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Antimicrobial Stewardship

Annual Report 2019-2020

Prepared by the Fraser Health Antimicrobial Stewardship Program

August 2020

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Executive Summary

The Fraser Health Antimicrobial Stewardship Program (ASP) is a small but highly skilled team. We work closely with other clinical staff members who are already championing antimicrobial stewardship on the front line. Our team is currently comprised of five specialized pharmacists and one Infectious Diseases consultant.

Our purpose is to promote appropriate antimicrobial use within Fraser Health. To accomplish this, we have set three goals which guide all of our program activities: to optimize patient care through appropriate antimicrobial use, to slow the emergence of antimicrobial resistance, and to improve health care efficiency. These goals are consistent with the patient safety mandate to minimize preventable harm to patients.

With our team of ASP clinicians, we are routinely reviewing patient cases involving targeted antibiotics and interacting with prescribers in a systematic fashion at multiple acute care sites. Over the past year, our team has reviewed 13,933 patient cases and made specialized clinical interventions in 4,927 patient cases. Our recommendations were accepted in 87% of cases.

We have continued to expand our FH specific ASP Handbook, which is a consolidated, evidence-based reference for treatment of common infections. This year we have released chapters to support and guide clinicians in management of pleural infections, COPD exacerbation, pneumonia in Long Term Care, central nervous system infections, sepsis in CPO colonized patients, and colistin dosing.

We continue to take part in an international point prevalence survey, Global-PPS, which allows us to longitudinally track antimicrobial use in our facilities. The ASP is involved in development and revision of pre-printed order sets that include antimicrobials. Pre-printed orders (PPO) help standardize care across Fraser Health in line with best practices. Our team took a leadership role in synthesizing best-available clinical practice for the COVID-19 PPO and related treatment guidelines in our Spectrum smartphone application.

Our program's activities have continued to put downward pressure on broad-spectrum antimicrobial use. Usage of targeted antimicrobials including carbapenems increased slightly, but remains far below pre-ASP levels. Usage of piperacillin-tazobactam, linezolid, and daptomycin have reduced or remained stable. Usage of fluoroquinolones continues to drop. *C. difficile* infection rates remain low compared to historical trends.

In an effort to improve health care efficiency, the ASP seeks to promote wise and effective use of taxpayer money. Fraser Health has seen a \$560,317 increase in antimicrobial expenditure in FY2019-20 compared to FY2018-19 – though this remains \$2,601,044 (22.4%) below peak expenditures in FY2013-14.

This report provides further details on our program's initiatives, as well as the various performance measures we follow. We've learned a great deal from our clinicians and staff, and have been tremendously fortunate to have such broad support. We look forward to any comments or questions regarding this report. As we strive to use antimicrobials wisely in today's patients, we hope to prolong their effectiveness for tomorrow's patients.

Background

The rise of antimicrobial resistance is a significant threat to patient care and public health. An estimated 18,000 Canadians every year develop drug-resistant infections within our hospitals.¹ The emergence of antimicrobial resistance impacts patient morbidity and mortality, leading to increased healthcare costs. Major problems include the rise of methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *Enterococcus faecium* (VRE), and multidrug-resistant gram-negative organisms, including *Pseudomonas*, *Acinetobacter*, and carbapenem-resistant Enterobacteriaceae (CRE). Unchecked, mortality attributable to antimicrobial resistance is estimated to increase to over 300,000 annually in North America by 2050.²

Concurrently, the healthcare system has had to manage the rise of *Clostridioides difficile* infection (CDI). Concerted efforts to reduce CDI include improving infection prevention and control practices, as well as promoting appropriate use and selection of antimicrobials through an antimicrobial stewardship program (ASP).

ASPs have been shown to improve antimicrobial usage, improving the quality of patient care through more appropriate selection and dosing of antimicrobials. Patient safety is also improved through reduced toxicity and adverse events from antimicrobial misuse. Institution of an effective ASP can decrease CDI, as well as put downward pressure on the rise of antimicrobial resistance. Furthermore, all of these benefits can be realized while saving the healthcare system money.

Our ASP's purpose and goals are as follows:

Purpose:

The ASP promotes appropriate use of antimicrobials within Fraser Health (FH).

Goals:

The goals of the program are threefold:

- a. To optimize patient care through appropriate selection and use of antimicrobials, while minimizing adverse events
- b. To slow the emergence of antimicrobial resistance by limiting selection pressure from antimicrobial misuse
- c. To improve health care efficiency by reducing unnecessary antimicrobial use

¹ Public Health Agency of Canada. Antimicrobial resistance and use in Canada: A federal framework for action. Can Commun Dis Rep. 2014;40 Suppl 2:2-5.

² Review on Antimicrobial Resistance. Antimicrobial resistance: tackling a crisis for the health and wealth of nations. 2014. Available from <http://amr-review.org/Publications>.

ASP Team Members

Clinical Team

The clinical team conducts the daily activities of the ASP. This includes performing audit and feedback of antimicrobial prescribing, providing education for clinicians, undertaking quality improvement initiatives, and liaising with stakeholders and leaders across the health authority.

Members of the clinical team include:

Dr. Kevin Afra	<i>ASP Medical Director & ID Consultant</i>
Dr. Vivian Leung	<i>Pharmacy Coordinator, Antimicrobial Stewardship</i>
Ms. Julia Cahill	<i>Clinical Pharmacy Specialist, Antimicrobial Stewardship</i>
Dr. Ivy Chow	<i>Clinical Pharmacy Specialist, Antimicrobial Stewardship</i>
Dr. Colin Lee	<i>Clinical Pharmacy Specialist, Antimicrobial Stewardship</i>
Dr. Tim Leung	<i>Clinical Pharmacy Specialist, Antimicrobial Stewardship</i>
Dr. Maggie Wong	<i>Clinical Pharmacy Specialist, Antimicrobial Stewardship</i>

Administrative support for the program was provided by Anne Littlewood.

Data Team

Newly joining the ASP this year is our data team, an exciting collaboration with Infection Prevention and Control. The data team conducts the regular extraction, analysis, and synthesis of data for the ASP. They also provide expert guidance in study design and interpretation.

Members of the data team include:

Katy Short	<i>Senior Epidemiologist, IPC</i>
Katherine Wang	<i>Epidemiologist, IPC</i>
Eunsun (Sunny) Lee	<i>Data Analyst, IPC</i>

Executive Oversight

Dr. Kevin Afra, medical director of the ASP, is accountable to Linda Dempster (VP Patient Experience) and Dr. Roy Morton (VP Medicine) who provide executive-level guidance and oversight for the program. They also inform the Fraser Health Executive, the Board of Directors, and provincial stakeholders on the status of the ASP.

Dr. Vivian Leung is accountable to Dr. Adil Virani (Manager, Pharmacy Services), who reports to Mr. Spencer Tuttle (Director, Pharmacy Services).

Regional ASP Committee

The Regional ASP Committee is an inter-disciplinary group of clinicians and leaders within the health authority. The Committee discusses, develops, promotes, and evaluates strategies utilized by the ASP to meet its program goals. An associated Advisory Group is drawn upon as needed.

Members of the Regional ASP Committee include:

Dr. Kevin Afra (chair)	<i>ASP Medical Director & ID Consultant</i>
Ms. Wendy Bowles	<i>NP & Regional Department Head, Nurse Practitioners</i>
Dr. Elizabeth Brodtkin	<i>Executive Medical Director, IPC & MHO</i>
Dr. Michael Chapman	<i>ID Division Head & ID Consultant, SMH</i>
Dr. Vivian Leung	<i>ASP Pharmacy Coordinator</i>

Dr. Sangita Malhotra	<i>ID Consultant, RCH</i>
Dr. Shazia Masud	<i>Medical Microbiologist</i>
Dr. Neil Mina	<i>Medical Microbiologist</i>
Dr. Susan Roman	<i>Medical Microbiologist</i>
Dr. Gabi Vasile	<i>Hospitalist, ERH</i>
Dr. Adil Virani	<i>Manager, Pharmacy Services</i>
Dr. Davie Wong	<i>ID Consultant, RCH</i>
Ms. Anne Littlewood	<i>Administrative Assistant</i>

Members of the Regional ASP Committee Advisory Group include:

Dr. John Diggle	<i>Regional Department Head, Medicine</i>
Dr. Laurenna Peters	<i>ID Consultant, BH</i>
Dr. Steven Reynolds	<i>Critical Care Physician & Site Medical Director, RCH</i>
Dr. Michael Paletta	<i>Regional Department Head, Hospitalists</i>

Acknowledgements

The ASP would like to thank the countless individuals who have supported our program. We have been encouraged by our growing collaboration with the FH Executive Team, Site Medical Directors, and Site Executive Directors. We are fortunate to enjoy a strong partnership with Pharmacy Services. It is a privilege to support our front-line medical and clinical staff as we strive towards excellence in patient care.

Our special thanks also goes to:

- Division of Infectious Diseases
- Medical Microbiology
- Infection Prevention and Control (IPC)
- Lower Mainland Pharmacy Services (LMPS) Medication Use Evaluation
- Clinical Policy Office
- Our colleagues from other antimicrobial stewardship programs, including the Antimicrobial Stewardship Programs of Providence Health Care and Vancouver Coastal Health.
- The Provincial Antimicrobial Stewardship Clinical Expert Group (PACE)

Program Activities

Audit and Feedback

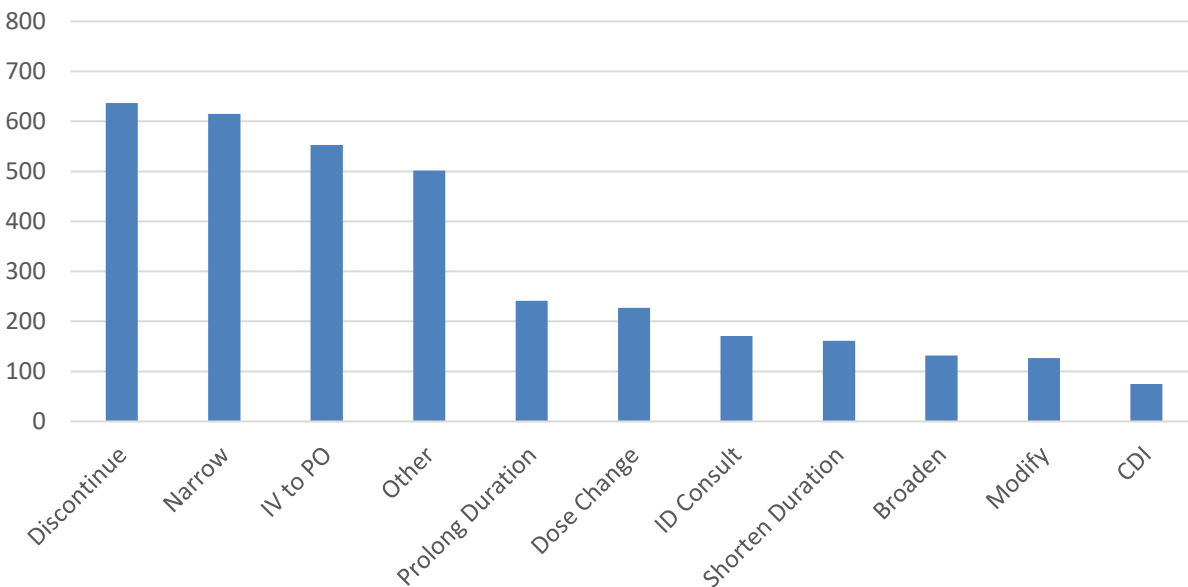
Prospective audit and feedback is one of the core activities of an ASP. It involves real time case-by-case assessment of patients with direct feedback to the patient’s care team – most often Medical Staff and Pharmacists. We prospectively identify patients receiving targeted antimicrobials or with certain infectious conditions. One of our team members assesses the patient and identifies whether there is an opportunity to optimize infection management. If so, recommendations are communicated to the care team. Our audit and feedback service does not change medication orders without permission of the most responsible provider.

Our team’s intervention statistics are as follows:

Fiscal Year	Patient Cases Reviewed	Patient Cases Intervened Upon	Acceptance Rate
FY2017	6,241	3,173	82 %
FY2018	10,434	3,191	90 %
FY2019	12,596	3,928	87 %
FY2020	13,933	4,927	87 %

Specific intervention data is collected using a sampling methodology. In FY2020 we sampled 2,513 patient cases which had 3,441 specific interventions (**Figure 1**).³

Figure 1. ASP audit and feedback interventions by type

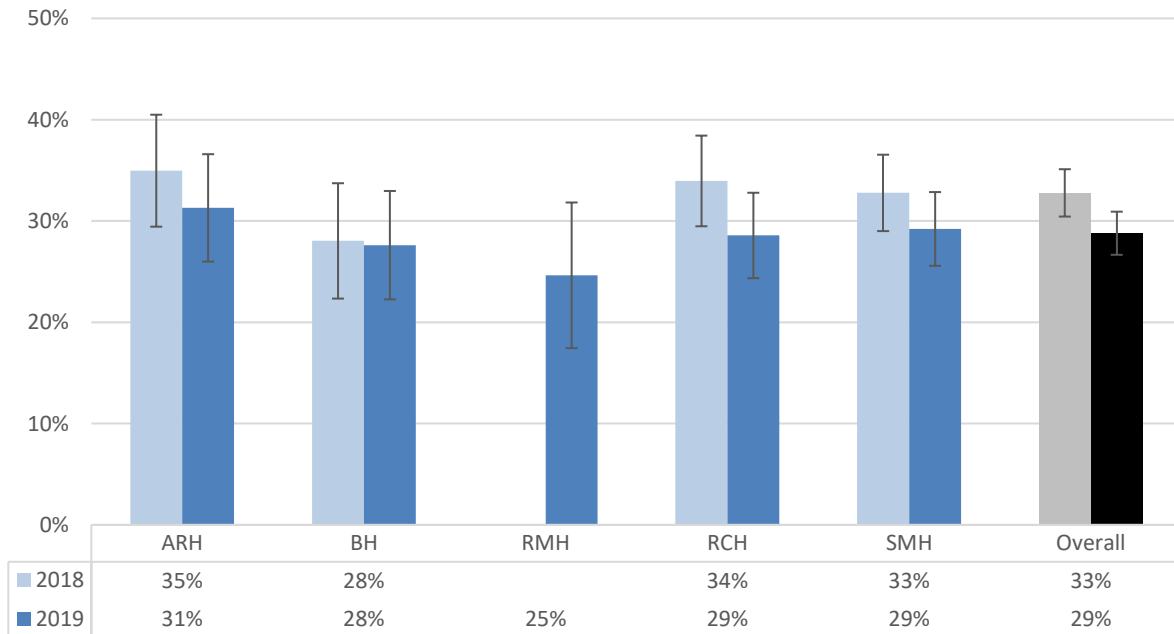


³ A patient case may be associated with more than one concurrent intervention, e.g., narrowing therapy plus IV to PO step-down

Point Prevalence Survey

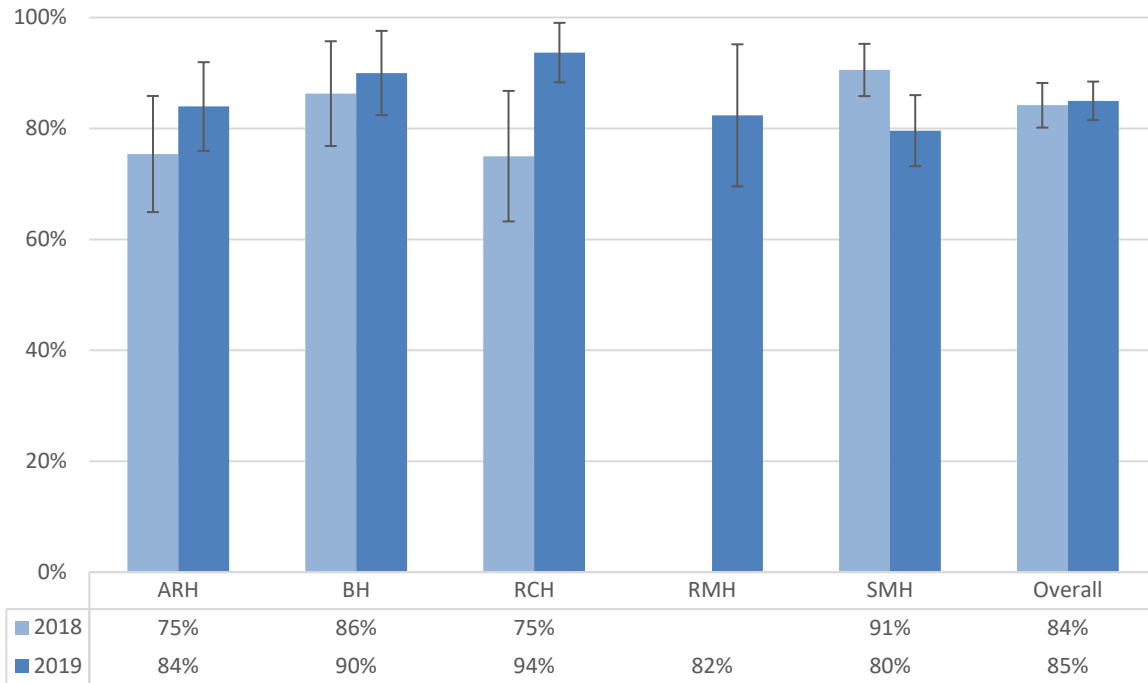
During the winter of 2019, the ASP took part in an international point prevalence survey called Global-PPS. Five hospitals were audited, each in the span of a single day, for every patient receiving an antimicrobial. RMH was audited for the first time, in addition to previously included sites (ARH, BH, RCH, SMH). Antimicrobial use prevalence was 29% overall (**Figure 2**). In other words, one in three hospitalized patients on any given day was receiving an antimicrobial. This finding is consistent with antimicrobial use reported in the literature. While each hospital trended to lower antimicrobial use prevalence in 2019 compared to 2018, this was not statistically significant.

Figure 2. Prevalence of antimicrobial use by hospital, Global-PPS audit.



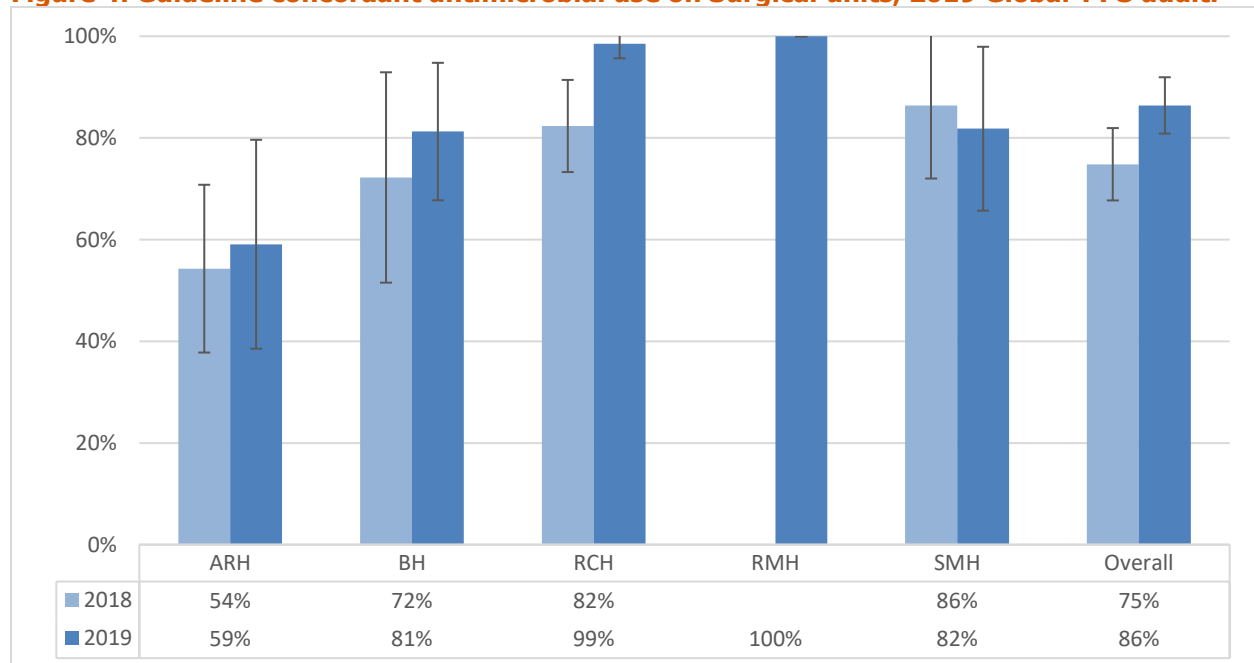
Overall, 87% of antimicrobial therapy was concordant with clinical guidelines. Guideline concordance by hospital and unit type is shown below, with year-over-year trends (**Figures 3 to 6**). RCH showed a statistically significant increase in guideline concordance for Medical units, Surgical units, and all units overall. SMH showed a statistically significant reduction in guideline concordance for Medical units. Note that in the Global-PPS methodology, route of administration or duration of therapy is not considered when assessing guideline concordance.

Figure 3. Guideline concordant antimicrobial use on Medical units, 2019 Global-PPS audit.



Note: Statistically significant increase for RCH in 2019 compared to 2018. Statistically significant decrease for SMH in 2019 compared to 2018.

Figure 4. Guideline concordant antimicrobial use on Surgical units, 2019 Global-PPS audit.



Note: Statistically significant increase for RCH in 2019 compared to 2018.

Figure 5. Guideline concordant antimicrobial use on Critical Care units, 2019 Global-PPS audit.

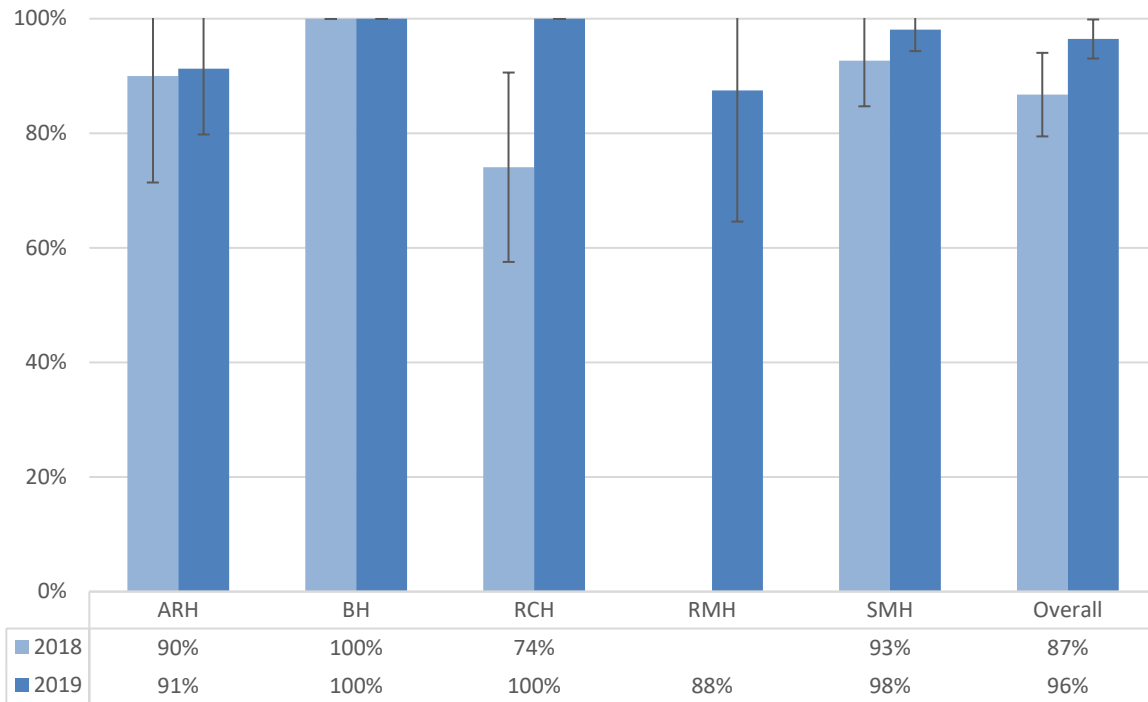
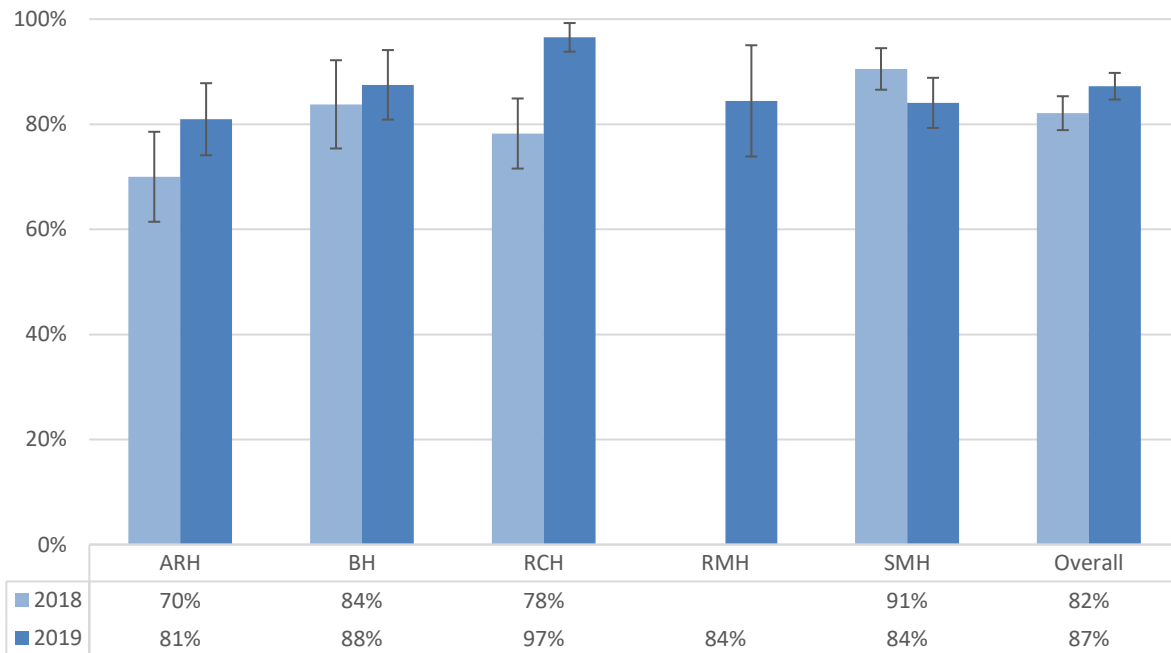


Figure 6. Guideline concordant antimicrobial use on all units, 2019 Global-PPS audit.



Note: Statistically significant increase for RCH in 2019 compared to 2018.

Guideline compliant duration of therapy was assessed for the first time this year. Overall, 81% of antimicrobial therapy duration was compliant with clinical guidelines (**Figures 7 to 10**).

Figure 7. Guideline compliant duration of therapy on Medical units, 2019 Global-PPS audit.

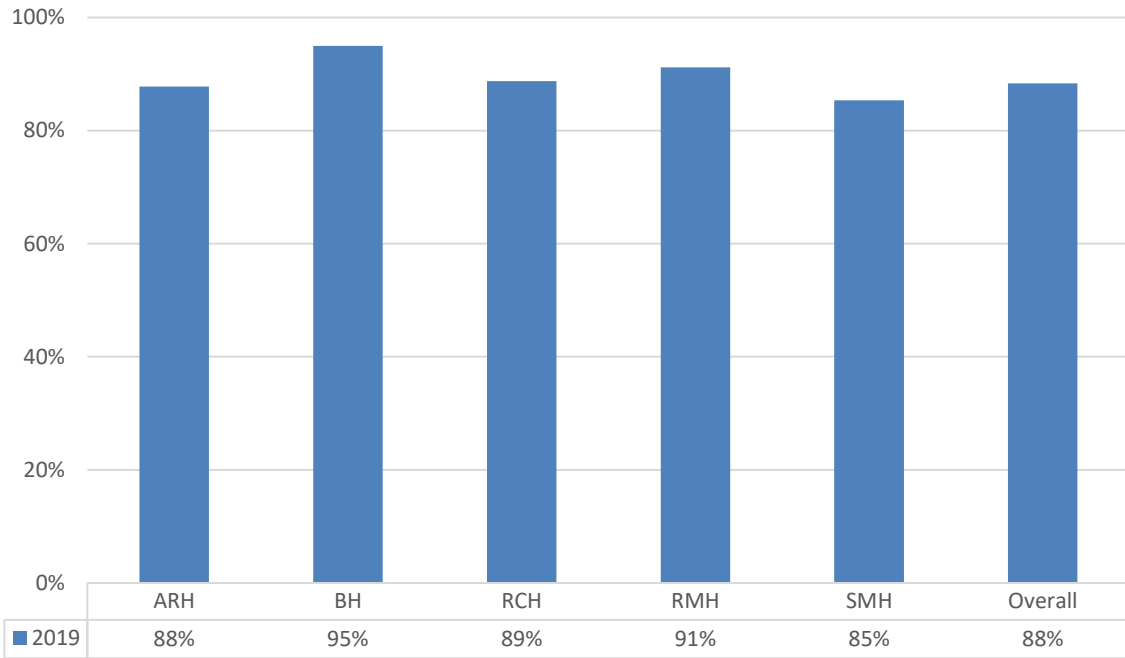


Figure 8. Guideline compliant duration of therapy on Surgical units, 2019 Global-PPS audit.

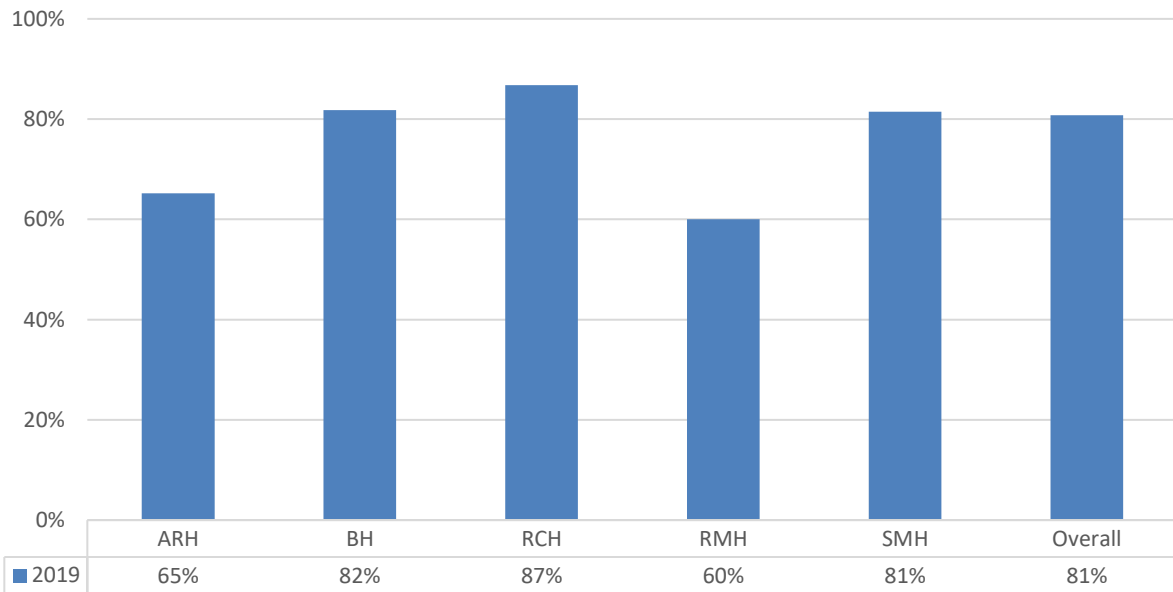


Figure 9. Guideline compliant duration of therapy on Critical Care units, 2019 Global-PPS audit.

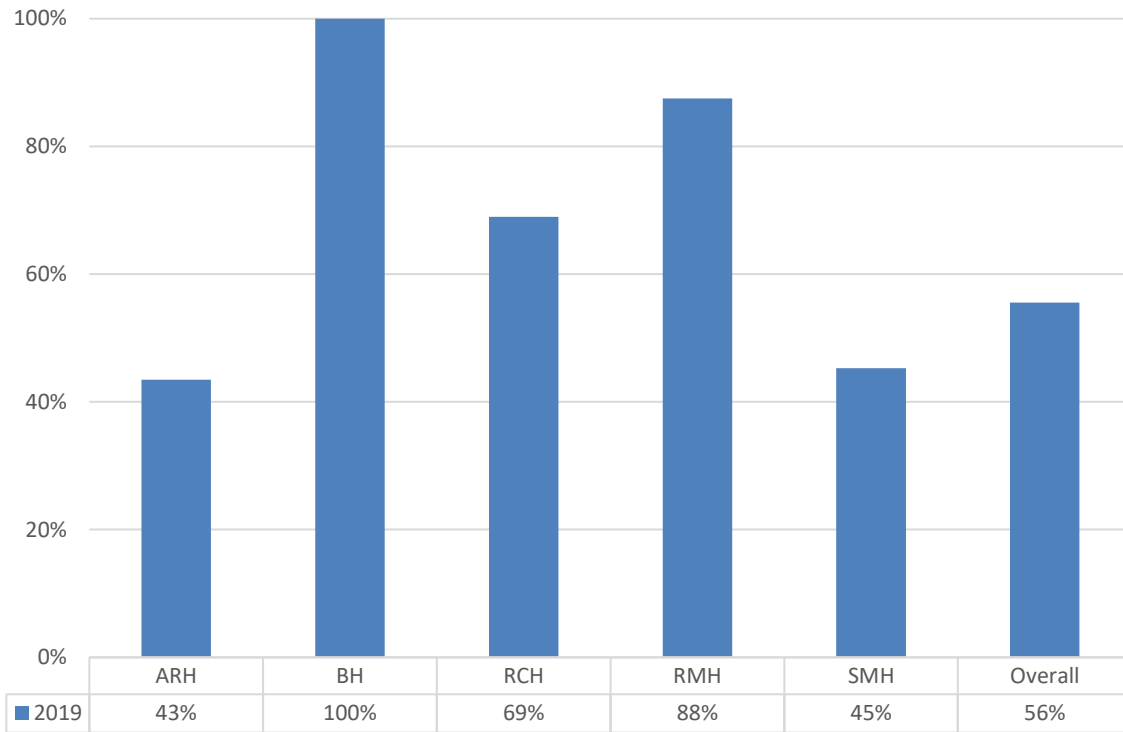
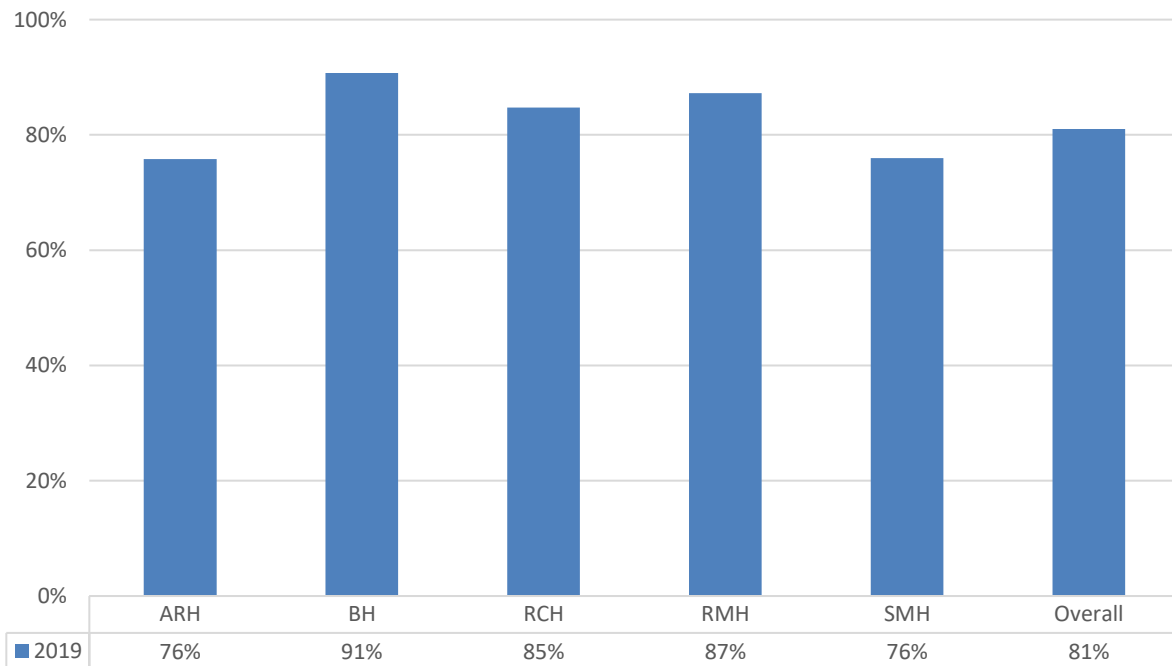


Figure 10. Guideline compliant duration of therapy on all units, 2019 Global-PPS audit.



We plan to continue performing point prevalence surveys on an annual basis. This will allow ongoing longitudinal monitoring and comparison.

ASP Handbook

The ASP has created a Handbook to consolidate in a single reference our guidance on treatment of common infectious conditions and important antimicrobial use issues. This inter-disciplinary collaboration is created by the ASP in conjunction with the Regional ASP Committee, the Division of Infectious Diseases, Medical Microbiology, and our clinicians. The Handbook integrates best available medical literature, recommendations from professional organizations, regional antimicrobial resistance (our antibiogram), and regional formulary.

This fiscal year, we have continued to develop and publish content:

- Pleural infections
- COPD Exacerbation
- Pneumonia in Long Term Care
- Central Nervous System infections
- Sepsis in CPO Colonized Patients
- Colistin dosing

This adds to our previously released content on:

- Community-acquired pneumonia
- Aspiration pneumonia
- Hospital acquired pneumonia
- Ventilator-associated pneumonia
- Pathogen directed therapy for pneumonia
- Skin and soft tissue infections
- Diabetic foot infections
- Intra-abdominal infection
- Urinary tract infections
- C. difficile infection
- Inpatient sepsis
- Penicillin allergies
- Pediatric infections
- Vancomycin dosing and therapeutic monitoring
- Aminoglycoside dosing and therapeutic monitoring

New chapters are planned for the coming fiscal year. Existing chapters will be reviewed annually for updates taking into account evolving practice standards, local antimicrobial resistance, and formulary.

ASP Website

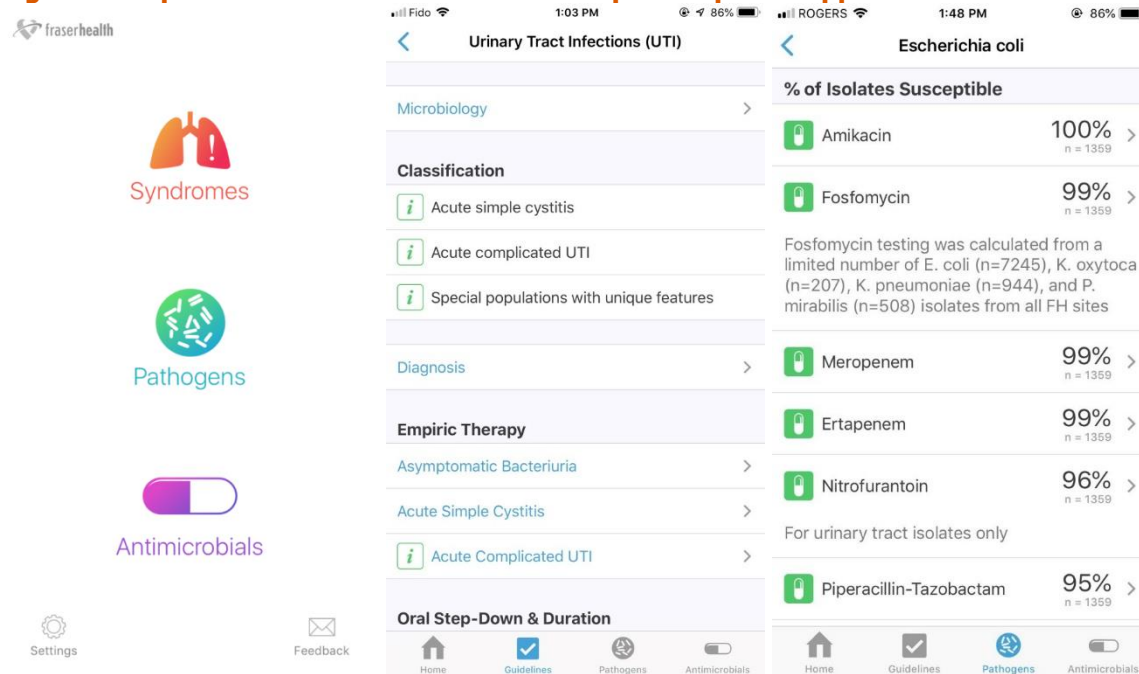
The ASP has a website on the Fraser Health intranet in order to improve visibility of our program and consolidate all our communication and reports in a single location. Our website includes our ASP Handbook, local antibiograms, our reports, and contact information for our clinical teams across the region.

Check out our internal website [here](#). In order to improve accessibility for clinicians, we have mirrored our content on the externally accessible Fraser Health Medical Staff website. Click [here](#) to take a look.

ASP Smartphone App (Spectrum)

The ASP has clinical guidance content integrated into a customized antimicrobial stewardship smartphone app called Spectrum (Figure 11). This app is available for free on iOS and Android based devices. We currently have over 1000 active monthly users.

Figure 11. Spectrum antimicrobial stewardship smartphone app



Pre-Printed Orders

The ASP acts as a regional resource and reviewer for antimicrobials on pre-printed orders (PPO's) undergoing development or revision. Some of these are initiated by the ASP, while others are at the request of other clinical departments or divisions within Fraser Health. We collaborate with representatives from relevant specialties and stakeholder groups to review the best available medical literature, recommendations from professional organizations, regional antimicrobial resistance, and local resource availability.

This fiscal year, we have been involved in revision/development of the following PPO's:

- Pediatric Sepsis
- Neonatal Sepsis
- Adult Inpatient Sepsis
- Preterm Prelabour Rupture of Membranes
- Admission of Microprem Newborns
- COPD Exacerbation
- COPD Exacerbation in Long Term Care
- PD Catheter Insertion
- PD Peritonitis
- Antibiotic Lock Solutions for Catheter Related Bloodstream Infections in Hemodialysis
- Penicillin Allergy Challenge
- Suspected/Confirmed COVID-19

- Jaw surgery
- ENT surgery
- Arthroscopic or Open Shoulder Post-Operative

COVID-19 Response

The ASP took a leadership role in supporting Fraser Health's COVID-19 response. We synthesized best available clinical evidence to create a COVID-19 PPO used for adult inpatients with suspected or confirmed COVID-19. We worked with a wide range of clinical experts including Hospitalists, Critical Care, Internal Medicine, Emergency, Obstetrics, Infectious Diseases, Medical Microbiology, Lab Medicine, and Pharmacy. Our team will ensure this PPO remains continuously updated as our understanding of best-practices in the care of COVID-19 patients evolves. The ASP also summarized COVID-19 management guidelines in its Spectrum smartphone app.

Our team continued to provide daily audit and feedback clinical support despite the COVID-19 pandemic, including for patients with suspected and confirmed COVID-19. Our mandate to promote appropriate antimicrobial use did not change with the pandemic.

Antimicrobial Usage Trends

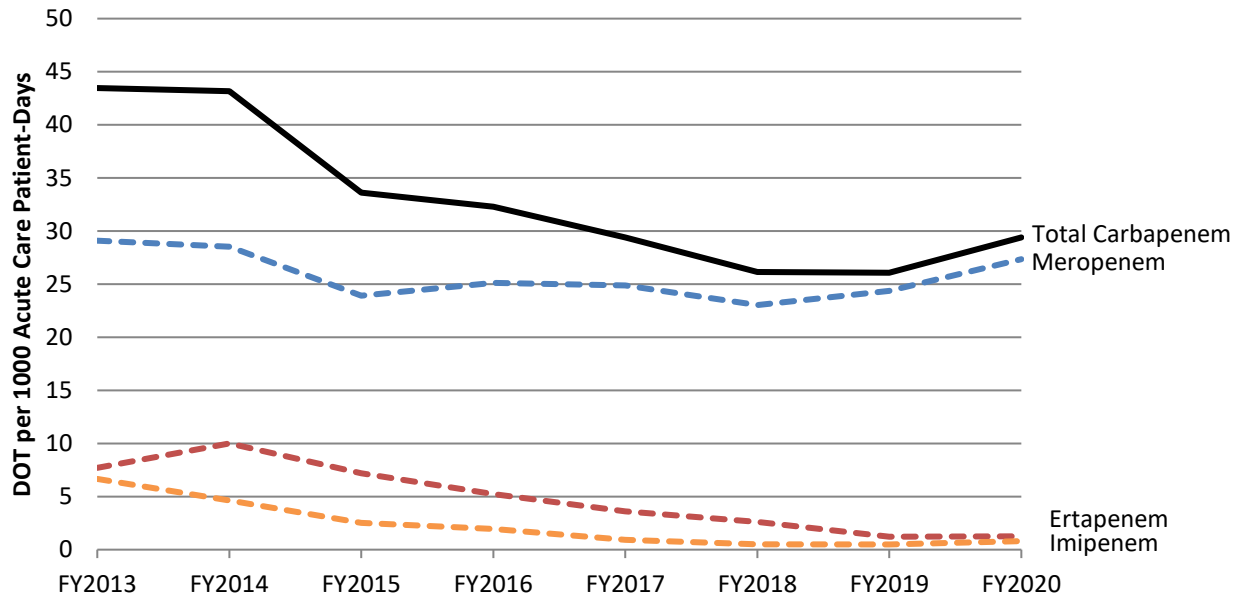
The ASP reviews usage trends of targeted antimicrobials on an ongoing basis. Our primary reporting metric is days of therapy (DOT). DOT is the number of days that a patient receives an antimicrobial agent regardless of dose. This is the most accurate and preferred measure of antimicrobial use, endorsed by the Centers for Disease Control and the US National Healthcare Safety Network.⁴ Total DOT is then normalized to the common denominator of 1,000 patient-days. The resulting unit of measure, "DOT per 1,000 patient-days", does not account for interhospital differences in case mix and patient acuity. However, it is a metric that accounts for hospital size and patient volume, and is used by many other institutions.

Usage data reflects admitted inpatients only. It does not reflect treatment of non-inpatients through emergency departments, day-medicine/infusion centres, or the home IV program.

Carbapenems are one of our most potent class of antimicrobials. Resistance to carbapenems in gram-negative infections is a serious public health threat and a strong impetus for antimicrobial stewardship. Carbapenem usage has dropped significantly over time (**Figure 12**), though a slight increase was seen in FY2020. Furthermore, meropenem comprises a greater proportion of our carbapenem usage, which the ASP views favourably given its lower daily cost compared to imipenem and ertapenem.

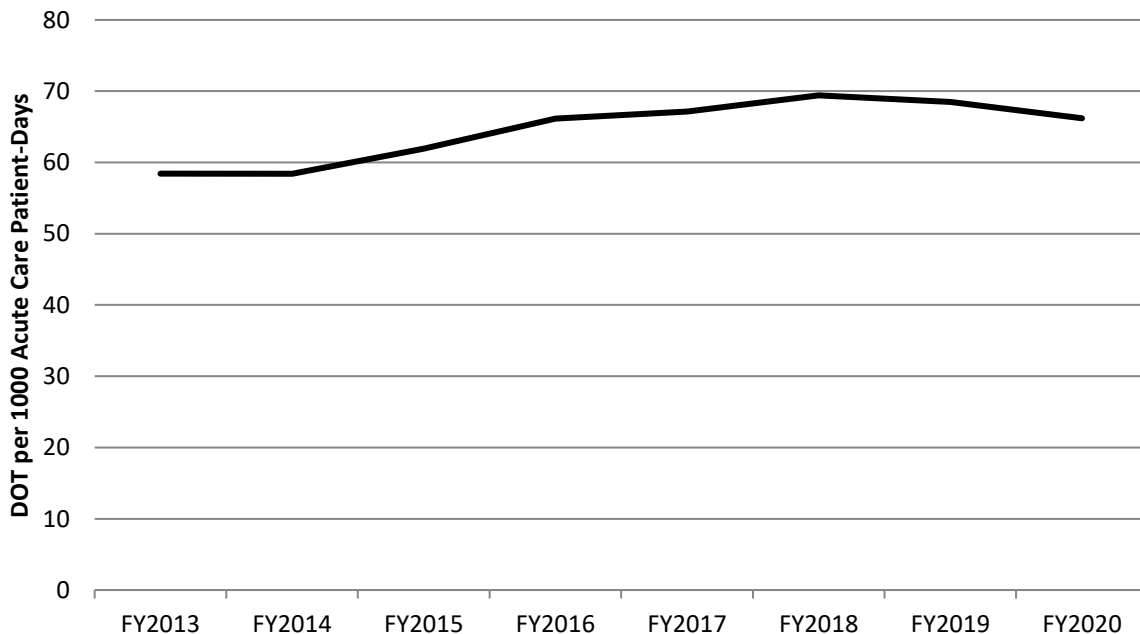
⁴ https://www.publichealthontario.ca/en/eRepository/Antimicrobial_Stewardship_Metrics_Evaluation_2014.pdf

Figure 12. Inpatient carbapenem usage.



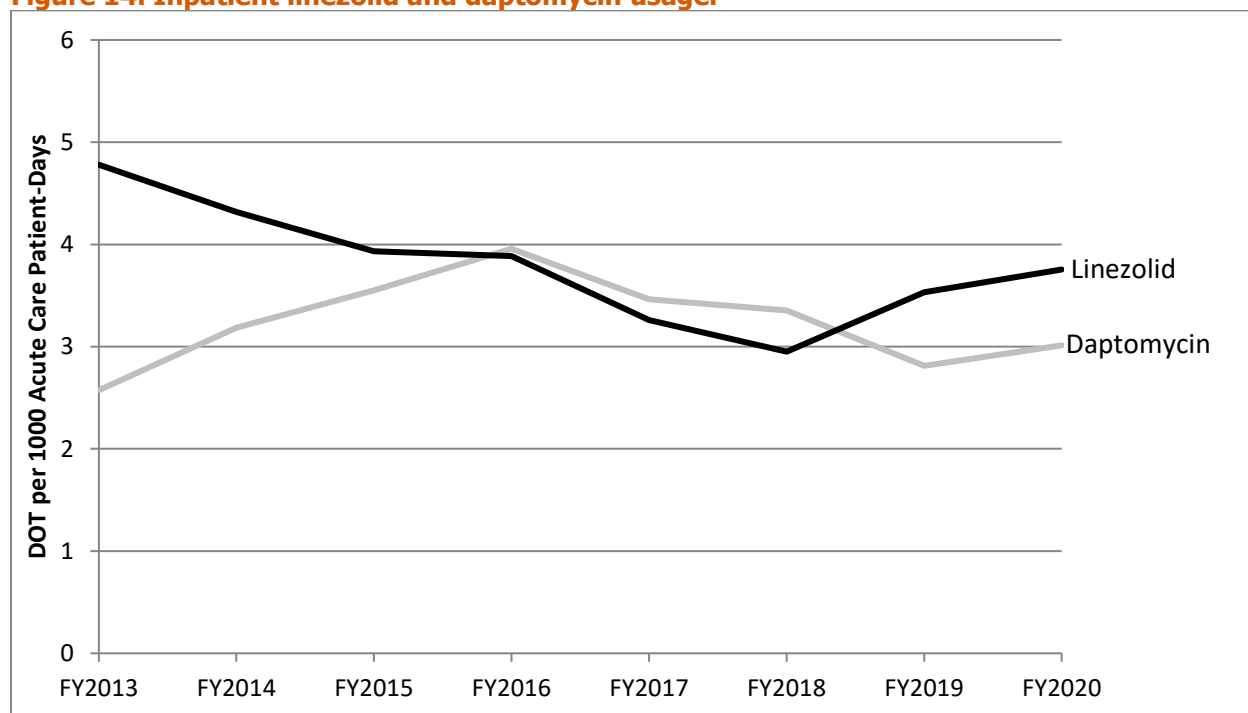
Piperacillin-tazobactam as another broad-spectrum antimicrobial targeted by the ASP. A long-term increasing trend of piperacillin-tazobactam use is now showing consecutive yearly decreases (**Figure 13**).

Figure 13. Inpatient piperacillin-tazobactam usage.



The ASP also tracks usage of two restricted drugs used for resistant gram-positive organisms: linezolid and daptomycin. Usage of both agents remains low and stable (**Figure 14**). Note that DOT per 1000 patient-days for both of these agents is in the single digits, an order of magnitude lower than most other targeted antimicrobials that the ASP tracks.

Figure 14. Inpatient linezolid and daptomycin usage.

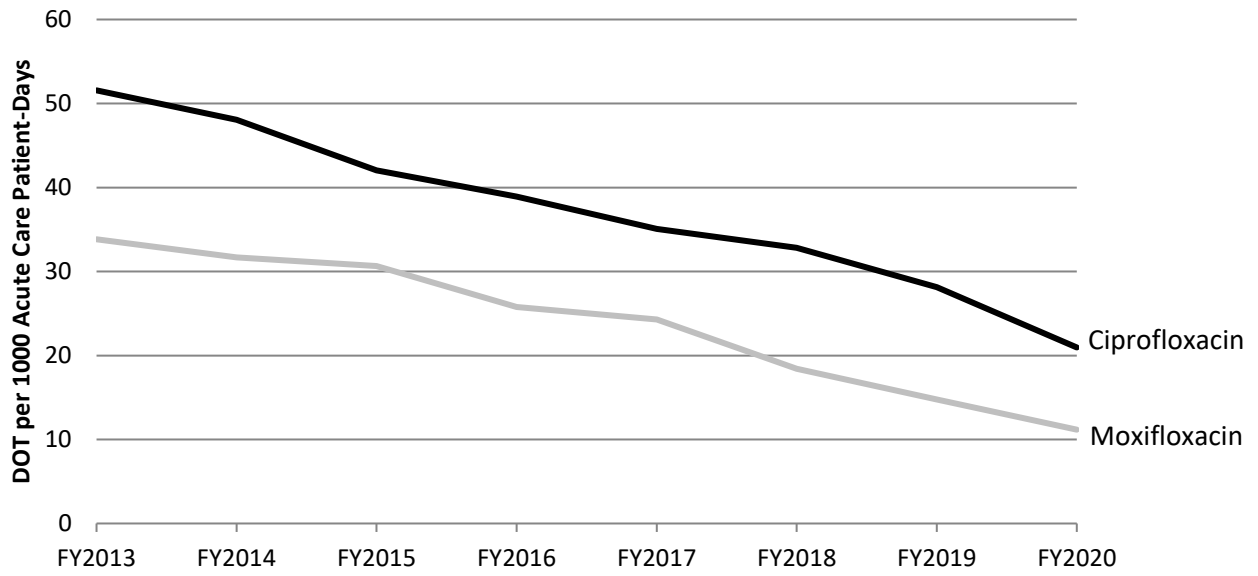


Fluoroquinolones are under heightened scrutiny due to increased appreciation of their side-effects⁵ and strong epidemiological association with *Clostridioides difficile* infection.⁶ The ASP has utilized education, guidelines, and pre-printed orders to guide appropriate use of fluoroquinolones. Ongoing reduction in fluoroquinolone usage is viewed favourably (**Figure 15**).

⁵ See <https://www.canada.ca/en/health-canada/services/drugs-health-products/medeffect-canada/safety-reviews/summary-safety-review-fluoroquinolones-assessing-potential-risk-persistent-disabling-effects.html> and <https://www.fda.gov/drugs/drug-safety-and-availability/fda-drug-safety-communication-fda-updates-warnings-oral-and-injectable-fluoroquinolone-antibiotics>.

⁶ Dingle KE et al. Effects of control interventions on *Clostridium difficile* infection in England: an observational study. *Lancet Infect Dis.* 2017;17:411-421.

Figure 15. Inpatient fluoroquinolone usage.



Please refer to the statistical appendix for hospital-specific usage of targeted antimicrobials.

Financials

Antimicrobial expenditures are presented for combined inpatient and outpatient antimicrobial usage based on pharmacy data. The expenditures exclude some home IV program patients as they are supplied by the vendor Calea.

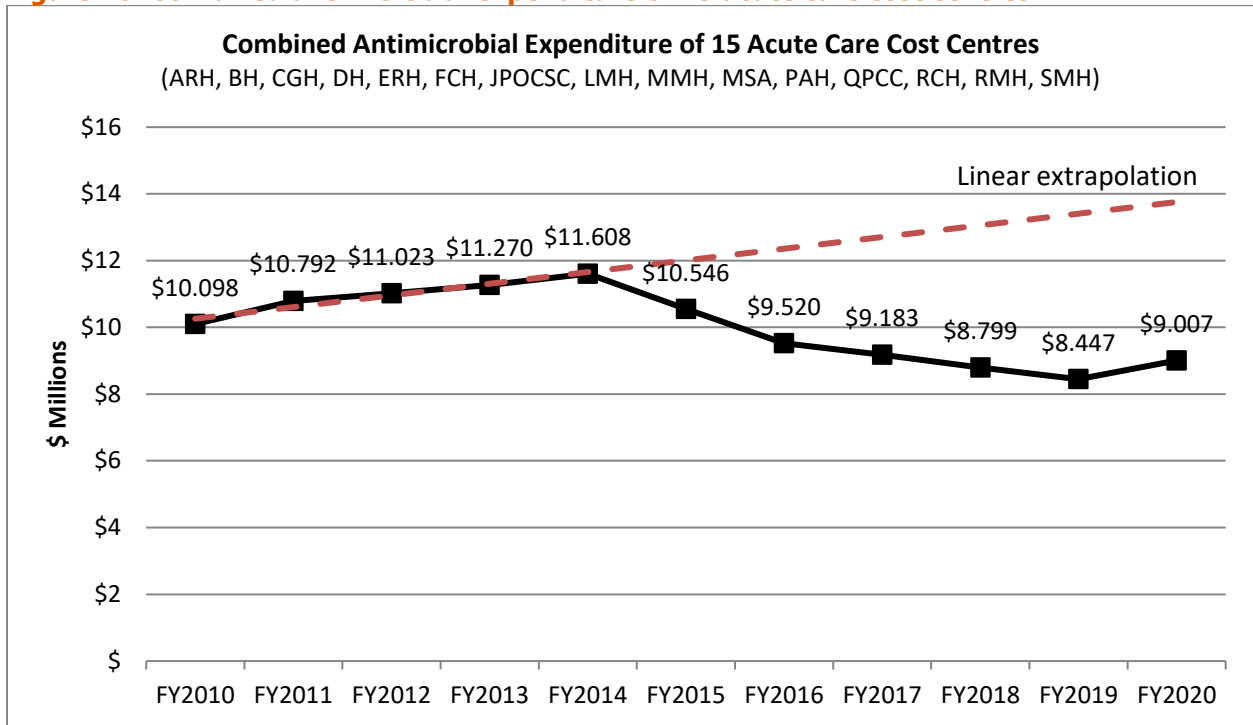
Daptomycin continues to be our agent with the highest expenditure (**Table 1**). Daptomycin is mostly used in the outpatient setting, where the ASP is not currently providing prospective audit and feedback service. Ertapenem is also nearly exclusively used in the outpatient setting, as a therapeutic interchange to meropenem governs inpatient use. Increased expenditures on daptomycin and ertapenem have been the most prominent change from FY2019. A change in contract pricing for linezolid contributed to an increase in its expenditures. Meropenem and imipenem expenditures increased, though the absolute impact was minimal.

Combined antimicrobial expenditure across 15 acute care cost centres remains suppressed from historical trends (**Figure 16**). Annual antimicrobial expenditures in Fraser Health have been reduced by \$2,601,044 (a 22.4% reduction) from their peak in FY2013-14. Over the past year, antimicrobial expenditures have increased by \$560,317 (a 6.6% increase).

Table 1. Combined cost of five restricted antimicrobial drugs.

Restricted Antimicrobials	Total Inpatient & Outpatient Expenditure (excluding Home IV supplied by Calea)			Difference (FY2019 vs. FY2018)
	FY2019	FY2020		
Daptomycin	\$1,367,084	\$1,790,117	↑	\$423,033
Ertapenem*	\$811,623	\$930,332	↑	\$118,709
Meropenem*	\$339,380	\$374,758	↑	\$35,378
Linezolid	\$55,683	\$110,917	↑	\$55,234
Imipenem*	\$23,564	\$34,641	↑	\$11,077
Total	\$2,597,334	\$3,240,765	↑	\$643,431
*Carbapenems	\$1,174,567	\$1,339,731	↑	\$165,164

Figure 16. Combined antimicrobial expenditure of 15 acute care cost centres.



Statistical Appendix

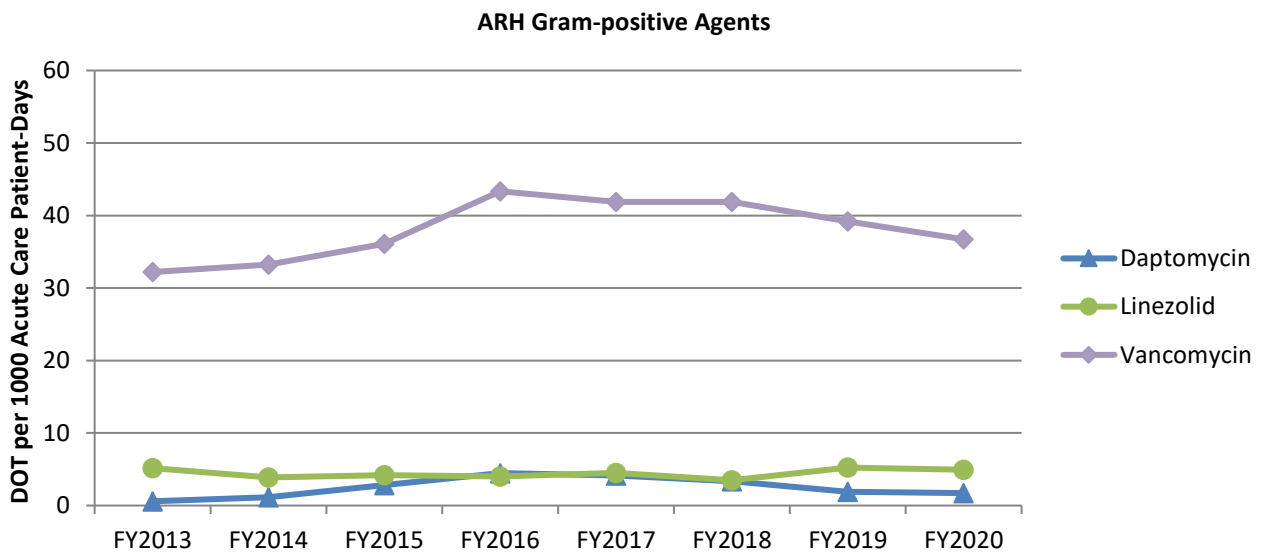
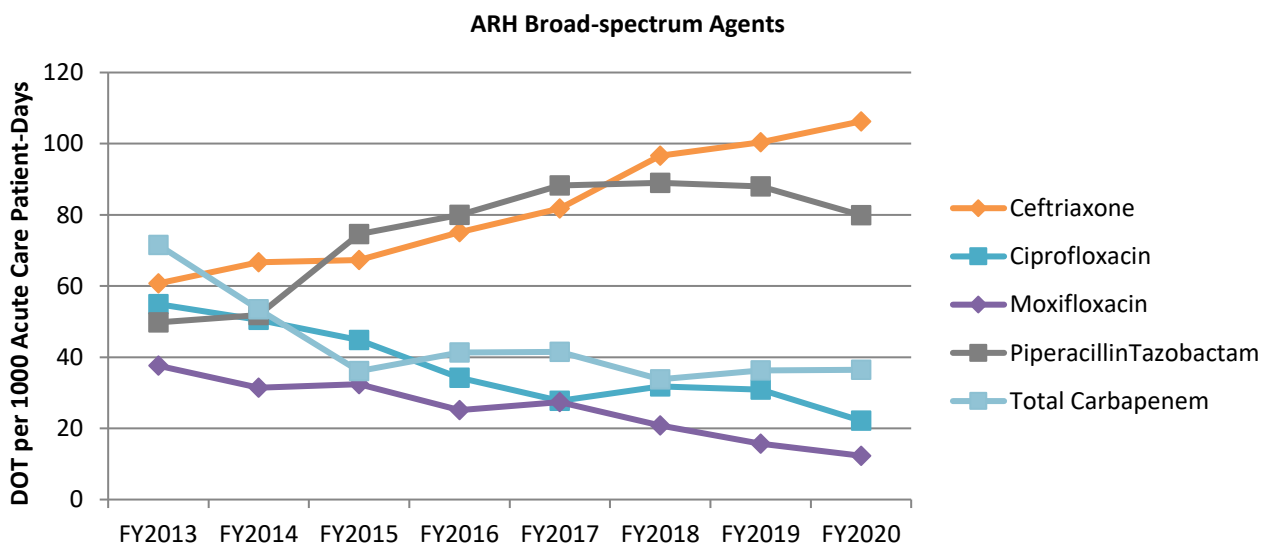
Notes to Interpretation

Antimicrobial usage data is expressed in days of therapy (DOT) per 1,000 acute care patient-days. Usage data reflects admitted inpatients only. It does not reflect treatment of non-inpatients through emergency departments, day-medicine/infusion centres, or the home IV program.

The vertical axis for all graphs has been set to the same scale to facilitate interhospital comparison. Broad-spectrum agents active against gram-negative infections are shown separately from gram-positive agents.

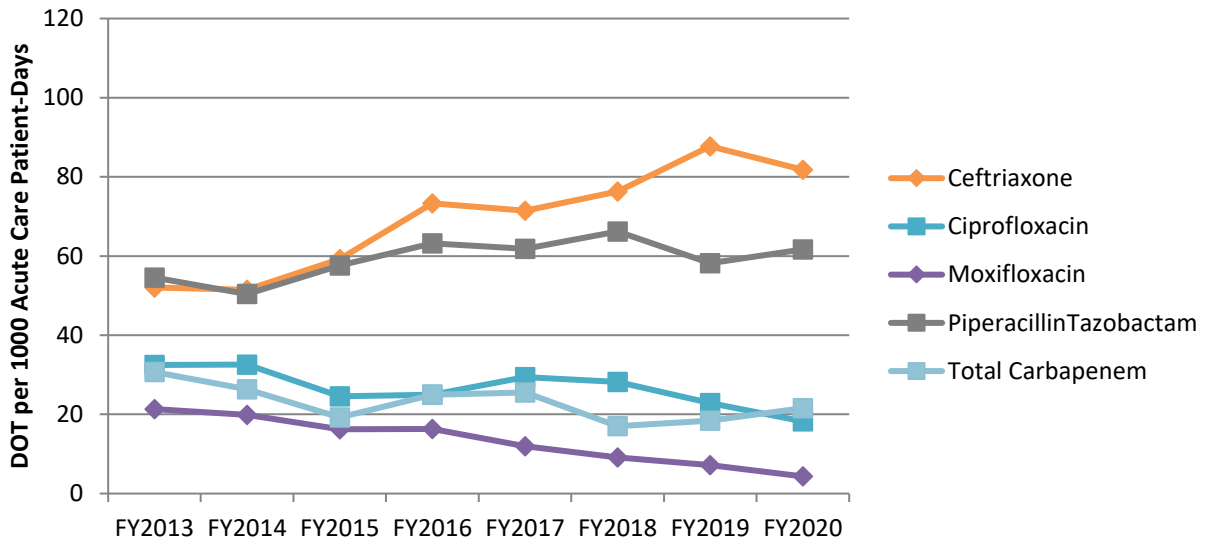
Targeted Antimicrobial Usage by Site

ARH

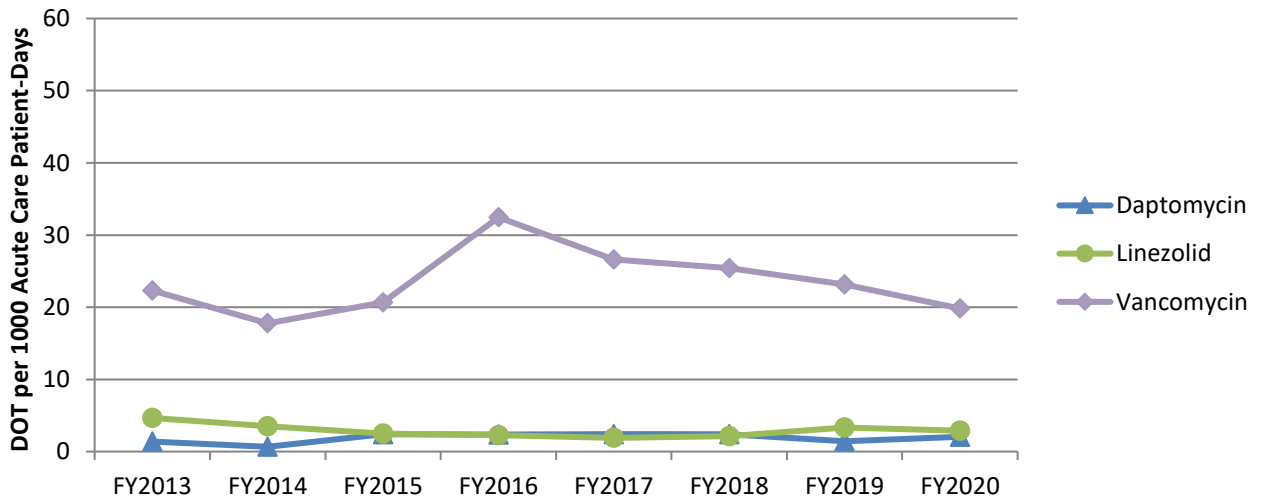


BH

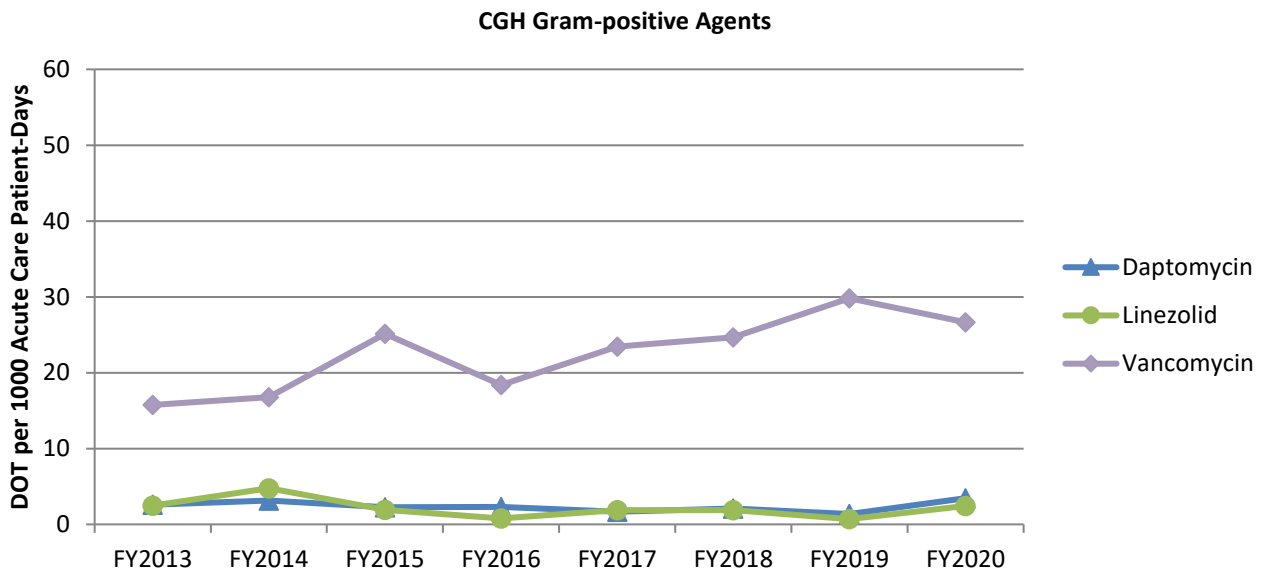
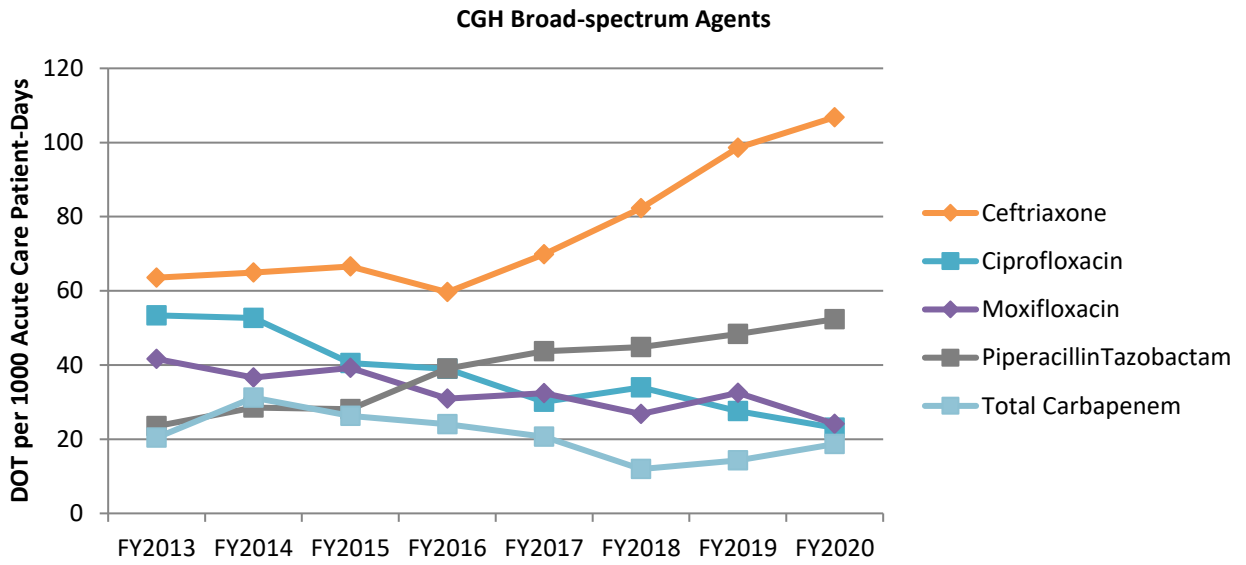
BH Broad-spectrum Agents



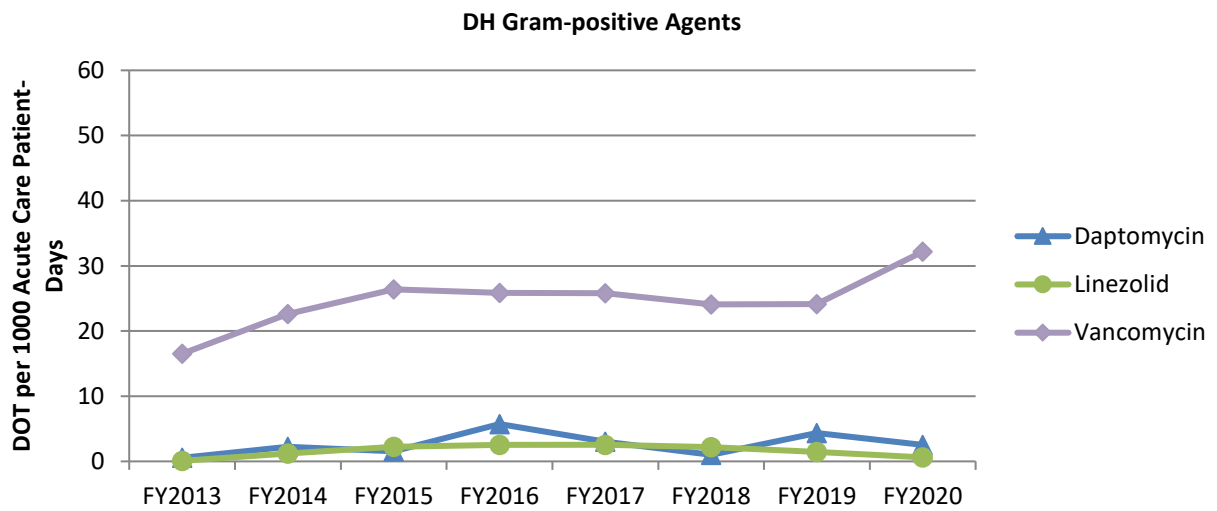
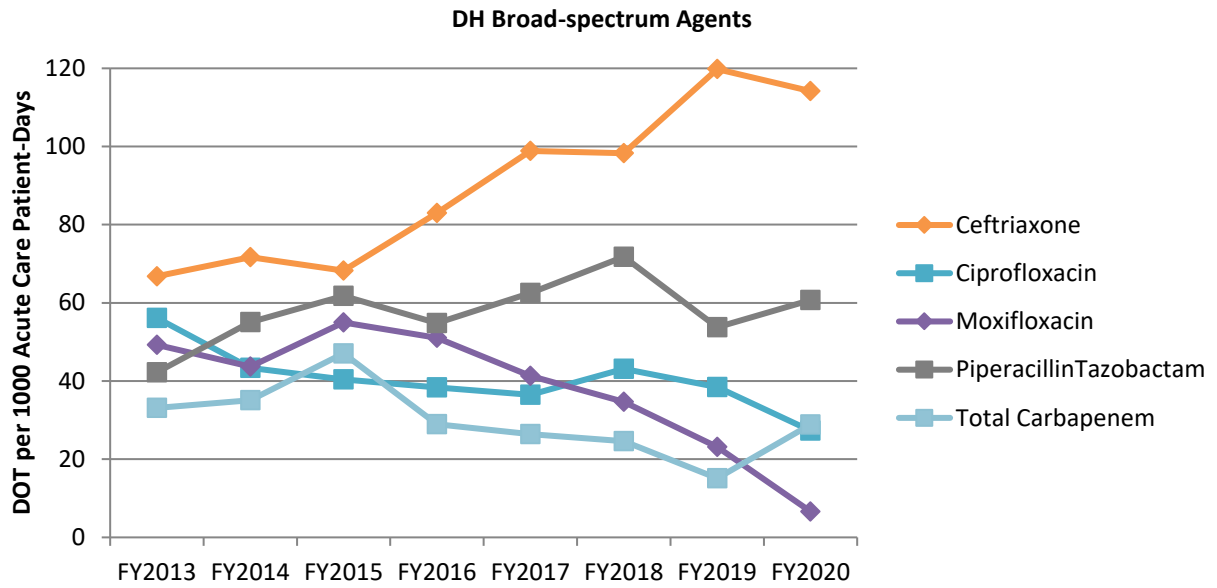
BH Gram-positive Agents



CGH

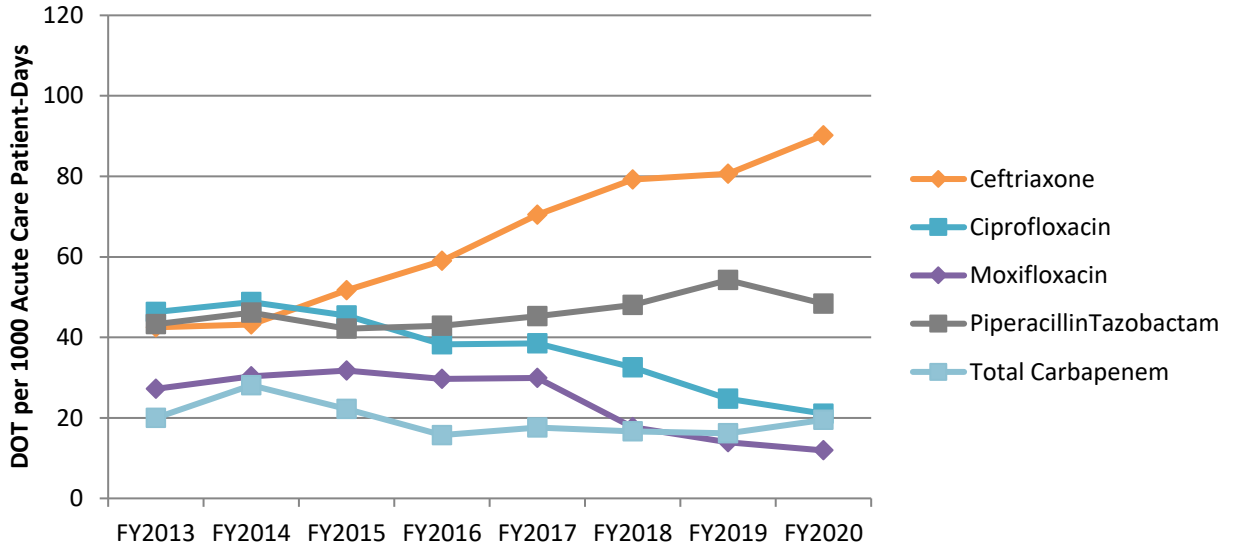


DH

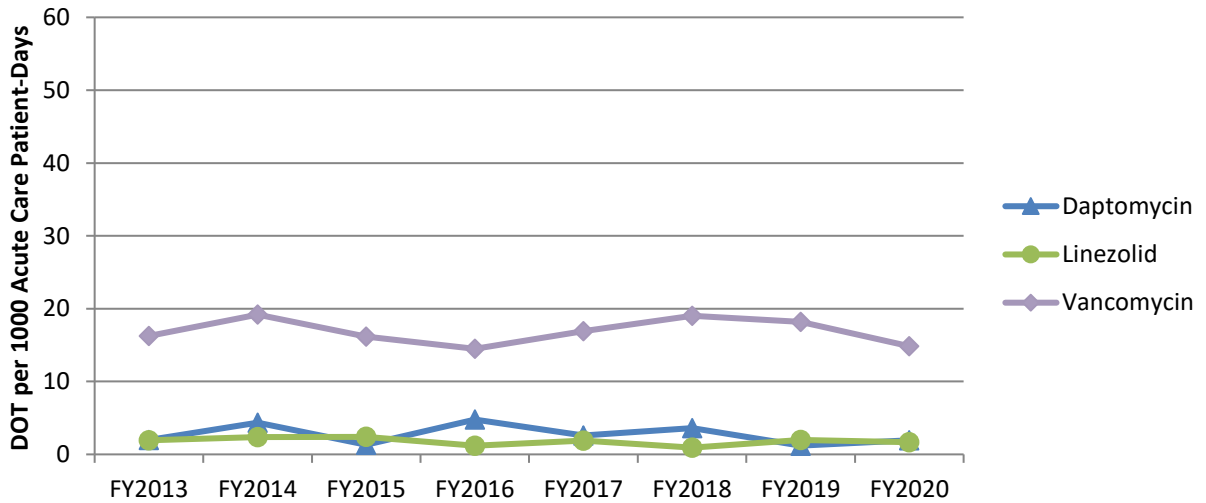


ERH

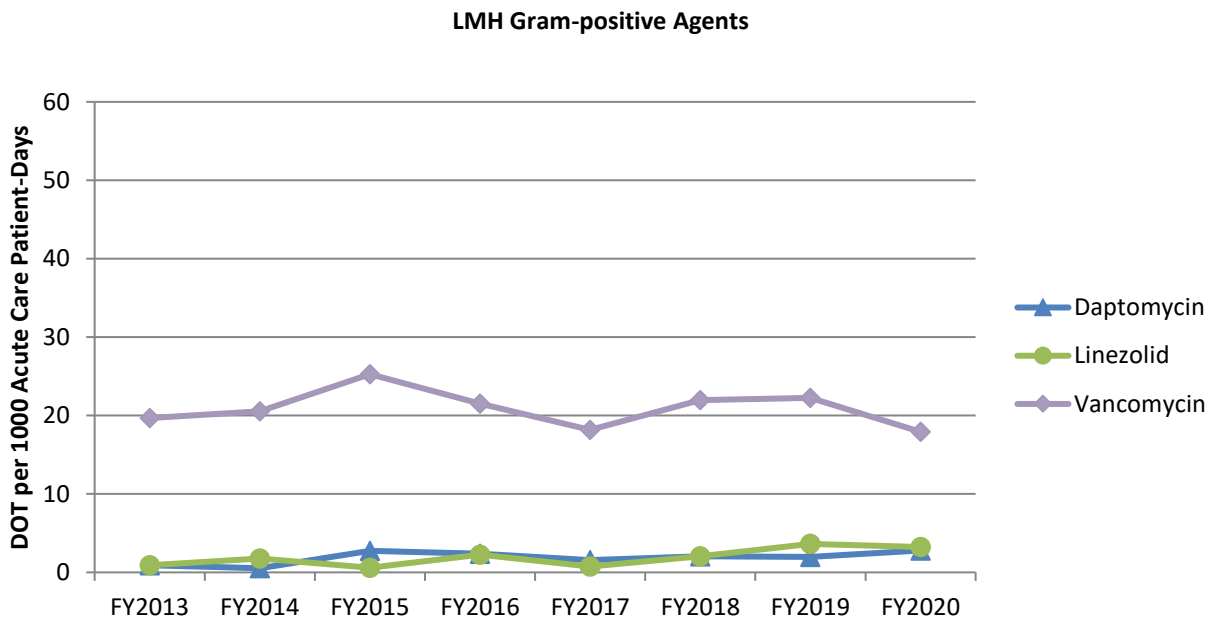
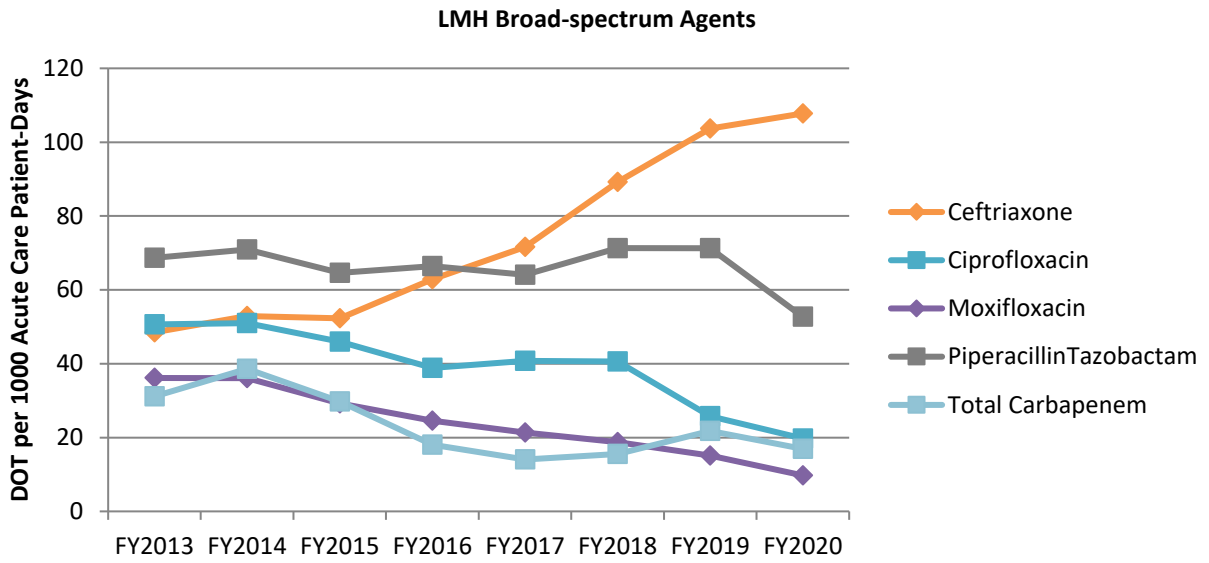
ERH Broad-spectrum Agents



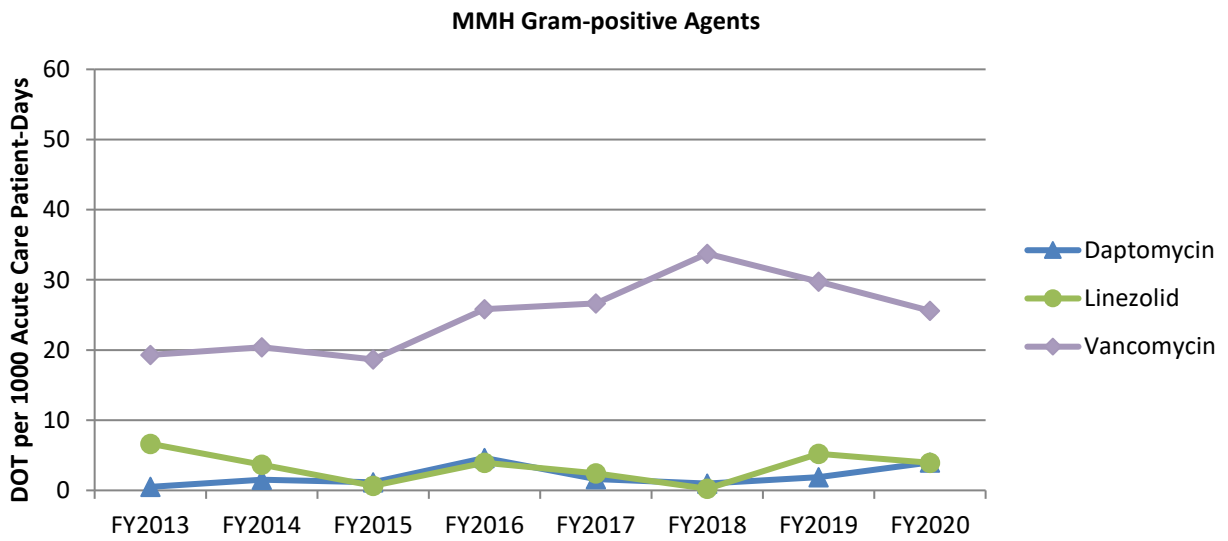
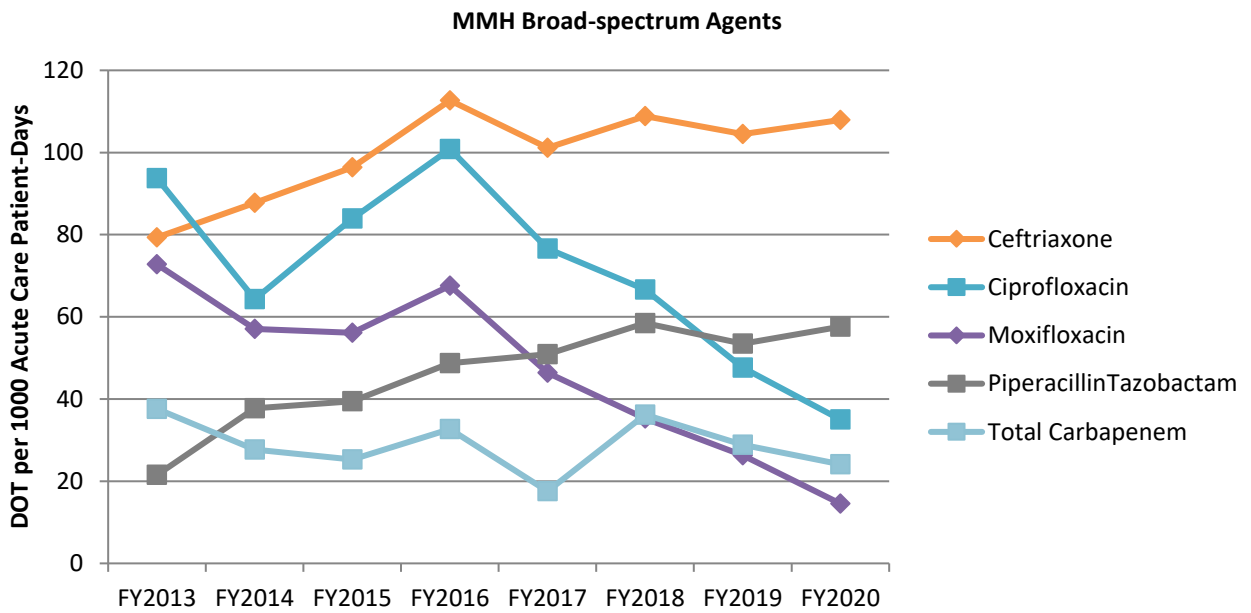
ERH Gram-positive Agents



LMH

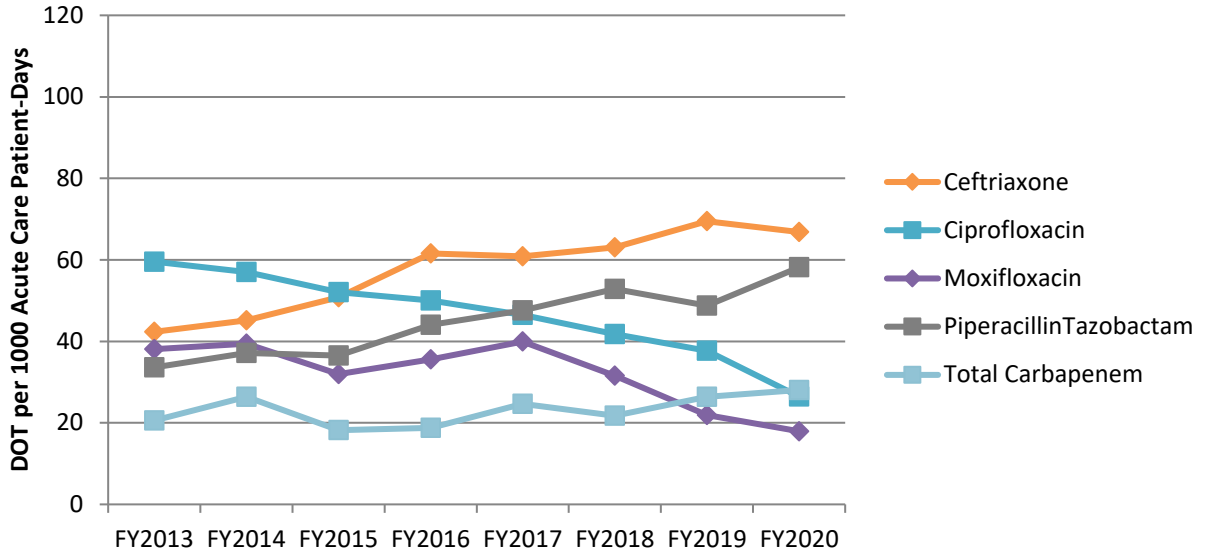


MMH

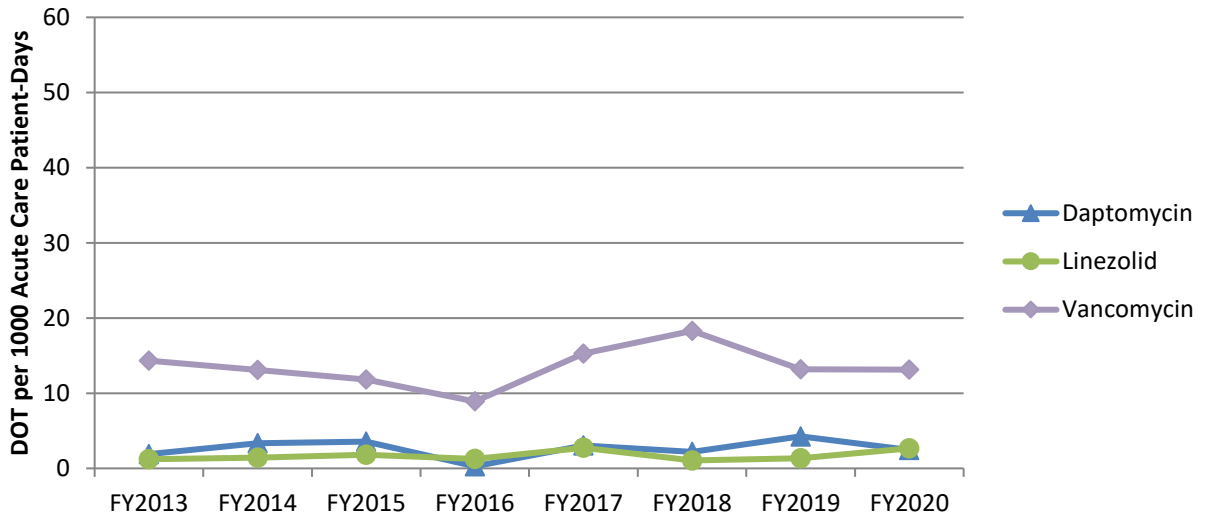


PAH

PAH Broad-spectrum Agents

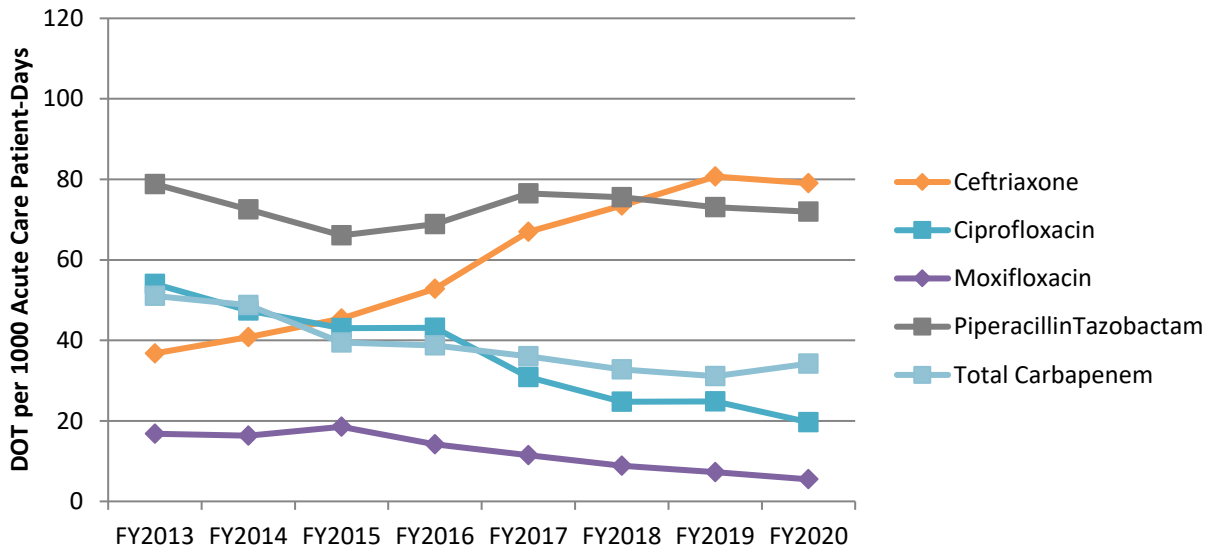


PAH Gram-positive Agents

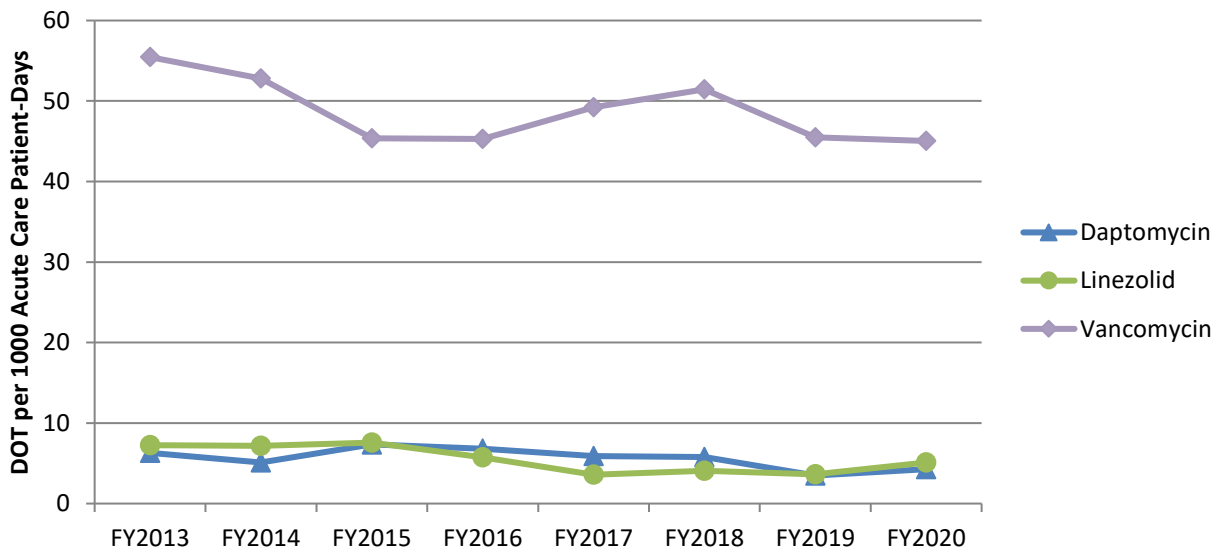


RCH

RCH Broad-spectrum Agents

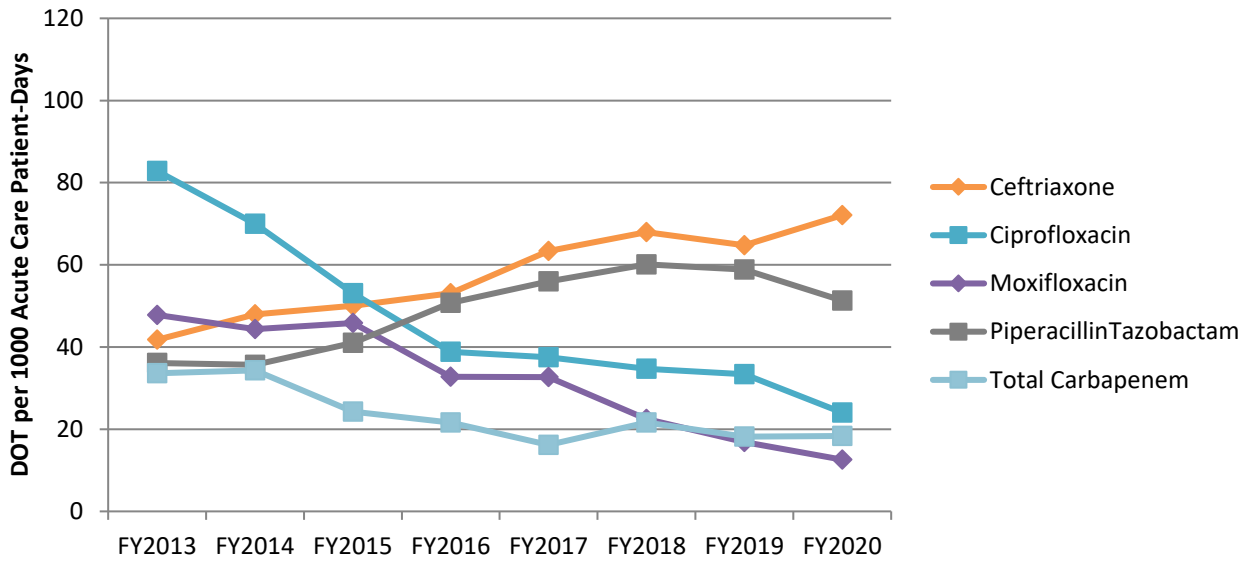


RCH Gram-positive Agents

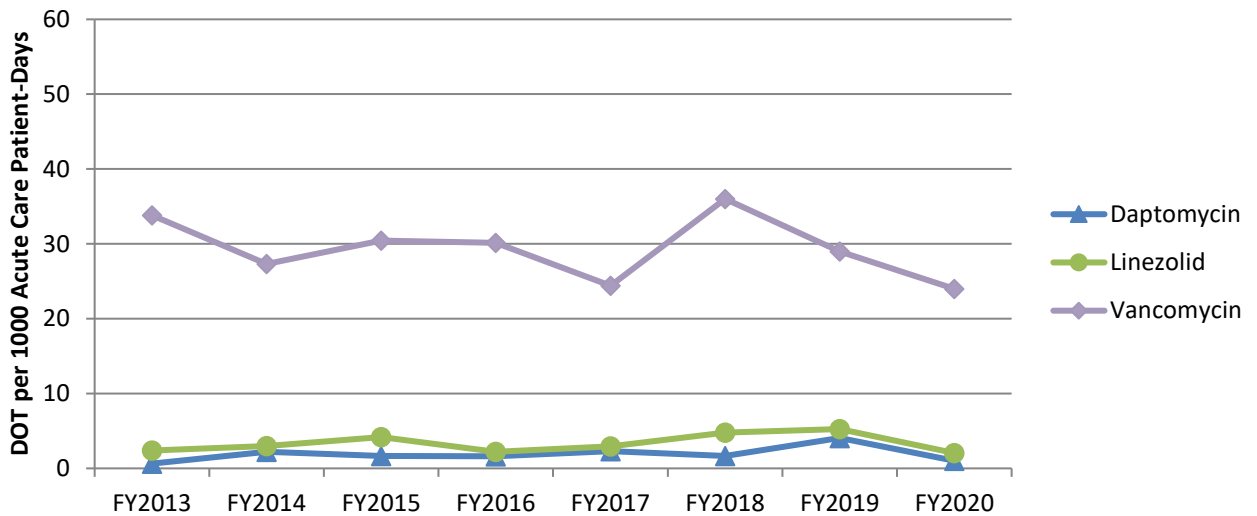


RMH

RMH Broad-spectrum Agents



RMH Gram-positive Agents



SMH

