

July 2, 2020

Community Antimicrobial Stewardship Program

Annual Report 2019/20



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



BRITISH COLUMBIA

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Executive summary

Beginning in 2005 with Do Bugs Need Drugs?, the Community Antimicrobial Stewardship program at the B.C. Centre for Disease Control (BCCDC) has been tackling the important issues of antibiotic overuse and misuse and antimicrobial resistance. In 2019/20 the team undertook a wide range of activities aimed at addressing this growing public health concern.

Activities

- A multifaceted advertising campaign in late 2019 and early 2020 garnered more than 25 million impressions in communities across B.C.
- The program's online presence continued to grow through the Antibiotic Wise and Do Bugs Need Drugs? websites, and social media channels (LinkedIn account launched for first time).
- 5,612 individuals were provided education through the Do Bugs Need Drugs? program.
- Collaborative partnership with Kids Boost Immunity grew to include I Boost Immunity this year, with 1,500 users and nearly 37,000 questions answered.
- 3,657 health care professionals received antimicrobial resistance continuing education.
- B.C. users of the Bugs & Drugs online reference guide grew by 23% this year.

Outcomes

- Overall prescription rate of antibiotics in B.C. decreased 4.2% in 2018 compared to 2017, and is down 22.5% overall since 2005.
- The dental prescribing rate decreased 1.5% in 2017, but is still up 4% since 2005.
- Antimicrobial resistance trends of bacteria to specific antibiotics continued to be tracked and reported publicly across B.C. in the program's [Antimicrobial Resistance Dashboard](#).
- The results of the program's cost-benefit analysis were published in the Canadian Journal of Public Health.
- A research study on the link between antibiotic use in infants and childhood asthma was published in the Lancet Respiratory Medicine.

Impacts

- The prescription rate of clindamycin is down 25% since 2010. The prescription rate for ciprofloxacin decreased 43% in this same period.
- The defined daily dose per prescription for naturopaths remains high compared to other professions, but decreased 8% from 2017 to 2018.
- Overall defined daily dose per prescription remained steady from 2017 to 2018, and is still up 6% since 2005.

Introduction

Antibiotics have been used since the mid-20th century to treat bacterial infections, and great strides have been made in health care and public health due to their use. Infections which in the past may have been deadly are now often easily treated, and the use of antibiotics has made modern medical procedures such as surgeries and chemotherapy possible.

However human antibiotic use is a known driver of antibiotic resistance^{1,2}. Although antibiotic resistance is a naturally occurring biological phenomenon, it has been exacerbated by the overuse and misuse of antibiotics. When antibiotics are used too much or incorrectly, bacteria causing illness may no longer respond to the drug.

Antibiotic resistance is a global concern. If not managed, it has the potential to undo many of the gains made in global health over the past century³. 5,400 Canadians died as a direct result of antimicrobial resistance in 2018, and this number could reach nearly 14,000 by 2050⁴. As such, concerted effort is needed to strategically reduce the overuse and misuse of antibiotics at the individual and population levels. Combined, these efforts not only have the potential to arrest and possibly reverse the current upward trends in resistance, but also have the potential to alleviate the burden placed on individuals and the health care system associated with antimicrobial resistant infections⁵.

The Community Antimicrobial Stewardship program at the B.C. Centre for Disease Control is tackling this important issue. Beginning with Do Bugs Need Drugs? in 2005, the program has grown into a multifaceted initiative with activities focusing on community outreach, public and healthcare professional education, and research and surveillance. The program aims to reduce the overuse and misuse of antibiotics in B.C. to ensure we continue to have effective treatments for bacterial infections in the future.

The wide array of projects and activities undertaken by the Community Antimicrobial Stewardship program all tie back to three key messages which are targeted at the public and health care professionals in the community:



Wash your hands

Hand washing is the best way to stop the spread of infections.



Know that not all bugs are created equal

Antibiotics work against bacteria, but not against viruses.



Use antibiotics wisely

Bacteria can become resistant to antibiotics if not used appropriately.

Program logic model

RESOURCES	ACTIVITIES	OUTPUTS	OUTCOMES	IMPACTS
<p>Funds and endorsement for the program from the Ministry of Health</p> <p>Community Antimicrobial Stewardship Program team</p>	<p>Public outreach and awareness</p> <ul style="list-style-type: none"> Public engagement and advertising Online engagement Public events Materials and resources 	<ul style="list-style-type: none"> Campaign reach Social media reach Website traffic Event attendance Materials distributed 	<p>Increased public knowledge</p> <ul style="list-style-type: none"> Viral infections do not require antibiotics Some bacterial infections do not require antibiotics Limitations of antibiotics for asymptomatic bacteriuria and in dentistry 	<p>Reduction in morbidity associated with antibiotic use in BC</p> <ul style="list-style-type: none"> Decreased adverse events from antibiotics (e.g. <i>C. difficile</i> infection) No increase in harms associated with decreased antibiotic use Decreased prescribing of fluoroquinolones and clindamycin
<p>Contribution from health care professionals, health science school programs, health care students, and ECE staff and students</p> <p>Program support from the BCCDC</p>	<p>Public education</p> <ul style="list-style-type: none"> Preschool-aged education programs School-aged education programs Older adult education programs Online engagement 	<ul style="list-style-type: none"> Education session attendance/courses completed Number of community partners Website traffic 	<p>Change public behaviours</p> <ul style="list-style-type: none"> Proper handwashing Decreased requests for antibiotics Return unused antibiotics to pharmacist Acceptance of symptomatic treatment 	<p>Stabilization or reduction of antimicrobial resistance in community pathogens in BC</p>
<p>Program stakeholder committee consisting of physicians, nurses, epidemiologists, pharmacists, infectious disease specialists, dentists, naturopaths, nurse practitioners and others</p>	<p>Professional education</p> <ul style="list-style-type: none"> Continuing education (in-person and online) Clinical tools and resources Curriculum contribution Online engagement Professional audit and feedback 	<ul style="list-style-type: none"> Education session attendance/courses completed Website traffic Clinical resource use Number of professional education opportunities Materials distributed Prescribing portraits and college outreach 	<p>Increased healthcare practitioner knowledge</p> <ul style="list-style-type: none"> Evidence-based guidelines for prescribing and infection control 	<p>Reduction in prescribing and use of antibiotics in BC</p> <ul style="list-style-type: none"> Decreased overall prescribing rate Decreased prescribing by dentists Prescribing by naturopaths adheres to evidence-based guidelines Decreased prescribing for UTI in the elderly Decreased prescribing for respiratory infections Decreased length of antibiotic courses
<p>Collaboration with external groups including DBND Alberta, prescribing colleges, and other local, national and international partners</p>	<p>Surveillance and research</p> <ul style="list-style-type: none"> Published research Updating dashboards and data analysis Knowledge translation 	<ul style="list-style-type: none"> AMR/AMU dashboards Dashboard traffic Articles published Policy input/development 	<p>Change healthcare practitioner behaviours</p> <ul style="list-style-type: none"> Decreased unnecessary and inappropriate prescribing of antibiotics for suspected viral infections Increased use of first line antibiotics 	

The program logic model depicts the different components of the overall program as well as how they contribute to a decrease in antibiotic resistance in B.C. through public and professional education and an increase in proper antibiotic prescribing practices. The model is used in the planning, implementation, and evaluation of the program. The model is dynamic and changes as the program develops. An update on the progress of logic model impacts is included in the [Impacts](#) section of this report.

The logic model is a living document, and was significantly revised in the 2017/18 fiscal year. New long term impacts have been identified to help determine the future success of the program.

Program team



The Community Antimicrobial Stewardship program team

Team members

Dr. David Patrick	Medical Epidemiology Lead
Dr. Edith Blondel-Hill	Medical Director, Do Bugs Need Drugs?
Stephanie Dion	Public Health Manager
Nick Smith	Project Manager
Dr. Abdullah Mamun	Epidemiologist
Dr. Erin Fraser	Public Health Veterinarian
Kate O'Connor	Nurse Educator
Dr. Emily Rempel	Knowledge Translation Lead
Dr. Hannah Lishman	Post-Doctoral Fellow

The team would also like to recognize the contributions of former team member Hattaw Khalid in 2019/20.



Activities

The CAS team at the BCCDC's annual Science World After Dark event, October 2019



Canadian Centre for Infectious Disease Control and Prevention
Public Health Agency of Canada



Public outreach

Doctor's office advertising

For the first time the CAS program purchased advertising space on digital screens in doctor's office waiting rooms across the province. This was part of the program's penicillin allergy campaign, with a short 30 second video playing every 15 to 20 minutes during regular office hours.

DATES

October 14 – November 17, 2019

REACH

249,805⁶

54

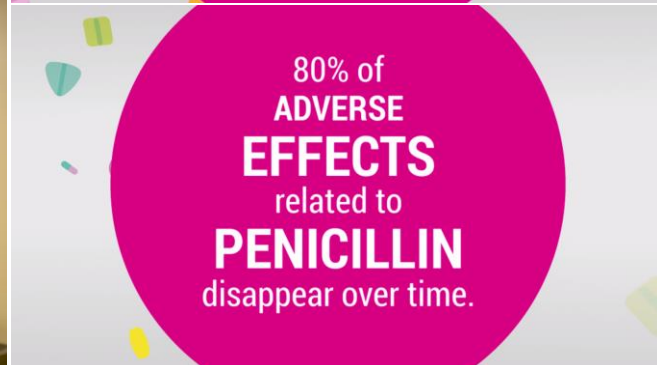
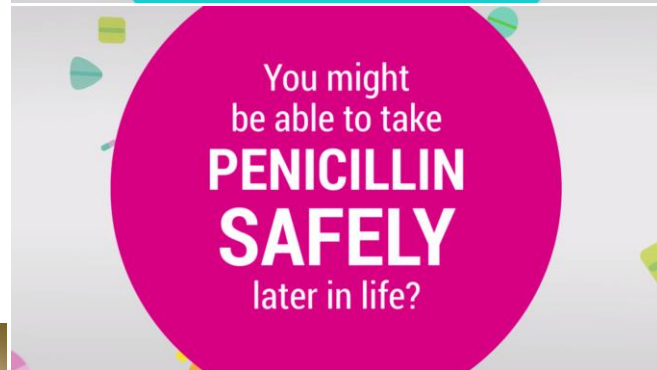
SCREENS

28

COMMUNITIES



[View the video on YouTube](#)



Television advertising

A 15 second television ad was created to support the program's antibiotic prescribing in adults over the age of 65 campaign. Advertising time was purchased for programs most watched by the 65+ age demographic, and the video was also shown during designated Public Service Announcement timeslots at no cost to the program.

DATES

January 27 – March 2, 2020



View the video on YouTube

PLANNED REACH

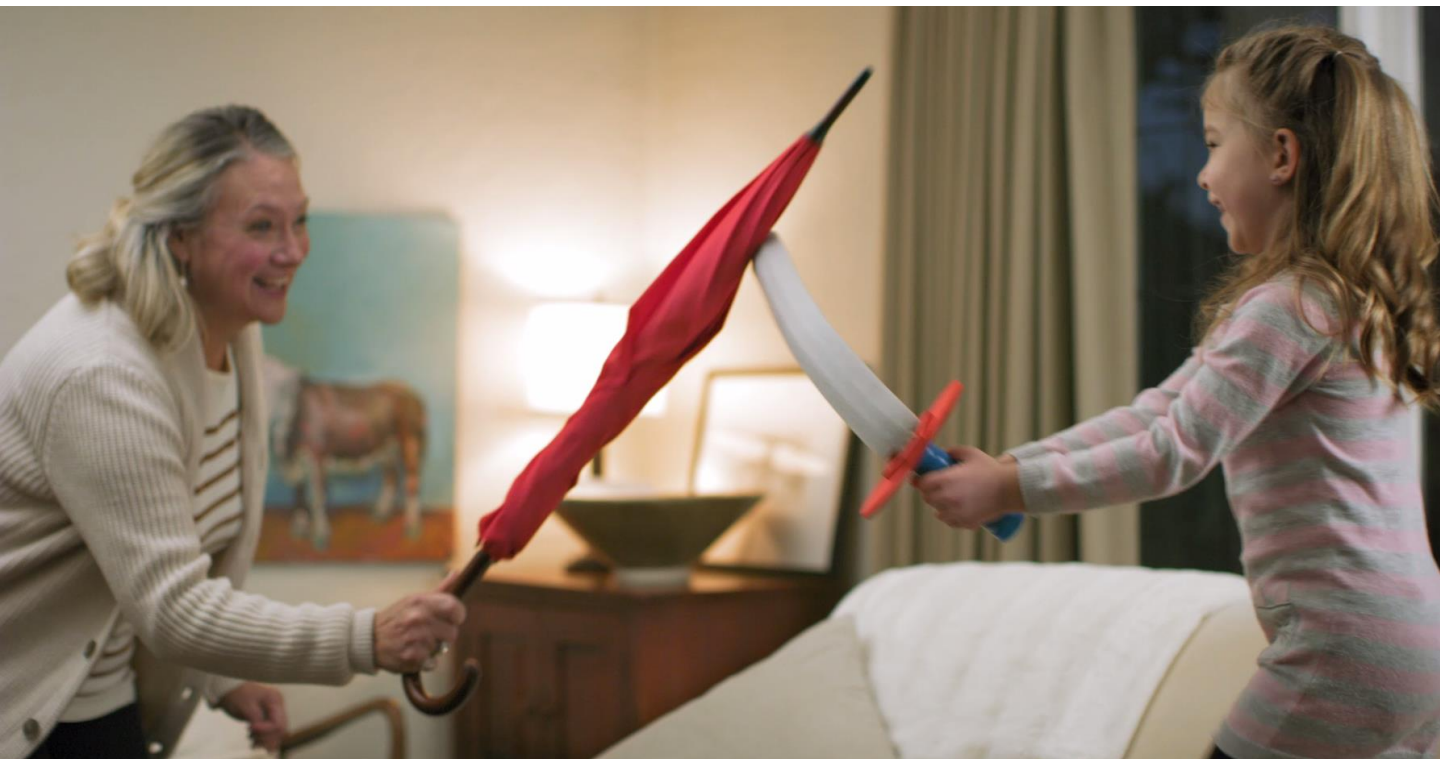
6 million

ACTUAL REACH

22 million

PSA REACH⁶

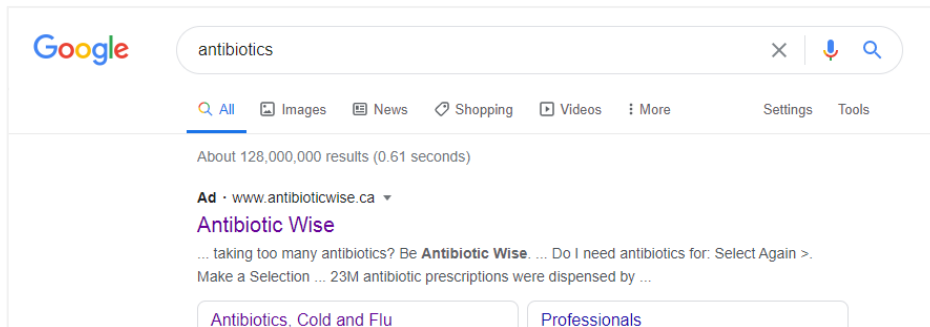
4.7 million



Online advertising

Various means of online advertising were used to enhance and support the adults over 65 campaign on television. These ads ran over the same time period (January to March 2020) as the television ad.

	Impressions ⁶	Clicks to Website ⁶
Display Ads Banner ads displaying on news and health websites	1.6 million	1,864
Search Ads Antibiotic Wise appears at top of relevant Google Search results	91,608	1,531
Social Ads Ad appearing on Facebook and Instagram social media networks	1.3 million	36,340



Social media



Twitter

	@AntibioticWise	@DoBugsNeedDrugs
Total followers	664	1,348
Followers gained this year	160	69
Change in followers	+32%	+5%
Total reach	564,638	935,576
Reach this year	344,518	184,000



Facebook

	/AntibioticWise	/DoBugsNeedDrugs
Total followers	179	417
Followers gained this year	66	52
Change in followers	+58%	+14%
Total reach	401,033	3,824,841
Reach this year	277,216	36,862



Instagram

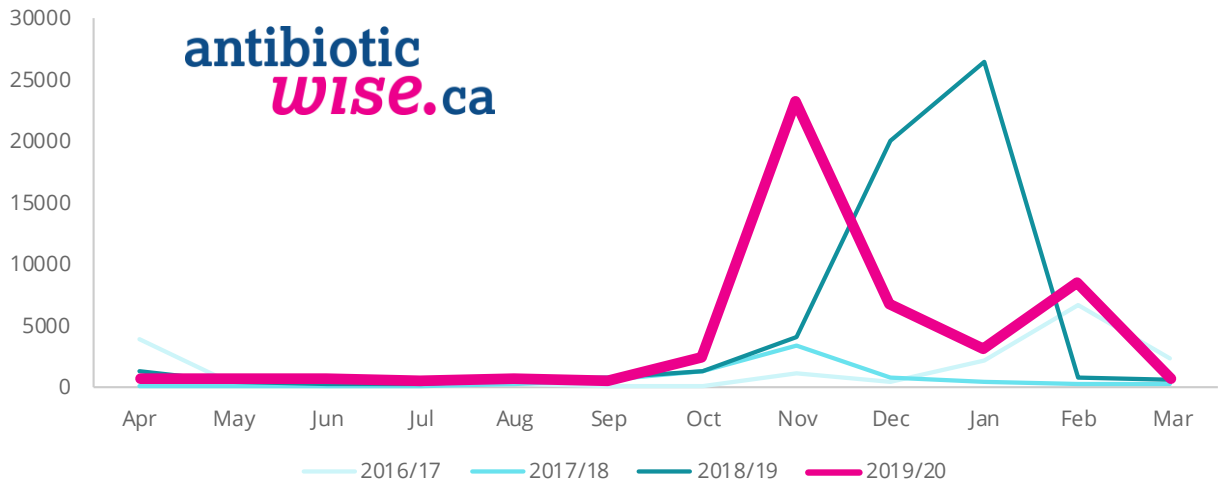


LinkedIn

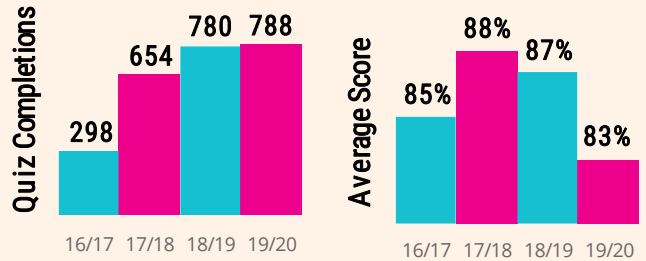
	@AntibioticWise	/Antibiotic-Wise
Total followers	134	33
Followers gained this year	92	33

Websites

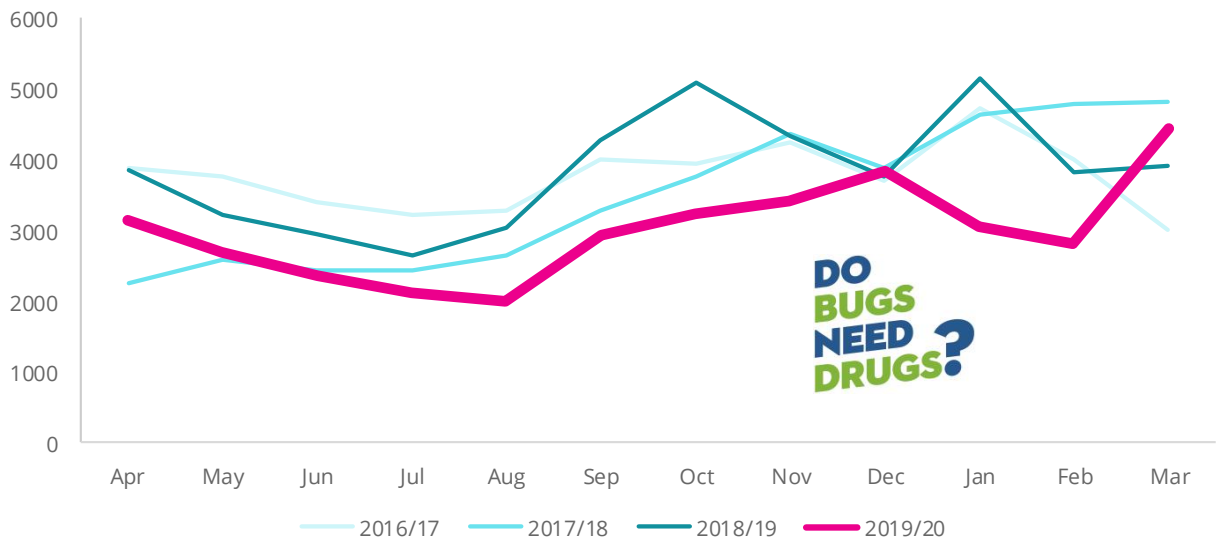
antibioticwise.ca monthly sessions, 2016/17-2019/20⁷



A quiz about antibiotics and AMR available on antibioticwise.ca saw a slight increase in the number of completions, while the average score decreased to the lowest level since the quiz was launched. However, knowledge of the basics of antibiotics and AMR remains quite high.



do bugsneeddrugs.org monthly sessions, 2016/17-2019/20⁷

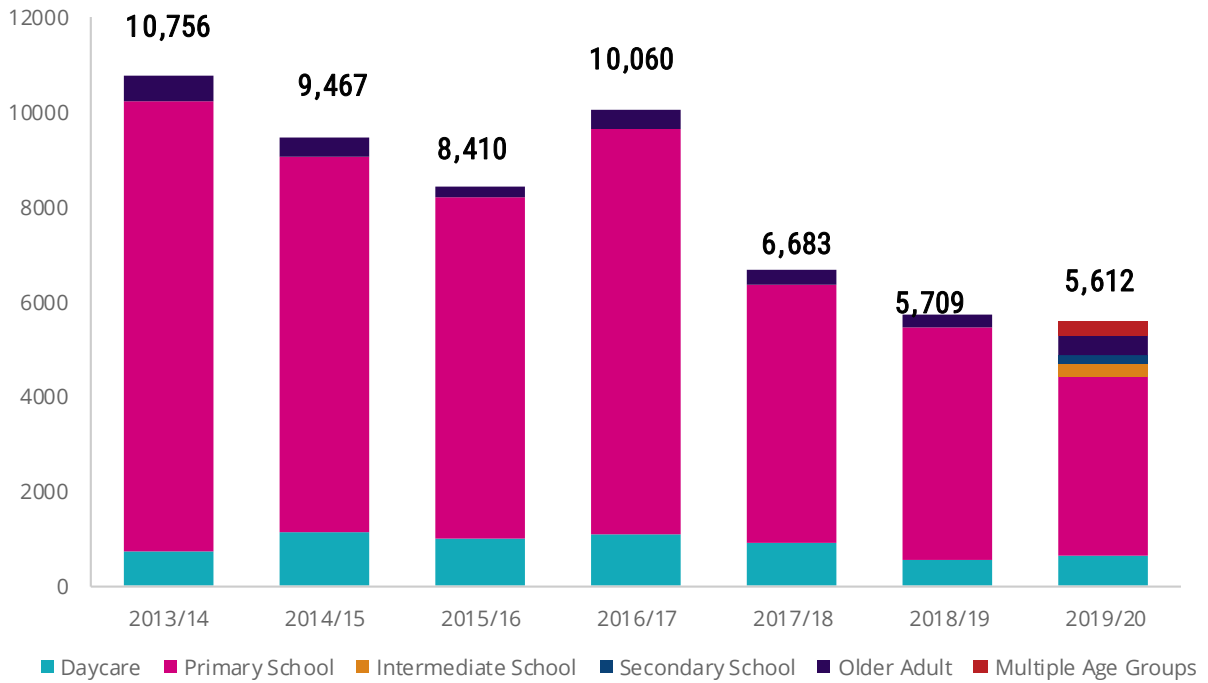


Do Bugs Need Drugs?



Program	Description
Daycare	For pre-school children aged 2-5 emphasizing the importance of handwashing and introducing germs and illness through activities, songs and parent-intended material.
Grade 2	For children aged 7 and 8 stressing the importance of proper and frequent handwashing, the dangers of misusing antibiotics, and the basic differences between viruses and bacteria.
Kindergarten – Grade 3	Resources meeting B.C. education curriculum that allow teachers to incorporate Do Bugs Need Drugs into their classroom, intended for children approximately 6 to 10 years of age.
General Teaching	Sessions incorporating elements of the formal education programs adapted for different age groups or abilities. Delivery and adaptations of these sessions is at the discretion of the trainer.
Older Adult	Focused on teaching older adults in care the three key messages of Do Bugs Need Drugs.

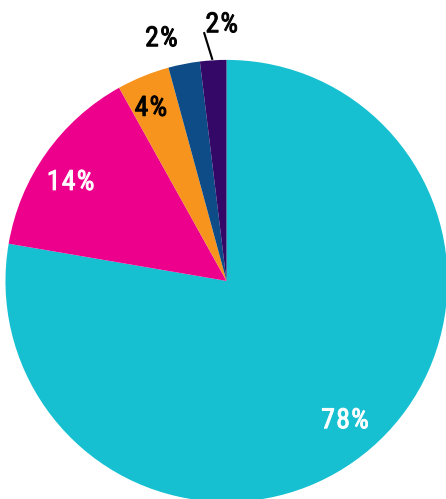
Number of individuals taught *Do Bugs Need Drugs?* curriculum



Under-reporting and curriculum fatigue may be contributing to the decrease in DBND participants. Both these issues are being addressed through a new online reporting form, and a refresh of all teaching curricula in 2019/20.

138,807

people across B.C. have been taught the *Do Bugs Need Drugs?* curriculum since 2005



Designation of person providing *Do Bugs Need Drugs?* curriculum

- Nursing Student
- Medical Student
- ECE Student
- Health Care Assistant
- Other

Kids Boost Immunity & I Boost Immunity



Kids Boost Immunity (KBI) is an online learning resource linked with science and social studies school curricula that provides an opportunity for students to earn vaccines for children in need through UNICEF. The CAS program has partnered with KBI for antibiotic resistance content since 2017.

1,227

students completing AMR content



I Boost Immunity (IBI) is an immunization advocacy program which provides quizzes, articles and stories related to vaccination, and allows users to earn vaccines for children in need through UNICEF. The CAS program has partnered with IBI for antibiotic resistance content since 2018.

295

users completing AMR content

36,709

total questions answered

76%

questions answered correctly

3,105

total vaccines earned

Answers to questions on both KBI and IBI indicate that the public has a strong understanding that antibiotics only treat bacterial infections, and that overuse and misuse of antibiotics can cause an increase in resistant bacteria.

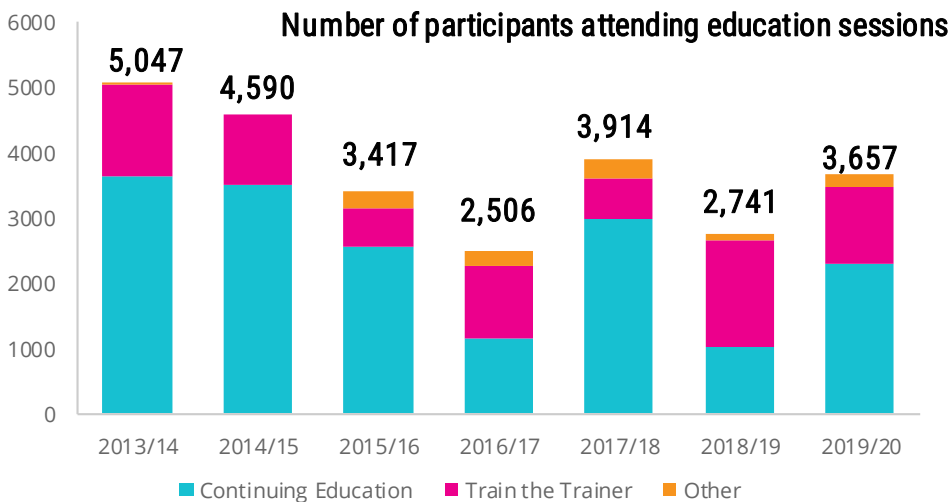
Conversely, there is still a widespread belief that resistance occurs within an individual's body, rather than within bacteria, and that antibiotics are ineffective at treating colds and flu.



Professional education

Education sessions

Professional education sessions provide training for healthcare professionals and students to teach the DBND education curriculum, as well as continuing education for professionals on the program's main messages, including CME events, and conference posters and presentations.



Professional education participation increased 33% in 2019/20, with continuing education jumping 123%.

2019/20 professional education highlights

St. Paul's Hospital CME | Nov. 26-29, 2019
Vancouver, BC
1,618 total attendees

Presentation
Management of Community-Acquired Pneumonia
Dr. David Patrick

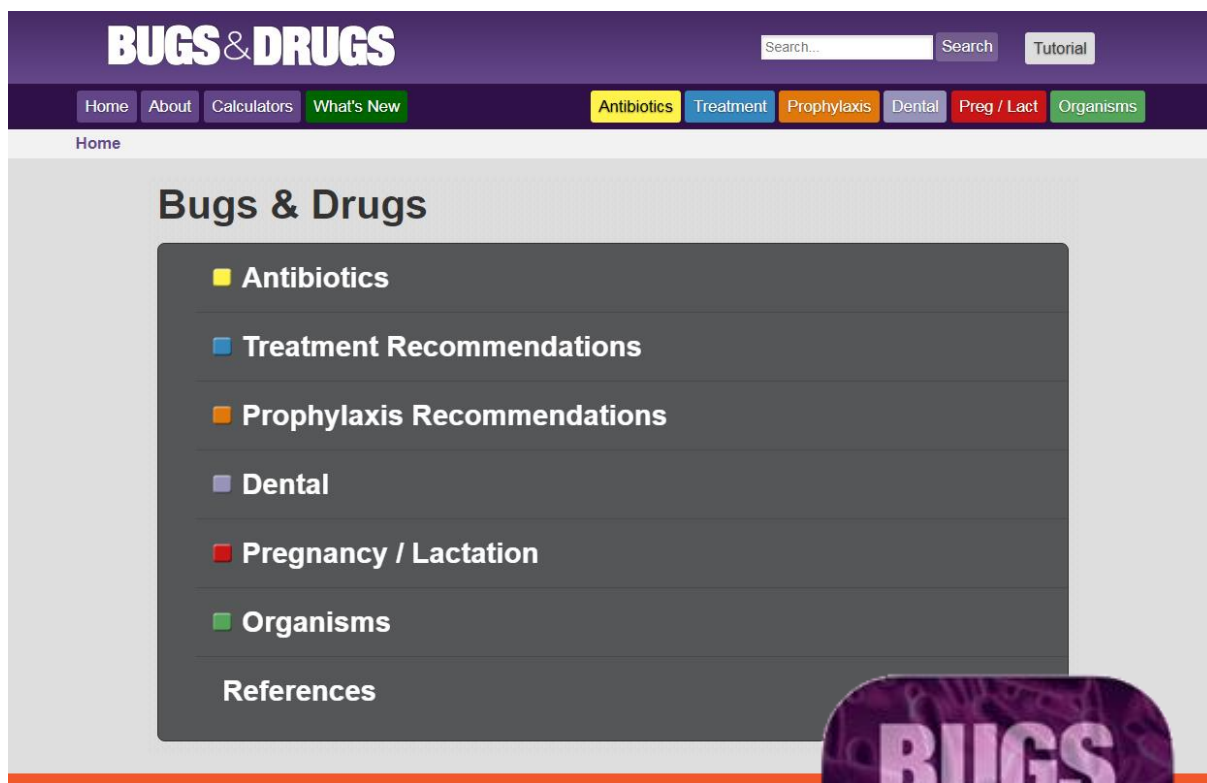


Pacific Dental Conference | March 7 & 8, 2019 | Vancouver, BC
13,777 total attendees

Presentation
Safe and Effective Antibiotic Prescribing for the Busy Dental Practitioner
Dr. David Patrick

Antibiotic Wise Exhibitor Booth: >200 visitors to booth

Bugs & Drugs reference guide



The Bugs & Drugs Antimicrobial Reference Guide has been available free-of-charge across B.C. since March 2017. The guide is also available for purchase as an iPhone/Android mobile app. A new design for both the website and app was launched in 2020, with the app moving to a new subscription-based model. The statistics below represent the web version of the guide only⁸.



2019/20 Bugs & Drugs website statistics		2018/19
Total users	19,454	+23%
Total sessions	60,909	+17%
Pages per session	8.38	-2%
Number of communities guide accessed in	86	-3%





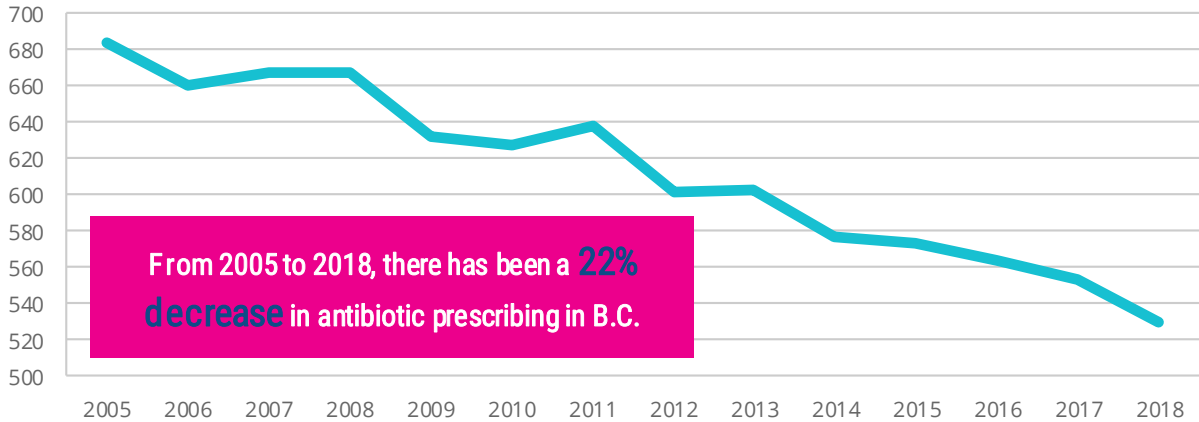
Outcomes

Antimicrobial utilization



Detailed prescribing data for B.C. can be found on the Antimicrobial Utilization Dashboard on the BCCDC website

Overall B.C. prescription rate/1000 population/year

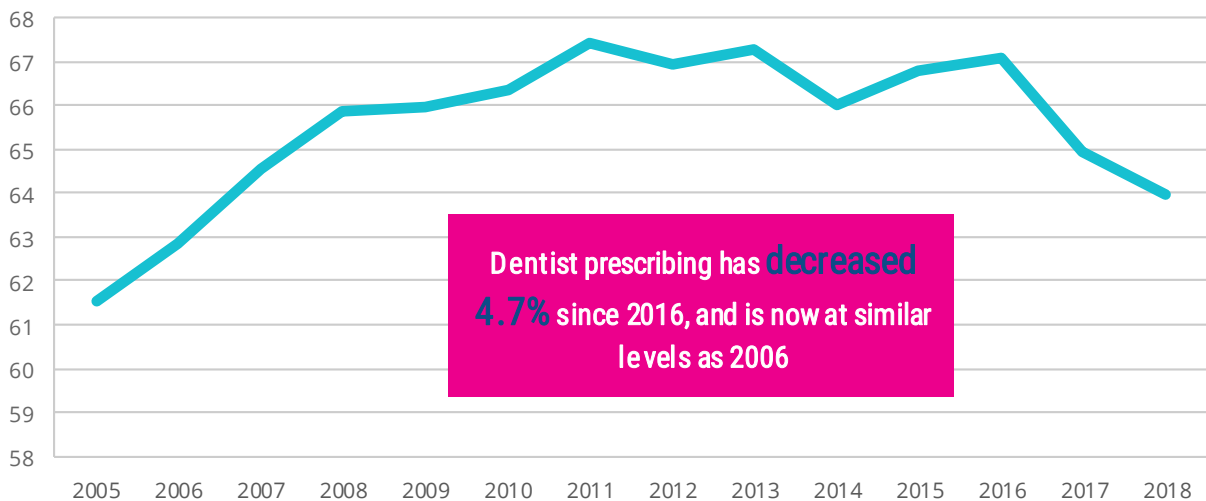


Top prescribed antibiotics in B.C.

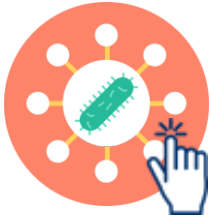
Amoxicillin | Clarithromycin | Azithromycin |
Amoxicillin and enzyme inhibitors | Doxycycline



Dentist prescribing rate/1000 population/year



Antimicrobial resistance



Detailed resistance data for B.C. can be found on the Antimicrobial Resistance Dashboard on the BCCDC website

Surveillance activities allow for the evaluation of the impact of the Community Antimicrobial Stewardship program on resistance rates for specific pathogens and drug classes of interest in B.C. Data analysis limitations have delayed updates to the AMR Dashboard using data provided by LifeLabs. A data analyst is currently being recruited by the program to address this issue.

Below are highlighted some additional work completed by the team and the BCCDC Public Health Laboratory/PICNet to track resistance rates in BC.

AMR patterns in companion animals

MPH student Laurel White undertook an analysis of AMR data received from IDEXX Laboratory (a private veterinary lab) for companion animals. A comparison was made of AMR patterns between human and companion animals.

Among the findings were that *E. coli* resistance in isolates from animals was consistently lower than those from humans (BC only) for a small panel of antimicrobials that were analyzed. Further analysis of more detailed data sets is now in the planning stages.

Non-susceptibility trends in *E. coli* from urine isolates from humans and animals for cephalosporins



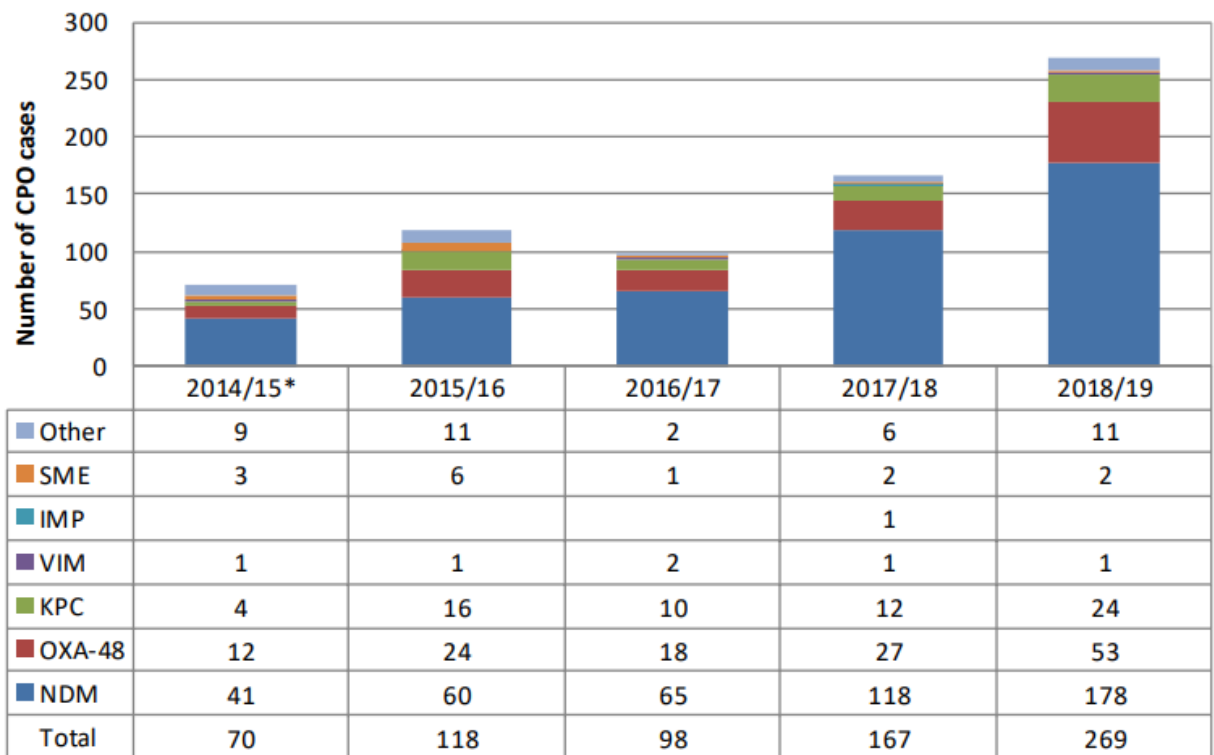
Carbapenemase producing organism surveillance

A mandatory provincial carbapenemase producing organism (CPO) surveillance program was introduced in BC acute care facilities in 2014. Since 2017 CPOs have been reportable, meaning all new cases identified in community care settings are reported to PICNet.

The 2018 Canadian Antimicrobial Resistance Surveillance System report indicates that colonization by CPOs has increased in hospitals and the community in Canada, and PICNet evidence would support this statement in BC.

Nearly 20% of patients identified to have a CPO infection died in the period 2014-2018. More than half of all CPO cases in 2018/19 reported an overnight stay of hospitalization or medical/surgical procedure outside Canada in the previous 12 months. Conversely, 20% of cases reported no known risk factors for CPO infection.

CPO patient isolates in BC from 2014/15 to 2018/9 ⁹



Note: The number of CPO cases includes CPO identified in both healthcare facilities and community care settings.

* From July 18, 2014 to March 31, 2015 only

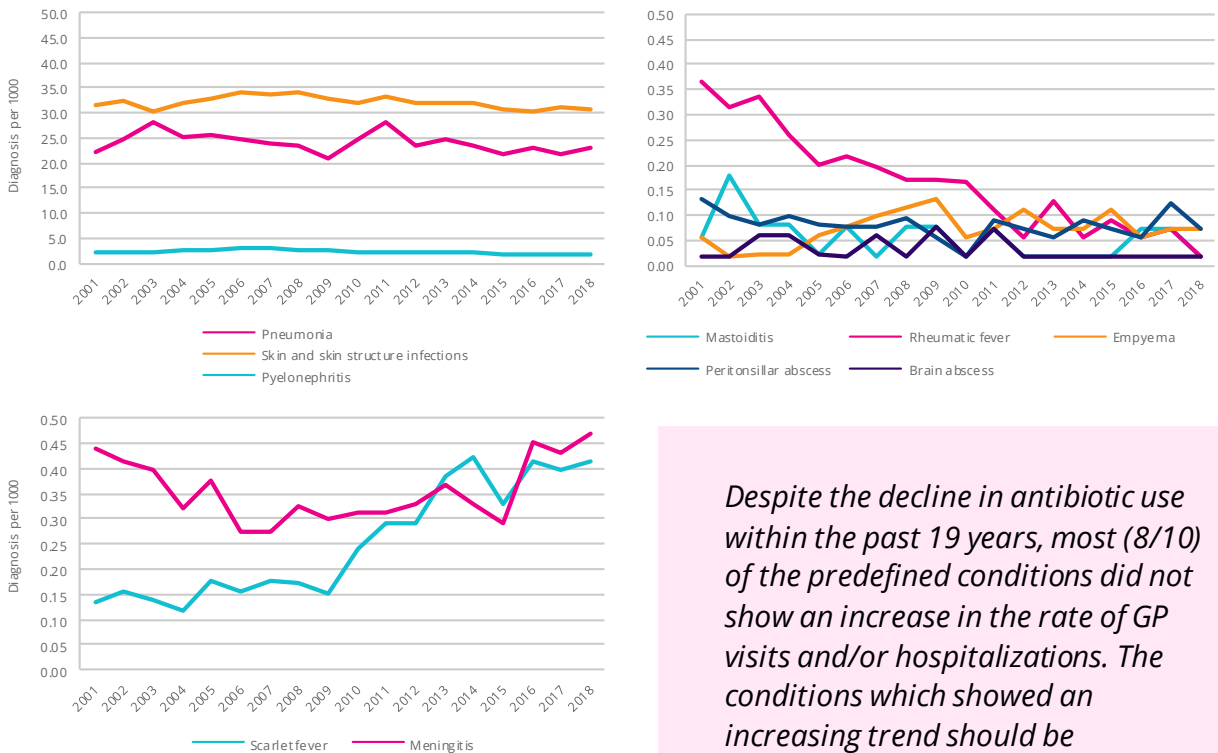
Unintended consequences

The program has begun tracking the incidence of potential, unintended consequences resulting from reduced antibiotic prescribing in BC. In the first exploratory analysis, it was investigated whether there has been an increase in practitioner encounters and hospital admissions arising from untreated or inadequately treated infections in children aged 5 years and younger.

10 conditions were identified in which delayed or absent antibiotic intervention could progress to more severe complications.

- Pneumonia
- Skin structure infections
- Pyelonephritis
- Mastoiditis
- Rheumatic fever
- Empyema
- Peritonsillar abscess
- Brain abscess
- Scarlet fever
- Meningitis

Rate of various conditions in BC children ≤5 (2001-2018) ¹⁰



Despite the decline in antibiotic use within the past 19 years, most (8/10) of the predefined conditions did not show an increase in the rate of GP visits and/or hospitalizations. The conditions which showed an increasing trend should be interpreted with caution as they are relatively rare (scarlet fever and meningitis). The rise in scarlet fever may in fact be due to changes in the underlying epidemiology of circulating streptococcal strains.

A more in-depth analysis of sepsis rates in BC, broken down further by age as well as etiologic agent, will be undertaken over the next year.

All data were generated from BC Data Scout™ service (Sep 19 - Oct 17, 2019; IDs 737407 - 571440). All inferences, opinions, and conclusions drawn in this publication are those of the author(s), and do not necessarily reflect the opinions or policies of the British Columbia Ministry of Health.

Research

Published

THE LANCET
Respiratory Medicine

Decreasing antibiotic use, the gut microbiota, and asthma incidence in children: evidence from population-based and prospective cohort studies

Patrick DM, Sbihi H, Dai DL, Al Mamun A, Rasali D, Rose C, Marra F, Boutin RC, Petersen C, Stiemsma LT, Winsor GL, Brinkman SL, Kozyrskyj AL, Azad MB, Becker AB, Mandhane PJ, Moraes TJ, Sears MR, Subbarao P, Finlay BB, Turvey SE
The Lancet Respiratory Medicine, 2020 March 24

CJPH
RCSP

Cost-benefit analysis of a population-based education program on the wise use of antibiotics

Mamun A, Zhao B, McCabe M, Dreher K, Otterstatter M, Smith N, Blondel-Hill E, Marra F, Patrick DM
Canadian Journal of Public Health, 2019 Dec;110(6):732-40

BCM J

BC Medical Journal

Beta-lactam allergy: Benefits of de-labeling can be achieved safely

Patrick DM, Mamun A, Smith N, Rempel E, Calissi P, Blondel-Hill E
BCM J, 2019 Nov, 61(9): 350-1, 361

Upcoming research

- MPH student Hadi Dalati is working with the team to explore antibiotic prescribing rates by Local Health Area (LHA) in BC to compare trends in urban/rural/metro LHAs and identify LHAs in need of future interventions.
- MPH student Anastasiia Lisovskaia is currently undertaking a project to analyze the length of antibiotic prescriptions in BC, and will compare duration of therapy by profession, major indications of prescription, and major prescribed drug class. These results will be compared with existing antibiotic treatment guidelines.

Impacts

The Community Antimicrobial Stewardship program’s logic model outlines a number of measurable indicators of change representing the intended outcome’s of the program’s activities. While direct causation for these impacts cannot be attributed to the program, these achievements reinforce the value of the program’s initiatives. An overview of the progress made on current impacts is listed in the table below.

Community Antimicrobial Stewardship Logic Model Impacts

Impact Measure	Description
Reduction in morbidity associated with antibiotic use in B.C.	
Decreased adverse events from antibiotics (e.g. <i>C. difficile</i> infection)	The proportion of beta lactam antibiotics (associated with lesser adverse events) has increased 6.3% since 2012, accounting for 34.4% of all antibiotic prescriptions in 2018.
Decreased unnecessary prescribing of fluoroquinolones and clindamycin	Since 2010, the prescription rate/1000 population/year has decreased 25% for clindamycin and 43% for ciprofloxacin. From 2017 to 2018, 6.3% and 8% reductions were seen, respectively. These antibiotics are associated with increased risks of adverse events (including <i>C. difficile</i>).
No increase in harms associated with decreased antibiotic use	<i>See Outcomes – Unintended Consequences (page 21)</i>
Stabilization or reduction of antimicrobial resistance in community pathogens in B.C.	
<i>See Outcomes – Antimicrobial Resistance (pages 20-21)</i>	

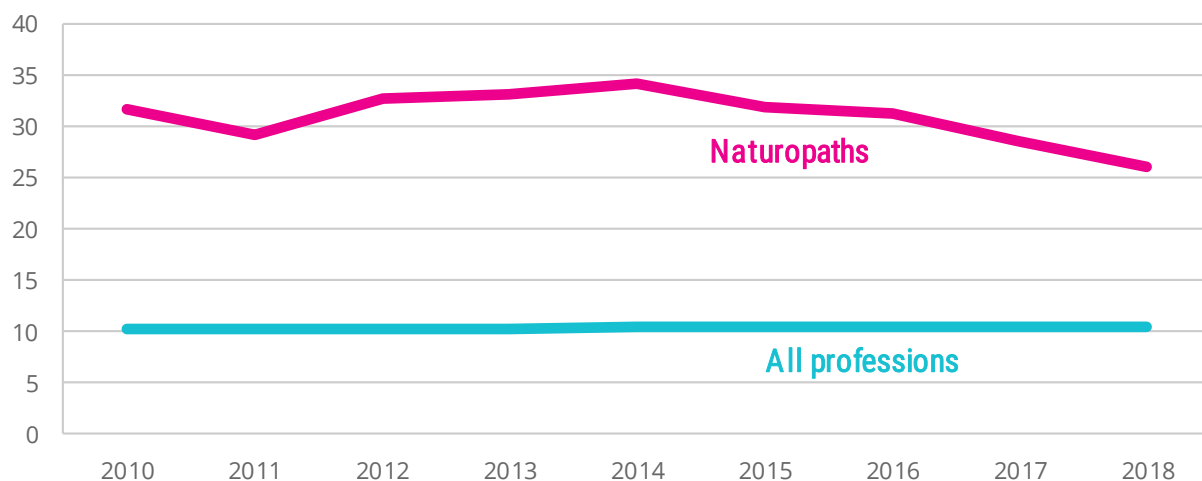


Community Antimicrobial Stewardship Logic Model Impacts (cont.)

Reduction in prescribing and use of antibiotics in B.C.

Decreased overall prescribing rate	The overall community prescription rate/1000 population/year has decreased 22.5% since 2005. From 2017 to 2018, a 4.2% reduction was observed.
Decreased prescribing by dentists	The prescription rate/1000 population/year for dentists has increased by 4% since 2005, but has been decreasing since 2016. From 2017 to 2018, a 1.5% decrease was observed.
Prescribing by naturopaths adheres to evidence-based guidelines	Defined daily dose (DDD) per prescription for naturopaths was 26.1 in 2018, still remaining much higher than other professions (10.4 DDD/prescription for all professions). However, dentist DDD has been decreasing since 2014, and saw a reduction of 8% from 2017 to 2018.
Decreased prescribing for UTI in the elderly	Prescribing for urinary tract infections in those aged 65+ has decreased 9.8% since 2005. From 2017 to 2018, a 1.4% decrease was seen.
Decreased prescribing for respiratory infections	Antibiotic prescribing for respiratory tract infections has decreased 43% since 2005. From 2017 to 2018, an 8.1% reduction was observed.
Decreased length of antibiotic courses	Overall defined daily dose (DDD) per prescription has increased 6% since 2005. DDD per prescription remained steady from 2017 to 2018.

Defined daily dose/prescription for naturopaths and all other professions



Conclusions

The Community Antimicrobial Stewardship program continues to be a leader in the field in Canada, providing a strong reference for other stewardship programs across the country.

Program components have been implemented to various degrees across the province over the past 15 years and continue to expand. A large number of children, adults and health professionals continue to receive teaching through the Do Bugs Need Drugs? program.

Advertising through traditional media channels has built strong awareness of the program with the general public, and increased focus on social media and online advertising in recent years has allowed for more targeted campaigning and more direct contact with British Columbians.

At the same time, engagement with health care professionals continues. Through ongoing collaboration with the Provincial Academic Detailing program, development of continuing education opportunities, and providing access to clinical resources such as the Bugs & Drugs reference guide, significant gains have been made in addressing the unnecessary and incorrect

prescribing of antibiotics. Gains have been made within dentistry due to increased focus on that prescribing group, and further activities are planned to support nurse practitioners in future.

The work completed in the past 15 years has had a significant impact on antimicrobial resistance in B.C. (and saved the public and government hundreds of millions of dollars). Evaluation of the program and interventions are ongoing, looking for ways to further improve the reach of the program and reduce unnecessary prescribing. Results of a small area analysis of prescribing and interventions by Local Health Area will be instrumental in this.

Some prescribing trends continue to worry. The program is re-committing to working with all prescriber groups to help understand specific needs and tailor programming accordingly.

The indicators reflected in this report will continue to inform program planning in an attempt to further improve appropriate utilization of antibiotics, stabilize trends in antibiotic resistance, and ultimately minimize negative health outcomes.



References

- 1 Bronzwaer SL, Cars O, Buchholz U, et al. A European study on the relationship between antimicrobial use and antimicrobial resistance. *Emerg Infect Dis.* 2002; 8(3):278-282.
- 2 Goossens H, Ferech M, Vander SR, Elseviers M. Outpatient antibiotic use in Europe and association with resistance: a cross-national database study. *Lancet.* 2005; 365(9459):579-587.
- 3 Review on Antimicrobial Resistance. Tackling drug-resistant infections globally: final report and recommendations. https://amr-review.org/sites/default/files/160525_Final%20paper_with%20cover.pdf. Published May 19, 2016. Accessed May 25, 2018.
- 4 Council of Canadian Academies, 2019. When Antibiotics Fail. Ottawa (ON): The Expert Panel on the Potential Socio-Economic Impacts of Antimicrobial Resistance in Canada, Council of Canadian Academies.
- 5 Arnold SR, Straus SE. Interventions to improve antibiotic prescribing practices in ambulatory care. *Cochrane Database Syst Rev.* 2005;(4):CD003539.
- 6 Antibiotic Wise 2019-2020 Post-Campaign Report. Lamar Advertising. Email Communication. April 30, 2020.
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The audience at a film screening and Q&A session at Science World, February 2020



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