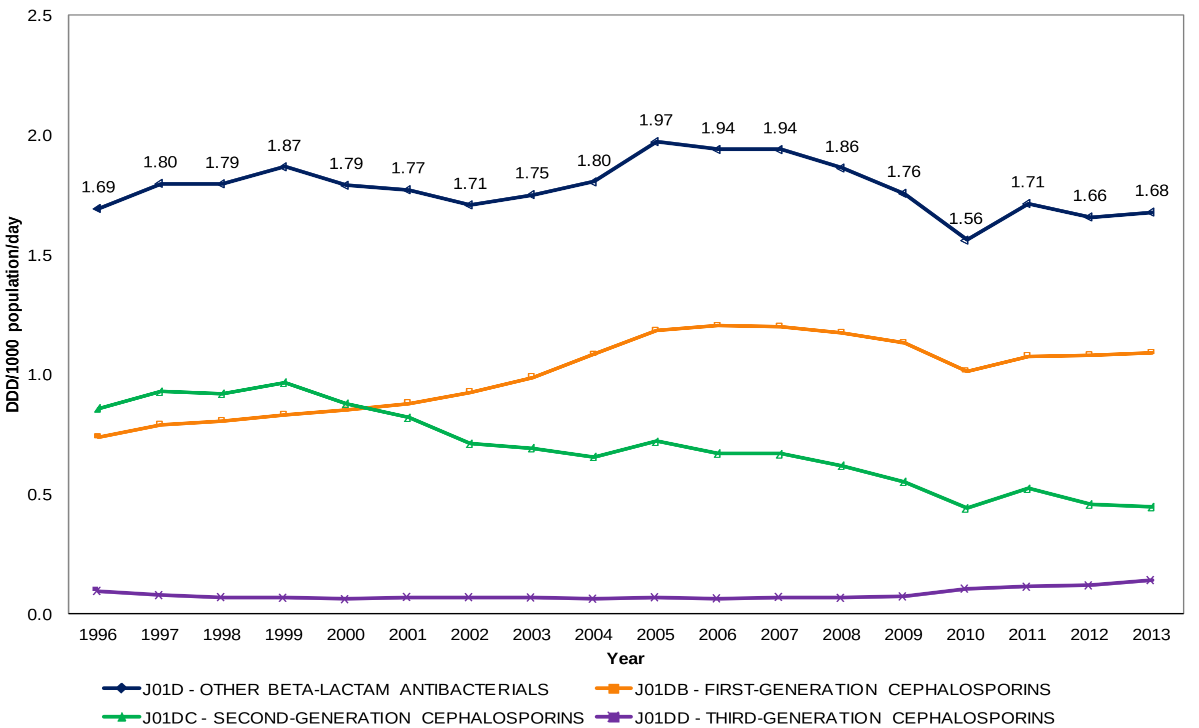


Figure 25: Daily consumption rates for cephalosporins (J01D) and the subclass agents from 1996 to 2013

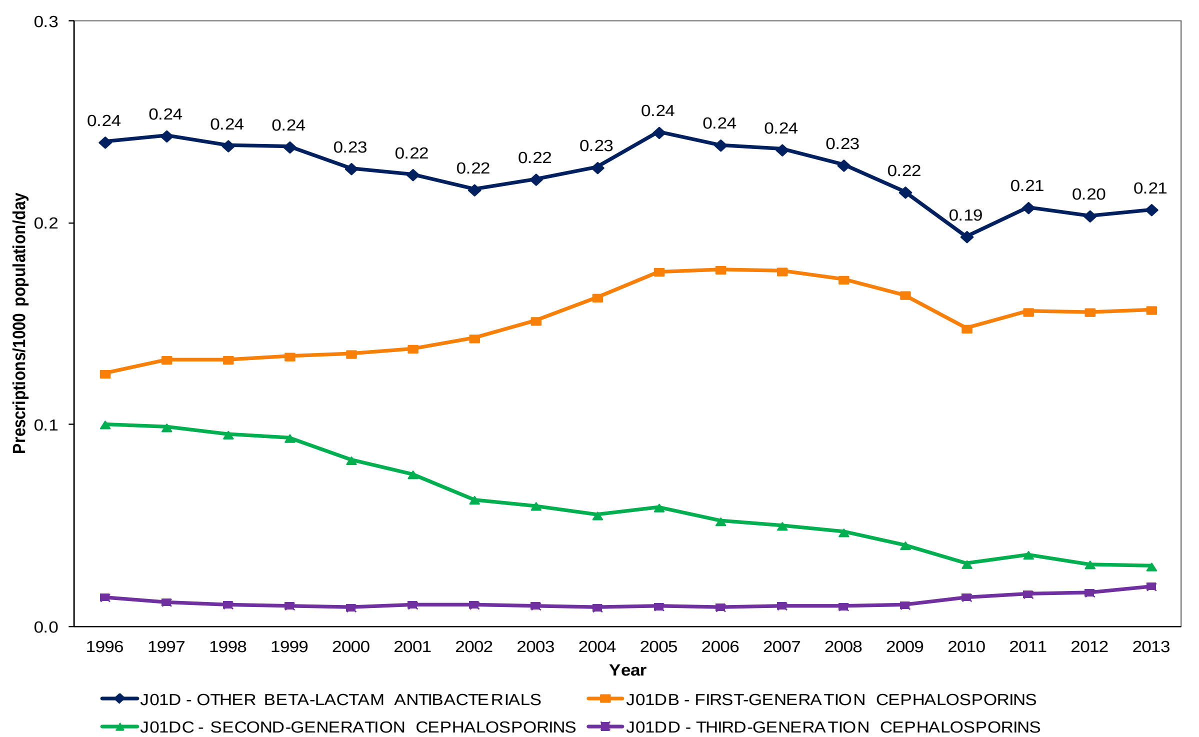
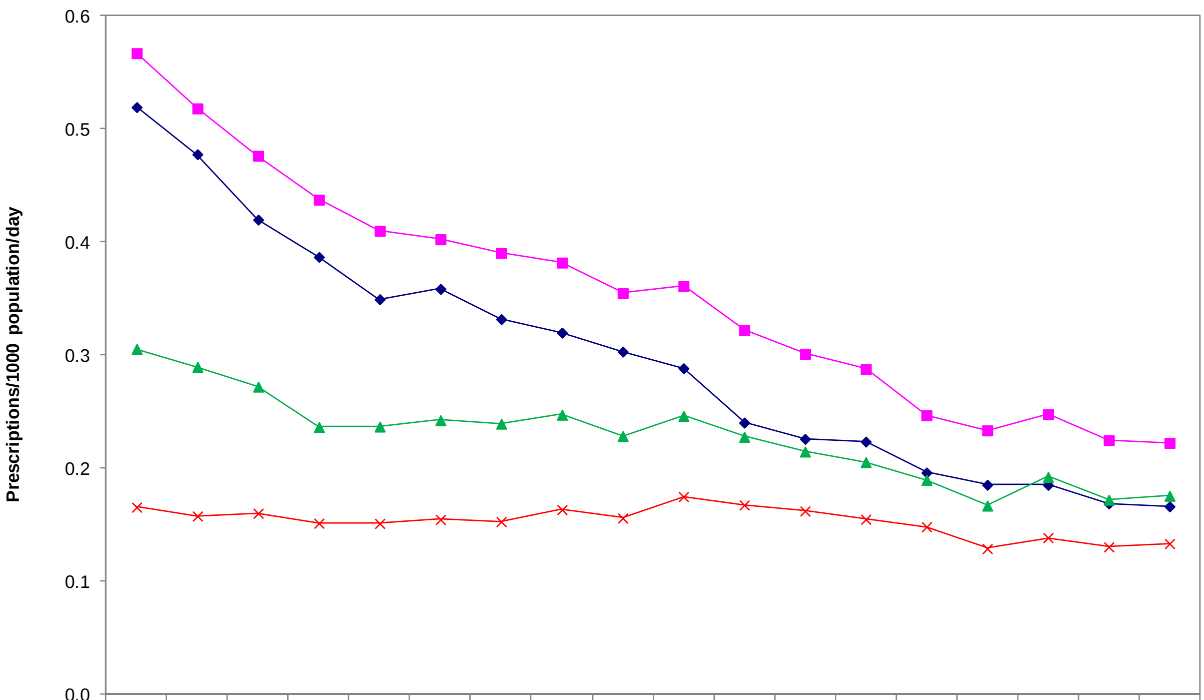


Figure 26: Daily prescription rates for cephalosporins (J01D) and the subclass agents from 1996 to 2013

2. By Age

a. Children (< 15 years)

Similar to the penicillins, cephalosporins are also compatible with pregnancy and lactation. They target pathogens associated with many common paediatric infectious diseases, and include agents that are available in oral suspensions that facilitate paediatric administration (11). In line with other antimicrobial agents, patients 1 to 4 years of age were the highest overall consumers of cephalosporins at 0.22 prescriptions/1000 population/day, followed by those 5 to 9 years (0.18 prescriptions/1000 population/day), below 1 year (0.17 prescriptions/1000 population/day), then 10 to 14 years (0.13 prescriptions/1000 population/day) in 2013. While the other three groups experienced a consistent drop by approximately 55% in prescription rates over the years, the prescription rate for the 10 to 14 age group remained stable up until 2005, after which a decrease of 24% occurred, compared to 1996 estimates.

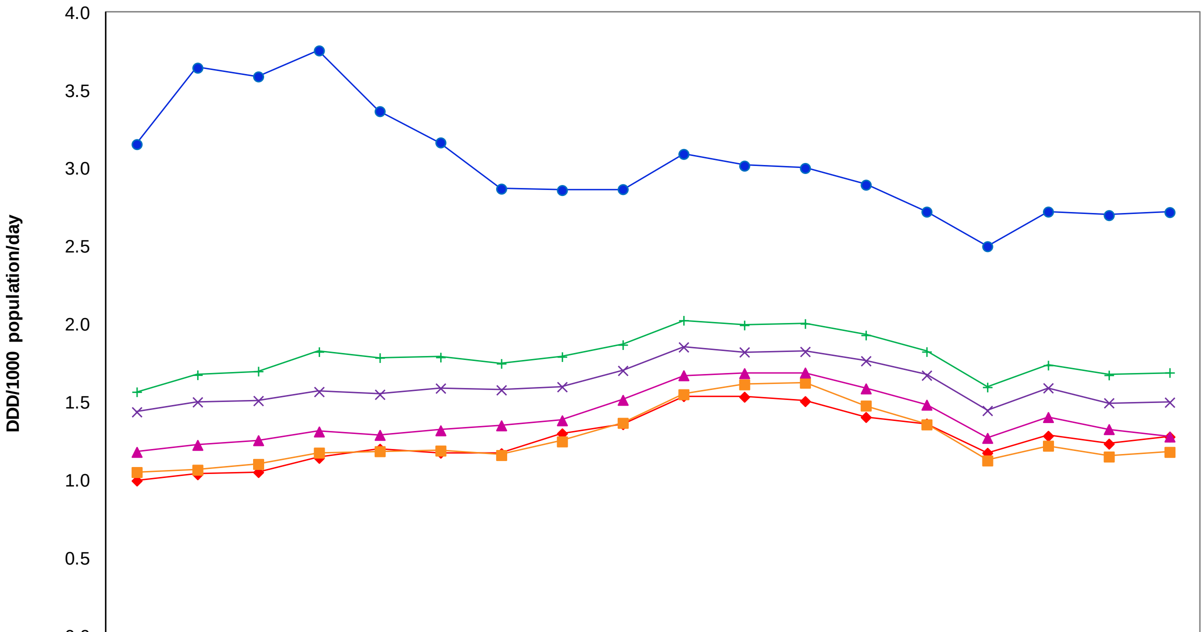


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
<1	0.52	0.48	0.42	0.39	0.35	0.36	0.33	0.32	0.30	0.29	0.24	0.23	0.22	0.20	0.19	0.19	0.17	0.17
1-4	0.57	0.52	0.48	0.44	0.41	0.40	0.39	0.38	0.35	0.36	0.32	0.30	0.29	0.25	0.23	0.25	0.22	0.22
5-9	0.31	0.29	0.27	0.24	0.24	0.24	0.24	0.25	0.23	0.25	0.23	0.21	0.21	0.19	0.17	0.19	0.17	0.18
10-14	0.17	0.16	0.16	0.15	0.15	0.15	0.15	0.16	0.16	0.17	0.17	0.16	0.15	0.15	0.13	0.14	0.13	0.13

Figure 27: Cephalosporins (J01D) daily prescription rates in children by age group from 1996 to 2013

b. Adults (≥ 15 years)

In 2013, cephalosporins consumption rates in adults 60 years and older exceeded those in all other adult age groups by at least 61% and was at a rate of 2.72 DDD/1000 population/day; utilization in other adults ranged between 1.18 and 1.69 DDD/1000 population/day. All adult age groups under 60 showed similar trends consisting of an increase in utilization from 1996 to 2005 followed by a three year plateau; the plateau ended after 2007 when all rates dropped 20 to 30% to near 1996 levels. Patients 60 years and above demonstrated a very different rate before 2002 involving an initial sharp increase until 1999 and dramatic decrease; after 2002, this age group mirrored the rest in terms of utilization rate for a drop by 14% since 1996 (Figure 28).

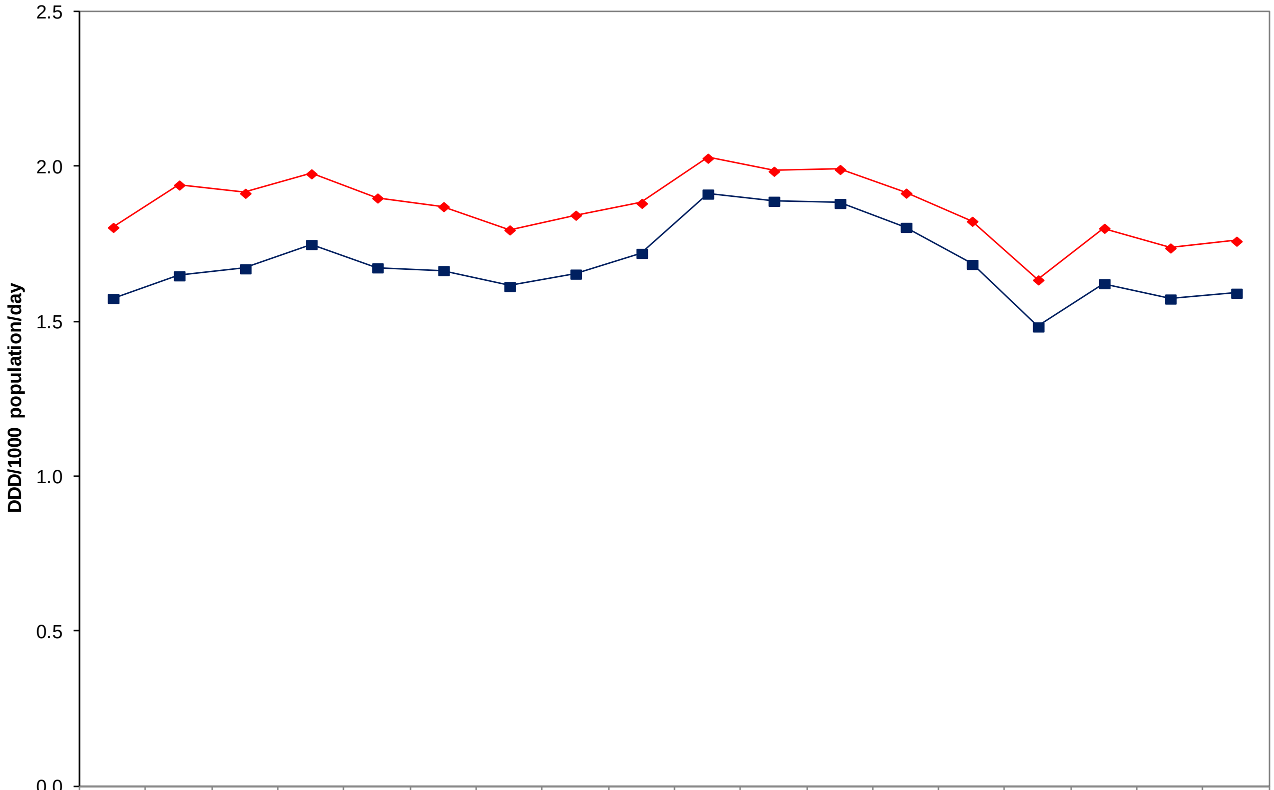


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
15-19	1.00	1.04	1.05	1.14	1.20	1.17	1.17	1.30	1.36	1.54	1.53	1.51	1.40	1.36	1.17	1.28	1.23	1.28
20-24	1.05	1.07	1.10	1.17	1.18	1.19	1.16	1.25	1.37	1.55	1.61	1.62	1.48	1.36	1.12	1.22	1.15	1.18
25-29	1.18	1.22	1.25	1.31	1.29	1.32	1.35	1.38	1.51	1.67	1.68	1.69	1.59	1.48	1.27	1.40	1.33	1.28
30-39	1.44	1.50	1.51	1.57	1.55	1.59	1.58	1.60	1.70	1.85	1.82	1.82	1.76	1.67	1.45	1.59	1.49	1.50
40-59	1.57	1.67	1.70	1.82	1.78	1.79	1.75	1.79	1.87	2.02	1.99	2.00	1.93	1.82	1.60	1.74	1.67	1.69
60+	3.15	3.64	3.59	3.75	3.37	3.16	2.87	2.86	2.86	3.09	3.02	3.00	2.89	2.72	2.50	2.72	2.70	2.72

Figure 28: Cephalosporins (J01D) daily consumption rates in adults by age group from 1996 to 2013

3. By Gender

In 2013, cephalosporin consumption among females exceeded consumption among males by 11% (1.76 vs. 1.59 DDD/1000 population/day). This difference was relatively small compared to sex-based differences observed among other classes of antibiotics. The difference in rates between females and males gradually decreased until 2006 when the gap began to grow as both rates decreased (Figure 29).

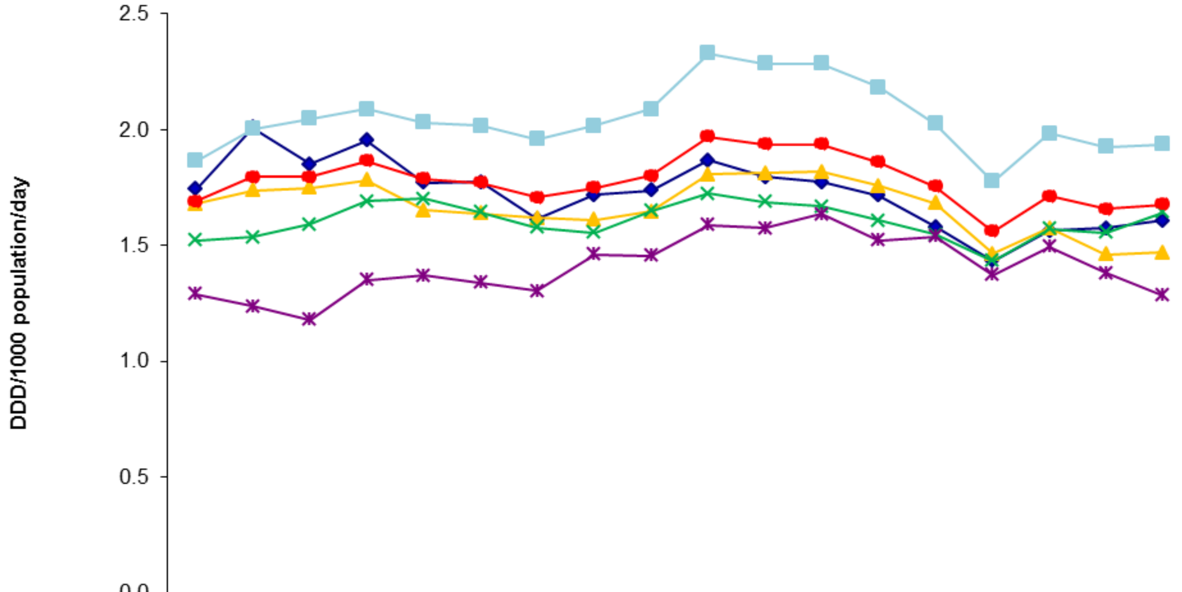


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
F	1.80	1.94	1.91	1.98	1.90	1.87	1.80	1.84	1.88	2.03	1.99	1.99	1.91	1.82	1.63	1.80	1.74	1.76
M	1.57	1.65	1.67	1.75	1.67	1.66	1.61	1.65	1.72	1.91	1.89	1.88	1.80	1.68	1.48	1.62	1.57	1.59

Figure 29: Cephalosporins (J01D) daily consumption rates by gender from 1996 to 2013

4. By Health Authority & Health Services Delivery Area

In 2013, the highest reported cephalosporins consumption rates were observed in Fraser region at 1.94 DDD/1000 population/day. All other regions had a consumption rate below the provincial average. Island and Interior had a similar consumption rate to the provincial average at approximately 1.60 DDD/1000 population/day in 2013. This was followed by 1.47 DDD/1000 population/day in Vancouver Coastal and 1.29 DDD/1000 population/day in Northern, which was 13% and 23% below the provincial average, respectively. Despite varying rates, trends in rates were fairly similar across all HAs from 1996 to 2013. Rates in most HAs reached the peak and plateau from 2005 to 2007, sharply decreasing until 2010 and followed by a slight increase (Figure 30).



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1-IHA	1.74	2.01	1.85	1.95	1.77	1.77	1.61	1.72	1.74	1.87	1.80	1.77	1.72	1.58	1.43	1.56	1.57	1.61
2-FHA	1.86	2.00	2.05	2.09	2.03	2.02	1.96	2.02	2.09	2.33	2.29	2.28	2.18	2.03	1.78	1.98	1.93	1.94
3-VCHA	1.68	1.74	1.75	1.78	1.65	1.64	1.62	1.61	1.65	1.81	1.81	1.82	1.76	1.68	1.47	1.58	1.46	1.47
4-VIHA	1.52	1.54	1.59	1.69	1.70	1.64	1.58	1.55	1.65	1.73	1.69	1.67	1.61	1.55	1.44	1.57	1.55	1.64
5-NHA	1.29	1.24	1.18	1.35	1.37	1.34	1.31	1.46	1.45	1.59	1.57	1.63	1.52	1.54	1.37	1.49	1.38	1.29
BC	1.69	1.80	1.79	1.87	1.79	1.77	1.71	1.75	1.80	1.97	1.94	1.94	1.86	1.76	1.56	1.71	1.66	1.68

Figure 30: Cephalosporins (J01D) daily consumption rates by health authority from 1996 to 2013

In Interior, the overall cephalosporin utilization rate decreased by 8% from 1996 to 2013. Similar utilization rates were seen in East Kootenay, Okanagan, and Thompson Cariboo Shuswap (1.60, 1.65, and 1.64 DDD/1000 population/day, respectively) followed by Kootenay Boundary (1.33 DDD/1000 population/day) in 2013. The largest percent decrease occurred in East Kootney (28%) between 1996 to 2013.

Within Fraser, cephalosporins consumption rates were relatively similar between the three HSDAs between 1996 and 2002. Since then, utilization has diverged dramatically, with Fraser East and Fraser South reaching the highest consumption rates in 2011 at 2.38 and 2.05 DDD/1000 population/day, respectively. Consumption rates at all sites have decreased slightly since 2010 and stabilized. In 2013, consumption rates were reported to be at 2.20, 1.70 and 2.04 DDD/1000 population/day for Fraser East, Fraser North, and Fraser South, respectively (Table 4).

In recent years, all HSDAs of Vancouver Coastal demonstrated an overall decreasing trend (a 12% decline from 1996 to 2013). Rates in both Richmond and Vancouver decreased since 1996 (by 16% and 21%, respectively). In North Shore/Coast Garibaldi, however, the consumption rate increased by 16% from 1.37 in 1996 to 1.59 DDD/1000 population/day in 2013 (Table 4).

The rate of cephalosporins consumption in Vancouver Island has increased over the years by 8%. In North Vancouver Island, the consumption rate increased from 1996, reaching its peak of 1.97 DDD/1000 population/day in 2007. Rates on Central Vancouver Island reached its peak of 2.08 DDD/1000 population/day in 2005. Rates from all three HSDA decreased to their lowest rate in 2010 and increased again in 2013 to 1.79, 1.71, and 1.56 DDD/1000 population/day in North Vancouver Island, Central Vancouver Island, and South Vancouver Island, respectively (Table 4).

Lastly, rates within Northern Health have individually varied over the years. Despite noticeable drops since 2008, the utilization rates remained high in Northwest at 1.21 DDD/1000 population/day in 2013 (an increase of 25% since 1996). Similarly, despite an initial 22% drop in usage in Northern Interior between 1996 and 2002, rates have since increased by 8% to 1.40 DDD/1000 population/day in 2013. The opposite trend occurred in Northeast where consumption rates rose from 1.21 DDD/1000 population/day in 1996 to a peak of 2.42 DDD/1000 population/day in 2003 (a total percentage increase of 77%). Since 2003, consumption rates have fallen by 50% to 1.06 DDD/1000 population/day in 2013 (Table 4).

Table 4: Cephalosporins (J01D) daily consumption rates by health authority and health services delivery area from 1996 to 2013

HA/HSDA	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	% Change
IHA	1.74	2.01	1.85	1.95	1.77	1.77	1.61	1.72	1.74	1.87	1.80	1.77	1.72	1.58	1.43	1.56	1.57	1.61	-7.70
11-EK	2.22	2.49	2.27	2.45	2.33	2.40	2.10	2.23	2.30	2.21	1.91	1.92	1.86	1.69	1.55	1.64	1.58	1.60	-27.86
12-KB	1.58	1.68	1.67	1.70	1.62	1.66	1.42	1.52	1.49	1.56	1.51	1.50	1.43	1.35	1.23	1.29	1.33	1.33	-15.95
13-OK	1.81	2.26	1.89	1.91	1.77	1.73	1.54	1.64	1.67	1.79	1.78	1.78	1.72	1.56	1.40	1.57	1.62	1.65	-8.77
14-TCS	1.53	1.60	1.71	1.93	1.63	1.66	1.62	1.72	1.73	1.99	1.87	1.80	1.77	1.66	1.51	1.62	1.59	1.64	7.02
FHA	1.86	2.00	2.05	2.09	2.03	2.02	1.96	2.02	2.09	2.33	2.29	2.28	2.18	2.03	1.78	1.98	1.93	1.94	3.87
21-FE	1.68	1.99	2.09	2.13	2.12	2.09	2.01	2.15	2.24	2.56	2.48	2.43	2.40	2.30	2.07	2.38	2.23	2.20	30.99
22-FN	1.79	1.93	1.93	1.95	1.87	1.91	1.87	1.89	1.91	2.13	2.09	2.08	1.93	1.76	1.54	1.72	1.70	1.70	-5.50
23-FS	2.01	2.07	2.13	2.20	2.14	2.08	2.01	2.07	2.18	2.41	2.38	2.40	2.31	2.14	1.86	2.05	2.00	2.04	1.48
VCHA	1.68	1.74	1.75	1.78	1.65	1.64	1.62	1.61	1.65	1.81	1.81	1.82	1.76	1.68	1.47	1.58	1.46	1.47	-12.42
31-RMD	1.64	1.56	1.59	1.64	1.46	1.43	1.37	1.44	1.52	1.61	1.65	1.67	1.59	1.50	1.43	1.45	1.36	1.37	-16.38
32-VAN	1.84	1.92	1.92	1.93	1.75	1.73	1.72	1.71	1.69	1.87	1.84	1.82	1.80	1.70	1.45	1.58	1.45	1.45	-21.01
33-NSCG	1.37	1.47	1.49	1.56	1.57	1.57	1.57	1.50	1.63	1.79	1.85	1.92	1.78	1.77	1.53	1.64	1.56	1.59	16.07
VIHA	1.52	1.54	1.59	1.69	1.70	1.64	1.58	1.55	1.65	1.73	1.69	1.67	1.61	1.55	1.44	1.57	1.55	1.64	7.99
41-SVI	1.36	1.43	1.48	1.53	1.55	1.47	1.43	1.33	1.41	1.43	1.49	1.48	1.45	1.42	1.33	1.45	1.44	1.56	14.15
42-CVI	1.71	1.64	1.73	1.90	1.95	1.90	1.78	1.82	1.97	2.08	1.92	1.80	1.71	1.61	1.52	1.65	1.63	1.71	-0.05
43-NVI	1.61	1.62	1.62	1.72	1.67	1.64	1.59	1.67	1.71	1.88	1.79	1.97	1.88	1.79	1.58	1.76	1.75	1.79	10.82
NHA	1.29	1.24	1.18	1.35	1.37	1.34	1.31	1.46	1.45	1.59	1.57	1.63	1.52	1.54	1.37	1.49	1.38	1.29	-0.39
51-NW	0.97	1.01	1.03	1.19	1.24	1.19	1.14	1.29	1.30	1.42	1.42	1.49	1.44	1.39	1.29	1.19	1.15	1.21	24.50
52-NI	1.51	1.41	1.26	1.36	1.34	1.29	1.24	1.26	1.36	1.60	1.65	1.75	1.59	1.63	1.51	1.77	1.63	1.44	-4.51
53-NE	1.21	1.12	1.20	1.55	1.63	1.66	1.68	2.17	1.86	1.75	1.58	1.56	1.47	1.50	1.17	1.25	1.13	1.06	-12.91
BC	1.69	1.80	1.79	1.87	1.79	1.77	1.71	1.75	1.80	1.97	1.94	1.94	1.86	1.76	1.56	1.71	1.66	1.68	-0.91

5. Comparison of Antimicrobial Utilization in British Columbia, Other Provinces and Europe

When compared to that of several European nations, the 2011 cephalosporins utilization rate in BC was medial (12 countries reported less utilization and 11 countries reported more), despite great variations in European cephalosporins consumption (Figure 31). In 2011, BC had a similar cephalosporins rate to Spain, Belgium, and the Czech Republic (Figure 31). When compared to other Canadian provinces, BC had medial cephalosporins use in 2011 (Figure 8).

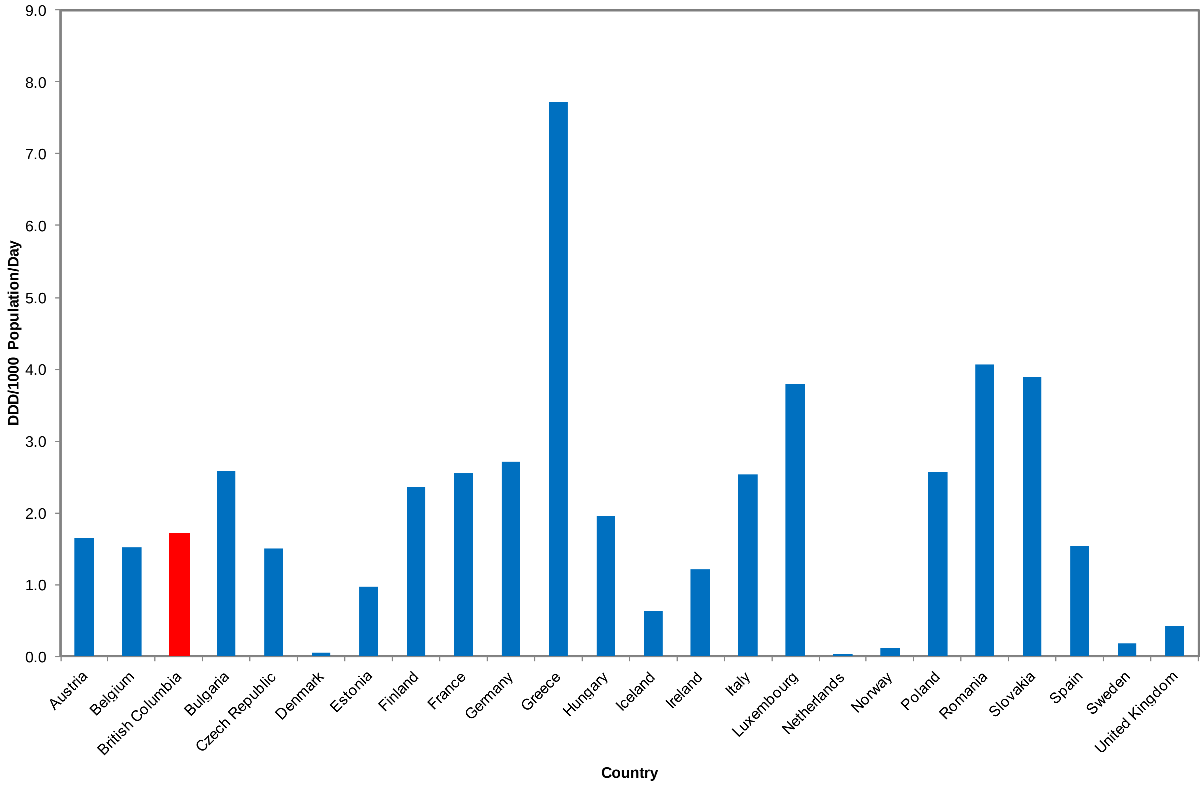


Figure 31: Defined daily rate of cephalosporins (J01D) use in BC and several European nations for 2011

Source: PharmaNet (BC data); European Surveillance of Antimicrobial Consumption (ESAC) (6)

See Table for the list of antimicrobials included in this class

J01E – Sulfonamides and Trimethoprim

1. Over-Time Trend

Sulfonamides are among the earliest antimicrobial agents synthesized and were first introduced in the 1930s (10). They have selective gram-positive and gram-negative activity, but poor anaerobic coverage (14). Since the discovery of trimethoprim in the 1960s, the combination of sulfonamides with trimethoprim has largely replaced the use of either of these agents alone; the resulting combination, co-trimoxazole, is a 5:1 ratio of sulfamethoxazole and trimethoprim (TMP-SMX) (10). The two agents are bacteriostatic and act synergistically by inhibiting different parts of the folate synthesis pathway, thereby terminating the bacterial DNA replication cycle (10). Although the prescribing of co-trimoxazole is decreasing with the advent of newer antimicrobials, it remains one of the first-line agents for UTIs (11).

Of all antibacterial agents, sulfonamides and trimethoprim experienced the most dramatic decline in utilization over the years. The daily consumption rate fell from 2.17 DDD/1000 population in 1996 to 0.70 DDD/1000 population/day in 2013, a total percentage drop of 68%. Of note, in the last two years, utilization of this antibiotic class has stabilized. As noted above, co-trimoxazole constitutes the vast majority of the usage from this class of antimicrobials; consumption rates for trimethoprim and its derivatives, short-acting and intermediate-acting sulfonamides, were consistently below 0.1 DDD/1000 population/day over the year (Figure 32).

Prescription rates as shown in Figure 33 demonstrate similar overall trends compared to antibiotic consumption.

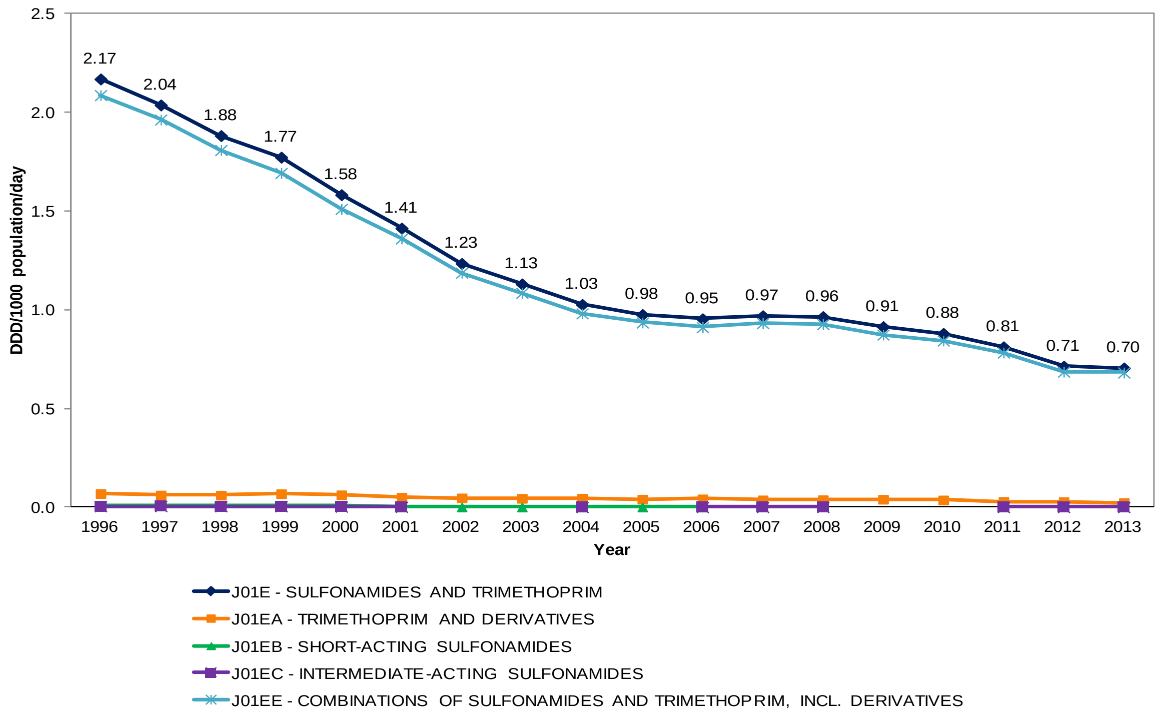


Figure 32: Daily consumption rates for sulfonamides and trimethoprim (J01E) and the subclass agents from 1996 to 2013

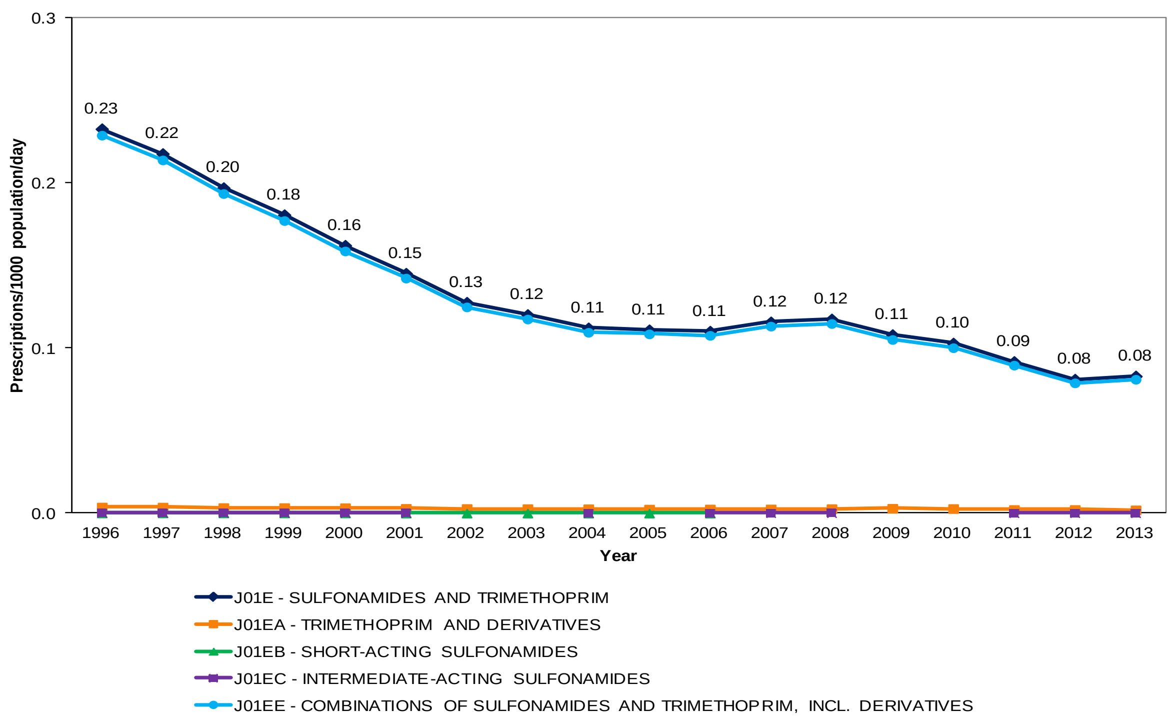
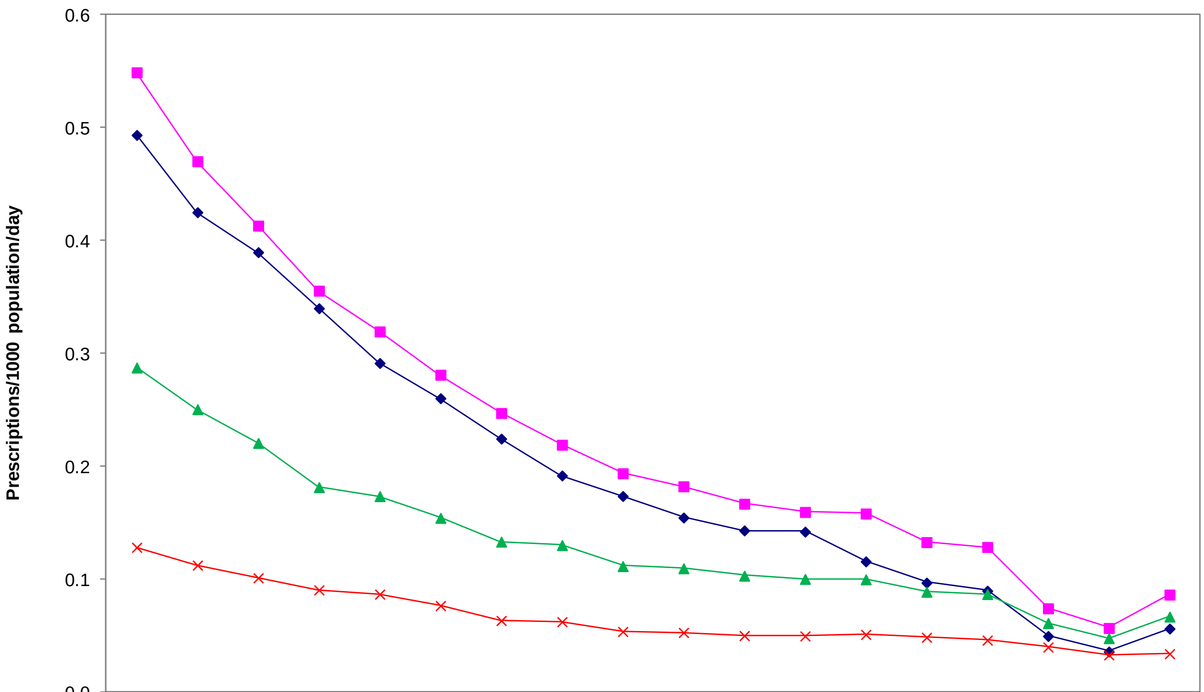


Figure 33: Daily prescription rates for sulfonamides and trimethoprim (J01E) and the subclass agents from 1996 to 2013

2. By Age

a. Children (< 15 years)

Co-trimoxazole (SMX-TMP) is contraindicated in infants younger than 2 months of age because sulfonamides compete for bilirubin on albumin-binding sites, increasing the risk of jaundice and kernicterus in the newborn (10;11). It is available in oral suspension, rendering it a viable alternative to amoxicillin for patients older than 2 months in the treatment of otitis media and UTIs. Over the past decade, daily prescription rates were consistently the highest among children 1 to 4 years of age, followed by those below 1 year, 5 to 9 years, and then 10 to 14 years up until 2010. During the last three years, prescription rates in those between 5 to 9 years were higher than those between 1 to 4 years of age by approximately 30%. Dramatic reductions were observed in all paediatric age groups between 1996 and 2010. During the last three years, the prescription rate has remained stable or slightly increased, and was reported to be at 0.06, 0.09, 0.07, and 0.03 prescriptions/1000 population/day in the 1 to 4 age group, the 5 to 9 age group, the under 1 years age group, and the 10 to 14 age group, respectively (Figure 34).



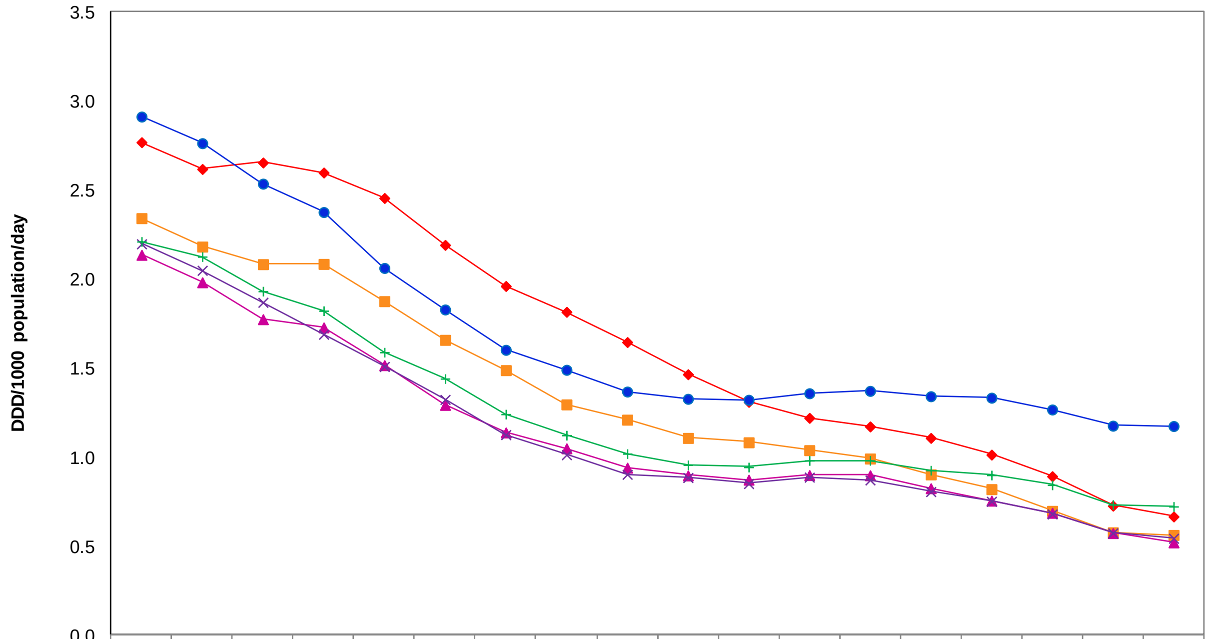
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
<1	0.49	0.43	0.39	0.34	0.29	0.26	0.22	0.19	0.17	0.15	0.14	0.14	0.12	0.10	0.09	0.05	0.04	0.06
1-4	0.55	0.47	0.41	0.36	0.32	0.28	0.25	0.22	0.19	0.18	0.17	0.16	0.16	0.13	0.13	0.07	0.06	0.09
5-9	0.29	0.25	0.22	0.18	0.17	0.15	0.13	0.13	0.11	0.11	0.10	0.10	0.10	0.09	0.09	0.06	0.05	0.07
10-14	0.13	0.11	0.10	0.09	0.09	0.08	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.03	0.03

Figure 34: Sulfonamides and trimethoprim (J01E) daily prescription rates in children from 1996 to 2013

b. Adults (≥ 15 years)

Within the adult population, consumption of sulfonamides and trimethoprim was highest in adults over 60 years of age at 1.17 DDD/1000 population/day in 2013. This was followed by those 40 to 59 years of age with a rate of 0.72 DDD/1000 population/day; all other adult age groups were within the close range of

0.52 to 0.67 DDD/1000 population/day. Due to the association of SMX-TMP with birth defects, it is generally contraindicated during pregnancy (11). This may partly explain the low utilization in patients 25 to 39 years of age, despite a higher risk of UTIs during pregnancy (Figure 35).

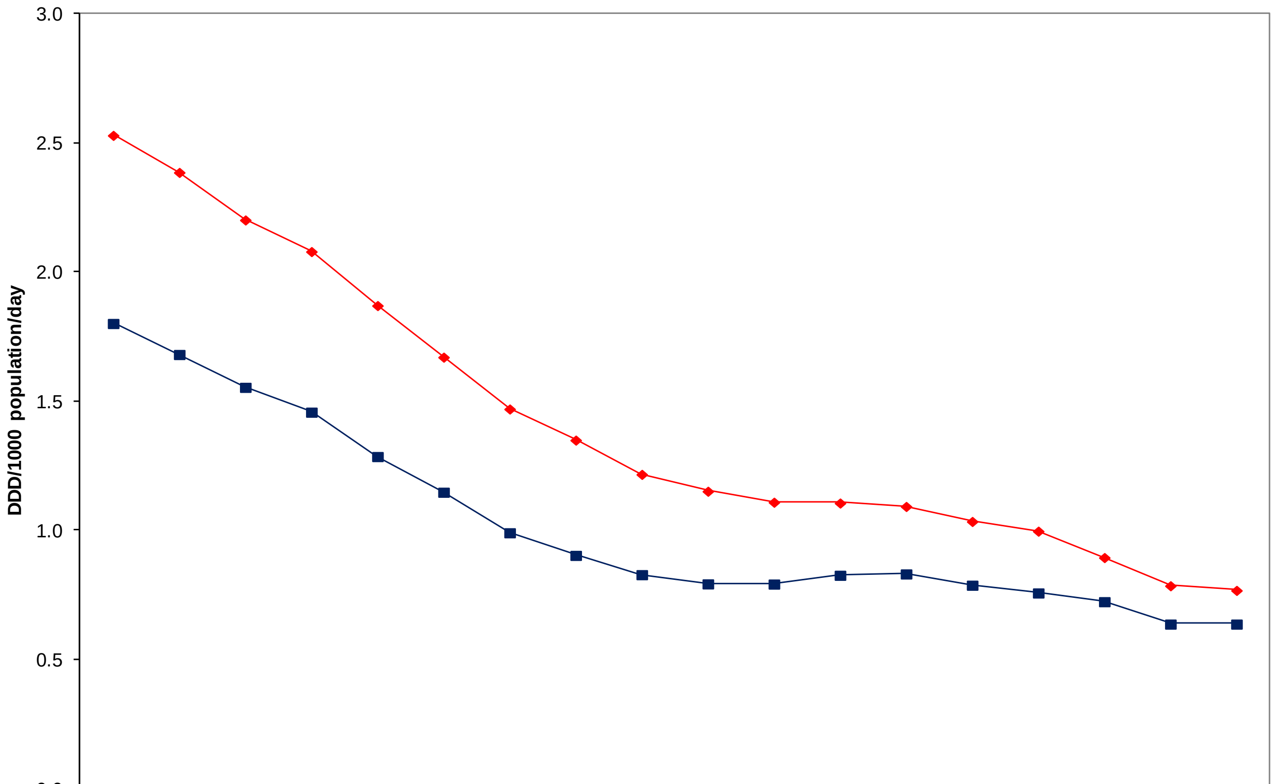


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
15-19	2.77	2.62	2.65	2.60	2.45	2.19	1.96	1.82	1.65	1.47	1.31	1.22	1.17	1.11	1.01	0.89	0.73	0.67
20-24	2.34	2.18	2.08	2.08	1.88	1.66	1.49	1.30	1.21	1.11	1.08	1.04	0.99	0.90	0.82	0.70	0.58	0.56
25-29	2.14	1.98	1.77	1.73	1.52	1.29	1.14	1.05	0.94	0.90	0.87	0.90	0.90	0.83	0.76	0.69	0.57	0.52
30-39	2.20	2.05	1.87	1.69	1.51	1.32	1.13	1.01	0.90	0.89	0.85	0.89	0.87	0.81	0.75	0.68	0.58	0.55
40-59	2.21	2.13	1.93	1.82	1.59	1.44	1.24	1.12	1.02	0.96	0.94	0.98	0.98	0.93	0.90	0.84	0.73	0.72
60+	2.91	2.76	2.54	2.38	2.06	1.83	1.60	1.49	1.37	1.33	1.32	1.36	1.37	1.34	1.33	1.27	1.18	1.17

Figure 35: Sulfonamides and trimethoprim (J01E) daily consumption rates in adults from 1996 to 2013

3. By Gender

Similar to other antimicrobial agents, consumption of sulfonamides and trimethoprim among females exceeded that for males by 20% in 2013. The higher rate of symptomatic UTIs among females likely explains this discrepancy. Both females and males experienced similar rates of reduction in the usage of these agents over the years. From 1996 to 2013, female and male consumption rates declined by 70% and 64%, respectively (Figure 36).

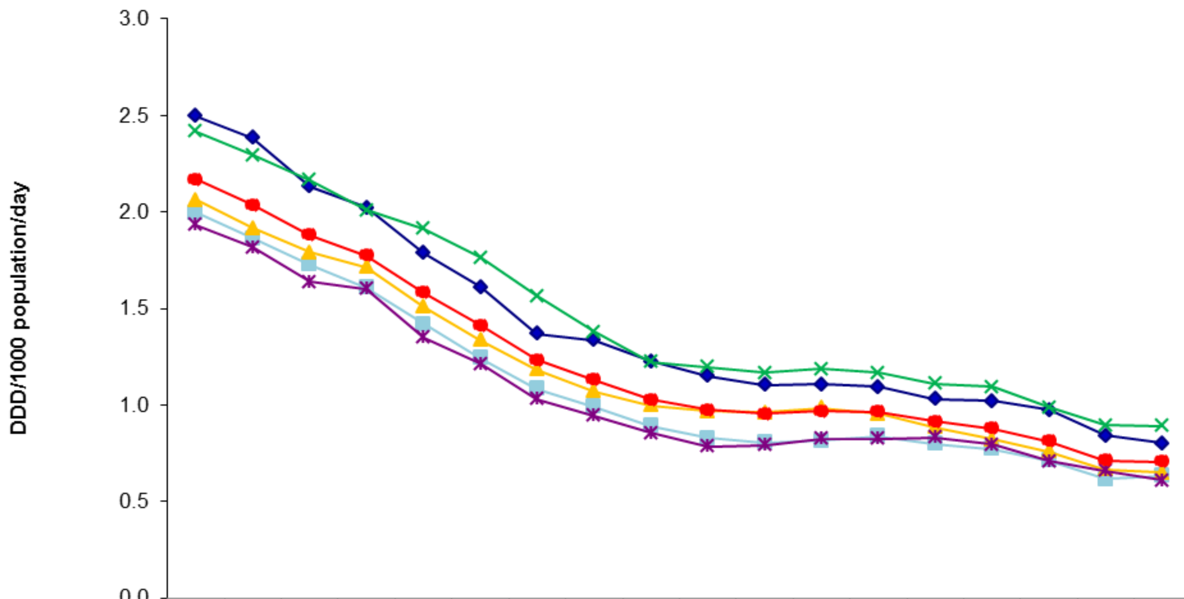


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
F	2.53	2.39	2.20	2.08	1.87	1.67	1.47	1.35	1.22	1.15	1.11	1.11	1.09	1.04	1.00	0.90	0.79	0.77
M	1.80	1.68	1.55	1.46	1.29	1.15	0.99	0.90	0.83	0.79	0.79	0.83	0.83	0.79	0.76	0.73	0.64	0.64

Figure 36: Sulfonamides and trimethoprim (J01E) daily consumption rates by gender from 1996 to 2013

4. By Health Authority & Health Services Delivery Area

Between the years 1996 to 2013, similar declining trends in SMX-TMP consumption were observed in all five BC HAs. By 2013, the average rate for BC had dropped 67.7% from 2.17 DDD/1000 population/day in 1996 to 0.70 DDD/1000 population/day in 2013. Rates in Vancouver Island and Interior Health were consistently higher than the provincial average, while Fraser and Northern had rates slightly below across all years. In 2013, the highest consumption rates occurred in Vancouver Island at 0.89 DDD/1000 population/day. Rates in Interior, Vancouver, Fraser, and Northern were 0.80, 0.65, 0.63, and 0.61 DDD/1000 population/day, respectively (Figure 37).



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1-IHA	2.50	2.38	2.13	2.02	1.79	1.61	1.37	1.34	1.23	1.15	1.10	1.11	1.09	1.03	1.02	0.97	0.84	0.80
2-FHA	2.00	1.86	1.73	1.61	1.42	1.24	1.08	0.99	0.89	0.83	0.80	0.81	0.84	0.80	0.77	0.71	0.62	0.63
3-VCHA	2.06	1.92	1.79	1.71	1.51	1.33	1.18	1.07	1.00	0.97	0.96	0.98	0.96	0.89	0.82	0.76	0.67	0.65
4-VIHA	2.42	2.29	2.17	2.01	1.91	1.76	1.56	1.38	1.22	1.20	1.17	1.19	1.17	1.11	1.09	0.99	0.89	0.89
5-NHA	1.93	1.82	1.64	1.60	1.35	1.21	1.03	0.94	0.86	0.79	0.79	0.83	0.82	0.83	0.79	0.71	0.66	0.61
BC	2.17	2.04	1.88	1.77	1.58	1.41	1.23	1.13	1.03	0.98	0.95	0.97	0.96	0.91	0.88	0.81	0.71	0.70

Figure 37: Sulfonamides and trimethoprim (J01E) daily consumption rates by health authority from 1996 to 2013

In 2013, prescribing rates in all four HSDAs in Interior were similar and ranged between 0.65 (East Kootenay) and 0.92 DDD/1000 population/day (Okanagan). There has been little difference in rates between HSDAs since 2002. There was an overall decreasing trend from 2.50 DDD/1000 population/day in 1996 to 0.80 DDD/1000 population/day in 2013 (a 68% decrease) (Table 5).

In Fraser, SMX-TMP prescribing rates were identical among the three HSDAs between 1999 and 2006. Rates increased in Fraser East, peaking at 1.03 DDD/1000 population/day in 2008, and is reported to be at 0.83 DDD/1000 population/day in 2013. Rates in Fraser North and Fraser South showed a consistent decreasing trend and was reported to be at 0.56 and 0.61 DDD/1000 population/day in 2013. (Table 5).

Over the past decade, rates in Richmond have been substantially lower than the average rate for Vancouver Costal and North Shore/Coast Garibaldi (21% to 23% below, respectively in 2013). In 2013, consumption rate for SMP-TMX in Richmond was at 0.53 DDD/1000 population/day while the rates for Vancouver Coastal and North Shore/Coast Garibaldi were higher at 0.67 and 0.69 DDD/1000 population/day in 2013 (Table 5).

Within Vancouver Island, the highest consumption occurred in South Vancouver Island at 0.94 DDD/1000 population/day in 2013, followed by Central Vancouver Island (0.88 DDD/1000 population/day) and North Vancouver Island (0.77 DDD/1000 population/day). While SMX-TMP utilization in South Vancouver Island has typically been approximately 4% to 19% above the average rates for Vancouver Island, and rates in

North Vancouver Island were 5% to 31% below the average; such differences have been converging since 2004 (Table 5).

Similar declining trends in SMP-TMX consumption were observed in the three HSDAs in Northern between the years 1996 and 2006. Rates increased slightly in 2008 in Northern Interior, and have since decreased to 0.68 DDD/1000 population/day in 2013 (a relative decrease of 29%). A similar trend was observed in Northwestern, and the rate was reported to be at 0.63 DDD/1000 population/day. In Northeast, however, a peak was reached in 2006 at 0.73 DDD/1000 population/day and has decreased since to 0.44 DDD/1000 population/day in 2013 (Table 5).

Table 5: Sulfonamides and trimethoprim (J01E) daily consumption rates by health authority and health services delivery area from 1996 to 2013

HA/HSDA	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	% Change
1-IHA	2.50	2.38	2.13	2.02	1.79	1.61	1.37	1.34	1.23	1.15	1.10	1.11	1.09	1.03	1.02	0.97	0.84	0.80	-67.96
11-EK	2.14	2.12	1.94	1.88	1.52	1.40	1.26	1.18	1.05	0.96	0.97	0.90	0.91	0.83	0.81	0.77	0.65	0.65	-69.75
12-KB	2.46	2.50	2.53	2.43	2.08	1.80	1.53	1.43	1.24	1.24	1.22	1.15	1.14	1.11	0.96	0.95	0.82	0.76	-68.97
13-OK	2.83	2.69	2.31	2.16	1.91	1.73	1.47	1.44	1.34	1.23	1.18	1.19	1.19	1.16	1.20	1.14	0.96	0.92	-67.46
14-TCS	2.19	2.01	1.80	1.72	1.59	1.44	1.21	1.21	1.12	1.07	0.99	1.04	1.00	0.86	0.84	0.79	0.73	0.68	-69.03
2-FHA	2.00	1.86	1.73	1.61	1.42	1.24	1.08	0.99	0.89	0.83	0.80	0.81	0.84	0.80	0.77	0.71	0.62	0.63	-68.34
21-FE	2.21	2.01	1.88	1.67	1.48	1.32	1.12	1.05	1.00	0.86	0.85	0.90	1.03	0.95	0.97	0.94	0.80	0.83	-62.29
22-FN	1.95	1.84	1.66	1.57	1.33	1.19	1.04	0.95	0.85	0.83	0.82	0.78	0.76	0.72	0.70	0.63	0.54	0.56	-71.05
23-FS	1.95	1.82	1.72	1.62	1.48	1.27	1.11	1.00	0.88	0.82	0.78	0.80	0.84	0.80	0.75	0.69	0.60	0.61	-68.68
3-VCHA	2.06	1.92	1.79	1.71	1.51	1.33	1.18	1.07	1.00	0.97	0.96	0.98	0.96	0.89	0.82	0.76	0.67	0.65	-68.54
31-RMD	1.58	1.50	1.43	1.29	1.11	0.95	0.87	0.76	0.70	0.65	0.65	0.63	0.62	0.62	0.56	0.58	0.52	0.53	-66.70
32-VAN	2.16	1.98	1.85	1.76	1.55	1.39	1.24	1.10	1.03	1.00	1.01	1.03	1.01	0.93	0.86	0.78	0.67	0.67	-68.98
33-NSCG	2.16	2.03	1.89	1.88	1.67	1.47	1.27	1.22	1.13	1.10	1.07	1.13	1.05	0.97	0.90	0.83	0.75	0.69	-68.15
4-VIHA	2.42	2.29	2.17	2.01	1.91	1.76	1.56	1.38	1.22	1.20	1.17	1.19	1.17	1.11	1.09	0.99	0.89	0.89	-63.19
41-SVI	2.79	2.61	2.51	2.37	2.29	2.06	1.81	1.57	1.40	1.35	1.29	1.34	1.25	1.18	1.18	1.05	0.93	0.94	-66.35
42-CVI	2.04	1.95	1.85	1.67	1.59	1.53	1.43	1.26	1.12	1.12	1.12	1.10	1.13	1.08	1.03	0.95	0.87	0.88	-57.01
43-NVI	2.13	2.07	1.83	1.62	1.45	1.37	1.10	1.06	0.92	0.88	0.88	0.91	0.98	0.98	0.96	0.88	0.84	0.77	-63.72
5-NHA	1.93	1.82	1.64	1.60	1.35	1.21	1.03	0.94	0.86	0.79	0.79	0.83	0.82	0.83	0.79	0.71	0.66	0.61	-68.52
51-NW	1.78	1.76	1.57	1.49	1.25	1.08	0.97	0.90	0.77	0.72	0.75	0.82	0.76	0.87	0.83	0.74	0.66	0.63	-64.63
52-NI	2.05	1.87	1.69	1.67	1.37	1.29	1.11	1.00	0.95	0.88	0.84	0.91	0.96	0.94	0.88	0.79	0.74	0.68	-66.67
53-NE	1.87	1.79	1.60	1.59	1.43	1.22	0.93	0.86	0.75	0.67	0.73	0.64	0.61	0.56	0.57	0.51	0.50	0.44	-76.49
BC	2.17	2.04	1.88	1.77	1.58	1.41	1.23	1.13	1.03	0.98	0.95	0.97	0.96	0.91	0.88	0.81	0.71	0.70	-67.51

5. Comparison of Antimicrobial Utilization in British Columbia, Other Provinces and Europe

When compared to that of several European nations, the 2011 SMX-TMP utilization rate in BC was higher than most countries (17 countries reported less utilization and 6 countries reported more) (Figure 31). In 2011, BC had a similar SMX-TMP rate to the Czech Republic (Figure 31). When compared to other Canadian provinces, BC had the third lowest SMX-TMP use in 2009 (Figure 8).

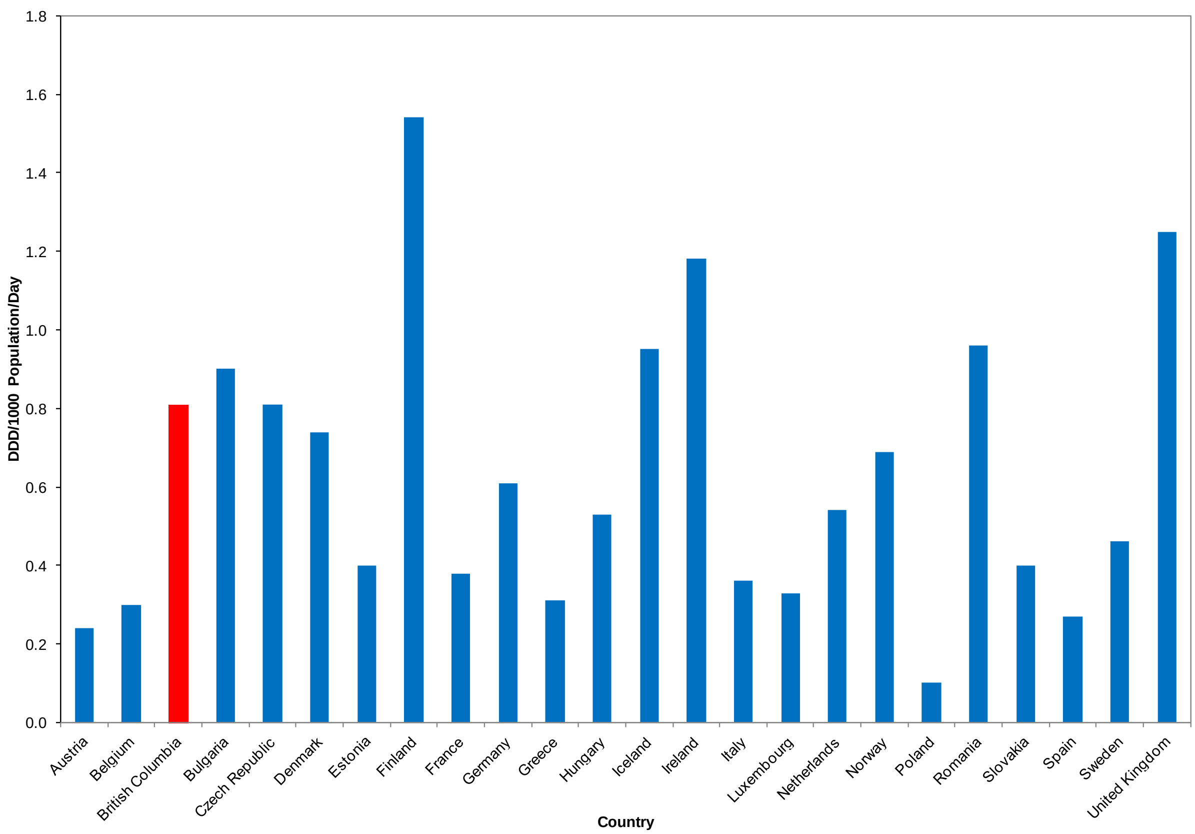


Figure 38: Defined daily rate of sulfonamides and trimethoprim (J01E) use in BC and several European nations for 2011
Source: PharmaNet (BC data); European Surveillance of Antimicrobial Consumption (ESAC) (6)
See Table for the list of antimicrobials included in this class

J01F – Macrolides, lincosamides, and steptogramins

1. Over-Time Trend

Macrolide antimicrobials are commonly prescribed for community-acquired respiratory infections. They have unique activity against atypical pathogens that are not susceptible to the penicillins. Erythromycin was the first macrolide antibiotic introduced (10). It is active against *S. pneumoniae*, *L. monocytogenes*, *Chlamydophila* spp., *Mycoplasma pneumoniae, N. meningitidis, M. catarrhalis,* and some anaerobic pathogens (14). Newer agents (e,g, spiramycin, azithromycin, clarithromycin and telithromycin) are longer-acting and cause less gastrointestinal adverse effects (10).

Macrolides, lincosamides (such as clindamycin) also serve as viable alternatives for patients with a penicillin allergy and for infections that have developed resistance against penicillin antibiotics. Macrolides work by binding to the 50S ribosomal subunit of the 70S ribosome, halting bacterial RNA-dependent protein synthesis (10). Resistance to these agents is thought to occur via two mechanisms: (1) increased antimicrobial efflux by expression of an efflux pump and (2) ribosomal modification through expression of ribosomal methylase (10). The first mechanism is associated with the M phenotype of antimicrobial resistance, while the second with the MLS_B phenotype (10). These phenotypes lead to multi-drug resistance against macrolides (10).

Since the highest consumption rate of drugs in this class was reached in 2005, consumption has dropped by 21% to 3.04 DDD/1000 population/day in 2013; however, this rate still represents a 14% increase from 1998 when utilization was at its lowest value of 2.65 DDD/1000 population/day. Clarithromycin (macrolide) prescribing has been the main driver of this trend and consumption increased significantly over the years and plateau from 2005 to 2011 at approximately 2.50 DDD/1000 population/day. It has since decreased to 2.08 DDD/1000 population/day; however, this was still an increase by 150% compared to the low rate seen in 1996 (0.83 DDD/1000 population/day). This trend may be attributed to its broader spectrum of activity against microorganisms as well as an improved pharmacokinetic and adverse effect profile when compared to other antibiotics within the macrolide class thus is typically better tolerated in patients (15). Azithromycin and clindamycin consumption rates experienced relatively slow rate of increases compared to clarithromycin over the years. Among the macrolides, erythromycin consumption was the only antibiotic that experienced a great declining trend from 2.13 DDD/1000 population/day in 1996 to 0.14 DDD/1000 population/day in 2013 (Figure 39).

Similar overall trends were observed in prescription rates (Figure 40).

Please note, no outpatient streptogramin data was available for the specified date range.

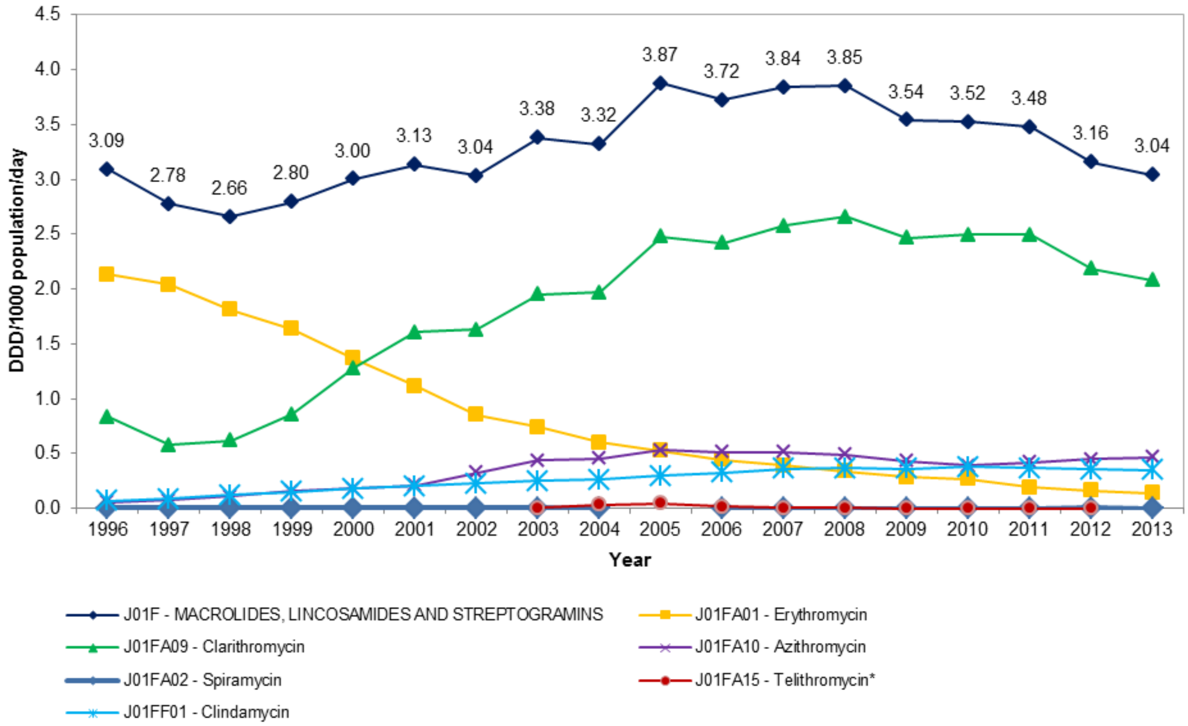


Figure 39: Daily consumption rates for macrolides and lincosamindes (J01F) and subclass agents between years 1996 to 2013.
* Data for telithromycin was only available from 2003 to 2012.

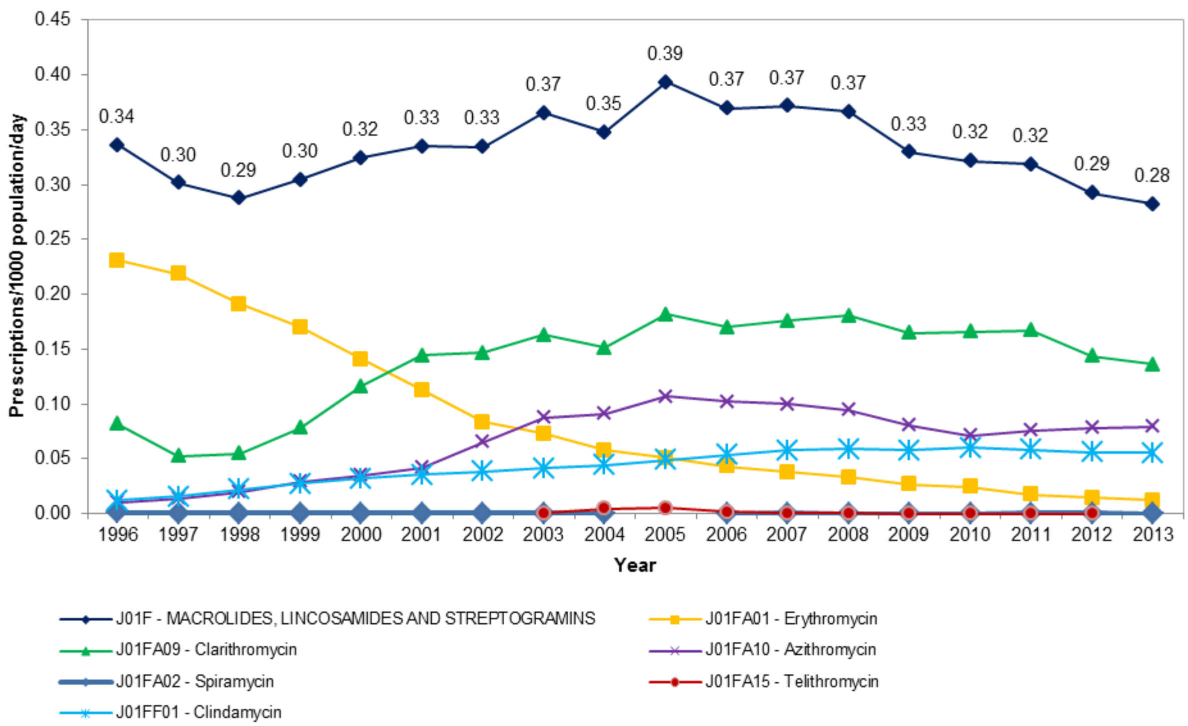


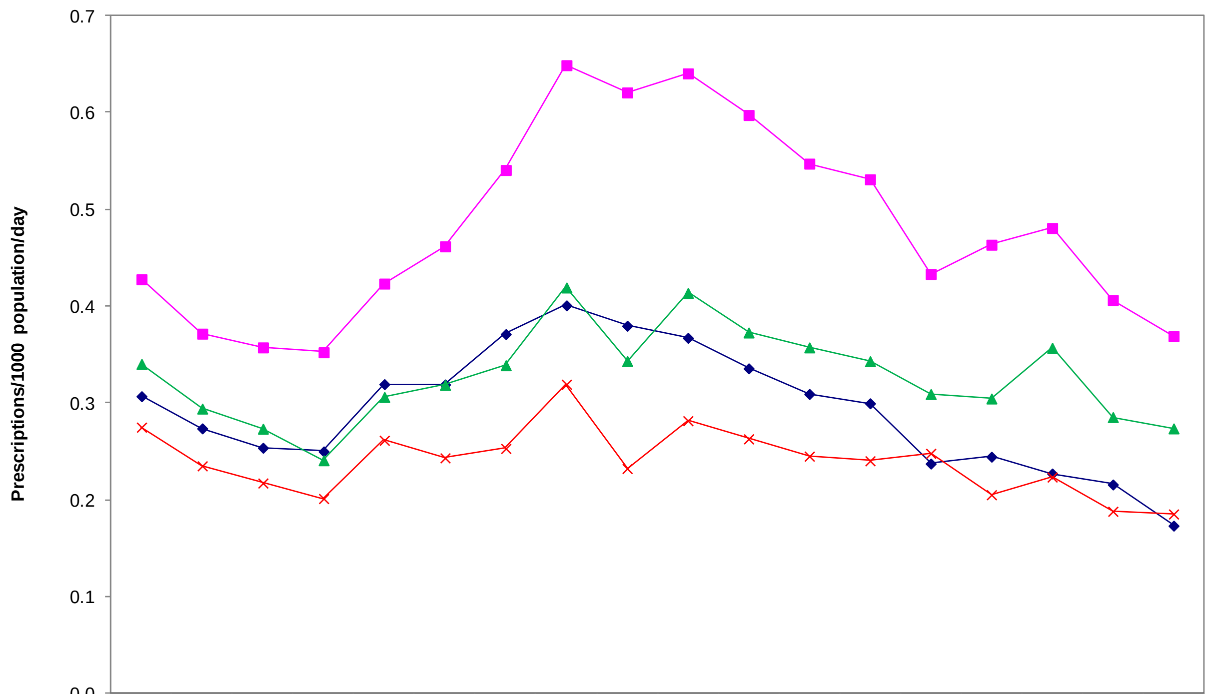
Figure 40: Daily prescription rates for macrolides (J01F) and subclass agents between years 1996 to 2013.

2. By Age

a. Children (< 15 years)

Macrolide antibiotics are amongst the first-line agents recommended for the treatment of pharyngitis and community-acquired pneumonia (11). Both azithromycin and clarithromycin are available as oral suspensions, which offers practical and compliance advantages for this age group.

Similar to the trends seen with other antimicrobial agents, children 1 to 4 years of age were the highest consumers of drugs from this class (mostly macrolides) in 2013 at 0.37 prescriptions/1000 population/day, followed by those 5 to 9 years (0.27 prescriptions/1000 population/day), 10 to 14 years (0.19 prescriptions/1000 population/day), and below 1 year of age (0.17 prescriptions/1000 population/day). Overall, total macrolide and lincosamide prescription rates in children decreased by a range of 14% to 45% over the years with the highest prescription rates seen between 2003 and 2005 (Figure 41).



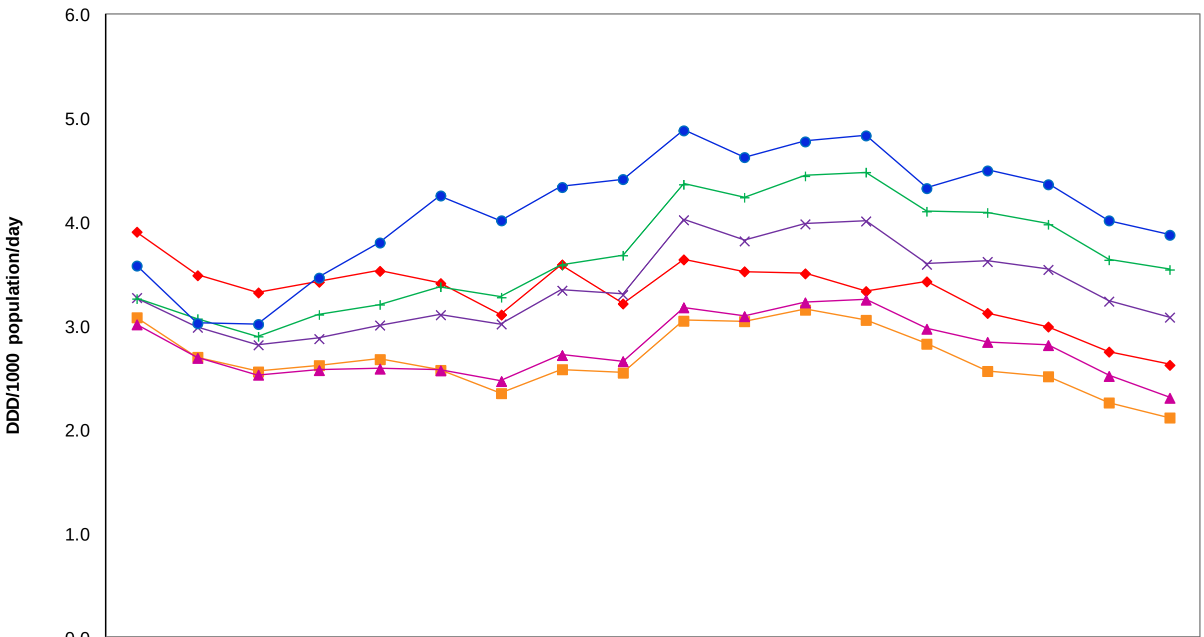
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
<1	0.31	0.27	0.25	0.25	0.32	0.32	0.37	0.40	0.38	0.37	0.34	0.31	0.30	0.24	0.24	0.23	0.22	0.17
1-4	0.43	0.37	0.36	0.35	0.42	0.46	0.54	0.65	0.62	0.64	0.60	0.55	0.53	0.43	0.46	0.48	0.41	0.37
5-9	0.34	0.29	0.27	0.24	0.31	0.32	0.34	0.42	0.34	0.41	0.37	0.36	0.34	0.31	0.30	0.36	0.29	0.27
10-14	0.27	0.24	0.22	0.20	0.26	0.24	0.25	0.32	0.23	0.28	0.26	0.25	0.24	0.25	0.21	0.22	0.19	0.19

Figure 41: Macrolide and lincosamide (J01F) daily prescription rates in children from 1996 to 2013

b. Adults (≥ 15 years)

The trends seen in consumption rates for the J01F class of drugs among adults were similar across all age groups with an increasing trend that reached its peak in 2005, after which a decreasing trend occurred. During the period from 1996 to 2013, a decreasing trend was observed for the youngest four age groups ranging from 5% to 33%; while the trend for the oldest two age groups demonstrated an increase in consumption by approximately 8% (Figure 42).

In 2013, drugs from this class were most frequently consumed by adults 60 years and above, at a daily rate of 3.88 DDD/1000 population/day; this was followed by adults 40 to 59 years, 30 to 39 years, 15 to 19 years, 25 to 29 years, and 20 to 24 years, which had corresponding rates of 3.54, 3.09, 2.63, 2.31 and 2.12 DDD/1000 population/day, respectively (Figure 42).

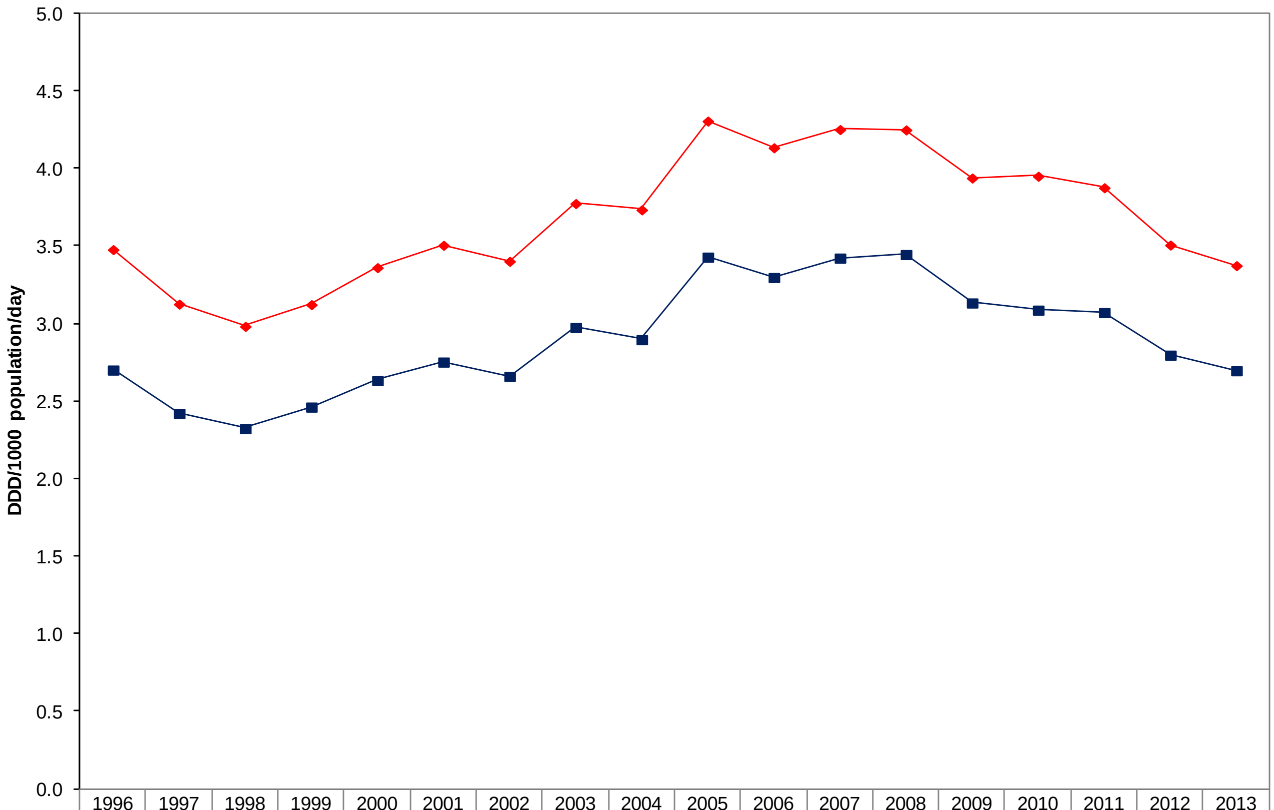


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
15-19	3.91	3.49	3.32	3.43	3.53	3.41	3.11	3.59	3.22	3.64	3.53	3.51	3.34	3.43	3.13	3.00	2.75	2.63
20-24	3.09	2.70	2.56	2.62	2.68	2.58	2.36	2.59	2.55	3.05	3.05	3.16	3.06	2.83	2.57	2.52	2.26	2.12
25-29	3.02	2.69	2.53	2.58	2.59	2.57	2.47	2.72	2.66	3.18	3.10	3.23	3.25	2.97	2.85	2.82	2.52	2.31
30-39	3.27	2.99	2.82	2.88	3.01	3.11	3.02	3.35	3.30	4.02	3.82	3.98	4.01	3.60	3.62	3.55	3.24	3.09
40-59	3.26	3.07	2.90	3.11	3.21	3.38	3.28	3.59	3.68	4.36	4.24	4.45	4.48	4.11	4.09	3.98	3.64	3.54
60+	3.58	3.03	3.02	3.47	3.80	4.26	4.02	4.34	4.42	4.88	4.63	4.78	4.84	4.33	4.50	4.36	4.02	3.88

Figure 42: Macrolide and lincosamide (J01F) daily consumption rates in adults from 1996 to 2013

3. By Gender

Both females and males exhibited an overall decrease in consumption from 1996 to 2013 (11% and 10%, respectively). Consumption among females remained consistently above consumption among males by an average of 27%, a similar observation as other antimicrobial agents. In 2013, the consumption rate among females was 3.02 DDD/1000 population/day, while the consumption rate among males was 2.36 DDD/1000 population/day (Figure 43).

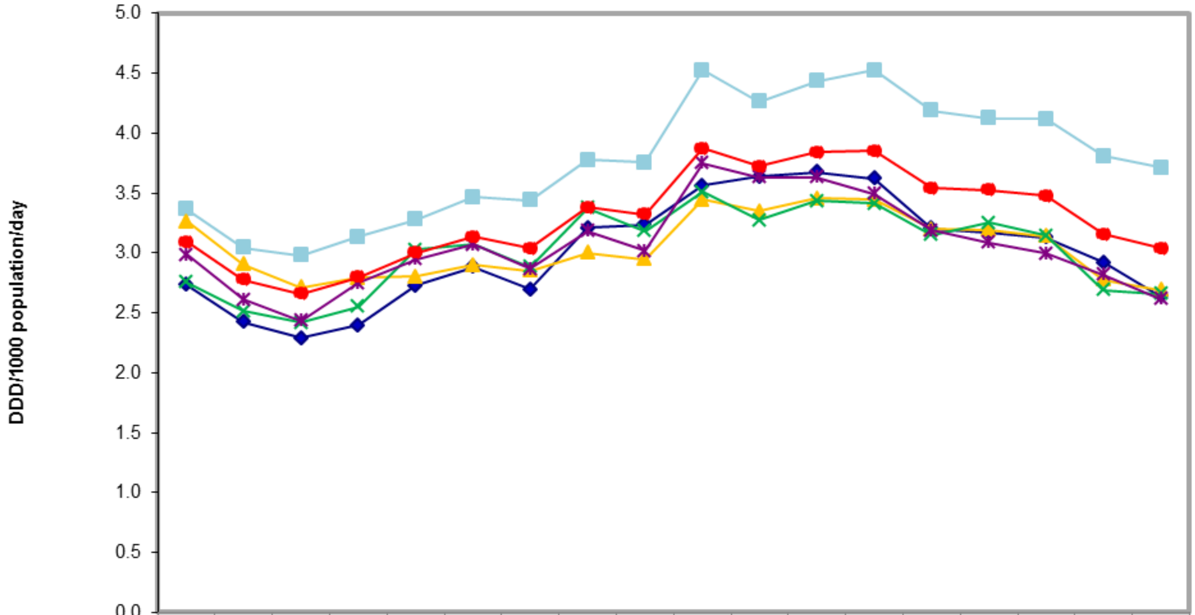


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
F	3.48	3.13	2.98	3.12	3.36	3.51	3.40	3.78	3.74	4.31	4.14	4.25	4.25	3.94	3.95	3.88	3.51	3.38
M	2.70	2.42	2.32	2.46	2.63	2.75	2.66	2.98	2.90	3.43	3.30	3.42	3.45	3.13	3.09	3.07	2.80	2.70

Figure 43: Macrolide and lincosamide (J01F) daily consumption rates by gender from 1996 to 2013

4. By Health Authority & Health Services Delivery Area

Over the years, macrolide and lincosamide consumption trends were similar in all BC HAs. Consumption rates were lowest in 1998 (ranging from 2.29 to 2.98 DDD/1000 population/day) and highest in 2005 and 2008 (ranging from 3.41 to 4.53 DDD/1000 population/day).



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1-IHA	2.73	2.42	2.29	2.39	2.73	2.88	2.70	3.21	3.24	3.56	3.64	3.67	3.62	3.21	3.17	3.13	2.92	2.64
2-FHA	3.37	3.04	2.98	3.13	3.28	3.47	3.44	3.78	3.75	4.53	4.26	4.44	4.53	4.19	4.12	4.12	3.81	3.72
3-VCHA	3.26	2.91	2.71	2.79	2.80	2.90	2.85	3.00	2.95	3.45	3.35	3.46	3.44	3.20	3.20	3.14	2.78	2.69
4-VIHA	2.76	2.52	2.42	2.55	3.03	3.08	2.88	3.38	3.19	3.51	3.28	3.43	3.41	3.15	3.25	3.15	2.69	2.66
5-NHA	2.99	2.61	2.44	2.75	2.95	3.07	2.87	3.18	3.02	3.75	3.63	3.63	3.50	3.19	3.09	3.00	2.82	2.61
BC	3.09	2.78	2.66	2.80	3.00	3.13	3.04	3.38	3.32	3.87	3.72	3.84	3.85	3.54	3.52	3.48	3.16	3.04

Figure 44: Macrolide and lincosamide (J01F) daily consumption rates by health authority from 1996 to 2013

The greatest consumption decrease since 1996 occurred in Vancouver Coastal by 18%, while the only increase occurred in Fraser by 10%. Rates in all other HAs exhibited increases between these two extremes. The provincial average decreased 2% from 3.09 to 3.04 DDD/1000 population/day (Figure 44).

Within Interior, the most dramatic decrease in macrolides consumption was observed in East Kootenay from 2.95 DDD/1000 population/day in 1996 to 2.18 DDD/1000 population/day in 2013, a 26% decrease. This was followed by a decrease of 18% in consumption in Kootenay Boundary, a decrease of 9% in Okanagan. Thompson Cariboo Shuswap, on the other hand, experienced a 15% increase over the years (Table 6).

In Fraser, Fraser East and Fraser South follow similar trends in consumption over the years and were reported to be at 4.31 and 4.03 DDD/1000 population/day, respectively. The consumption rate in Fraser North was consistently lower over the years and was reported to be at 3.07 DDD/1000 population/day in 2013 (Table 6).

From 1996 to 2013, the trends in macrolide and lincosamide consumption rates in Vancouver Coastal differed substantially between HSDAs. The consumption rates in North Shore/Coast Garibaldi decreased dramatically from a peak in 2008 at 4.29 to 3.16 DDD/1000 population/day, similar to the rate observed in 1996. The rates in Vancouver and Richmond were substantially lower in 2013 at 2.47 and 2.79 DDD/1000 population/day, respectively (Table 6).

Consumption rates among the three HSDAs in Vancouver Island were similar as shown in Table 6. North Vancouver Island, however, showed the largest percent decrease from 2.95 DDD/1000 population/day in 1996 to 2.60 DDD/1000 population/day in 2013 (Table 6).

Lastly, utilization of drugs in the J01F class among HSDAs within Northern has fluctuated more dramatically than the other BC HAs. Despite notable fluctuations, macrolides consumption in Northern Interior and Northeast experienced a decrease by approximately 15% since 1996 while the rates in Northwest showed a decrease by 1%. The rates in 2013 were reported to be at 2.73 DDD/1000 population/day for both Northwest and Northern Interior but 2.27 DDD/1000 population/day for Northeast (Table 6).

Table 6: Macrolide and lincosamide (J01F) daily consumption rates by health authority and health services delivery area from 1996 to 2013

HA/HSDA	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	% Change
IHA	2.73	2.42	2.29	2.39	2.73	2.88	2.70	3.21	3.24	3.56	3.64	3.67	3.62	3.21	3.17	3.13	2.92	2.64	-3.46
11-EK	2.95	2.17	2.38	2.56	2.54	2.91	2.79	3.03	2.94	3.30	3.06	3.40	3.29	3.03	2.85	2.75	2.37	2.18	-26.08
12-KB	2.64	2.81	2.55	2.50	2.56	2.89	2.59	2.96	3.01	3.19	3.08	3.16	2.86	2.74	2.53	2.50	2.48	2.17	-17.59
13-OK	2.93	2.58	2.34	2.44	2.79	2.91	2.74	3.36	3.34	3.60	3.73	3.76	3.74	3.16	3.11	3.16	2.98	2.76	-5.98
14-TCS	2.42	2.16	2.08	2.23	2.78	2.83	2.65	3.14	3.28	3.73	3.89	3.82	3.83	3.51	3.61	3.44	3.19	2.78	15.12
FHA	3.37	3.04	2.98	3.13	3.28	3.47	3.44	3.78	3.75	4.53	4.26	4.44	4.53	4.19	4.12	4.12	3.81	3.72	10.37
21-FE	3.43	2.89	3.04	3.20	3.37	3.70	3.62	4.06	4.03	4.87	4.51	4.66	4.97	4.49	4.56	4.75	4.53	4.31	25.79
22-FN	3.13	2.82	2.73	2.83	2.98	3.11	3.13	3.42	3.41	4.07	3.88	4.03	3.94	3.58	3.47	3.42	3.11	3.07	-2.12
23-FS	3.55	3.31	3.17	3.38	3.51	3.70	3.64	3.98	3.94	4.78	4.49	4.69	4.85	4.58	4.50	4.46	4.11	4.03	13.48
VCHA	3.26	2.91	2.71	2.79	2.80	2.90	2.85	3.00	2.95	3.45	3.35	3.46	3.44	3.20	3.20	3.14	2.78	2.69	-17.48
31-RMD	3.19	2.77	2.63	2.59	2.54	2.73	2.62	2.78	2.58	3.04	2.87	3.07	2.91	2.74	2.93	2.98	2.80	2.79	-12.54
32-VAN	3.33	2.90	2.77	2.84	2.80	2.87	2.83	2.96	2.88	3.31	3.20	3.26	3.24	3.02	2.99	2.89	2.54	2.47	-26.02
33-NSCG	3.15	3.00	2.64	2.82	2.99	3.07	3.05	3.26	3.35	4.03	3.99	4.16	4.29	3.93	3.85	3.84	3.32	3.16	0.10
VIHA	2.76	2.52	2.42	2.55	3.03	3.08	2.88	3.38	3.19	3.51	3.28	3.43	3.41	3.15	3.25	3.15	2.69	2.66	-3.43
41-SVI	2.63	2.31	2.32	2.41	2.99	3.03	2.81	3.27	3.00	3.23	3.10	3.19	3.18	2.85	2.97	2.91	2.58	2.62	-0.57
42-CVI	2.83	2.60	2.43	2.69	3.07	3.12	2.93	3.46	3.47	3.86	3.52	3.72	3.65	3.46	3.63	3.45	2.83	2.74	-2.91
43-NVI	2.95	2.96	2.69	2.67	3.05	3.11	3.00	3.53	3.14	3.63	3.30	3.55	3.60	3.39	3.29	3.19	2.71	2.60	-11.92
NHA	2.99	2.61	2.44	2.75	2.95	3.07	2.87	3.18	3.02	3.75	3.63	3.63	3.50	3.19	3.09	3.00	2.82	2.61	-12.43
51-NW	2.74	2.47	2.30	2.54	2.88	2.79	2.74	3.10	2.75	3.31	3.20	3.47	3.35	3.25	3.20	3.23	3.15	2.73	-0.70
52-NI	3.27	2.69	2.44	2.88	3.03	3.13	2.97	3.21	3.18	4.04	3.82	3.86	3.76	3.29	3.25	3.05	2.79	2.73	-16.44
53-NE	2.65	2.61	2.62	2.74	2.84	3.30	2.79	3.23	2.99	3.64	3.73	3.32	3.10	2.91	2.65	2.65	2.54	2.27	-14.21
BC	3.09	2.78	2.66	2.80	3.00	3.13	3.04	3.38	3.32	3.87	3.72	3.84	3.85	3.54	3.52	3.48	3.16	3.04	-1.74

5. Comparison of Antimicrobial Utilization in British Columbia, Other Provinces and Europe

When compared to European nations, the 2011 macrolide and lincosamide utilization rate in BC was higher than half the countries (11 countries reported more utilization and 12 countries reported less) (Figure 31). In 2011, BC had a similar macrolides rate to Belgium, Bulgaria, and Romania (Figure 31). When compared to other Canadian provinces, BC had the third lowest macrolides use in 2011 (Figure 8).

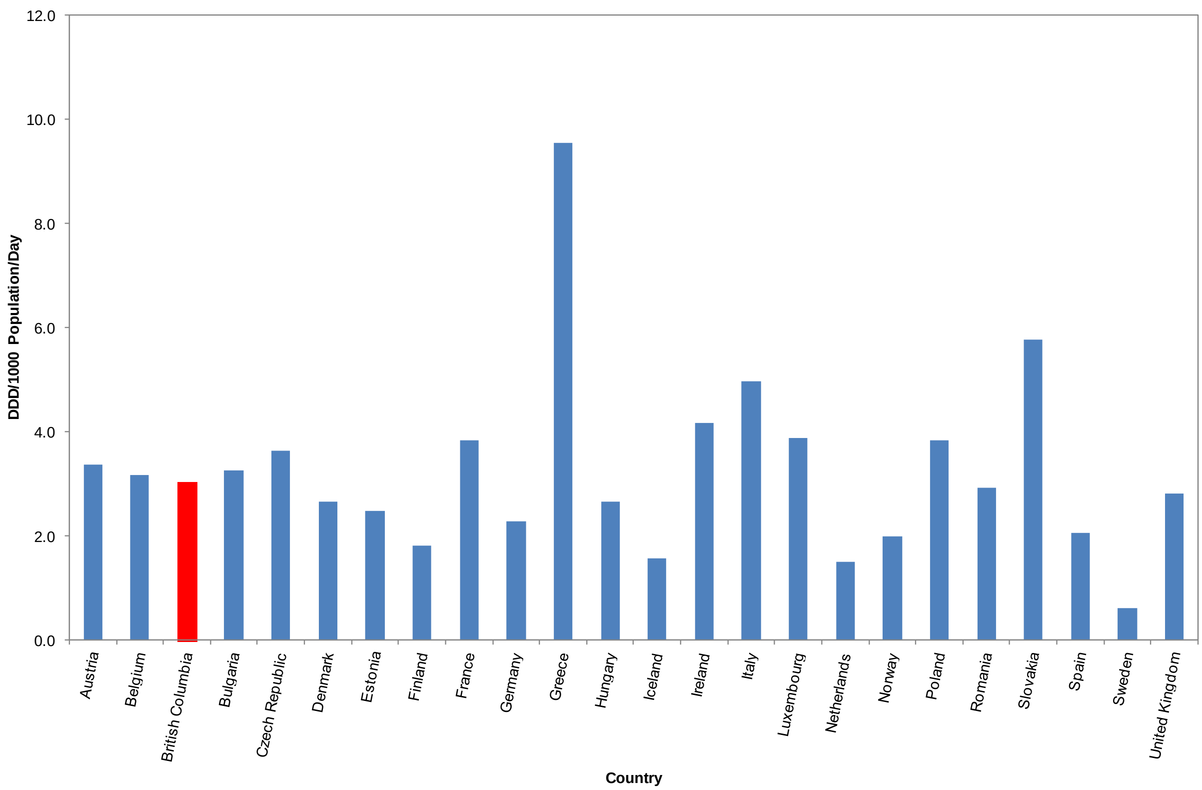


Figure 45: Defined daily rate of macrolides (J01F) use in BC and several European nations for 2011

Source: PharmaNet (BC data); European Surveillance of Antimicrobial Consumption (ESAC) (6)

See Table for the list of antimicrobials included in this class

J01M – Quinolones

1. Over-Time Trend

The use of quinolone antibiotics has increased exponentially in the past decade with a consumption rate surpassing that of cephalosporins. These bactericidal agents have a broad spectrum of antimicrobial activity, good oral bioavailability, and ideal pharmacokinetic characteristics that allow for once to twice daily dosing (10;16). Their broad antimicrobial coverage is reflected in the wide array of clinical indications including UTIs, intra-abdominal infections, gonococcal infections, and respiratory infections (10;11;16). They exert antimicrobial activity by binding to DNA gyrase and topoisomerase II and IV, inhibiting the coiling of bacterial DNA and, thus, DNA replication, transcription, repair and recombination (10). Resistance to these agents is facilitated via mutations in the genes encoding DNA gyrase (*gyrA* and *gyrB*) and topoisomerase (*parC* and *parE*), and enhancing the efflux of antimicrobials (10).

The consumption of quinolones climbed by 81% between 1996 to 2007. However, targeted efforts to reduce use of drugs in this class have resulted in a steady decrease that continued to 2013 (Figure 46). Usage has been exclusive to the fluoroquinolone subclass, which differs from other quinolones by the attachment of a fluorine atom to the central ring (10).

In particular, ciprofloxacin contributes to a majority of the overall fluoroquinolones use in BC. Between 1996 and 2013, ciprofloxacin consumption increased by 60% from 0.63 to 1.01 DDD/1000 population/day. Consumption of moxifloxacin, a newer fluoroquinolone, has consistently increased since its introduction in 2000 to constitute 11% of all quinolone consumption at 0.31 DDD/1000 population/day in 2013. In contrast, utilization of levofloxacin has been declining since 2003 after an initial increase since its introduction in 1998. Lastly, consumption of norfloxacin, an older agent, has decreased since 1996 to rate of 0.01 DDD/1000 population/day in 2013 (Figure 46).

Prescription rates show similar overall trends compared to utilization (Figure 47).

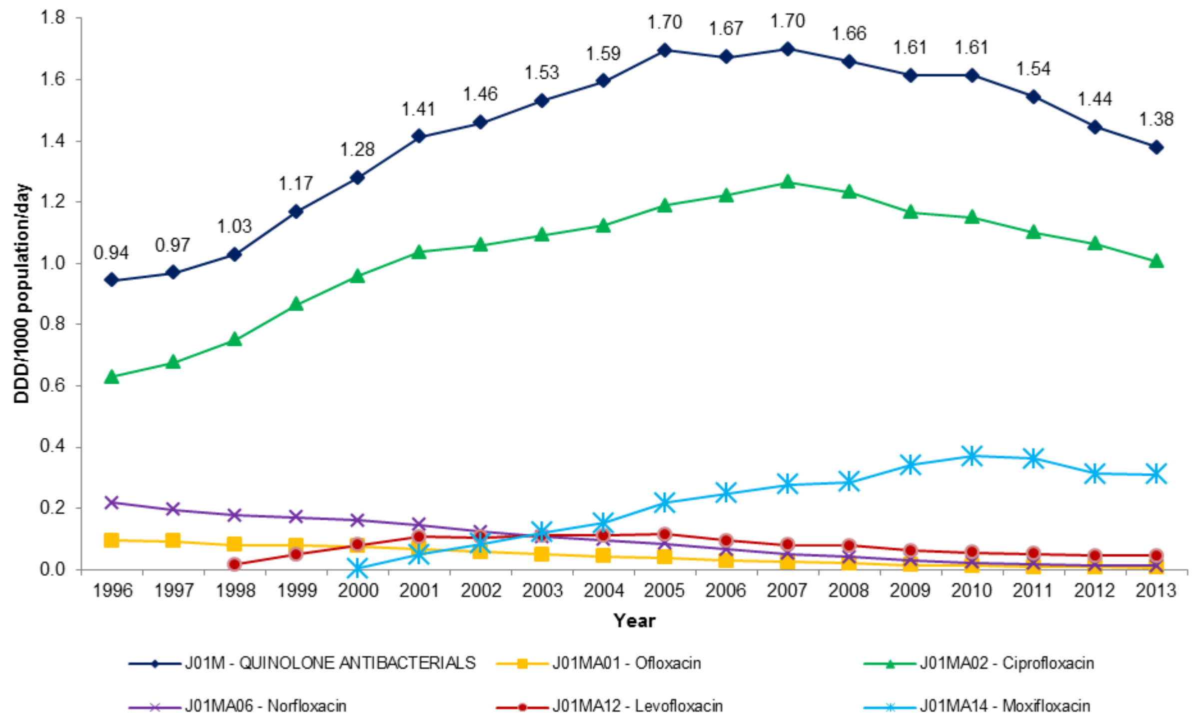


Figure 46: Daily consumption rates for quinolones (J01M) and subclass agents from 1996 to 2013

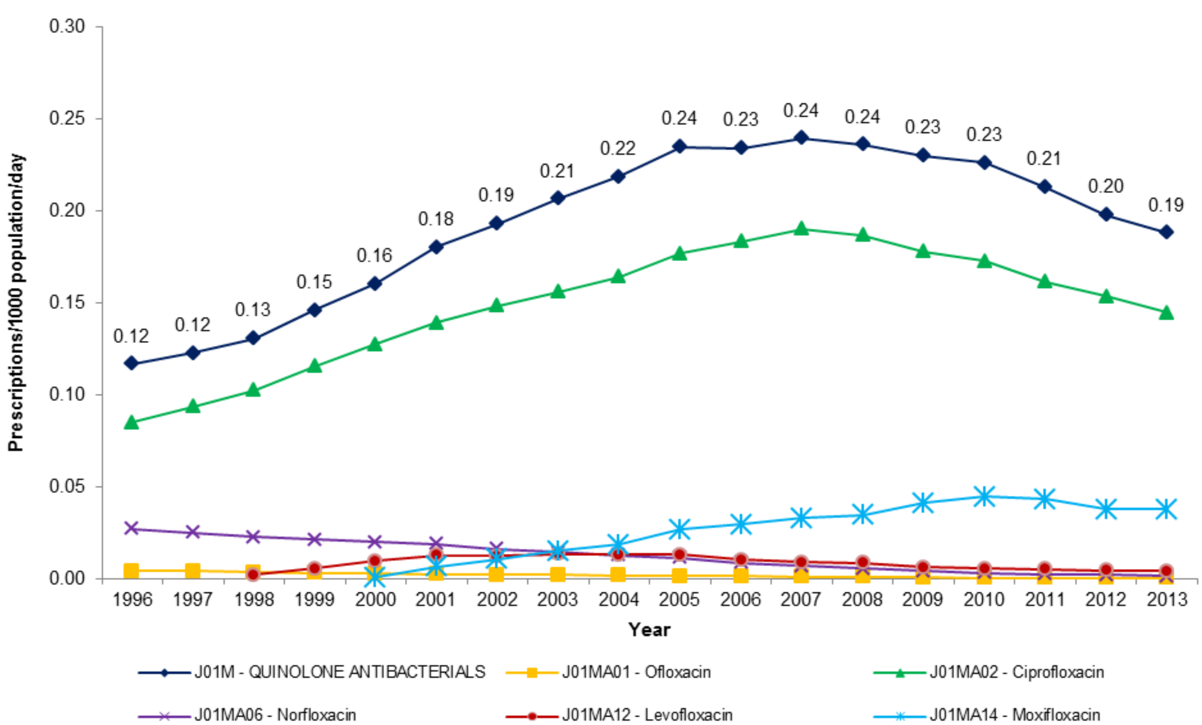
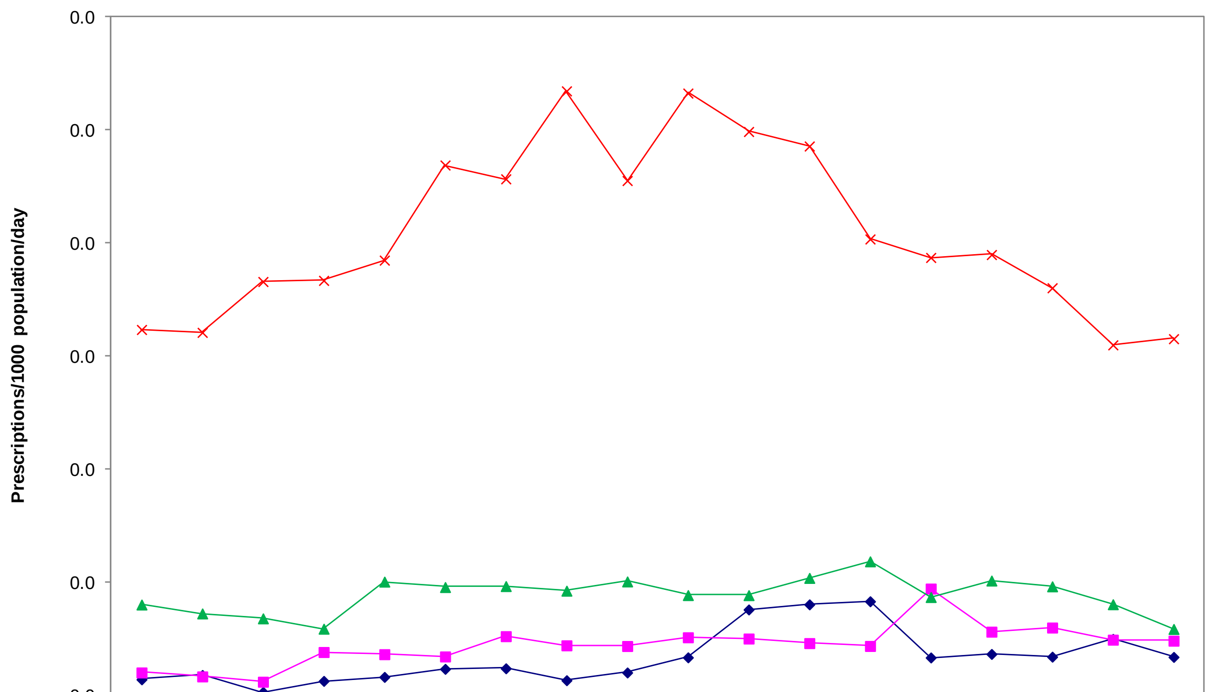


Figure 47: Daily prescription rates for quinolones (J01M) and subclass agents from 1996 to 2013

2. By Age

a. Children (< 15 years)

Quinolones consumption is minimal in the pediatric population. Children 10 to 14 years of age were prescribed these agents at a rate of 0.0063 prescriptions/1000 population/day in 2013. Usage in children under 10 years was negligible (below 0.0020 prescriptions/1000 population/day) across the years. Prescription rates in those 10 to 14 years of age peaked in 2003 and 2005 at 0.0103 prescriptions/1000 population/day, which was followed by a decline since then. These data are consistent with recommendations against the use of quinolones in children under the age of 18 due to the risk of cartilage and tendon malformation (10;16). Quinolones are, however, indicated in paediatric age groups under exceptional clinical circumstances (e.g. respiratory infections associated with cystic fibrosis, anthrax exposure, multi-drug resistant infections) (16) (Figure 48).

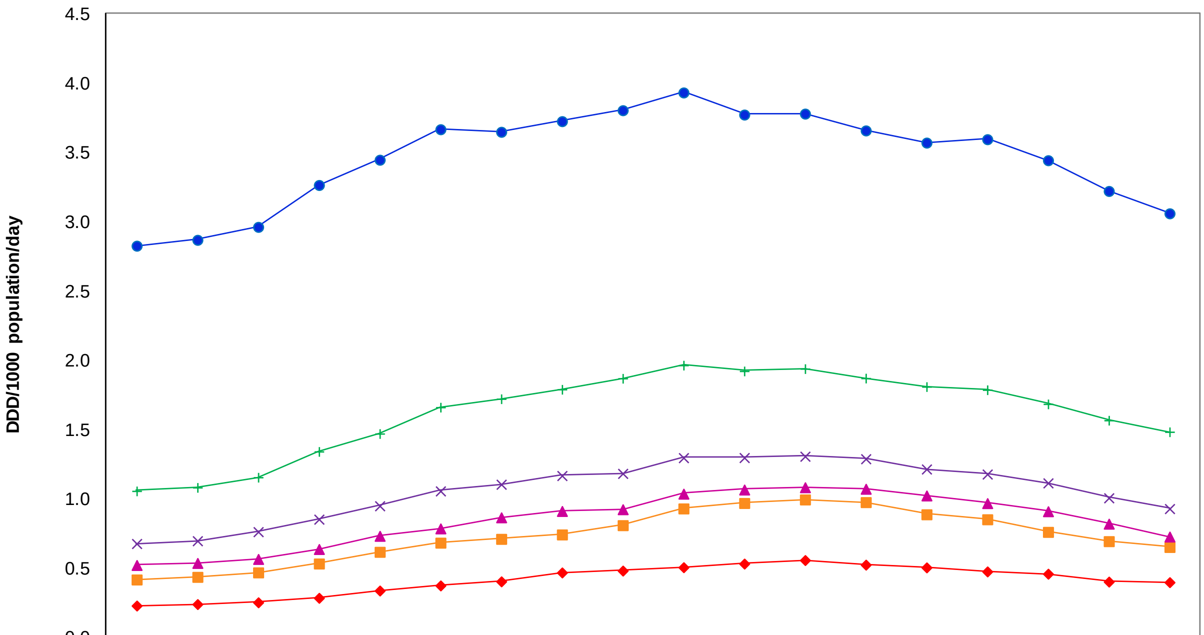


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
<1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5-9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10-14	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	0.01	0.01	0.01	0.01	0.01

Figure 48: Quinolones (J01M) daily prescription rates in children from 1996 to 2013

b. Adults (≥ 15 years)

From 1996 to 2013, quinolones consumption has increased in all adult age groups by a range of 8% (in adults over 60 years) to 74% (in adults 15 to 19 years); however, recent years have demonstrated rate declines in all age groups. Those 60 years and above are the highest consumers of these agents, exceeding the next highest group of consumers (40 to 59 years) by 106% in 2013. Despite the contraindicated use of quinolones in patients under 18 years, those between 15 to 19 years of age had a reported consumption rate of 0.40 DDD/1000 population/day in 2013 (Figure 49).

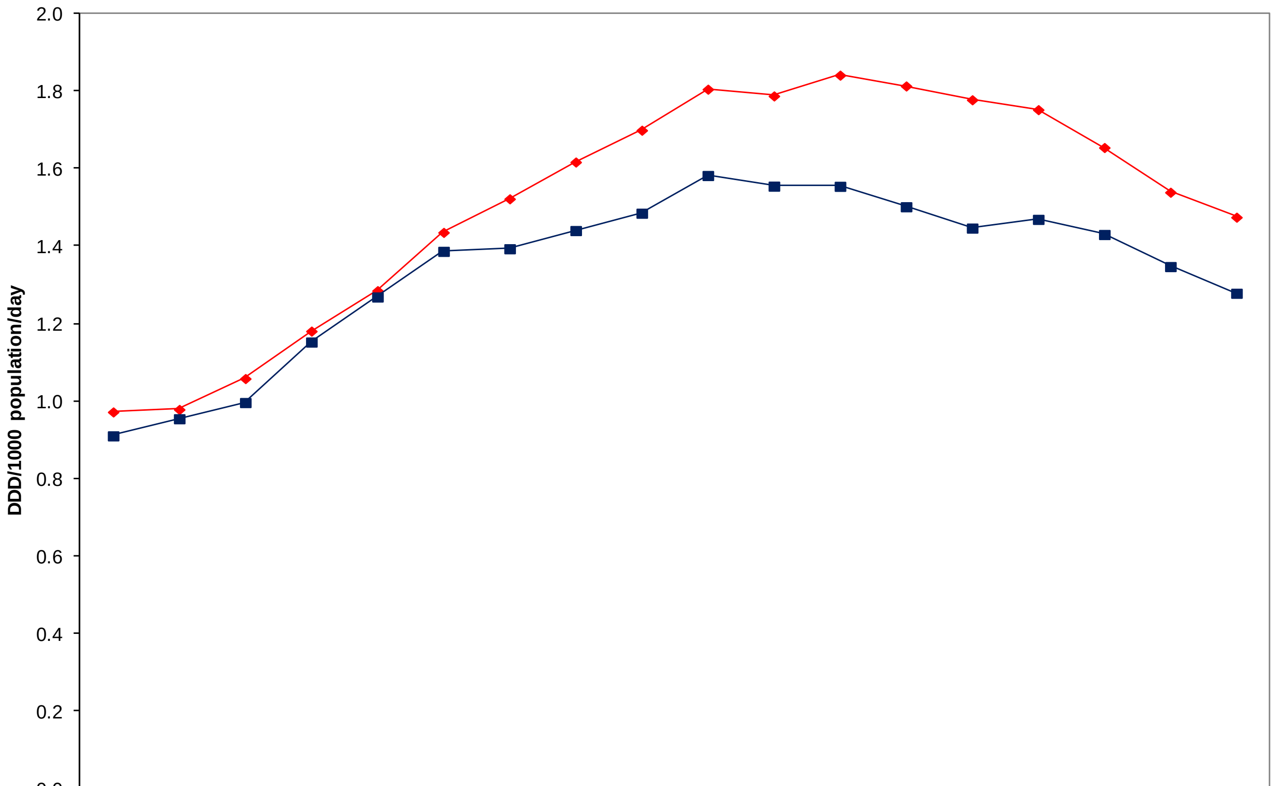


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
15-19	0.23	0.24	0.25	0.28	0.34	0.37	0.40	0.47	0.48	0.50	0.53	0.56	0.52	0.50	0.47	0.46	0.40	0.40
20-24	0.42	0.43	0.47	0.53	0.61	0.68	0.71	0.74	0.81	0.93	0.97	0.99	0.97	0.89	0.85	0.76	0.69	0.65
25-29	0.52	0.53	0.56	0.64	0.73	0.78	0.86	0.91	0.92	1.03	1.06	1.08	1.07	1.02	0.97	0.91	0.82	0.73
30-39	0.68	0.70	0.76	0.85	0.95	1.05	1.10	1.17	1.18	1.29	1.30	1.31	1.29	1.21	1.18	1.11	1.00	0.93
40-59	1.05	1.08	1.15	1.34	1.47	1.66	1.72	1.79	1.87	1.96	1.92	1.94	1.87	1.81	1.78	1.68	1.56	1.48
60+	2.82	2.87	2.96	3.26	3.44	3.66	3.65	3.72	3.80	3.93	3.77	3.78	3.66	3.57	3.59	3.44	3.22	3.06

Figure 49: Quinolones (J01M) daily consumption rates in adults from 1996 to 2013

3. By Gender

Consumption of quinolone antibiotics was relatively similar among females and males between the years 1996 and 2001. However, consumption rates began to diverge since this time, resulting in a 16% higher usage among females in 2013 at 1.48 DDD/1000 population/day. This difference was consistent with the trends observed for other antimicrobials and may be explained by the higher rate of symptomatic UTIs in the female population (Figure 50).

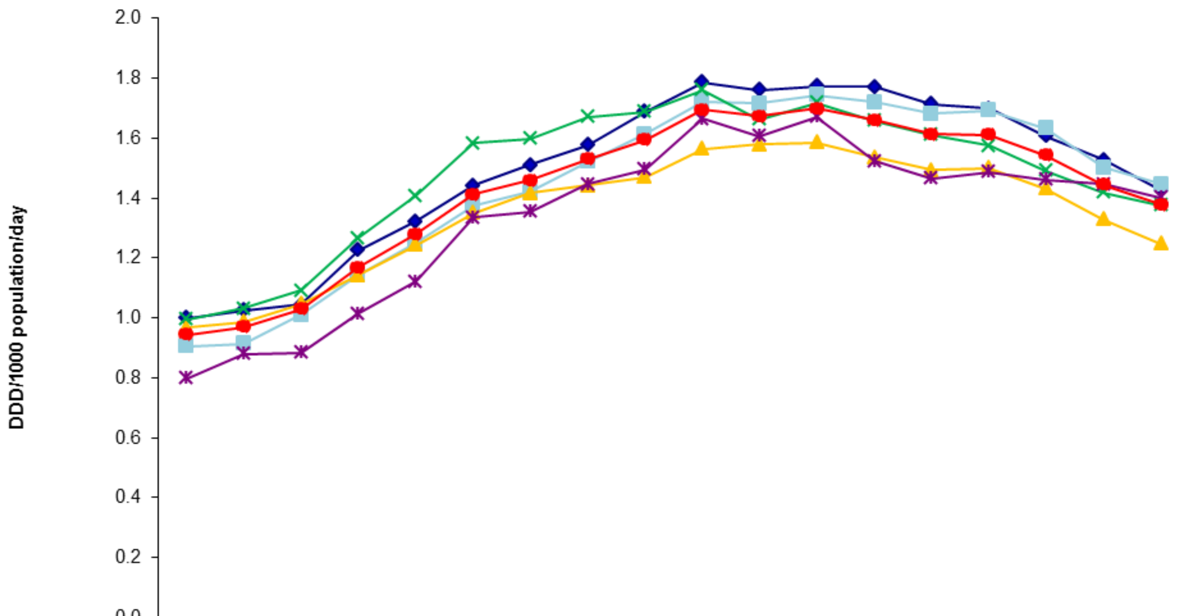


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
F	0.97	0.98	1.06	1.18	1.29	1.44	1.52	1.62	1.70	1.81	1.79	1.84	1.81	1.78	1.75	1.65	1.54	1.48
M	0.91	0.96	1.00	1.15	1.27	1.39	1.39	1.44	1.49	1.58	1.56	1.55	1.50	1.45	1.47	1.43	1.35	1.28

Figure 50: Quinolones (J01M) daily consumption rates by gender from 1996 to 2013

4. By Health Authority & Health Services Delivery Area

The consumption of quinolones has been relatively consistent within the five BC HAs from 1996 to 2013. Quinolones utilization rose by 29% in Vancouver Coastal, 38% in Vancouver Island, 43% in Interior, 75% in Northern, and 60% in Fraser. In 2013, the lowest quinolones consumption rate was observed in Vancouver Coastal at 1.25 DDD/1000 population/day, while consumption rates were highest in Fraser at 1.45 DDD/1000 population/day (Figure 51).



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1-IHA	1.00	1.02	1.04	1.23	1.32	1.44	1.51	1.58	1.69	1.79	1.76	1.77	1.77	1.71	1.70	1.61	1.53	1.43
2-FHA	0.91	0.91	1.01	1.14	1.25	1.38	1.42	1.52	1.61	1.72	1.72	1.74	1.72	1.68	1.69	1.63	1.50	1.45
3-VCHA	0.97	0.99	1.05	1.14	1.24	1.35	1.42	1.44	1.47	1.56	1.58	1.58	1.54	1.49	1.50	1.43	1.33	1.25
4-VIHA	1.00	1.03	1.09	1.27	1.41	1.58	1.60	1.67	1.69	1.76	1.66	1.72	1.66	1.61	1.57	1.49	1.42	1.38
5-NHA	0.80	0.88	0.88	1.02	1.12	1.34	1.35	1.45	1.50	1.66	1.61	1.67	1.52	1.46	1.49	1.46	1.45	1.40
BC	0.94	0.97	1.03	1.17	1.28	1.41	1.46	1.53	1.59	1.70	1.67	1.70	1.66	1.61	1.61	1.54	1.44	1.38

Figure 51: Quinolones (J01M) daily consumption rates (DDD/1000 population/day) by health authority from 1996 to 2013

Within Interior, rates in Thompson Cariboo Shuswap consistently ranked the highest over the years since 2005 with a rate of 2.78 DDD/1000 population/day in 2013. Consumption rates in Kootenay Boundary and East Kootenay were lowest in 2013 at a rate of 2.18 and 2.17 DDD/1000 population/day, respectively. While rates in all four HSDAs followed a similar upward trend through the years, rates in Okanagan experienced the greatest rise (50%) from 1996 to 2013 (Table 7).

Within Fraser, quinolones consumption rates in the three HSDAs closely mirrored one another until recent years, as rates began to diverge with rates in Fraser North remaining substantially lower than the other HSDAs. In 2013, rates in Fraser East ranked highest at 4.31 DDD/1000 population/day. Rates in Fraser South followed at 1.65 DDD/1000 population/day, while rates in Fraser North were the lowest at 1.25 DDD/1000 population/day (Table 7).

The most disparity in quinolone utilization between HSDAs over the years occurred in Vancouver Coastal. In 2013, consumption rates in North Shore/Coast Garibaldi were the highest at 1.49 DDD/1000 population/day, followed by Vancouver at 1.18 DDD/1000 population/day and Richmond at 1.10 DDD/1000 population/day. Although rates in North Shore/Coast Garibaldi and Vancouver have varied, consumption rates in Richmond has remained the lowest across the years. Quinolones utilization peaked in 2007 in North Shore/Coast Garibaldi and Vancouver, but rates in Richmond have stabilized (Table 7).

Similar to Fraser, quinolones consumption rates across HSDAs within Vancouver Island were comparable throughout the years. Usage climbed steadily from 1996 to 2005 and has since declined substantially. In

2013, daily consumption rates were 1.43 DDD/1000 population/day in North Vancouver Island, 1.34 DDD/1000 population/day in South Vancouver Island, and 1.41 DDD/1000 population/day in Central Vancouver Island. From 1996 to 2013, rates in North Vancouver Island jumped by 54%, while rates in South Vancouver Island rose by 38%. Rates in Central Vancouver Island increased by 33% (Table 7).

In Northern, the steepest relative rise in quinolone consumption occurred in Northeast from 0.59 DDD/1000 population/day in 1996 to 1.23 DDD/1000 population/day in 2013 (total percentage increase of 107%). The increase in Northwest followed closely at 99%, while the increase in Northern Interior was at a percentage of 59%. In 2013, rates in Northern Interior ranked the highest at 1.49 DDD/1000 population/day, followed by Northwest at 1.39 DDD/1000 population/day, and lastly Northeast at 1.23 DDD/1000 population/day (Table 7).

Table 7: Quinolones (J01M) daily consumption rates by health authority and health services delivery area from 1996 to 2013

HA/HSDA	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	% Change
1-IHA	1.00	1.02	1.04	1.23	1.32	1.44	1.51	1.58	1.69	1.79	1.76	1.77	1.77	1.71	1.70	1.61	1.53	1.43	42.85
11-EK	1.05	1.01	1.03	1.17	1.20	1.36	1.50	1.55	1.61	1.74	1.71	1.99	1.82	1.60	1.64	1.59	1.48	1.43	35.39
12-KB	0.83	0.88	0.90	1.08	1.09	1.25	1.32	1.30	1.39	1.46	1.50	1.55	1.54	1.43	1.47	1.36	1.41	1.24	49.71
13-OK	0.95	0.93	0.97	1.22	1.33	1.45	1.51	1.56	1.68	1.79	1.77	1.78	1.82	1.76	1.64	1.54	1.48	1.42	50.42
14-TCS	1.12	1.21	1.20	1.31	1.44	1.54	1.58	1.72	1.84	1.91	1.85	1.77	1.76	1.79	1.90	1.81	1.67	1.50	34.27
2-FHA	0.91	0.91	1.01	1.14	1.25	1.38	1.42	1.52	1.61	1.72	1.72	1.74	1.72	1.68	1.69	1.63	1.50	1.45	59.77
21-FE	0.86	0.92	1.05	1.25	1.50	1.57	1.55	1.60	1.77	1.82	1.83	1.84	1.87	1.84	1.92	1.85	1.68	1.65	91.19
22-FN	0.88	0.89	0.98	1.10	1.16	1.32	1.39	1.49	1.54	1.60	1.63	1.64	1.58	1.55	1.54	1.48	1.35	1.25	41.71
23-FS	0.94	0.93	1.02	1.14	1.23	1.35	1.40	1.52	1.61	1.78	1.74	1.80	1.78	1.73	1.73	1.68	1.56	1.53	62.27
3-VCHA	0.97	0.99	1.05	1.14	1.24	1.35	1.42	1.44	1.47	1.56	1.58	1.58	1.54	1.49	1.50	1.43	1.33	1.25	28.91
31-RMD	0.82	0.81	0.83	0.90	0.92	1.01	1.01	1.09	1.14	1.23	1.23	1.25	1.20	1.24	1.27	1.23	1.13	1.10	34.20
32-VAN	1.02	1.05	1.11	1.20	1.32	1.41	1.51	1.50	1.51	1.57	1.60	1.56	1.52	1.47	1.47	1.38	1.27	1.18	16.04
33-NSCG	0.94	0.95	1.04	1.17	1.30	1.44	1.48	1.56	1.61	1.78	1.78	1.86	1.79	1.72	1.74	1.68	1.60	1.49	58.68
4-VIHA	1.00	1.03	1.09	1.27	1.41	1.58	1.60	1.67	1.69	1.76	1.66	1.72	1.66	1.61	1.57	1.49	1.42	1.38	38.36
41-SVI	0.97	1.00	1.14	1.30	1.46	1.65	1.68	1.73	1.71	1.74	1.68	1.75	1.71	1.61	1.56	1.46	1.38	1.34	37.93
42-CVI	1.06	1.07	1.05	1.25	1.37	1.54	1.56	1.65	1.69	1.83	1.67	1.71	1.56	1.55	1.53	1.48	1.40	1.41	32.72
43-NVI	0.93	1.05	1.05	1.23	1.33	1.47	1.43	1.53	1.60	1.67	1.58	1.63	1.73	1.72	1.71	1.62	1.59	1.43	52.80
5-NHA	0.80	0.88	0.88	1.02	1.12	1.34	1.35	1.45	1.50	1.66	1.61	1.67	1.52	1.46	1.49	1.46	1.45	1.40	75.37
51-NW	0.70	0.73	0.70	0.81	0.90	1.09	1.21	1.39	1.42	1.58	1.62	1.78	1.57	1.52	1.58	1.46	1.39	1.39	98.71
52-NI	0.94	1.04	1.02	1.18	1.25	1.47	1.46	1.44	1.50	1.73	1.70	1.68	1.54	1.45	1.52	1.54	1.54	1.49	58.47
53-NE	0.59	0.71	0.81	0.90	1.12	1.35	1.29	1.52	1.56	1.62	1.40	1.52	1.44	1.45	1.32	1.30	1.33	1.23	107.41
BC	0.94	0.97	1.03	1.17	1.28	1.41	1.46	1.53	1.59	1.70	1.67	1.70	1.66	1.61	1.61	1.54	1.44	1.38	46.02

5. Comparison of Antimicrobial Utilization in British Columbia, Other Provinces and Europe

When compared to European nations, the 2011 quinolones utilization rate in BC ranked in the middle (10 countries reported more utilization and 13 countries reported less) (Figure 31). In 2011, BC had a similar quinolone consumption rate to Germany (Figure 31). When compared to other Canadian provinces, BC had the second lowest fluoroquinolones use in 2011 (second to Saskatchewan) (Figure 8).

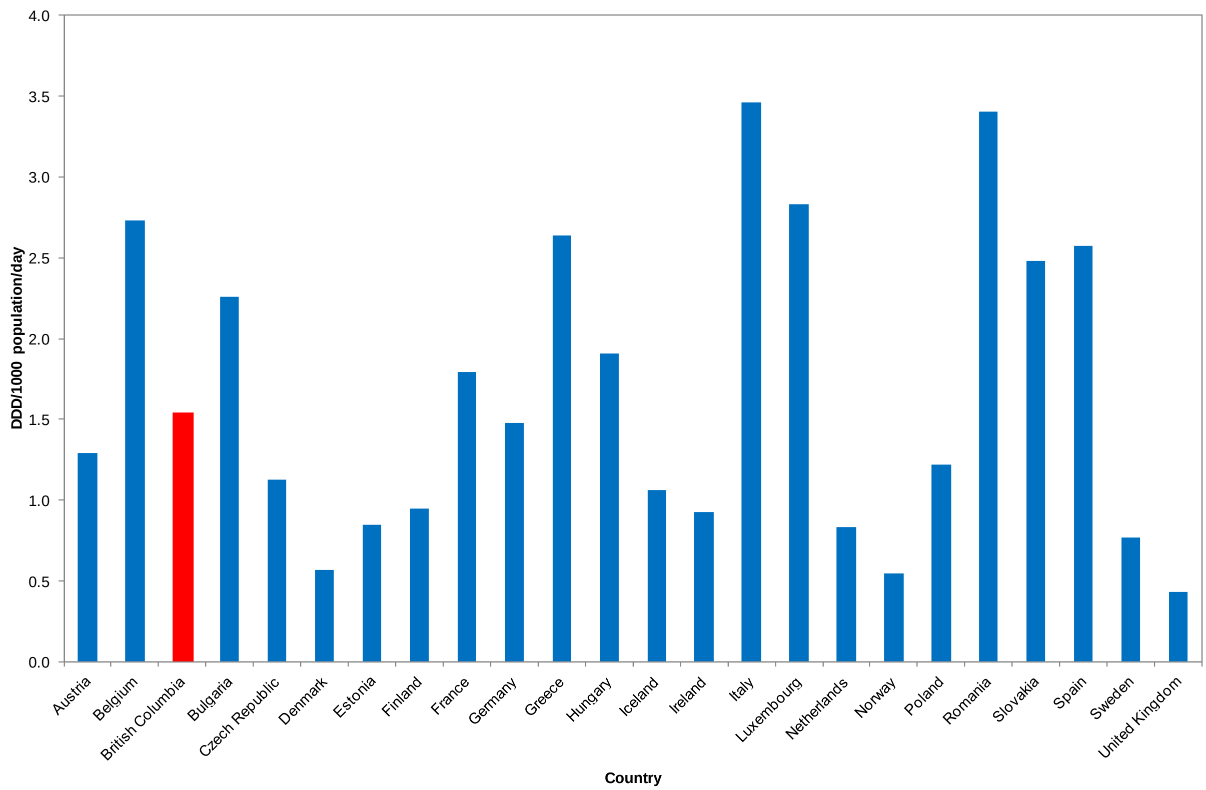


Figure 52: Defined daily rate of quinolones use in BC and several European nations for 2011
Source: PharmaNet (BC data); European Surveillance of Antimicrobial Consumption (ESAC) (6)
See Table A-3 for the list of antimicrobials included in this class

J01X – Other antibacterials

1. Over-Time Trend

The J01X group of antibiotics is comprised of drugs with various mechanisms of action that cannot be placed into the other drug classes. This class includes antibacterials such as nitrofuran derivatives (e.g. nitrofurantoin) among other drugs.

A substantial rise in the use of nitrofurantoin has been observed, from 0.30 DDD/1000 population/day in 1996 to 0.91 DDD/1000 population/day. This is driven primarily by increased use of nitrofurantoin, which has replaced ciprofloxacin as the recommended treatment for UTIs (11). All other drugs in this class were observed to have very low consumption rates across all years. Outpatient consumption of daptomycin (J01XX09) and metronidazole (J01XD01) were not observed in the data.

Similar overall trends were observed in the prescription data (Figure 54)

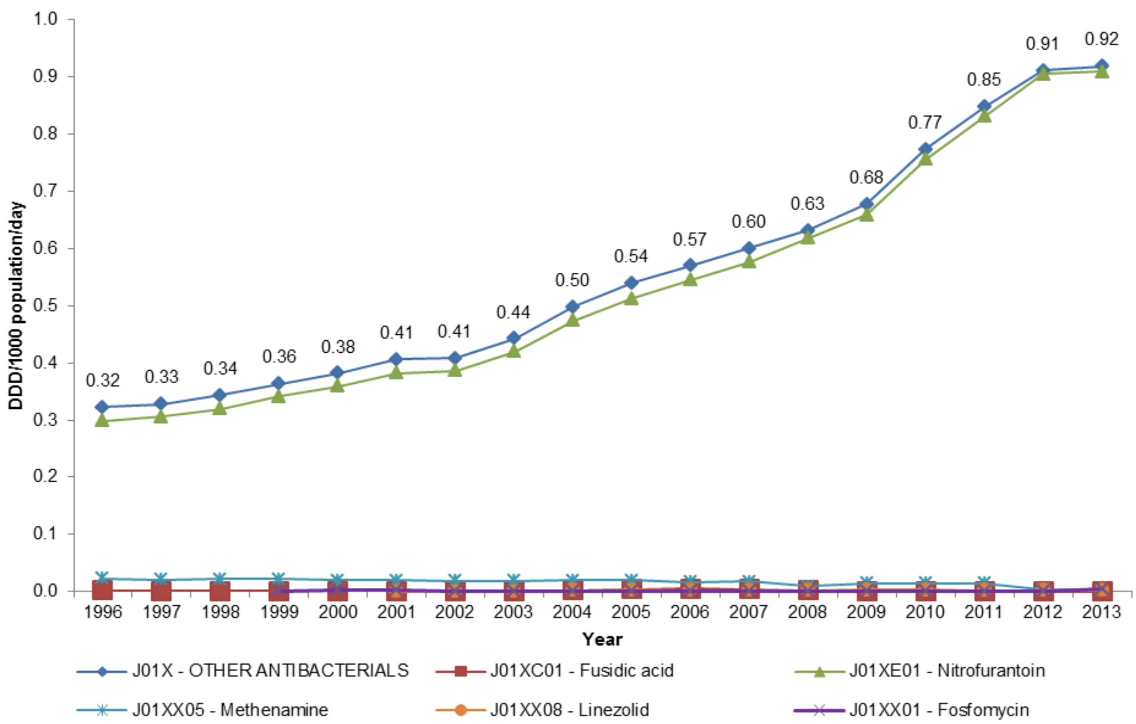


Figure 53: Daily consumption rates for other antibacterials (J01X) and subclass agents from 1996 to 2013

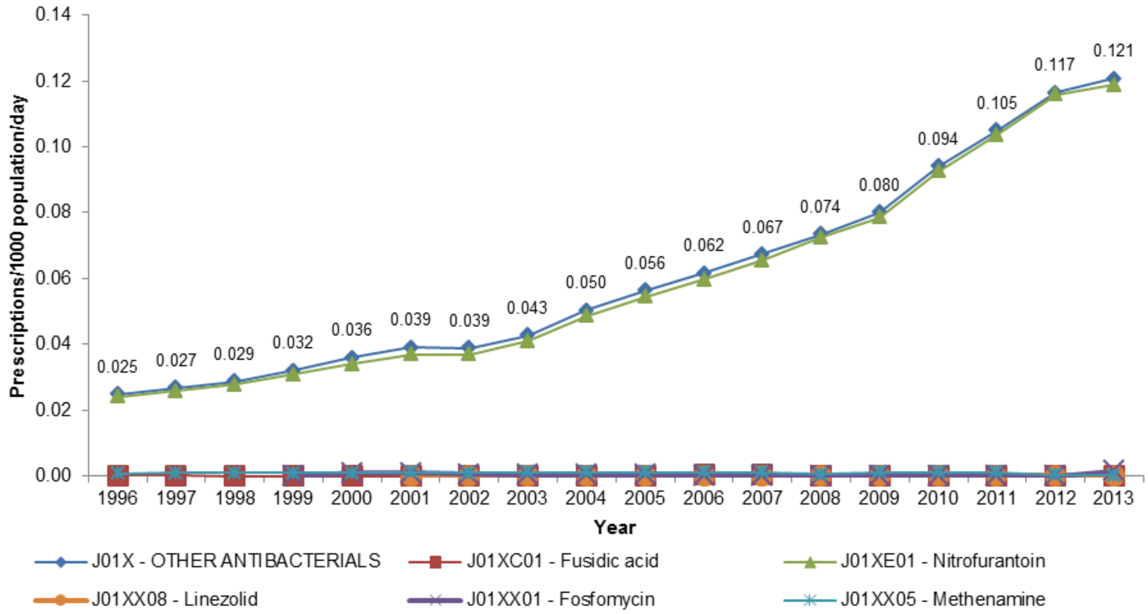


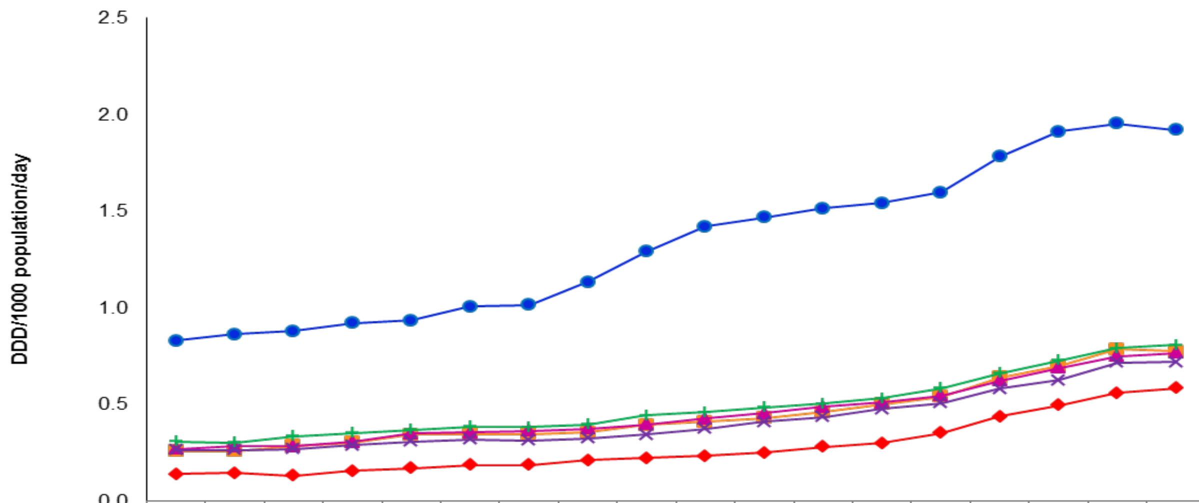
Figure 54: Daily prescription rates for other antibacterials (J01X) and subclass agents from 1996 to 2013

2. By Age

a. Adults (≥ 15 years)

An increase in utilization of drugs in the J01X class was seen from 1996 to 2013 among all age groups, although consumption rates in individuals 60 years of age and older were consistently higher than all other age groups. This age group was observed to have the highest utilization rate in 2013 of 1.92 DDD/1000 population/day. Increased use in this age group is likely due to the treatment of UTI.

Antibiotics in this class are only prescribed to children as a second or third line option for UTI. This resulted in sparse data in the pediatric age groups (data not shown).

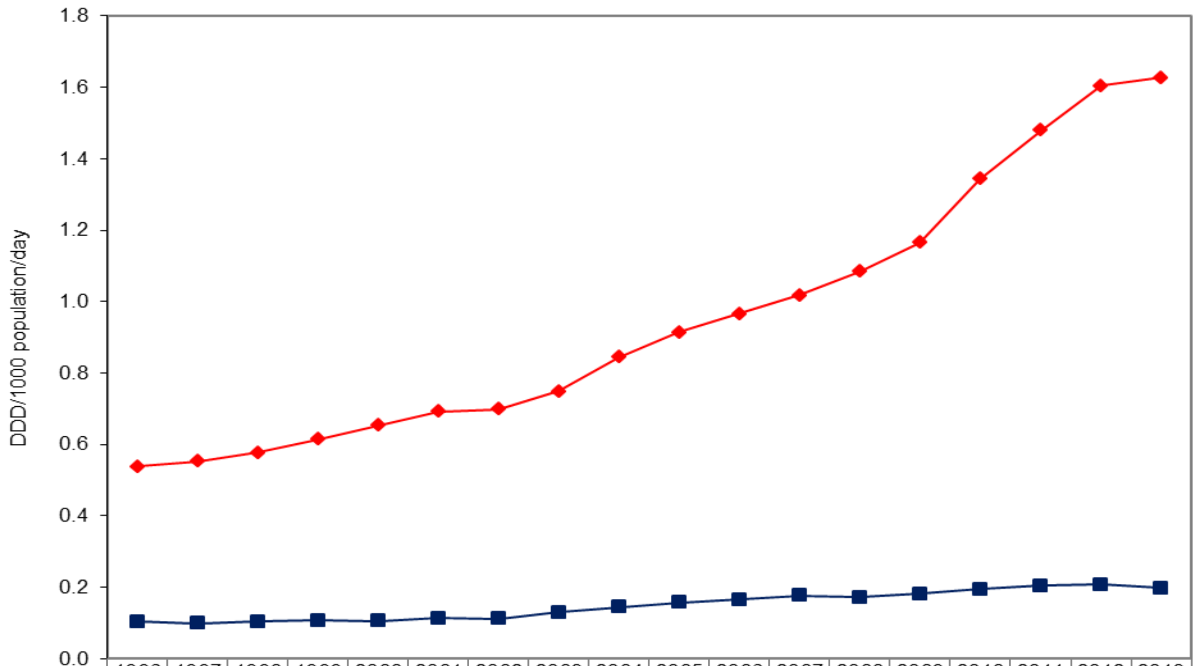


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
15-19	0.14	0.15	0.13	0.16	0.17	0.19	0.18	0.21	0.22	0.23	0.25	0.28	0.30	0.35	0.44	0.50	0.56	0.58
20-24	0.26	0.26	0.28	0.30	0.34	0.35	0.34	0.36	0.39	0.41	0.43	0.46	0.50	0.54	0.64	0.70	0.79	0.77
25-29	0.27	0.28	0.28	0.31	0.35	0.35	0.36	0.37	0.40	0.43	0.45	0.49	0.51	0.55	0.62	0.69	0.75	0.77
30-39	0.26	0.26	0.27	0.29	0.31	0.32	0.31	0.33	0.34	0.37	0.41	0.43	0.48	0.51	0.58	0.63	0.72	0.72
40-59	0.31	0.30	0.34	0.35	0.37	0.38	0.38	0.40	0.44	0.46	0.48	0.50	0.53	0.58	0.66	0.73	0.79	0.81
60+	0.83	0.86	0.88	0.92	0.93	1.01	1.01	1.13	1.29	1.42	1.47	1.52	1.54	1.60	1.78	1.91	1.95	1.92

Figure 55: Other antibacterials (J01X) daily consumption rates in adults from 1996 to 2013

3. By Gender

Females consistently consumed more antibiotics in the J01X class compared to males. In 2013, females consumed these antibiotics at a rate of 1.63 DDD/1000 population/day compared to males who consumed 0.20 DDD/1000 population/day. This difference between the sexes was consistent with the trends observed for other antimicrobials and may be explained by the higher rate of symptomatic UTIs in the female population.

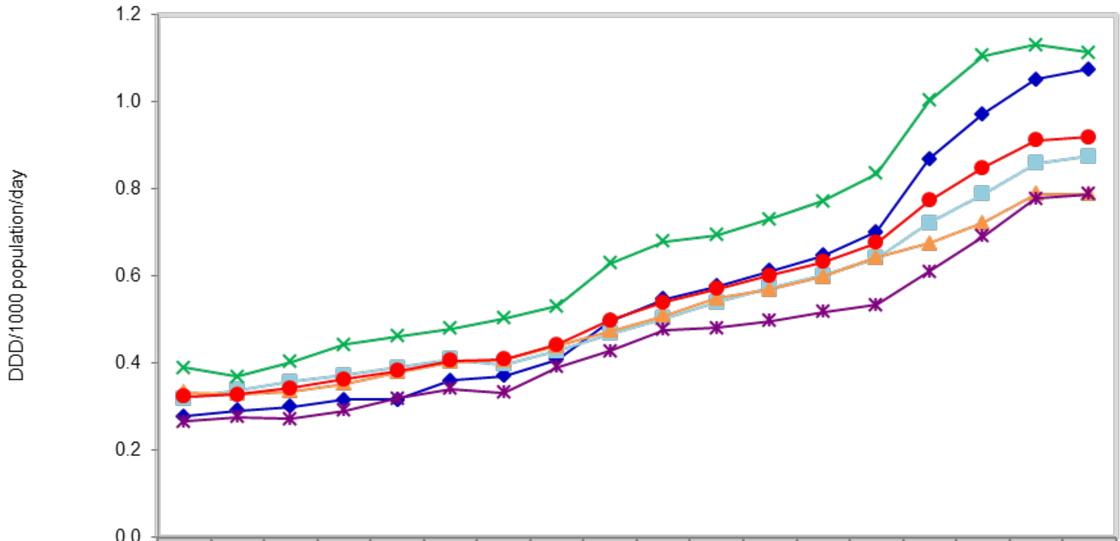


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
F	0.54	0.55	0.58	0.61	0.65	0.69	0.70	0.75	0.84	0.91	0.97	1.02	1.08	1.16	1.34	1.48	1.60	1.63
M	0.10	0.10	0.10	0.11	0.10	0.11	0.11	0.13	0.14	0.16	0.17	0.18	0.17	0.18	0.19	0.20	0.21	0.20

Figure 56: Other antibacterials (J01X) daily consumption rates by gender from 1996 to 2013

4. By Health Authority & Health Services Delivery Area

Consumption of antibiotics in the J01X class has increased across the five BC HAs from 1996 to 2013. The largest change since 1996 was observed in Interior Health (74%), while all other HAs increased consumption by 58 to 66%. In 2013, Vancouver Coastal and Northern represented the HAs with the lowest consumption rate, both at 0.79 DDD/1000 population/day (Figure 57).



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1-IHA	0.28	0.29	0.30	0.32	0.32	0.36	0.37	0.41	0.50	0.55	0.58	0.61	0.65	0.70	0.87	0.97	1.05	1.08
2-FHA	0.32	0.34	0.36	0.37	0.39	0.41	0.40	0.43	0.47	0.50	0.54	0.57	0.60	0.64	0.72	0.79	0.86	0.88
3-VCHA	0.33	0.33	0.33	0.35	0.38	0.40	0.41	0.44	0.47	0.51	0.55	0.57	0.60	0.64	0.67	0.72	0.79	0.79
4-VIHA	0.39	0.37	0.40	0.44	0.46	0.48	0.50	0.53	0.63	0.68	0.69	0.73	0.77	0.84	1.00	1.11	1.13	1.11
5-NHA	0.27	0.28	0.27	0.29	0.32	0.34	0.33	0.39	0.43	0.48	0.48	0.50	0.52	0.53	0.61	0.69	0.78	0.79
BC	0.32	0.33	0.34	0.36	0.38	0.41	0.41	0.44	0.50	0.54	0.57	0.60	0.63	0.68	0.77	0.85	0.91	0.92

Figure 57: Other antibacterials (J01X) daily consumption rates (DDD/1000 population/day) by health authority from 1996 to 2013

Within Interior HA, Okanagan was observed to have the highest consumption rate in 2013 (1.13 DDD/population/day) East Kootenay had the lowest observed consumption in 2013 of 0.99. While rates in all four HSDAs followed a similar upward trend through the years, rates in Thompson Cariboo Shuswap and Kootenay Boundary experienced the greatest rise (77%) among all HSDAs in the province from 1996 to 2013 (Table 8).

Although Fraser consumed drugs in the J01X class at a rate below the provincial average in 2013, Fraser East consistently consumed drugs in the J01X class at a higher rate compared to the other HSDAs and was observed at a rate of 1.03 DDD/population/day in 2013 (Table 8). Within this HA, Fraser Northern was observed to consume these drugs at the lowest rate of 0.82 DDD/1000 population/day (Table 8).

Within Vancouver Coastal, consumption rates were lowest in Richmond at 0.64 DDD/1000 population/day in 2013. Richmond also represented the lowest percent change in consumption rates since 1996. North Shore/Coast Garibaldi were the highest at 0.99 DDD/1000 population/day, followed by Vancouver at 0.74 DDD/1000 population/day (Table 8).

All HSDAs within Island Health were observed to consume antibiotics in the J01X at a rate consistently higher than the national average since 1996. South Vancouver Island was observed to have the highest rate of consumption of J01X drugs among all HSDAs in the province at a rate of 1.18 DDD/population/day in 2013. Central Vancouver Island had the largest percent change in utilization since 1996 (75%) (Table 8).

In Northern, the steepest relative rise in consumption for the J01X class of drug occurred in Northwest from 0.22 DDD/1000 population/day in 1996 to 0.82 DDD/1000 population/day in 2013 (total percentage increase of 73%). Northern Interior (65%) and Northwest (61%) observed similar increases over the time frame and had a consumption rate of 0.79 and 0.76 DDD/population/day in 2013, respectively.

Table 8: Other antibacterials (J01X) daily consumption rates by health authority and health services delivery area from 1996 to 2013

HA/HSDA	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	% Change
1-IHA	0.28	0.29	0.30	0.32	0.32	0.36	0.37	0.41	0.50	0.55	0.58	0.61	0.65	0.70	0.87	0.97	1.05	1.08	74.21
11-EK	0.27	0.32	0.41	0.41	0.42	0.48	0.49	0.53	0.51	0.52	0.57	0.59	0.60	0.73	0.83	0.86	0.96	0.99	72.56
12-KB	0.24	0.25	0.31	0.26	0.24	0.34	0.38	0.41	0.48	0.46	0.56	0.58	0.62	0.67	0.85	0.94	1.03	1.06	77.24
13-OK	0.32	0.33	0.32	0.34	0.35	0.39	0.38	0.42	0.53	0.57	0.55	0.56	0.61	0.65	0.88	0.99	1.09	1.13	71.58
14-TCS	0.23	0.23	0.23	0.27	0.26	0.28	0.31	0.35	0.45	0.55	0.61	0.71	0.73	0.79	0.88	1.00	1.04	1.03	77.24
2-FHA	0.32	0.34	0.36	0.37	0.39	0.41	0.40	0.43	0.47	0.50	0.54	0.57	0.60	0.64	0.72	0.79	0.86	0.88	63.68
21-FE	0.33	0.35	0.39	0.39	0.46	0.52	0.47	0.52	0.50	0.54	0.61	0.65	0.66	0.72	0.85	0.93	1.05	1.03	67.86
22-FN	0.34	0.35	0.36	0.37	0.36	0.37	0.39	0.40	0.45	0.46	0.49	0.52	0.55	0.58	0.67	0.75	0.80	0.82	58.43
23-FS	0.29	0.32	0.34	0.36	0.39	0.39	0.37	0.41	0.47	0.53	0.55	0.59	0.62	0.66	0.72	0.77	0.83	0.86	66.16
3-VCHA	0.33	0.33	0.33	0.35	0.38	0.40	0.41	0.44	0.47	0.51	0.55	0.57	0.60	0.64	0.67	0.72	0.79	0.79	57.82
31-RMD	0.32	0.33	0.35	0.34	0.34	0.33	0.36	0.38	0.41	0.43	0.46	0.47	0.47	0.50	0.51	0.58	0.61	0.64	50.85
32-VAN	0.32	0.32	0.33	0.35	0.38	0.40	0.40	0.42	0.45	0.48	0.53	0.54	0.58	0.60	0.64	0.69	0.76	0.74	56.60
33-NSCG	0.36	0.35	0.33	0.36	0.40	0.45	0.47	0.52	0.57	0.62	0.66	0.70	0.74	0.83	0.87	0.89	0.98	0.99	63.44
4-VIHA	0.39	0.37	0.40	0.44	0.46	0.48	0.50	0.53	0.63	0.68	0.69	0.73	0.77	0.84	1.00	1.11	1.13	1.11	65.06
41-SVI	0.45	0.41	0.43	0.48	0.51	0.52	0.54	0.58	0.68	0.72	0.71	0.73	0.78	0.85	1.02	1.13	1.16	1.18	61.54
42-CVI	0.27	0.27	0.31	0.34	0.34	0.36	0.40	0.42	0.52	0.58	0.59	0.64	0.68	0.74	0.93	1.05	1.09	1.08	74.93
43-NVI	0.44	0.45	0.51	0.53	0.56	0.59	0.60	0.62	0.71	0.78	0.86	0.94	0.95	1.01	1.12	1.14	1.15	0.97	54.80
5-NHA	0.27	0.28	0.27	0.29	0.32	0.34	0.33	0.39	0.43	0.48	0.48	0.50	0.52	0.53	0.61	0.69	0.78	0.79	66.31
51-NW	0.22	0.24	0.24	0.27	0.26	0.27	0.29	0.34	0.42	0.48	0.46	0.49	0.55	0.56	0.62	0.77	0.82	0.82	73.26
52-NI	0.28	0.28	0.28	0.32	0.34	0.36	0.33	0.43	0.46	0.49	0.50	0.50	0.54	0.53	0.59	0.64	0.73	0.79	64.53
53-NE	0.30	0.31	0.28	0.25	0.36	0.39	0.39	0.37	0.37	0.44	0.47	0.49	0.43	0.51	0.65	0.71	0.83	0.76	60.73
BC	0.32	0.33	0.34	0.36	0.38	0.41	0.41	0.44	0.50	0.54	0.57	0.60	0.63	0.68	0.77	0.85	0.91	0.92	64.87

5. Comparison of Antimicrobial Utilization in British Columbia, Other Provinces and Europe

When compared to European nations, the 2011 utilization rate for drugs in class J01X in BC ranked in top third (7 countries reported more utilization and 15 countries reported less) (Figure 58). In 2011, BC had a similar consumption rate to Denmark and the UK (Figure 58). When compared to other Canadian provinces, BC utilization was comparable to Ontario and less than Saskatchewan and Nova Scotia in 2011 (Figure 8).

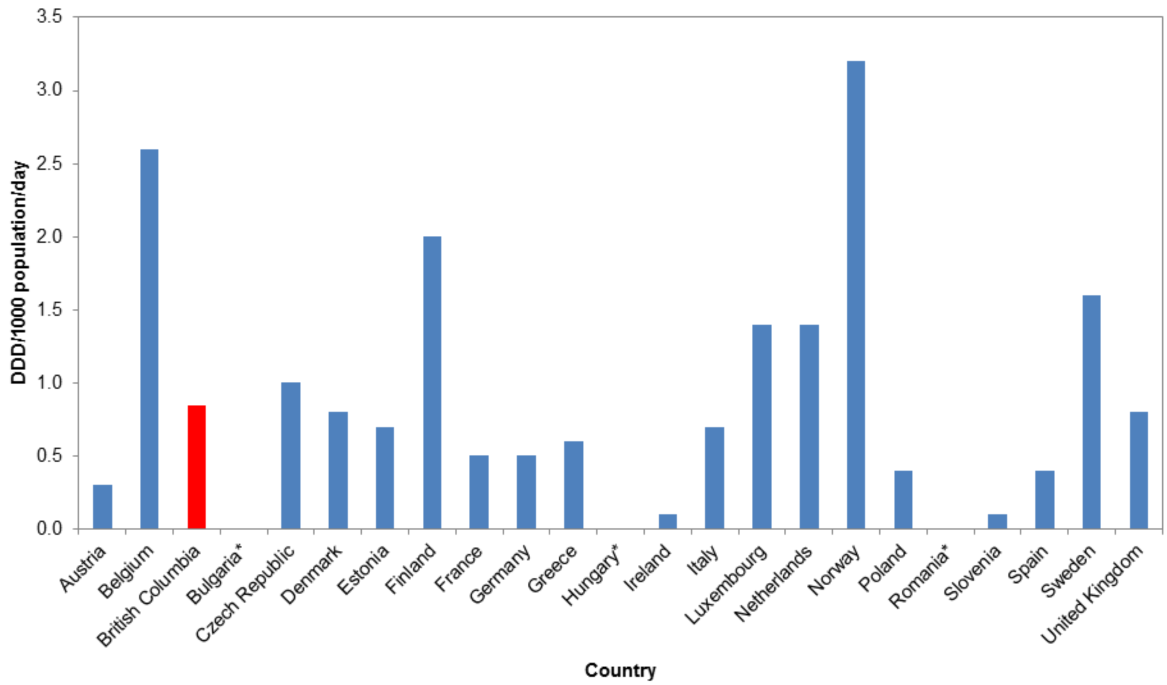


Figure 58: Defined daily rate of other antibacterials use in BC and several European nations for 2011
Source: PharmaNet (BC data); European Surveillance of Antimicrobial Consumption (ESAC) (6)
See Table A-3 for the list of antimicrobials included in this class
* Less than 0.1% of total consumption

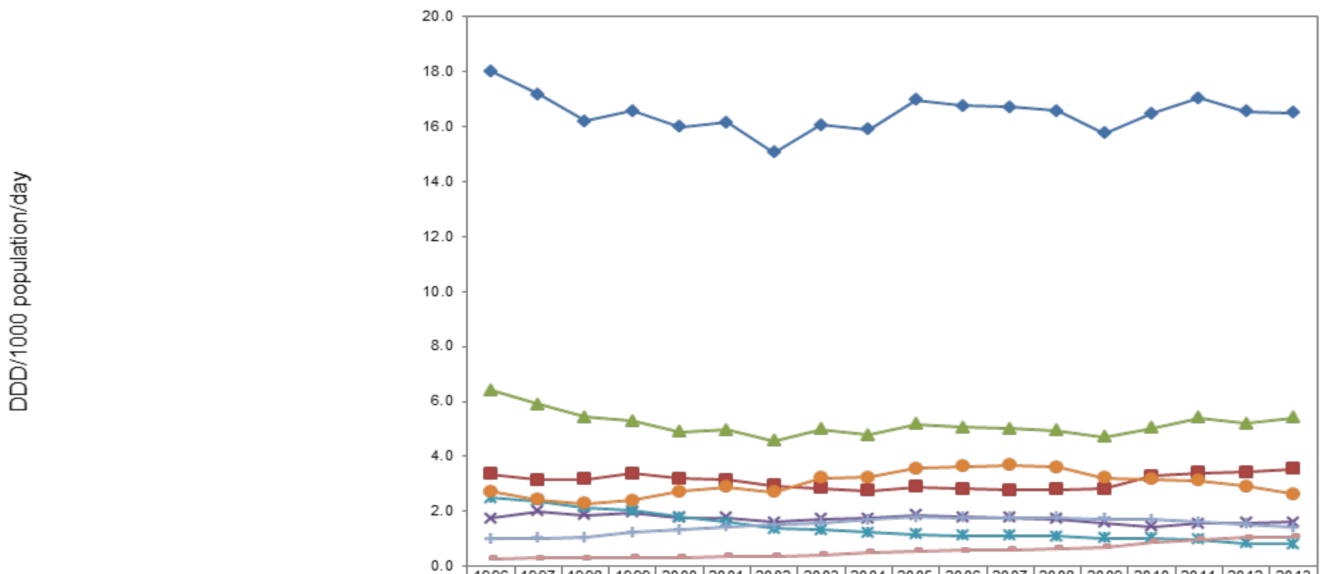
By Health Authority

Interior Health Authority

1. Overall Trend and Trend by Major Drug Class

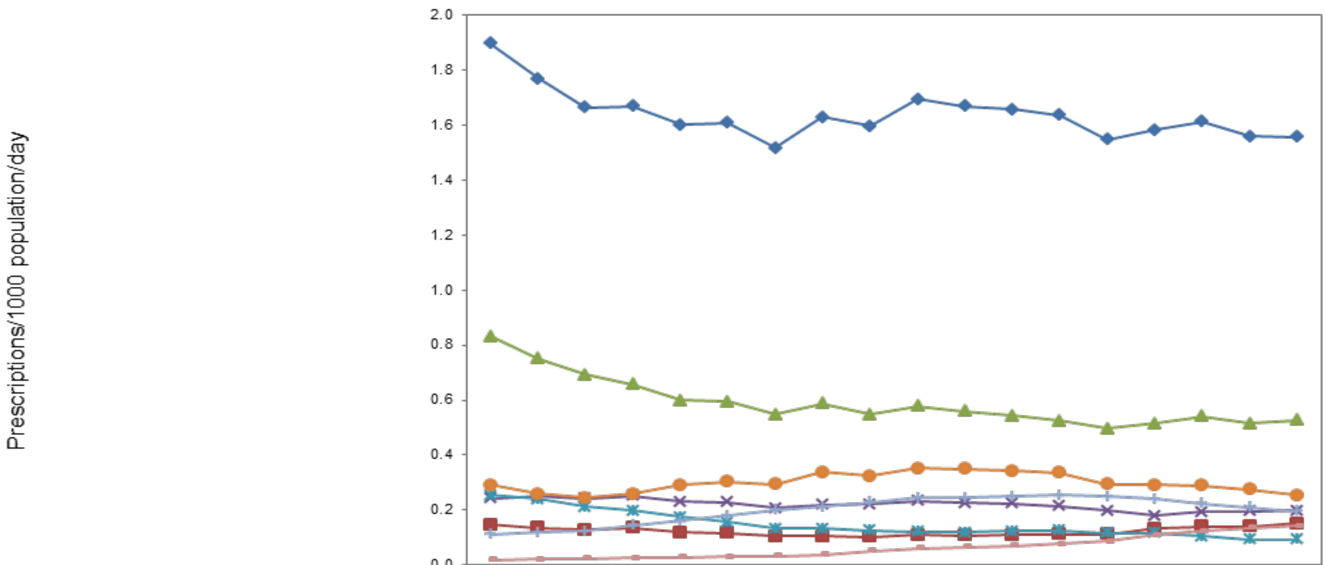
Over the past six years, with the exception of 2009, overall antibiotic utilization has remained fairly stable in Interior, hovering around 16.50 DDD/1000 population/day. Daily consumption rates are highest for penicillins, followed by tetracyclines, macrolides, and quinolones. Since 1996, consumption of penicillins has decreased by 15% from 6.40 to 5.42 DDD/1000 population/day (Figure 53).

Daily prescription rates show similar overall trends compared to utilization (Figure 54).



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
J01 - ANTIBACTERIALS FOR SYSTEMIC USE	18.02	17.19	16.21	16.58	16.00	16.16	15.07	16.07	15.91	16.97	16.76	16.72	16.59	15.75	16.49	17.05	16.55	16.51
J01A - TETRACYCLINES	3.36	3.15	3.16	3.37	3.19	3.14	2.94	2.83	2.75	2.88	2.83	2.78	2.80	2.81	3.27	3.41	3.42	3.54
J01C - BETA-LACTAM ANTIBACTERIALS, PENICILLINS	6.40	5.91	5.43	5.29	4.88	4.95	4.57	4.99	4.77	5.18	5.06	5.00	4.94	4.71	5.03	5.40	5.20	5.42
J01D - OTHER BETA-LACTAM ANTIBACTERIALS	1.74	2.01	1.85	1.95	1.77	1.77	1.61	1.72	1.74	1.87	1.80	1.77	1.72	1.58	1.43	1.56	1.57	1.61
J01E - SULFONAMIDES AND TRIMETHOPRIM	2.50	2.38	2.13	2.02	1.79	1.61	1.37	1.34	1.23	1.15	1.10	1.11	1.09	1.03	1.02	0.97	0.84	0.80
J01F - MACROLIDES, LINCOSAMIDES AND STREPTOGRAMINS	2.73	2.42	2.29	2.39	2.73	2.88	2.70	3.21	3.24	3.56	3.64	3.67	3.62	3.21	3.17	3.13	2.92	2.64
J01M - QUINOLONE ANTIBACTERIALS	1.00	1.02	1.04	1.23	1.32	1.44	1.51	1.58	1.69	1.79	1.76	1.77	1.77	1.71	1.70	1.61	1.53	1.43
J01X - OTHER ANTIBACTERIALS	0.28	0.29	0.30	0.32	0.32	0.36	0.37	0.41	0.50	0.55	0.58	0.61	0.65	0.70	0.87	0.97	1.05	1.08

Figure 59: Daily consumption rate by major drug class for Interior Health Authority



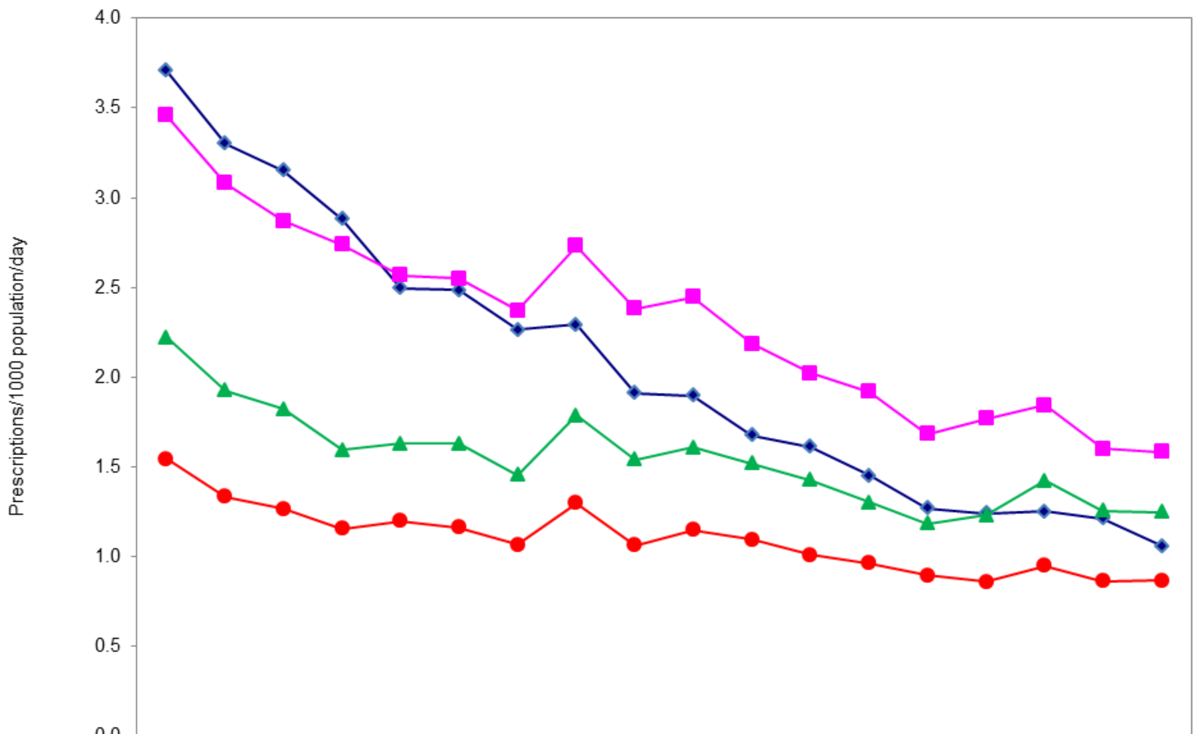
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
J01 - ANTIBACTERIALS FOR SYSTEMIC USE	1.90	1.77	1.67	1.67	1.60	1.61	1.52	1.63	1.60	1.70	1.67	1.66	1.64	1.55	1.58	1.61	1.56	1.56
J01A - TETRACYCLINES	0.15	0.13	0.13	0.13	0.12	0.12	0.11	0.10	0.10	0.11	0.11	0.11	0.11	0.11	0.13	0.14	0.14	0.15
J01C - BETA-LACTAM ANTIBACTERIALS, PENICILLINS	0.83	0.75	0.69	0.66	0.60	0.59	0.55	0.59	0.55	0.58	0.56	0.54	0.52	0.50	0.52	0.54	0.52	0.53
J01D - OTHER BETA-LACTAM ANTIBACTERIALS	0.24	0.25	0.24	0.25	0.23	0.23	0.21	0.22	0.22	0.23	0.23	0.22	0.21	0.20	0.18	0.19	0.20	0.20
J01E - SULFONAMIDES AND TRIMETHOPRIM	0.25	0.24	0.21	0.20	0.18	0.16	0.13	0.13	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.10	0.09	0.09
J01F - MACROLIDES, LINCOSAMIDES AND STREPTOGRAMINS	0.29	0.26	0.24	0.26	0.29	0.30	0.29	0.34	0.32	0.35	0.35	0.34	0.33	0.29	0.29	0.29	0.27	0.25
J01M - QUINOLONE ANTIBACTERIALS	0.11	0.12	0.12	0.14	0.16	0.18	0.20	0.21	0.23	0.24	0.24	0.25	0.25	0.25	0.24	0.22	0.21	0.20
J01X - OTHER ANTIBACTERIALS	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.05	0.06	0.06	0.07	0.08	0.08	0.11	0.12	0.13	0.14

Figure 60: Daily prescription rate by major drug class for Interior Health Authority

2. J01 Trend by age group

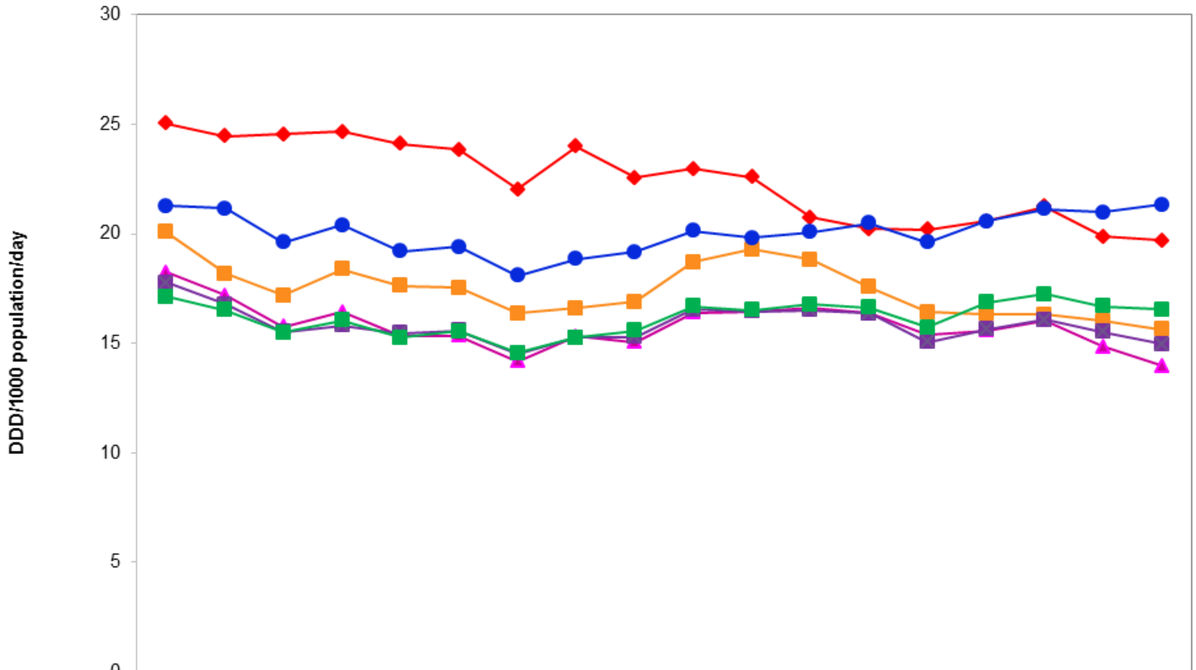
Daily prescription rates among children in Interior have displayed an overall declining trend since 1996 with the largest decrease seen in those below the age of 1 (by 70%). In 2013, children 1 to 4 years of age had the highest rates of overall antibiotic prescriptions (1.58 prescriptions/1000 population/day), followed by those 5 to 9 years of age (1.25 DDD/1000 population/day), those under 1 year of age (1.06 DDD/1000 population/day) and those 10 to 14 (0.86 DDD/1000 population/day) (Figure 55).

Adults 15 to 19 years of age had the highest rate of antibiotic consumption in Interior until 2007 when the 60+ age group surpassed them. In 2013, adults aged 60 years or older had the highest overall antibiotic consumption rate at 21.34 DDD/1000 population/day, and was followed by adults aged 15 to 19 at a rate of 19.69 DDD/1000 population/day. All other adult age groups had a rate between 13.98 and 16.54 DDD/1000 population/day in 2013 (Figure 56).



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
<1	3.71	3.30	3.15	2.88	2.50	2.49	2.26	2.29	1.91	1.90	1.67	1.61	1.45	1.27	1.24	1.25	1.21	1.06
1-4	3.46	3.08	2.87	2.74	2.57	2.55	2.37	2.73	2.38	2.45	2.18	2.02	1.92	1.68	1.77	1.84	1.60	1.58
5-9	2.22	1.93	1.82	1.59	1.63	1.63	1.45	1.79	1.54	1.61	1.52	1.43	1.30	1.18	1.23	1.42	1.25	1.25
10-14	1.54	1.33	1.27	1.15	1.20	1.16	1.07	1.30	1.06	1.15	1.09	1.01	0.96	0.90	0.86	0.95	0.86	0.86

Figure 61: Overall (J01) daily prescription rate for children in Interior Health Authority

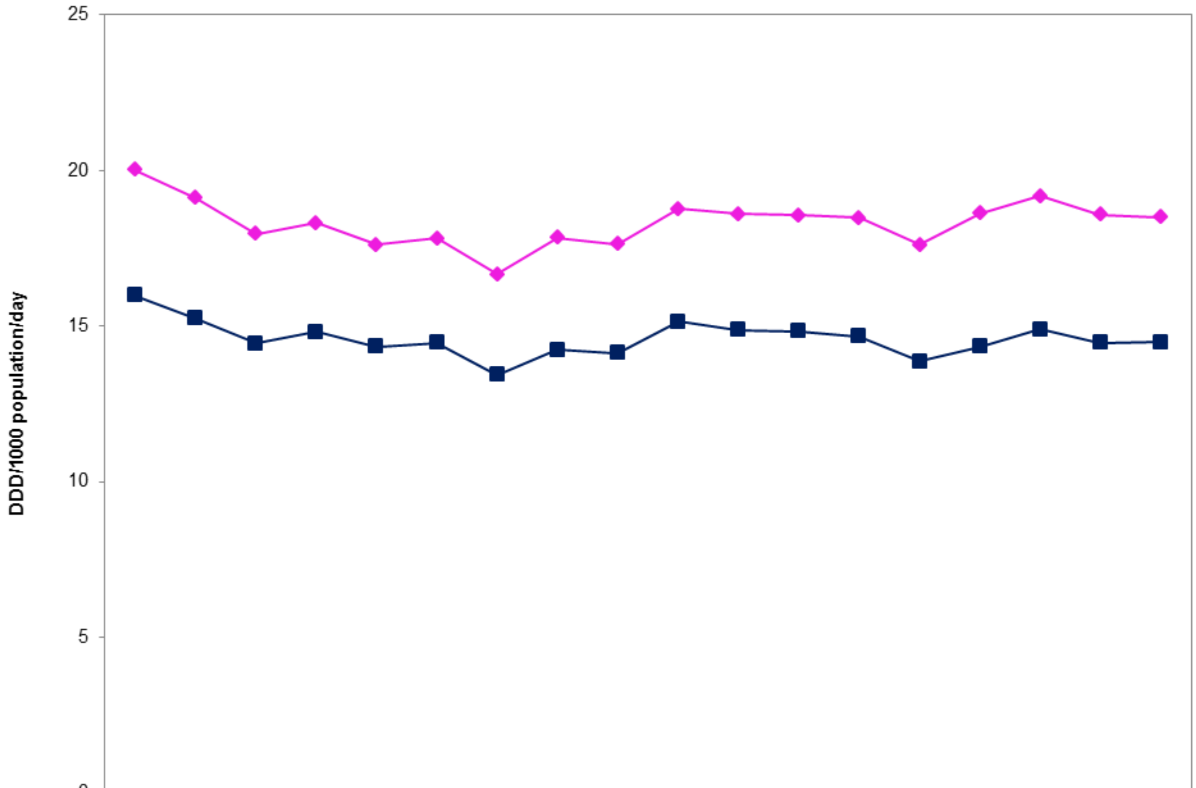


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
15-19	25.05	24.45	24.54	24.66	24.12	23.84	22.04	23.99	22.56	22.97	22.60	20.74	20.22	20.19	20.58	21.23	19.86	19.69
20-24	20.07	18.18	17.19	18.38	17.63	17.53	16.36	16.60	16.89	18.70	19.28	18.82	17.57	16.41	16.33	16.30	16.01	15.63
25-29	18.24	17.19	15.76	16.42	15.33	15.35	14.16	15.30	15.04	16.40	16.44	16.63	16.35	15.39	15.58	16.04	14.84	13.98
30-39	17.77	16.76	15.52	15.80	15.45	15.57	14.52	15.26	15.28	16.54	16.45	16.51	16.37	15.05	15.64	16.08	15.52	14.97
40-59	17.12	16.52	15.48	16.03	15.25	15.55	14.56	15.26	15.56	16.69	16.52	16.76	16.62	15.73	16.86	17.24	16.68	16.54
60+	21.27	21.15	19.60	20.40	19.19	19.41	18.10	18.84	19.18	20.14	19.81	20.08	20.48	19.61	20.56	21.12	20.99	21.34

Figure 62: Overall (J01) daily consumption rate for adults in Interior Health Authority

3. J01 Trend by gender

Females consistently consumed more antibiotics than males in Interior. Between 1996 and 2013, females consumed approximately 27% more antibiotics overall than males. In 2013, the overall antibiotic consumption rate was 18.50 DDD/1000 population/day and 14.48 DDD/1000 population/day for females and males, respectively (Figure 57).



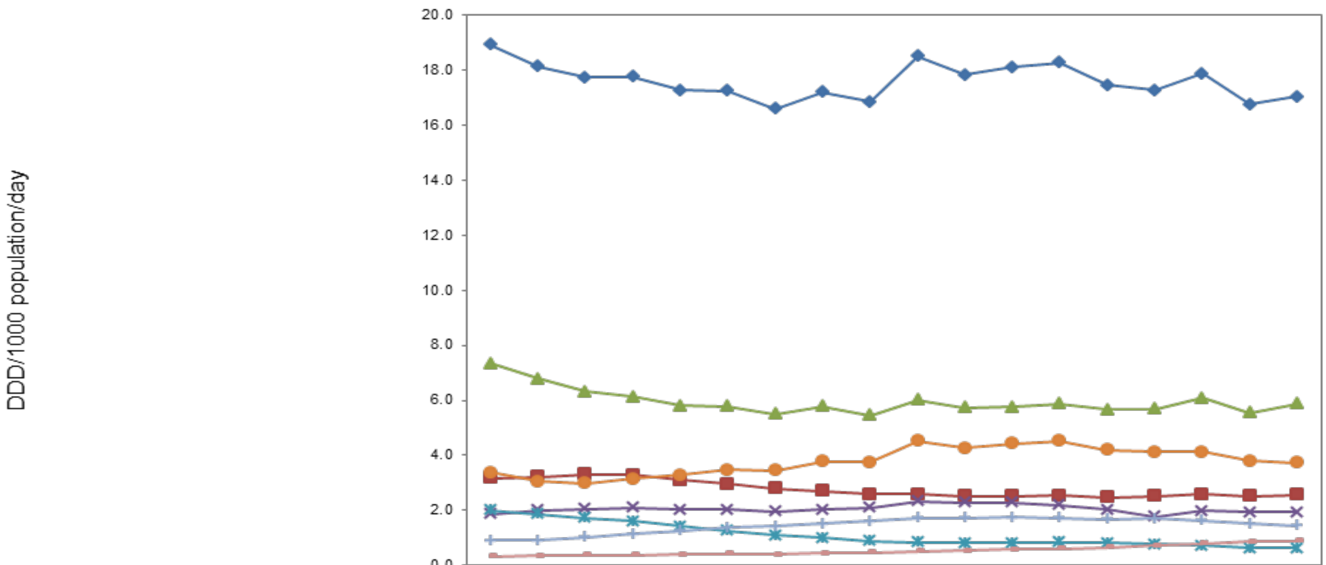
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
F	20.02	19.12	17.96	18.31	17.61	17.83	16.66	17.84	17.64	18.77	18.59	18.56	18.49	17.62	18.62	19.17	18.58	18.50
M	15.98	15.24	14.44	14.80	14.34	14.46	13.44	14.24	14.13	15.13	14.88	14.83	14.66	13.85	14.34	14.90	14.47	14.48

Figure 63: Daily consumption rate for overall antibiotics (J01) by gender in Interior Health Authority

Fraser Health Authority

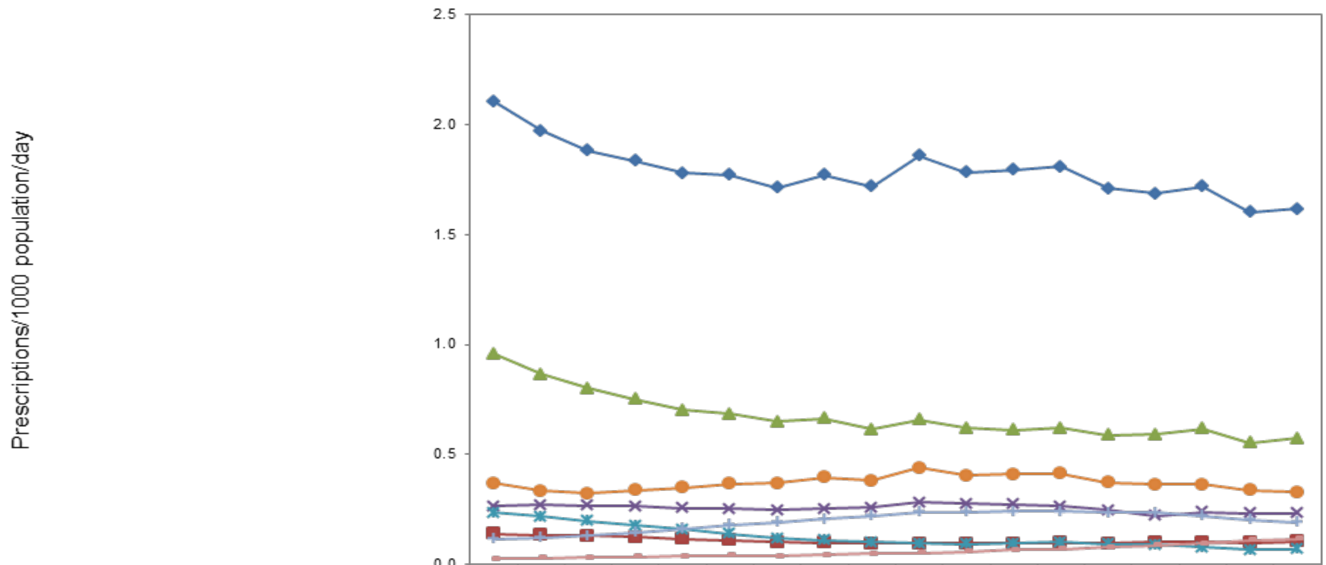
1. Overall Trend and Trend by Major Drug Class

The overall trend in antibiotic utilization has remained stable with a slight decrease in Fraser since 2005. The consumption rate was 17.04 DDD/1000 population/day in 2013. As with other Health authorities, daily consumption rates are highest for penicillins, followed by macrolides, tetracyclines, cephalosporins, quinolones and SMX-TMPs. Since 1996, consumption of penicillins has decreased by 20% from 7.33 to 5.87 DDD/1000 population/day. The majority of this decline occurred before 2002, and the rate has mostly remained stable since then. Consumption of macrolides has increased by 10% from 3.37 to 3.72 DDD/1000 population/day, although consumption has been reasonably stable in the last 6 years (Figure 58). Prescription rates as shown in Figure 59 show similar trends.



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
J01 - ANTIBACTERIALS FOR SYSTEMIC USE	18.95	18.15	17.75	17.78	17.29	17.25	16.60	17.21	16.85	18.51	17.85	18.12	18.29	17.46	17.29	17.89	16.77	17.04
J01A - TETRACYCLINES	3.16	3.21	3.30	3.29	3.11	2.97	2.80	2.71	2.59	2.59	2.51	2.51	2.53	2.47	2.50	2.58	2.52	2.56
J01C - BETA-LACTAM ANTIBACTERIALS, PENICILLINS	7.33	6.78	6.32	6.14	5.81	5.77	5.50	5.77	5.44	6.02	5.73	5.76	5.88	5.65	5.70	6.08	5.54	5.87
J01D - OTHER BETA-LACTAM ANTIBACTERIALS	1.86	2.00	2.05	2.09	2.03	2.02	1.96	2.02	2.09	2.33	2.29	2.28	2.18	2.03	1.78	1.98	1.93	1.94
J01E - SULFONAMIDES AND TRIMETHOPRIM	2.00	1.86	1.73	1.61	1.42	1.24	1.08	0.99	0.89	0.83	0.80	0.81	0.84	0.80	0.77	0.71	0.62	0.63
J01F - MACROLIDES, LINCOSAMIDES AND STREPTOGRAMINS	3.37	3.04	2.98	3.13	3.28	3.47	3.44	3.78	3.75	4.53	4.26	4.44	4.53	4.19	4.12	4.12	3.81	3.72
J01M - QUINOLONE ANTIBACTERIALS	0.91	0.91	1.01	1.14	1.25	1.38	1.42	1.52	1.61	1.72	1.72	1.74	1.72	1.68	1.69	1.63	1.50	1.45
J01X - OTHER ANTIBACTERIALS	0.32	0.34	0.36	0.37	0.39	0.41	0.40	0.43	0.47	0.50	0.54	0.57	0.60	0.64	0.72	0.79	0.86	0.88

Figure 64: Daily consumption rate by major drug class for Fraser Health Authority



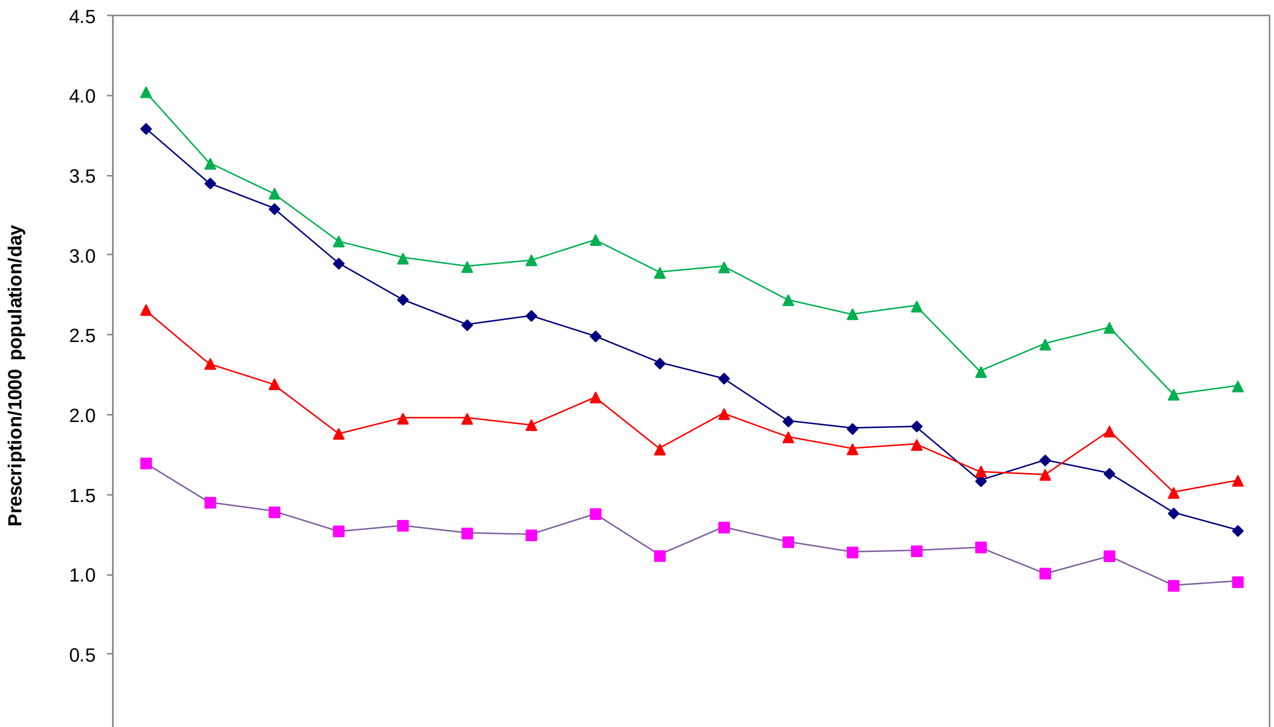
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
J01 - ANTIBACTERIALS FOR SYSTEMIC USE	2.11	1.97	1.88	1.84	1.78	1.77	1.71	1.77	1.72	1.86	1.78	1.80	1.81	1.71	1.69	1.72	1.60	1.62
J01A - TETRACYCLINES	0.14	0.13	0.13	0.13	0.11	0.11	0.10	0.10	0.10	0.10	0.09	0.10	0.10	0.10	0.10	0.10	0.10	0.10
J01C - BETA-LACTAM ANTIBACTERIALS, PENICILLINS	0.96	0.87	0.80	0.75	0.70	0.68	0.65	0.66	0.61	0.66	0.62	0.61	0.62	0.59	0.59	0.62	0.55	0.57
J01D - OTHER BETA-LACTAM ANTIBACTERIALS	0.26	0.27	0.27	0.26	0.26	0.25	0.25	0.25	0.26	0.28	0.28	0.27	0.26	0.25	0.22	0.24	0.23	0.23
J01E - SULFONAMIDES AND TRIMETHOPRIM	0.23	0.22	0.20	0.18	0.16	0.14	0.12	0.11	0.10	0.09	0.09	0.10	0.10	0.09	0.09	0.08	0.07	0.07
J01F - MACROLIDES, LINCOSAMIDES AND STREPTOGRAMINS	0.37	0.33	0.32	0.34	0.35	0.37	0.37	0.40	0.38	0.44	0.41	0.41	0.41	0.37	0.36	0.36	0.34	0.33
J01M - QUINOLONE ANTIBACTERIALS	0.12	0.12	0.13	0.15	0.16	0.18	0.19	0.21	0.22	0.24	0.24	0.24	0.24	0.24	0.24	0.22	0.20	0.19
J01X - OTHER ANTIBACTERIALS	0.02	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.05	0.05	0.06	0.06	0.07	0.08	0.09	0.10	0.11	0.12

Figure 65: Daily prescription rate by major drug class for Fraser Health Authority

2. J01 Trend by age group

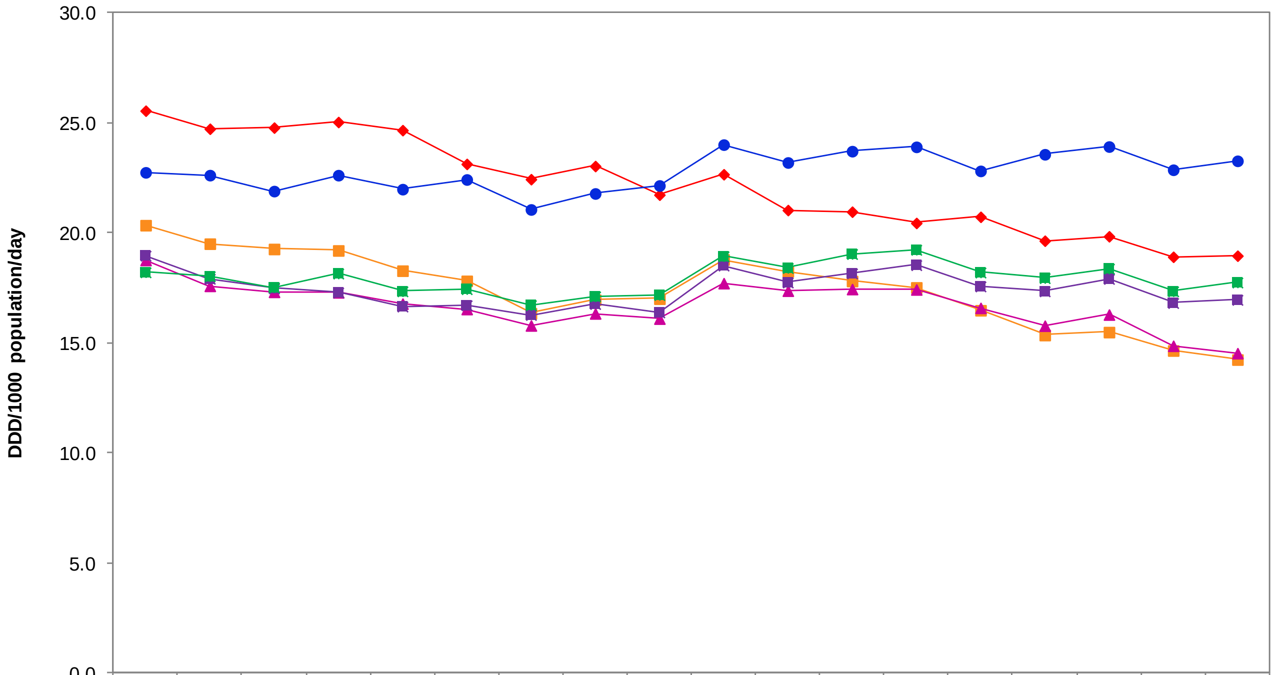
Daily prescription rates among children in Fraser have been declining since 1996. In 2013, children 1 to 4 years of age were prescribed the highest rates of antibiotics (2.18 prescriptions/1000 population/day), followed by children aged 5 to 9 years of age (1.59 DDD/1000 population/day), children less than 1 year of age (1.28 DDD/1000 population/day) and children 10 to 14 years of age (0.96 DDD/1000 population/day). The greatest percentage drop occurred among the less than 1 year age group, which saw a prescription rate decrease by 66% from 3.79 DDD/1000 population/day in 1996 to 1.28 DDD/1000 population/day in 2013 (Figure 60).

Adults 15 to 19 years of age had the highest rates of antibiotic consumption in Fraser until 2004 (21.73 DDD/1000 population/day) when the consumption rate for those 60 and older surpassed. For the next three years, the rates for adults 15 to 19 were comparable to adults 60 and over and was reported to be at 23% in 2013. Adults 60 years and older was the only age group to have increased consumption since 1996 (from 22.75 to 23.27 DDD/1000 population/day). The 20 to 24 age group experienced the greatest decline over the years and has a rate of 14.25 DDD/1000 population/day in 2013 (Figure 61).



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
<1	3.79	3.45	3.29	2.95	2.72	2.57	2.62	2.50	2.33	2.23	1.96	1.92	1.93	1.59	1.72	1.63	1.39	1.28
1-4	4.02	3.58	3.39	3.09	2.98	2.93	2.97	3.10	2.89	2.93	2.72	2.63	2.68	2.27	2.44	2.55	2.13	2.18
5-9	2.66	2.32	2.20	1.89	1.98	1.98	1.94	2.11	1.79	2.01	1.86	1.79	1.82	1.65	1.63	1.90	1.51	1.59
10-14	1.70	1.45	1.39	1.27	1.31	1.26	1.25	1.38	1.12	1.30	1.21	1.14	1.15	1.17	1.01	1.12	0.93	0.96

Figure 66: Overall (J01) daily prescription rate for children in Fraser Health Authority

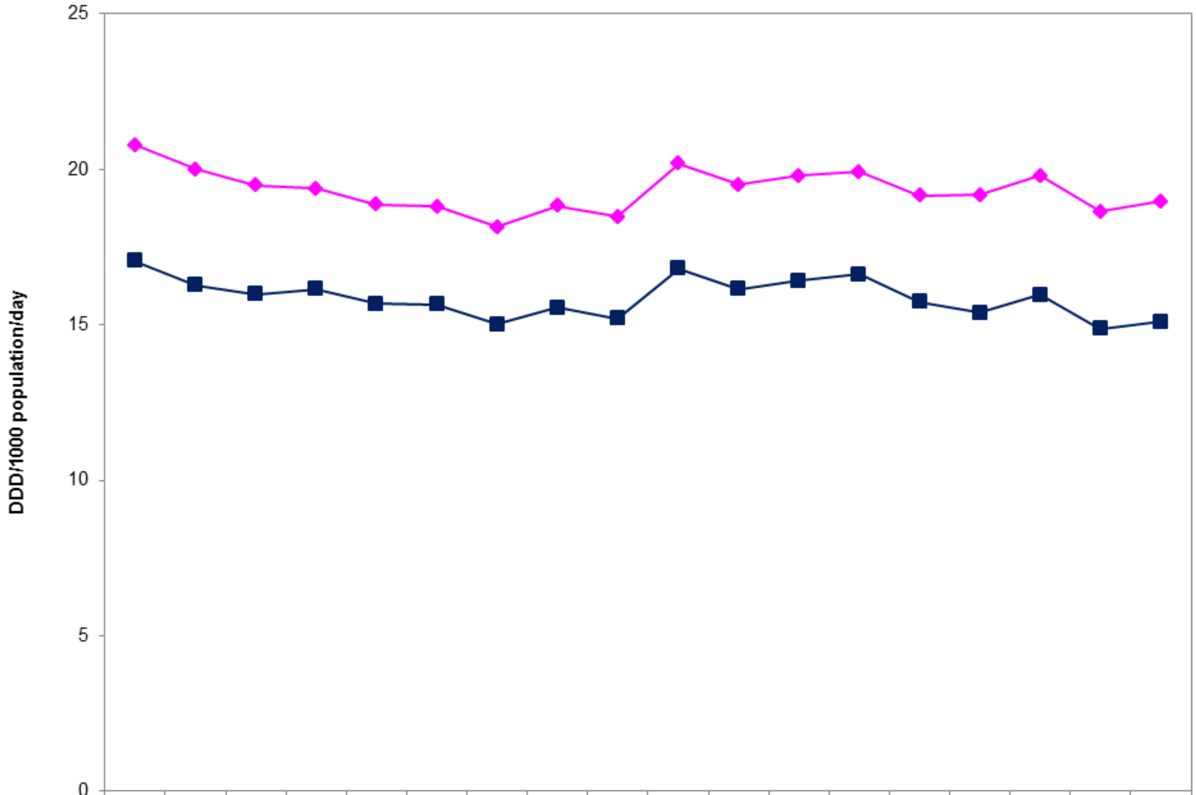


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
15-19	25.55	24.73	24.78	25.04	24.67	23.13	22.44	23.04	21.73	22.66	21.04	20.96	20.45	20.73	19.65	19.85	18.92	18.97
20-24	20.35	19.51	19.27	19.20	18.29	17.82	16.36	16.97	17.01	18.79	18.25	17.82	17.53	16.49	15.36	15.50	14.66	14.25
25-29	18.77	17.60	17.32	17.30	16.79	16.54	15.80	16.34	16.11	17.72	17.38	17.45	17.43	16.60	15.79	16.29	14.88	14.54
30-39	18.97	17.92	17.48	17.29	16.66	16.71	16.27	16.77	16.39	18.52	17.75	18.16	18.54	17.57	17.35	17.91	16.82	16.96
40-59	18.21	18.03	17.53	18.15	17.35	17.45	16.72	17.12	17.18	18.94	18.41	19.04	19.23	18.20	17.95	18.38	17.35	17.75
60+	22.75	22.62	21.90	22.62	21.99	22.43	21.07	21.79	22.15	24.01	23.20	23.71	23.91	22.82	23.57	23.92	22.87	23.27

Figure 67: Overall (J01) daily consumption rate for adults in Fraser Health Authority

3. J01 Trend by gender

Females consistently consumed more antibiotics than males in Fraser by approximately 25% over the years. In 2013, females consumed an overall rate of 18.96 DDD/1000 population/day of antibiotics while antibiotic consumption in males was 15.10 DDD/1000 population/day (Figure 62).



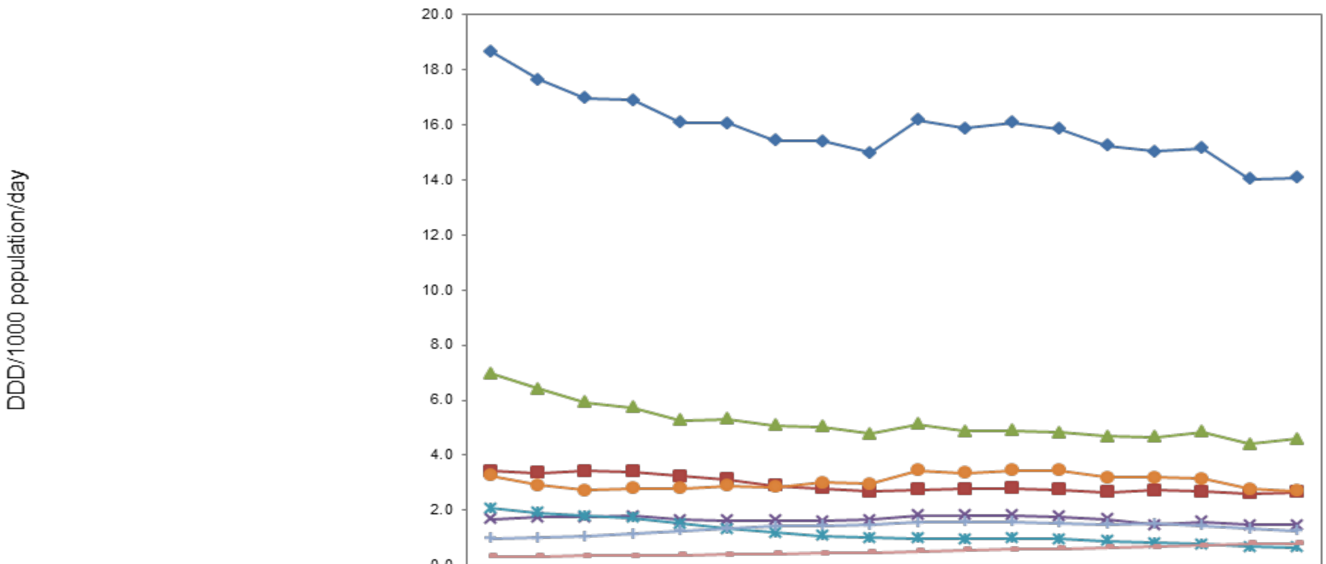
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
F	20.79	19.99	19.49	19.38	18.86	18.81	18.14	18.84	18.47	20.19	19.51	19.80	19.93	19.16	19.18	19.79	18.64	18.96
M	17.06	16.27	15.97	16.14	15.68	15.66	15.03	15.55	15.20	16.81	16.16	16.42	16.62	15.73	15.38	15.97	14.87	15.10

Figure 68: Daily consumption rate for overall antibiotics (J01) by gender in Fraser Health Authority

Vancouver Coastal Health Authority

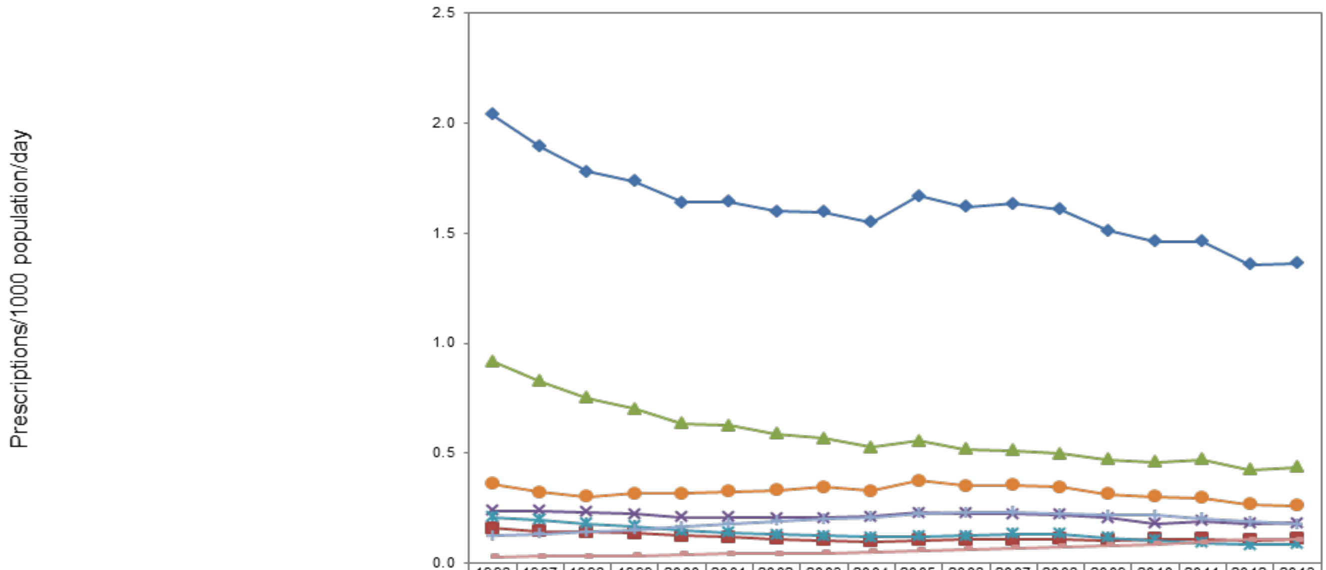
1. Overall Trend and Trend by Major Drug Class

Overall antibiotic utilization in Vancouver Coastal decreased consistently (21%) from 1996 to 2004, jumped 8% in 2005, and has since decreased by 13% to 14.07 DDD/1000 population/day in 2013. The daily consumption rate for penicillins remains the highest, although it has been decreasing since 1996. Tetracyclines and macrolides have hovered around the same levels for the past six years. Since 1996, consumption of penicillins has decreased by 34% from 6.96 to 4.58 DDD/1000 population/day. Consumption of macrolides has remained stable since 1996 averaging 3.15 DDD/1000 population/day, while cephalosporin usage decreased 13% to 1.47 DDD/1000 population/day in 2013 (Figure 63). As shown in Figure 65, prescription rates over the years show similar trends.



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
J01 - ANTIBACTERIALS FOR SYSTEMIC USE	18.69	17.65	16.99	16.90	16.09	16.06	15.44	15.40	14.99	16.18	15.89	16.09	15.86	15.24	15.04	15.16	14.04	14.07
J01A - TETRACYCLINES	3.42	3.35	3.43	3.39	3.24	3.11	2.88	2.80	2.69	2.75	2.77	2.79	2.74	2.64	2.72	2.69	2.61	2.64
J01C - BETA-LACTAM ANTIBACTERIALS, PENICILLINS	6.96	6.42	5.92	5.73	5.26	5.32	5.08	5.03	4.77	5.13	4.87	4.89	4.83	4.69	4.66	4.84	4.41	4.58
J01D - OTHER BETA-LACTAM ANTIBACTERIALS	1.68	1.74	1.75	1.78	1.65	1.64	1.62	1.61	1.65	1.81	1.81	1.82	1.76	1.68	1.47	1.58	1.46	1.47
J01E - SULFONAMIDES AND TRIMETHOPRIM	2.06	1.92	1.79	1.71	1.51	1.33	1.18	1.07	1.00	0.97	0.96	0.98	0.96	0.89	0.82	0.76	0.67	0.65
J01F - MACROLIDES, LINCOSAMIDES AND STREPTOGRAMINS	3.26	2.91	2.71	2.79	2.80	2.90	2.85	3.00	2.95	3.45	3.35	3.46	3.44	3.20	3.20	3.14	2.78	2.69
J01M - QUINOLONE ANTIBACTERIALS	0.97	0.99	1.05	1.14	1.24	1.35	1.42	1.44	1.47	1.56	1.58	1.58	1.54	1.49	1.50	1.43	1.33	1.25
J01X - OTHER ANTIBACTERIALS	0.33	0.33	0.33	0.35	0.38	0.40	0.41	0.44	0.47	0.51	0.55	0.57	0.60	0.64	0.67	0.72	0.79	0.79

Figure 69: Daily consumption rate (DDD/1000 population/day) by major drug class for Vancouver Coastal Health Authority



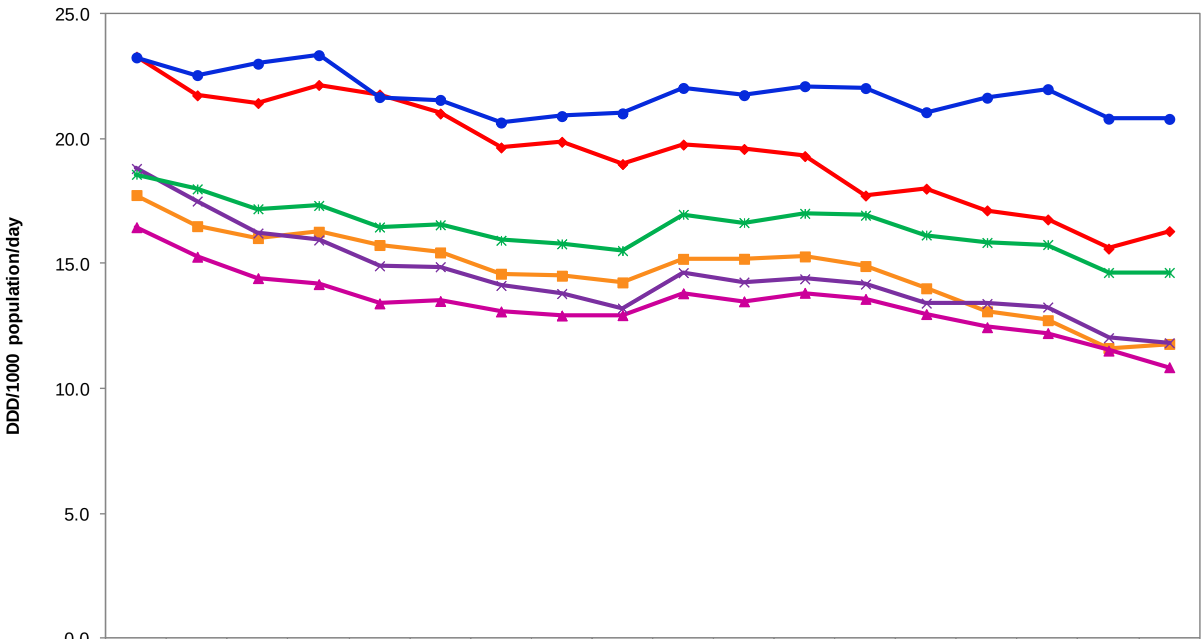
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
J01 - ANTIBACTERIALS FOR SYSTEMIC USE	2.04	1.90	1.78	1.74	1.64	1.64	1.60	1.60	1.55	1.67	1.62	1.63	1.61	1.51	1.46	1.46	1.36	1.36
J01A - TETRACYCLINES	0.16	0.15	0.14	0.14	0.13	0.12	0.11	0.11	0.10	0.10	0.11	0.11	0.11	0.10	0.11	0.11	0.11	0.11
J01C - BETA-LACTAM ANTIBACTERIALS, PENICILLINS	0.92	0.83	0.75	0.70	0.63	0.63	0.59	0.57	0.53	0.56	0.52	0.51	0.50	0.47	0.46	0.47	0.43	0.44
J01D - OTHER BETA-LACTAM ANTIBACTERIALS	0.24	0.24	0.23	0.23	0.21	0.21	0.21	0.21	0.21	0.23	0.23	0.22	0.22	0.21	0.18	0.19	0.18	0.18
J01E - SULFONAMIDES AND TRIMETHOPRIM	0.21	0.20	0.18	0.17	0.15	0.14	0.13	0.12	0.12	0.12	0.12	0.13	0.13	0.12	0.10	0.09	0.08	0.09
J01F - MACROLIDES, LINCOSAMIDES AND STREPTOGRAMINS	0.36	0.32	0.30	0.32	0.32	0.33	0.33	0.35	0.33	0.37	0.35	0.35	0.35	0.31	0.30	0.30	0.27	0.26
J01M - QUINOLONE ANTIBACTERIALS	0.13	0.13	0.14	0.15	0.16	0.18	0.19	0.20	0.21	0.23	0.23	0.23	0.23	0.22	0.22	0.20	0.19	0.18
J01X - OTHER ANTIBACTERIALS	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.05	0.05	0.06	0.06	0.07	0.08	0.08	0.09	0.09	0.11	0.11

Figure 70: Daily prescription rate by major drug class for Vancouver Coastal Health Authority

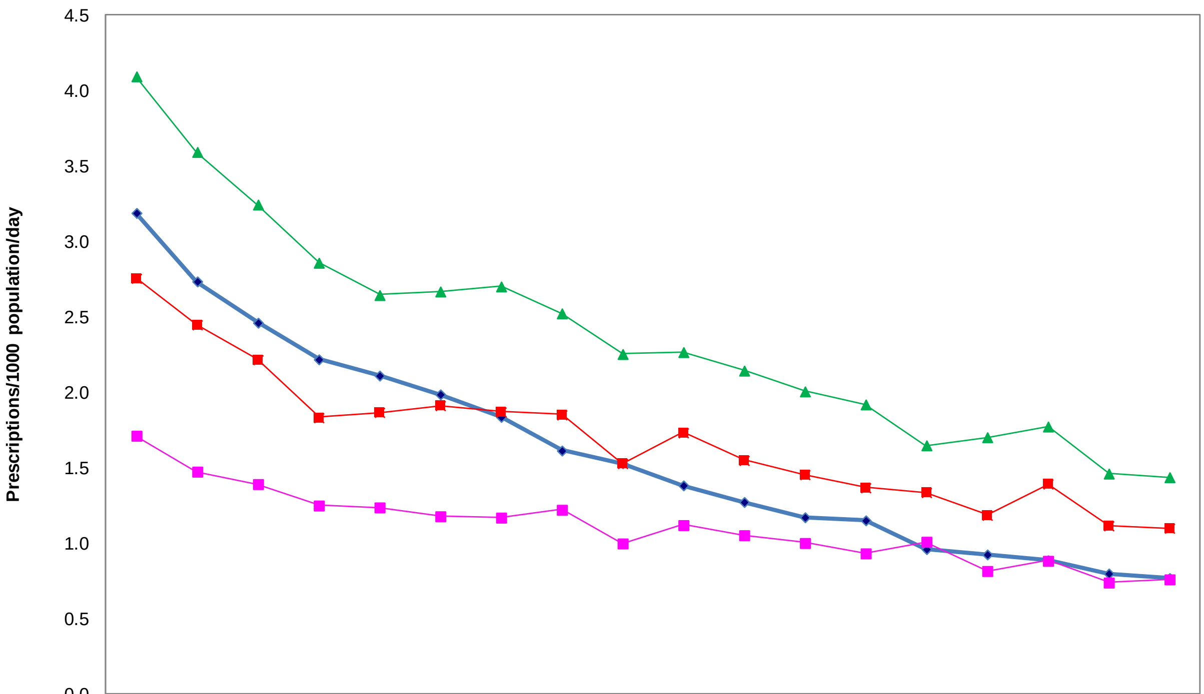
2. J01 Trend by age group

Daily prescription rates among children in Vancouver Coastal have been declining since 1996. Children 1 to 4 years of age have consistently had the highest antibiotic prescription rates (1.44 prescriptions/1000 population/day in 2013), followed since 2001 by children 5 to 9 years (1.10 prescriptions/1000 population/day), less than 1 year (0.77 prescriptions/1000 population/day) and 10 to 14 years (0.76 prescriptions/1000 population/day). The greatest percentage drop was among the less than one year old group, which saw prescription rates decrease by 76% (from 3.19 prescriptions/1000 population/day in 1996 to 0.77 prescriptions /1000 population/day in 2013) (Figure 65).

Adults aged 60 years and older have had the highest antibiotic consumption rates in Vancouver Coastal since 2000 (20.80 DDD/1000 population/day in 2013). The 15 to 19 age group remains the second highest group of consumers, although consumption has decreased by 34% since 1996. Consumption among those 40 to 59 followed with a reported rate of 14.65 DDD/1000 population/day in 2013. Less notable decreasing trends were observed among all other age groups, with rates ranging from 10.00 to 12.00 DDD/1000 population/day in 2013 (Figure 66).

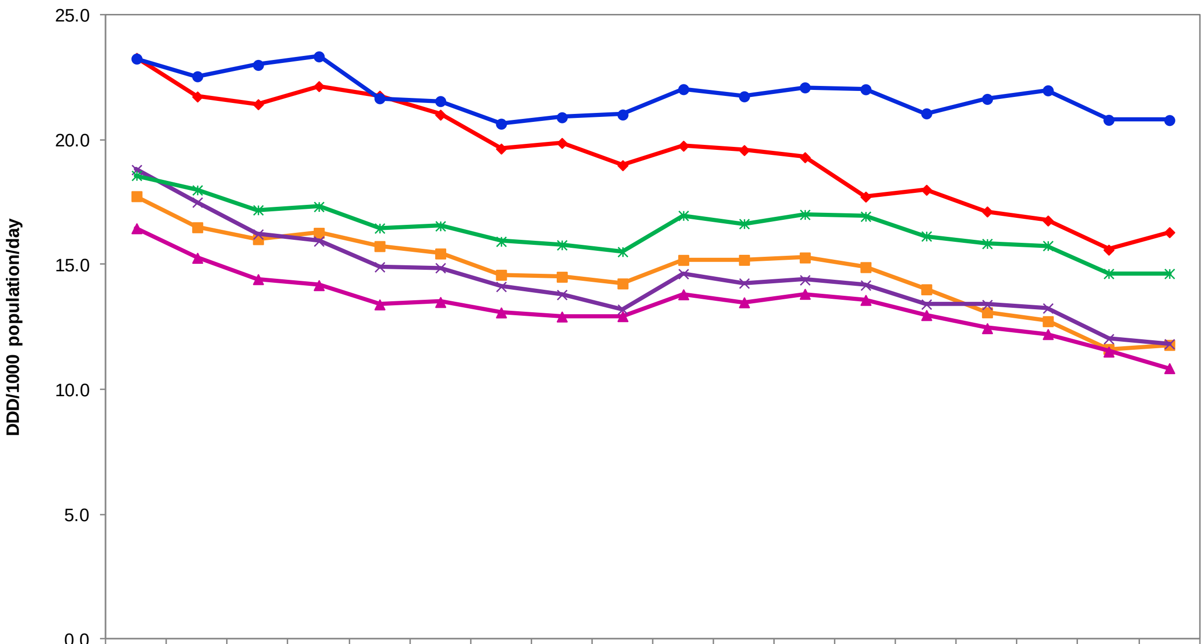


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
15-19	23.29	21.74	21.43	22.15	21.77	21.01	19.65	19.88	18.99	19.77	19.59	19.31	17.73	18.00	17.13	16.77	15.60	16.30
20-24	17.75	16.50	16.03	16.28	15.75	15.45	14.60	14.52	14.25	15.20	15.20	15.29	14.91	14.02	13.10	12.74	11.63	11.79
25-29	16.46	15.28	14.42	14.18	13.41	13.51	13.09	12.93	12.94	13.82	13.50	13.84	13.59	12.99	12.46	12.23	11.52	10.86
30-39	18.81	17.51	16.23	15.95	14.92	14.88	14.13	13.81	13.22	14.64	14.27	14.40	14.19	13.42	13.41	13.27	12.04	11.84
40-59	18.58	18.00	17.20	17.33	16.47	16.56	15.94	15.80	15.53	16.98	16.65	17.02	16.94	16.15	15.85	15.77	14.65	14.65
60+	23.26	22.55	23.00	23.35	21.67	21.56	20.65	20.91	21.02	22.03	21.75	22.10	22.03	21.06	21.64	21.99	20.80	20.80



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
<1	3.19	2.74	2.46	2.22	2.11	1.99	1.84	1.61	1.53	1.38	1.27	1.17	1.15	0.96	0.93	0.89	0.80	0.77
1-4	4.09	3.59	3.24	2.86	2.64	2.67	2.70	2.52	2.25	2.27	2.14	2.01	1.92	1.65	1.70	1.77	1.46	1.44
5-9	2.76	2.45	2.22	1.83	1.87	1.91	1.87	1.85	1.53	1.73	1.55	1.45	1.37	1.34	1.19	1.39	1.12	1.10
10-14	1.71	1.47	1.39	1.25	1.24	1.18	1.17	1.22	1.00	1.12	1.05	1.00	0.93	1.01	0.82	0.88	0.74	0.76

Figure 71: Overall (J01) daily prescription rate for children in Vancouver Coastal Health Authority

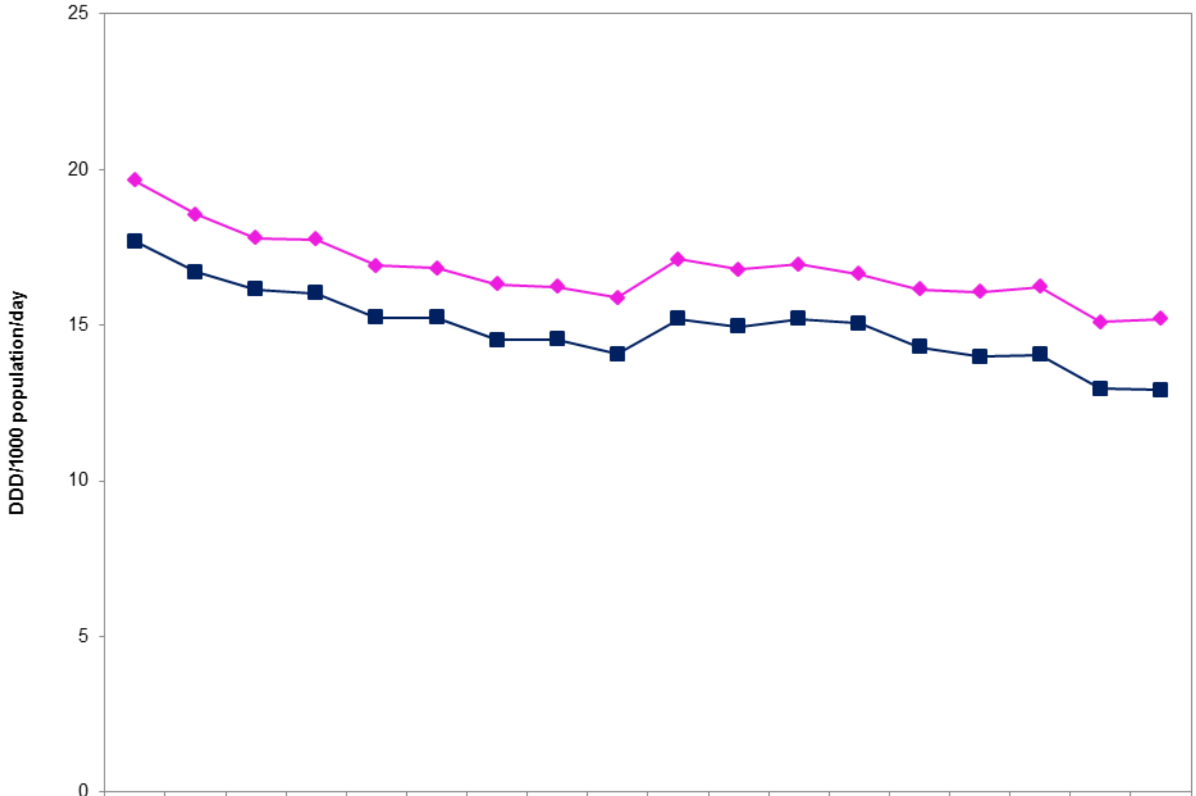


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
15-19	23.29	21.74	21.43	22.15	21.77	21.01	19.65	19.88	18.99	19.77	19.59	19.31	17.73	18.00	17.13	16.77	15.60	16.30
20-24	17.75	16.50	16.03	16.28	15.75	15.45	14.60	14.52	14.25	15.20	15.20	15.29	14.91	14.02	13.10	12.74	11.63	11.79
25-29	16.46	15.28	14.42	14.18	13.41	13.51	13.09	12.93	12.94	13.82	13.50	13.84	13.59	12.99	12.46	12.23	11.52	10.86
30-39	18.81	17.51	16.23	15.95	14.92	14.88	14.13	13.81	13.22	14.64	14.27	14.40	14.19	13.42	13.41	13.27	12.04	11.84
40-59	18.58	18.00	17.20	17.33	16.47	16.56	15.94	15.80	15.53	16.98	16.65	17.02	16.94	16.15	15.85	15.77	14.65	14.65
60+	23.26	22.55	23.00	23.35	21.67	21.56	20.65	20.91	21.02	22.03	21.75	22.10	22.03	21.06	21.64	21.99	20.80	20.80

Figure 72: Overall (J01) daily consumption rate for adults in Vancouver Coastal Health Authority

3. J01 Trend by gender

Females consistently consumed more antibiotics than males in Vancouver Coastal. In 2013, females consumed 18% more antibiotics than males (Figure 67).



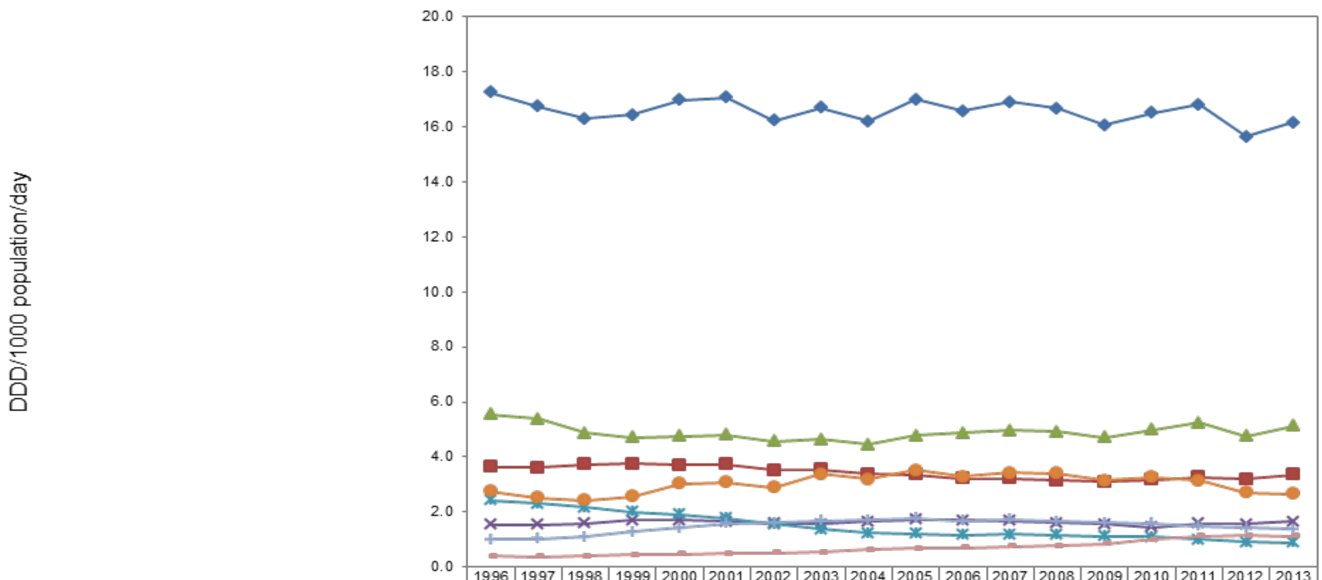
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
F	19.65	18.56	17.80	17.76	16.91	16.84	16.32	16.24	15.88	17.12	16.79	16.95	16.64	16.15	16.06	16.23	15.11	15.21
M	17.68	16.70	16.14	16.02	15.24	15.25	14.52	14.54	14.07	15.21	14.96	15.21	15.06	14.30	13.99	14.06	12.95	12.91

Figure 73: Daily consumption rate for overall antibiotics (J01) by gender in Vancouver Coastal Health Authority

Island Health (Vancouver Island Health Authority)

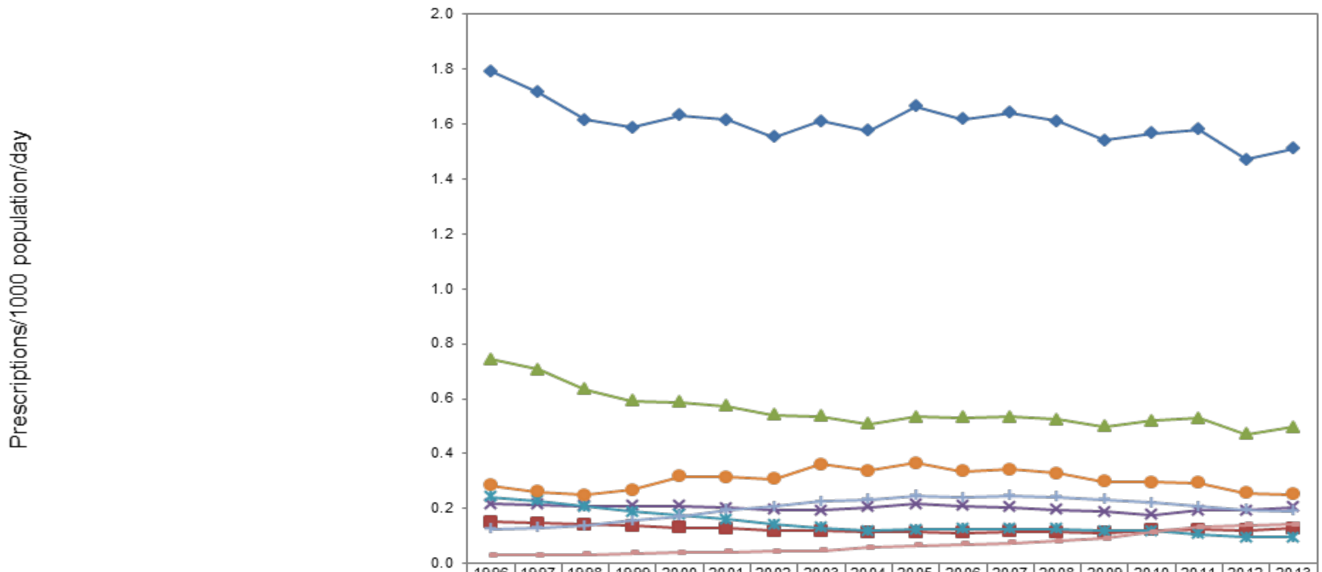
1. Overall Trend and Trend by Major Drug Class

Over the past four years, overall antibiotic utilization has remained fairly stable in Vancouver Island, averaging approximately 16.00 DDD/1000 population/day. Daily consumption rates are highest for penicillins. Macrolides consumption has increased since 1996; however, a decreasing trend resumed in 2010. Consumption rate of SMX-TMP decreased by 63% since 1996 and was reported to be at 0.89 DDD/1000 population/day in 2013. Consumption of quinolones, however, increased by 38% since 1996 and was reported to be at 1.38 DDD/1000 population/day in 2013 (Figure 68). As shown in Figure 70, prescription rates show similar overall trends over the years.



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
J01 - ANTIBACTERIALS FOR SYSTEMIC USE	17.26	16.74	16.29	16.45	16.97	17.07	16.23	16.69	16.22	17.01	16.57	16.91	16.67	16.06	16.51	16.82	15.65	16.16
J01A - TETRACYCLINES	3.62	3.61	3.73	3.75	3.70	3.73	3.52	3.54	3.38	3.36	3.21	3.21	3.15	3.09	3.17	3.26	3.20	3.36
J01C - BETA-LACTAM ANTIBACTERIALS, PENICILLINS	5.54	5.37	4.86	4.71	4.75	4.79	4.58	4.64	4.46	4.77	4.87	4.95	4.91	4.71	4.98	5.25	4.75	5.11
J01D - OTHER BETA-LACTAM ANTIBACTERIALS	1.52	1.54	1.59	1.69	1.70	1.64	1.58	1.55	1.65	1.73	1.69	1.67	1.61	1.55	1.44	1.57	1.55	1.64
J01E - SULFONAMIDES AND TRIMETHOPRIM	2.42	2.29	2.17	2.01	1.91	1.76	1.56	1.38	1.22	1.20	1.17	1.19	1.17	1.11	1.09	0.99	0.89	0.89
J01F - MACROLIDES, LINCOSAMIDES AND STREPTOGRAMINS	2.76	2.52	2.42	2.55	3.03	3.08	2.88	3.38	3.19	3.51	3.28	3.43	3.41	3.15	3.25	3.15	2.69	2.66
J01M - QUINOLONE ANTIBACTERIALS	1.00	1.03	1.09	1.27	1.41	1.58	1.60	1.67	1.69	1.76	1.66	1.72	1.66	1.61	1.57	1.49	1.42	1.38
J01X - OTHER ANTIBACTERIALS	0.39	0.37	0.40	0.44	0.46	0.48	0.50	0.53	0.63	0.68	0.69	0.73	0.77	0.84	1.00	1.11	1.13	1.11

Figure 74: Daily consumption rate by major drug class for Island Health



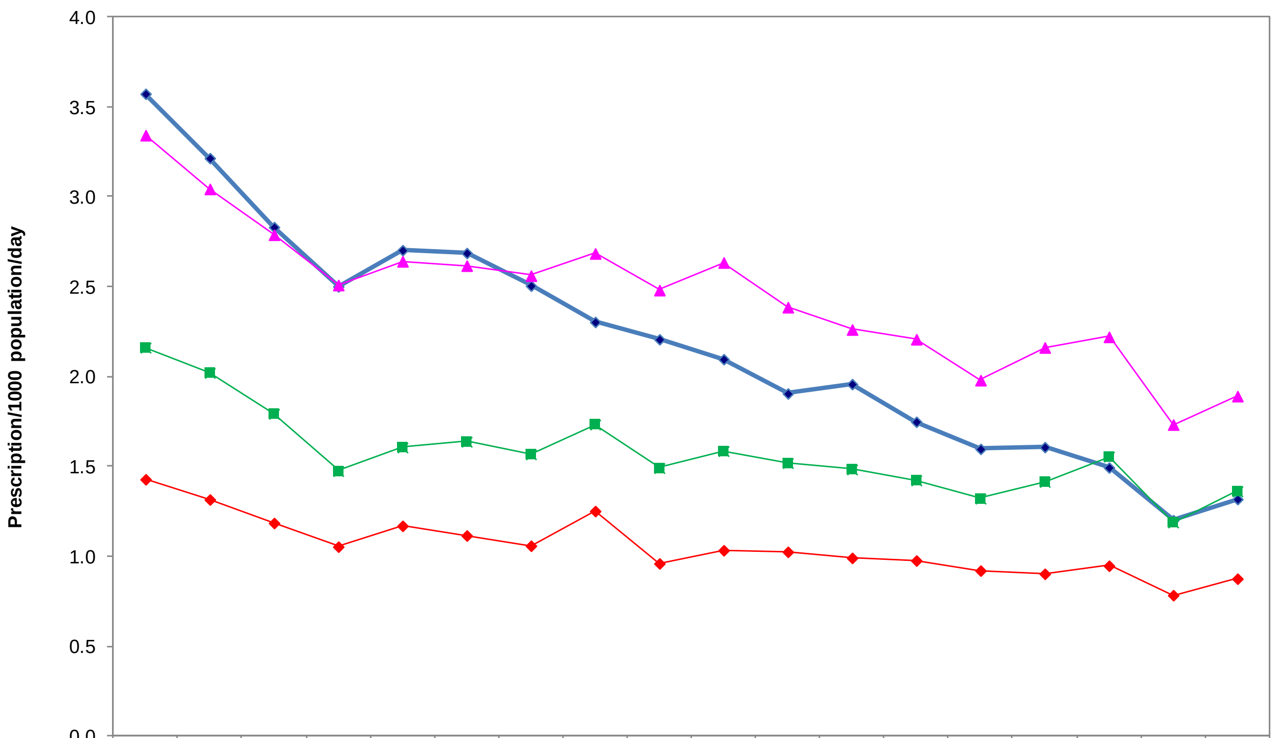
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
J01 - ANTIBACTERIALS FOR SYSTEMIC USE	1.79	1.72	1.62	1.59	1.63	1.62	1.55	1.61	1.58	1.67	1.62	1.64	1.61	1.54	1.57	1.58	1.47	1.51
J01A - TETRACYCLINES	0.15	0.15	0.14	0.14	0.13	0.13	0.12	0.12	0.11	0.11	0.11	0.12	0.11	0.11	0.12	0.12	0.12	0.13
J01C - BETA-LACTAM ANTIBACTERIALS, PENICILLINS	0.74	0.71	0.63	0.59	0.59	0.57	0.54	0.54	0.51	0.53	0.53	0.53	0.52	0.50	0.52	0.53	0.47	0.50
J01D - OTHER BETA-LACTAM ANTIBACTERIALS	0.22	0.21	0.21	0.21	0.21	0.20	0.20	0.19	0.21	0.22	0.21	0.21	0.20	0.19	0.18	0.19	0.19	0.20
J01E - SULFONAMIDES AND TRIMETHOPRIM	0.24	0.23	0.21	0.19	0.18	0.16	0.14	0.13	0.12	0.12	0.12	0.13	0.12	0.12	0.12	0.11	0.09	0.10
J01F - MACROLIDES, LINCOSAMIDES AND STREPTOGRAMINS	0.28	0.26	0.25	0.27	0.32	0.31	0.31	0.36	0.34	0.37	0.34	0.34	0.33	0.30	0.30	0.29	0.26	0.25
J01M - QUINOLONE ANTIBACTERIALS	0.12	0.13	0.14	0.16	0.17	0.20	0.21	0.23	0.23	0.25	0.24	0.25	0.24	0.23	0.22	0.21	0.20	0.19
J01X - OTHER ANTIBACTERIALS	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.05	0.06	0.07	0.07	0.07	0.08	0.09	0.11	0.13	0.14	0.14

Figure 75: Daily prescription rate by major drug class for Island Health

2. J01 Trend by age group

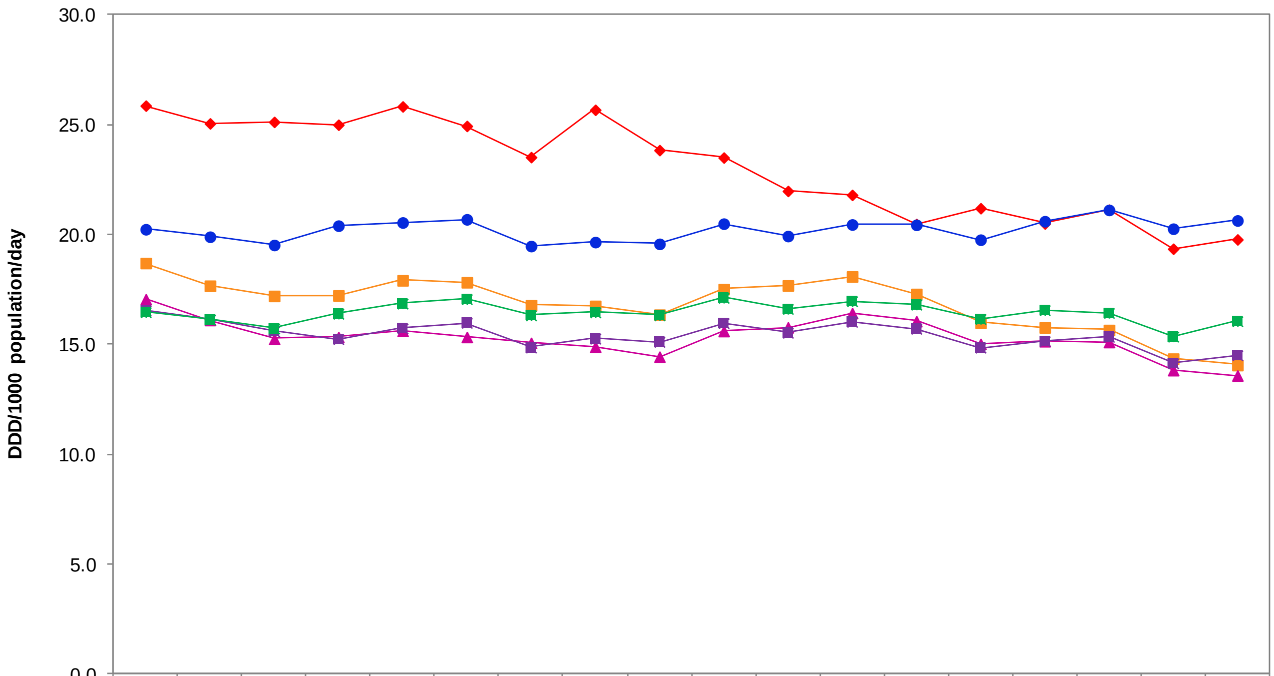
Daily prescription rates among children in Vancouver Island have been declining since 1996. Children 1 to 4 years of age have consistently had the highest antibiotic prescription rates (1.89 prescriptions/1000 population/day in 2013), followed by children less than 1 year and children 5 to 9 (with rates of 1.32 and 1.36 prescription/1000 population/day, respectively), and 10 to 14 years (0.88 prescriptions/1000 population/day). The greatest percentage drop was among the less than 1 year old age group, which saw a prescription rate decrease by 63% (from 3.34 prescriptions/1000 population/day in 1996 to 1.89 prescriptions/1000 population/day in 2013) (Figure 70).

Adults 15 to 19 years of age historically had the highest rates of antibiotic consumption in Vancouver Island from 1996 to 2007; however, as of 2008, consumption has stabilized and mimicked trends observed among those 60 years of age and older. The two rates are similar at 20.64 and 19.77 DDD/1000 population/day for 60+ and 15 to 19 year age groups, respectively, in 2013. All other age groups show similar trends as seen in the figure below with the 40 to 59 age group showing the highest rate among the four groups, followed by those 30 to 39, 20 to 24 and lastly 25 to 29 (Figure 71).



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
<1	3.57	3.21	2.83	2.50	2.70	2.69	2.51	2.30	2.21	2.10	1.91	1.96	1.75	1.60	1.61	1.49	1.20	1.32
1-4	3.34	3.04	2.79	2.51	2.64	2.62	2.56	2.68	2.48	2.63	2.39	2.26	2.21	1.98	2.16	2.22	1.73	1.89
5-9	2.16	2.02	1.79	1.47	1.61	1.64	1.57	1.73	1.49	1.59	1.52	1.48	1.42	1.32	1.41	1.55	1.19	1.36
10-14	1.43	1.32	1.18	1.05	1.17	1.12	1.06	1.25	0.96	1.03	1.02	0.99	0.98	0.92	0.90	0.95	0.78	0.88

Figure 76: Overall (J01) daily prescription rate for children in Island Health

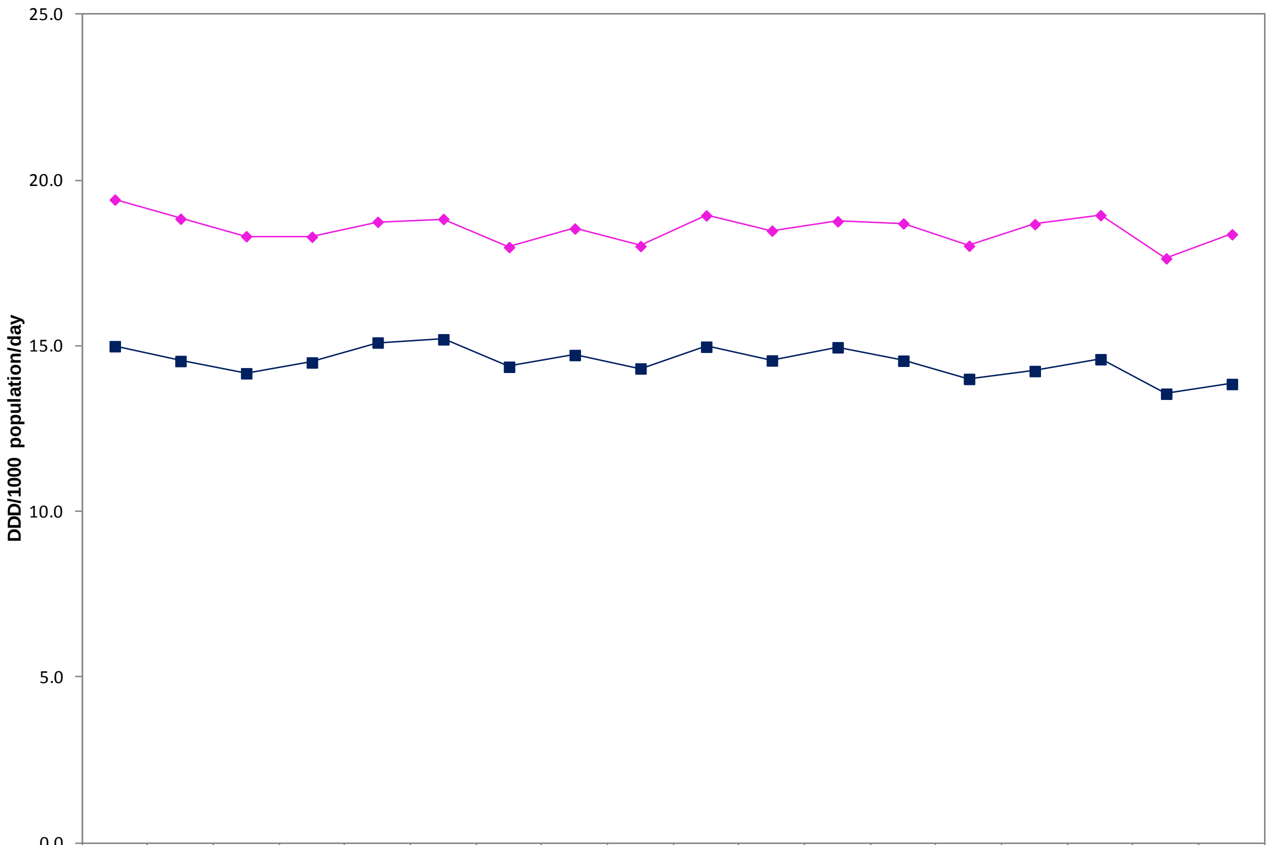


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
15-19	25.86	25.05	25.12	24.99	25.82	24.93	23.52	25.67	23.84	23.50	21.98	21.80	20.48	21.19	20.50	21.13	19.35	19.77
20-24	18.70	17.67	17.21	17.23	17.92	17.83	16.79	16.75	16.35	17.52	17.68	18.09	17.30	15.99	15.77	15.66	14.35	14.06
25-29	17.06	16.11	15.25	15.34	15.62	15.34	15.07	14.89	14.44	15.61	15.78	16.43	16.06	15.02	15.15	15.11	13.83	13.59
30-39	16.54	16.13	15.59	15.24	15.73	15.98	14.86	15.26	15.12	15.97	15.53	16.03	15.71	14.85	15.14	15.34	14.14	14.51
40-59	16.46	16.14	15.73	16.39	16.86	17.06	16.32	16.46	16.32	17.12	16.61	16.97	16.81	16.16	16.56	16.43	15.35	16.06
60+	20.24	19.90	19.52	20.40	20.54	20.69	19.47	19.65	19.57	20.49	19.93	20.45	20.44	19.76	20.60	21.12	20.26	20.64

Figure 77: Overall (J01) daily consumption rate for adults in Island Health

3. J01 Trend by gender

Females consistently consumed more antibiotics than males in Vancouver Island. In 2013, females consumed an average of 4.00 DDD/1000 population/day (33%) more than males (Figure 72).



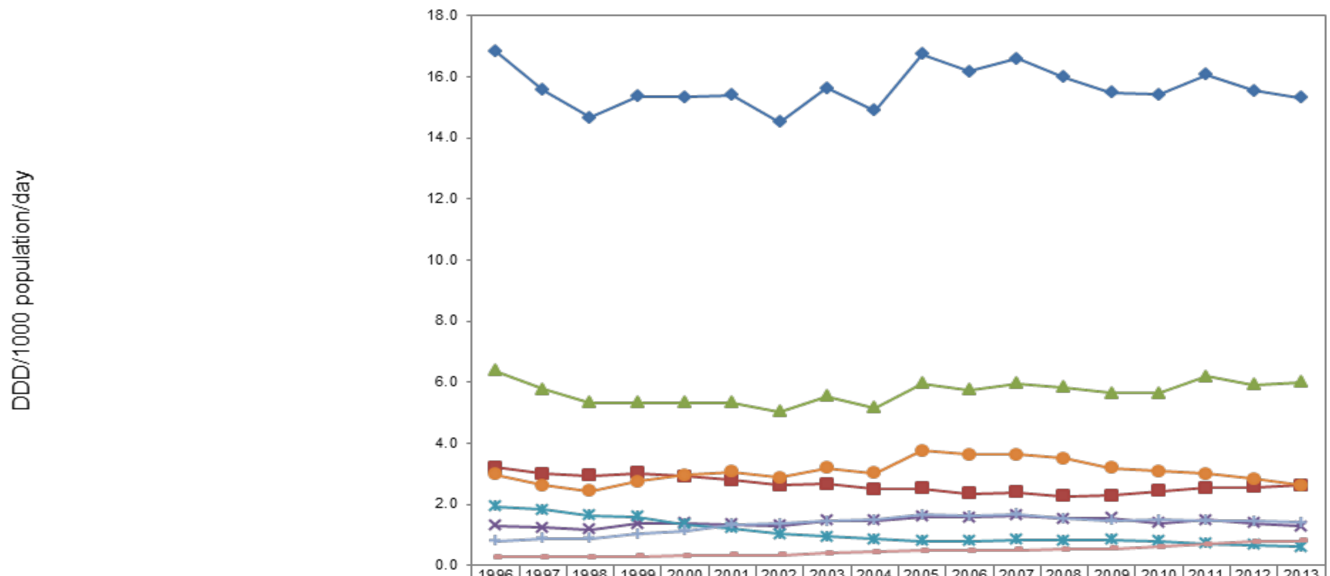
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
F	19.41	18.84	18.31	18.29	18.74	18.83	17.98	18.54	18.01	18.94	18.48	18.76	18.69	18.02	18.67	18.94	17.64	18.37
M	14.99	14.54	14.17	14.50	15.10	15.20	14.37	14.72	14.32	14.98	14.56	14.96	14.55	14.00	14.24	14.60	13.56	13.85

Figure 78: Daily consumption rate for overall antibiotics (J01) by gender in Island Health

Northern Health Authority

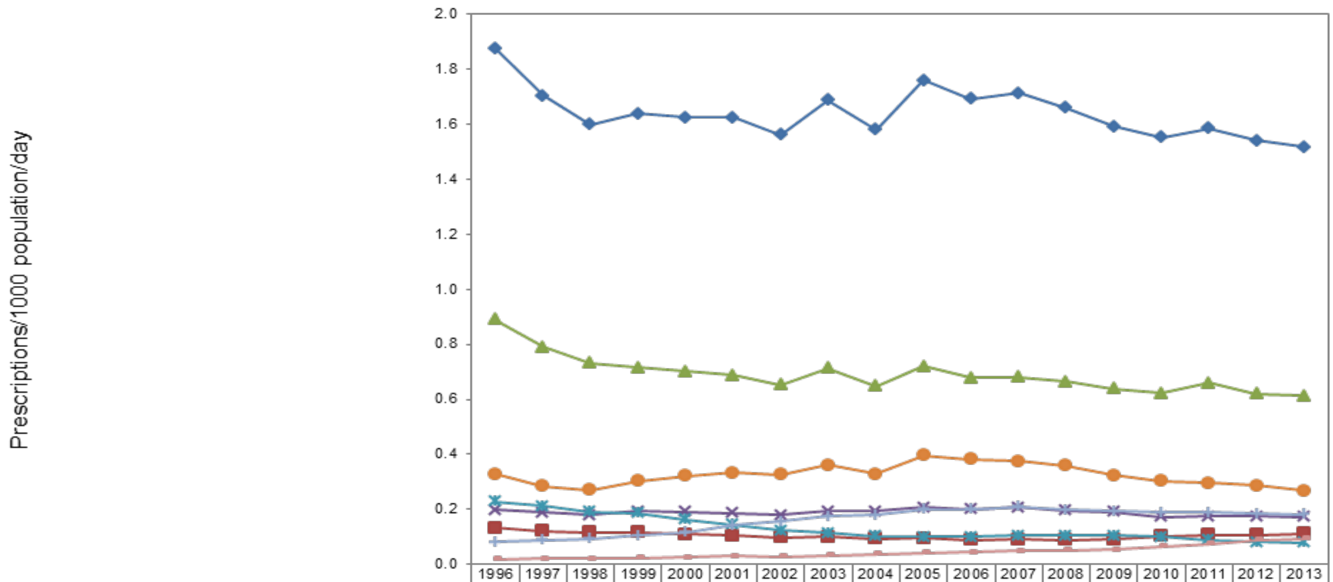
1. Overall Trend and Trend by Major Drug Class

The overall trend in antibiotic utilization in Northern decreased until 2002, rose to a peak in 2005, and has decreased since then to 15.32 DDD/1000 population/day in 2013. Daily consumption rates are highest for penicillins, followed by macrolides and tetracyclines. Consumption of penicillins largely mirrored the overall trend, resulting in a 6% decrease from 6.38 in 1996 to 6.00 DDD/1000 population/day in 2013. Consumption of macrolides decreased 13% from 1996 to 2013 from 2.99 to 2.61 DDD/1000 population/day (Figure 73). As shown in Figure 75, similar trends were observed in prescription rates.



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
J01 - ANTIBACTERIALS FOR SYSTEMIC USE	16.85	15.58	14.67	15.36	15.34	15.41	14.53	15.63	14.91	16.74	16.18	16.61	15.99	15.48	15.43	16.08	15.56	15.32
J01A - TETRACYCLINES	3.20	2.99	2.94	3.02	2.91	2.79	2.62	2.66	2.49	2.51	2.35	2.38	2.26	2.28	2.44	2.54	2.56	2.63
J01C - BETA-LACTAM ANTIBACTERIALS, PENICILLINS	6.38	5.77	5.32	5.33	5.32	5.32	5.03	5.54	5.17	5.96	5.74	5.96	5.84	5.64	5.64	6.19	5.92	6.00
J01D - OTHER BETA-LACTAM ANTIBACTERIALS	1.29	1.24	1.18	1.35	1.37	1.34	1.31	1.46	1.45	1.59	1.57	1.63	1.52	1.54	1.37	1.49	1.38	1.29
J01E - SULFONAMIDES AND TRIMETHOPRIM	1.93	1.82	1.64	1.60	1.35	1.21	1.03	0.94	0.86	0.79	0.79	0.83	0.82	0.83	0.79	0.71	0.66	0.61
J01F - MACROLIDES, LINCOSAMIDES AND STREPTOGRAMINS	2.99	2.61	2.44	2.75	2.95	3.07	2.87	3.18	3.02	3.75	3.63	3.63	3.50	3.19	3.09	3.00	2.82	2.61
J01M - QUINOLONE ANTIBACTERIALS	0.80	0.88	0.88	1.02	1.12	1.34	1.35	1.45	1.50	1.66	1.61	1.67	1.52	1.46	1.49	1.46	1.45	1.40
J01X - OTHER ANTIBACTERIALS	0.27	0.28	0.27	0.29	0.32	0.34	0.33	0.39	0.43	0.48	0.48	0.50	0.52	0.53	0.61	0.69	0.78	0.79

Figure 79: Daily consumption rate by major drug class for Northern Health Authority



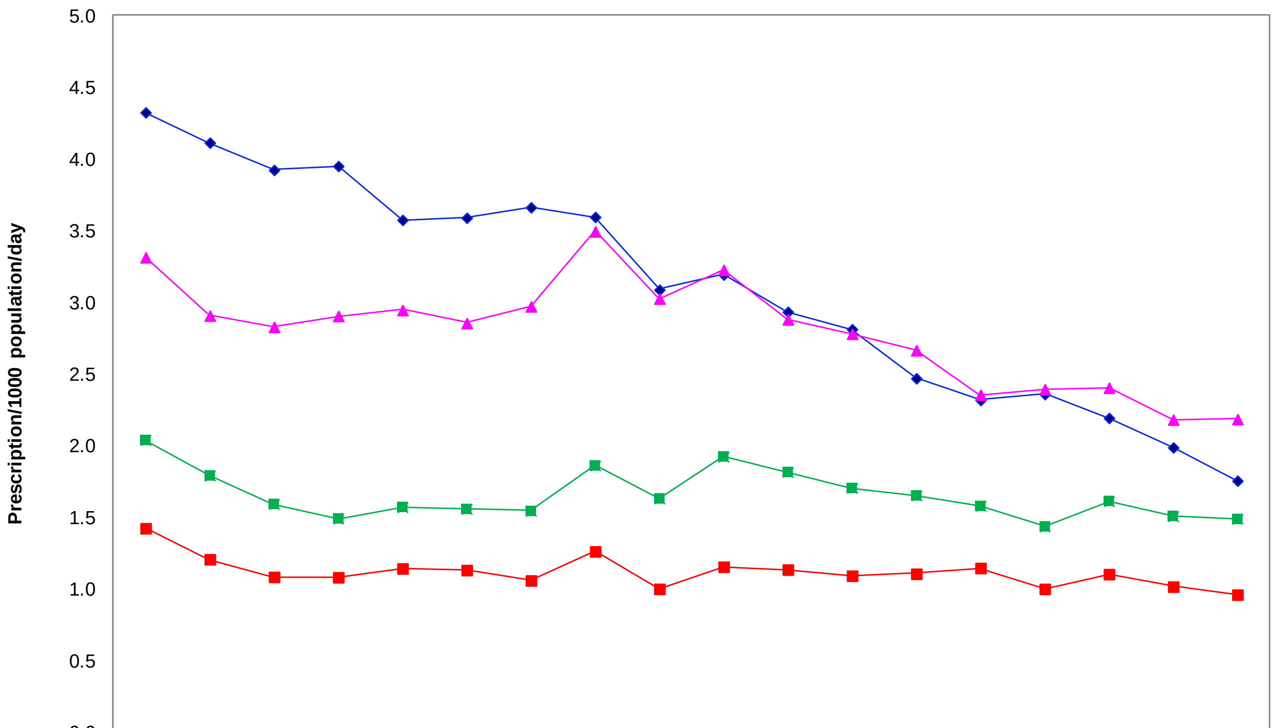
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
J01 - ANTIBACTERIALS FOR SYSTEMIC USE	1.88	1.70	1.60	1.64	1.63	1.62	1.56	1.69	1.58	1.76	1.69	1.71	1.66	1.59	1.55	1.58	1.54	1.52
J01A - TETRACYCLINES	0.13	0.12	0.12	0.12	0.11	0.10	0.10	0.10	0.09	0.10	0.09	0.09	0.09	0.09	0.10	0.11	0.11	0.11
J01C - BETA-LACTAM ANTIBACTERIALS, PENICILLINS	0.89	0.79	0.73	0.71	0.70	0.69	0.65	0.71	0.65	0.72	0.68	0.68	0.66	0.64	0.62	0.66	0.62	0.61
J01D - OTHER BETA-LACTAM ANTIBACTERIALS	0.20	0.19	0.18	0.19	0.19	0.19	0.18	0.19	0.19	0.21	0.20	0.21	0.20	0.19	0.17	0.17	0.17	0.17
J01E - SULFONAMIDES AND TRIMETHOPRIM	0.23	0.21	0.19	0.19	0.16	0.14	0.12	0.11	0.10	0.10	0.10	0.11	0.11	0.10	0.10	0.09	0.08	0.08
J01F - MACROLIDES, LINCOSAMIDES AND STREPTOGRAMINS	0.33	0.28	0.27	0.30	0.32	0.33	0.33	0.36	0.33	0.40	0.38	0.37	0.36	0.32	0.30	0.30	0.29	0.27
J01M - QUINOLONE ANTIBACTERIALS	0.08	0.09	0.09	0.10	0.12	0.14	0.16	0.18	0.18	0.20	0.20	0.21	0.20	0.19	0.19	0.19	0.18	0.18
J01X - OTHER ANTIBACTERIALS	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.05	0.05	0.05	0.06	0.08	0.09	0.09

Figure 80: Daily prescription rate by major drug class for Northern Health Authority

2. J01 Trend by age group

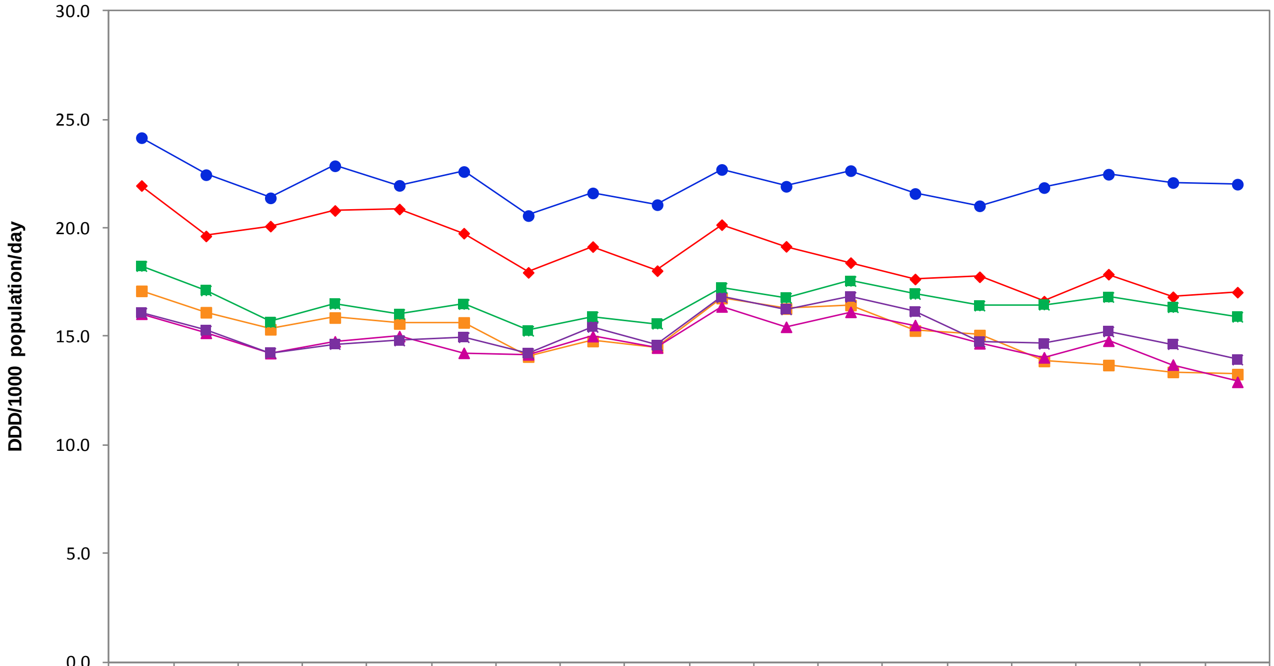
Daily prescription rates among children in Northern have been declining since 1996. There was a slight increase in 2003 in most age groups, after which the downward trend resumed. Children less than one year were prescribed the highest rate of antibiotics until 2003, when the rate of prescriptions among those 1 to 4 years of age surpassed them (2.18 prescriptions/1000 population/day among those 1 to 4 and 1.75 prescriptions/1000 population/day among those less than 1 year in 2010). The greatest percentage drop was among the less than one year age group, which saw prescription rates decrease by 61% (from 4.52 prescriptions/1000 population/day in 1996 to 1.75 prescriptions/1000 population/day in 2013) (Figure 75).

Adults aged 60 years and older have experienced the highest rates of antibiotic consumption in Northern since 1996 (29% higher than the second highest consumption rate in 2013). Historically, the second highest consuming age group had been the 15 to 19 year olds, although significant decreases since 2005 caused the rate to become comparable with the other age groups. Those 15 to 19 years of age and 20 to 24 years of age had the greatest decrease between 1996 and 2013 (approximately 22.4) (Figure 76).



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
<1	4.32	4.11	3.92	3.95	3.57	3.59	3.66	3.59	3.09	3.19	2.93	2.81	2.47	2.32	2.36	2.19	1.99	1.75
1-4	3.31	2.91	2.83	2.90	2.94	2.85	2.97	3.49	3.02	3.22	2.88	2.78	2.66	2.35	2.39	2.40	2.18	2.18
5-9	2.04	1.79	1.59	1.49	1.57	1.56	1.54	1.86	1.63	1.92	1.81	1.70	1.65	1.58	1.43	1.61	1.50	1.49
10-14	1.42	1.21	1.08	1.08	1.14	1.13	1.06	1.26	1.00	1.15	1.13	1.09	1.10	1.14	1.00	1.10	1.01	0.96

Figure 81: Overall (J01) daily prescription rate for children in Northern Health Authority

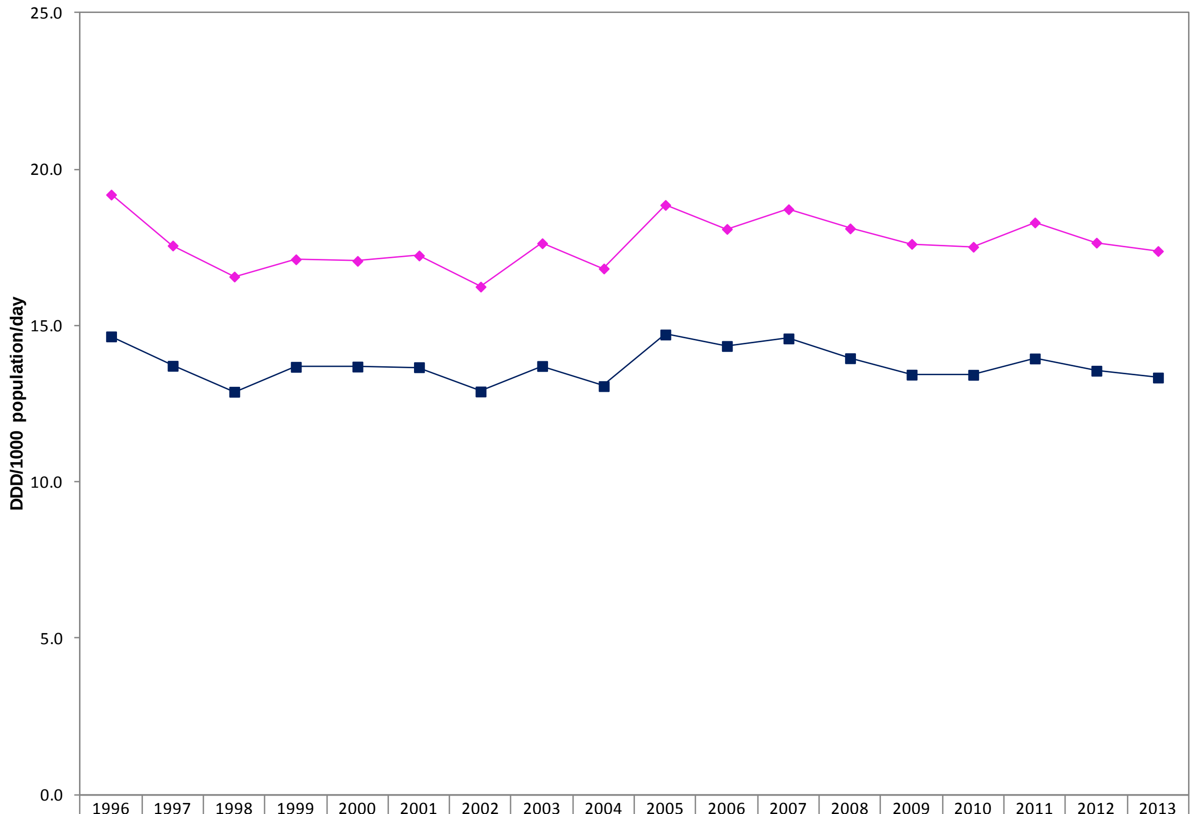


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
15-19	21.96	19.64	20.09	20.81	20.88	19.77	17.96	19.15	18.04	20.16	19.16	18.41	17.66	17.76	16.64	17.88	16.84	17.05
20-24	17.11	16.12	15.34	15.88	15.61	15.66	14.08	14.80	14.50	16.78	16.30	16.46	15.28	15.08	13.88	13.69	13.37	13.28
25-29	16.06	15.18	14.24	14.78	15.03	14.26	14.19	15.03	14.49	16.39	15.45	16.14	15.54	14.69	14.05	14.81	13.71	12.92
30-39	16.10	15.29	14.26	14.66	14.82	14.98	14.24	15.45	14.60	16.82	16.26	16.84	16.16	14.78	14.67	15.24	14.66	13.95
40-59	18.25	17.13	15.67	16.52	16.05	16.50	15.27	15.93	15.60	17.26	16.79	17.57	16.97	16.43	16.47	16.83	16.36	15.92
60+	24.17	22.46	21.40	22.87	21.97	22.61	20.58	21.62	21.08	22.70	21.93	22.65	21.60	21.03	21.87	22.48	22.10	22.03

Figure 82: Overall (J01) daily consumption rate for adults in Northern Health Authority

3. J01 Trend by gender

Females consistently consumed more antibiotics than males in Northern. In 2013, females consumed 30% more antibiotics than males at a rate of 17.39 DDD/1000 population/day.



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
F	19.19	17.56	16.57	17.12	17.07	17.24	16.25	17.63	16.83	18.86	18.09	18.72	18.11	17.61	17.52	18.30	17.65	17.39
M	14.66	13.72	12.89	13.68	13.69	13.67	12.90	13.71	13.07	14.72	14.35	14.59	13.96	13.43	13.43	13.95	13.56	13.34

Figure 83: Daily consumption rate for overall antibiotics (J01) by gender in Northern Health Authority

Appendix

Table A-1: List of Abbreviations

BCAMM	BC Association of Medical Microbiologists
BCCDC	BC Centre for Disease Control
CBSN	Canadian Bacterial Surveillance Network
DDD	Daily Defined Dose
HA	Health Authority
HSDA	Health Services Delivery Area
RTI	Respiratory Tract Infection
SMX-TMP	Sulfamethoxazole-Trimethoprim
UTI	Urinary Tract Infection

Table A-2: Health Authorities and Health Service Delivery Areas

Health Authorities	Health Service Delivery Areas	
FHA		Fraser Health Authority
	FE	Fraser East
	FN	Fraser North
	FS	Fraser South
IHA		Interior Health Authority
	EK	East Kootenay
	KB	Kootenay Boundary
	OK	Okanagan
	TCS	Thompson Cariboo Shuswap
NHA		Northern Health Authority
	NW	Northwest
	NI	Northern Interior
	NE	Northeast
VCHA		Vancouver Coastal Health Authority
	RMD	Richmond
	VAN	Vancouver
	NS/CG	North Shore/Coast Garibaldi
VIHA		Island Health (Vancouver Island Health Authority)
	SVI	South Vancouver Island
	CVI	Central Vancouver Island
	NVI	North Vancouver Island

Table A-3: Major Classes and Components of Consumption Comparison between British Columbia and Europe

Drug Class	Sub-Class	Antimicrobials Included	
		British Columbia	Europe
Tetracyclines (17)		Doxycycline Tetracycline Minocycline	Doxycycline Tetracycline Minocycline Oxytetracycline Lymecycline
Penicillins (18)	Extended Spectrum	Ampicillin Amoxicillin	Ampicillin Amoxicillin Pivmecillinam
	Narrow Spectrum	Phenoxymethylpenicillin	Phenoxymethylpenicillin
	Penicillinase-Resistant	Cloxacillin	Dicloxacillin Flucloxacillin
	Combinations of Penicillins Incl. β-Lactamase Inhibitors	Amoxicillin and enzyme inhibitor	Amoxicillin with enzyme inhibitor
Cephalosporins (19)	First Generation	Cefalexin Cefadroxil	Cefalexin Cefadroxil Cefazolin Cefatrizine Cefradine
	Second Generation	Cefaclor Cefprozil Cefuroxime	Cefaclor Cefprozil Cefuroxime
	Third Generation	Cefixime	Cefixime Ceftrixone Cefpodoxime Ceftibuten
Sulfonamides and Trimethoprim (17)		Trimethoprim Sulfamethoxazole Sulfamethoxazole and trimethoprim	Trimethoprim Sulfamethizole Sulfamethoxazole and trimethoprim Sulfadimethoxine
Macrolides (20)	Short-Acting	Erythromycin Spiramycin	Erythromycin Spiramycin
	Intermediate-Acting	Clarithromycin Telithromycin	Clarithromycin Telithromycin Roxithromycin,
	Long-Acting	Azithromycin	Azithromycin
Lincosamides (20)		Clindamycin	Clindamycin
Streptogramins (20)			Pristinamycin
Quinolones (21)	First Generation	Norfloxacin	Norfloxacin
	Second Generation	Ofloxacin Ciprofloxacin Levofloxacin	Ofloxacin Ciprofloxacin Levofloxacin
	Third Generation	Moxifloxacin	Moxifloxacin
Other Antibacterials (17)	Steroid antibacterials	Fusidic acid	Fusidic acid
	Nitrofuran derivatives	Nitrofurantoin	Nitrofurantoin Nitorfurtoinol
	Imidazole derivatives		Metronidazole
	Other antibacterials	Fosfomycin Methenamine Linezolid	Fosfomycin Methenamine Nitoxoline

Note: Antibiotics comprising < 1% of total European outpatient use in that class (in 2003 and/or 2009) were not included in this table but were included in graphs

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