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# Antimicrobial Stewardship

Annual Report 2020-2021

Prepared by the Fraser Health Antimicrobial Stewardship Program

July 2021

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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 four 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.

Our team remained highly active during the COVID-19 pandemic to support patient care and guide appropriate antimicrobial use. We were able to implement a new ASP software system—LUMED—in the midst of the pandemic. LUMED not only provides unparalleled support to our prospective audit and feedback activities, but also far more robust analytic capabilities.

Prospective audit and feedback, where our team of ASP clinicians routinely review patient cases in real time, remains the core of our ASP. During the past year, our team intervened in over 3,500 patient cases amounting to over 6,300 individual interventions. Our recommendations were accepted in 94% 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 *Enterococcus* and *S. aureus* bacteremia.

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. These were revised regularly throughout the pandemic.

After several years of decline, broad-spectrum antibiotic usage intensity increased this past year as a result of the COVID-19 pandemic. Use of carbapenems, a last-line antibiotic, has decreased slightly and remains far below pre-ASP levels. Usage of agents targeting resistant gram-positive infections remains stable. *C. difficile* infection rates continue to remain low.

In an effort to improve health care efficiency, the ASP seeks to promote wise and effective use of taxpayer money. Antimicrobial expenditures have remained below projected increases for several years. Fraser Health has seen a \$1,395,264 decrease in antimicrobial expenditure in FY2020-21 compared to FY2019-20. Much of this decrease is likely due to COVID-19 and is expected to rebound in future years as healthcare service delivery recovers.

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.<sup>1</sup> 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.<sup>2</sup>

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:

1. To optimize patient care through appropriate selection and use of antimicrobials, while minimizing adverse events
2. To slow the emergence of antimicrobial resistance by limiting selection pressure from antimicrobial misuse
3. To improve healthcare efficiency by reducing unnecessary antimicrobial use

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<sup>1</sup> 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.

<sup>2</sup> 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 &amp; ID Consultant</i>
Dr. Maggie Wong	<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. Tim Leung	<i>Clinical Pharmacy Specialist, Antimicrobial Stewardship</i>

We'd like to thank Dr. Vivian Leung and Dr. Colin Lee who have moved on to other positions during the fiscal year.

Administrative support for the program was provided by Anita Michela.

### Data Team

Our data team is a 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>
Joyce Ng	<i>Consultant, IPC</i>
Tamara Duncombe	<i>Epidemiologist, IPC</i>

### Executive Oversight

Dr. Kevin Afra, medical director of the ASP, is accountable to Linda Dempster (VP Patient Experience and Pandemic Response) and Dr. Ralph Belle (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. Maggie Wong 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 &amp; ID Consultant</i>
Ms. Wendy Bowles	<i>NP &amp; Regional Department Head, Nurse Practitioners</i>

Dr. Michael Chapman	<i>ID Division Head &amp; ID Consultant, SMH</i>
Dr. Greg Deans	<i>ID Consultant, SMH</i>
Dr. Sarah Henni	<i>ID Consultant, ARH</i>
Dr. Yiannis Himaras	<i>ID Consultant, ARH</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 Director, IPC &amp; 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>
Dr. Maggie Wong	<i>ASP Pharmacy Coordinator</i>
Ms. Anita Michela	<i>Administrative Assistant</i>

Members of the Regional ASP Committee Advisory Group include:

Dr. Mark Ballard	<i>Regional Department Head, Medicine</i>
Dr. Dave Konkin	<i>Regional Department Head, Surgery</i>
Dr. Laurenna Peters	<i>ID Consultant, BH</i>
Dr. Steven Reynolds	<i>Critical Care Physician &amp; 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

### Prospective Audit and Feedback

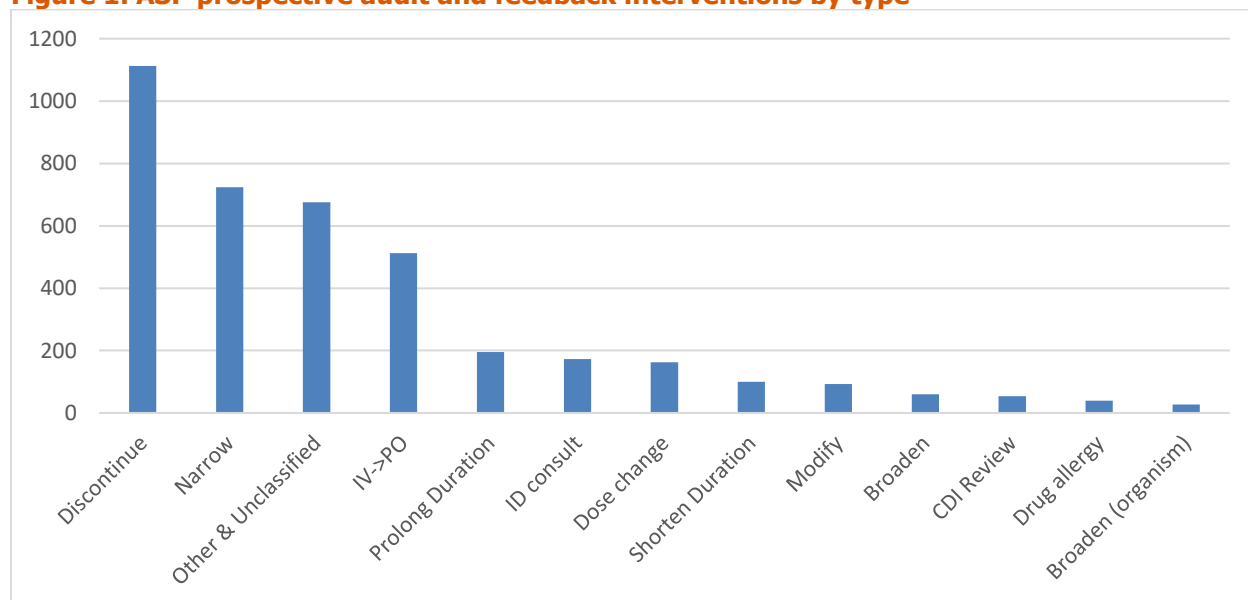
Prospective audit and feedback is one of the core activities of an ASP. It involves real time case-by-case assessment of patients with direct feedback to the patient’s care team – most often Medical Staff and Pharmacists. We prospectively identify patients receiving targeted antimicrobials or with certain 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 Intervened	# Total Interventions	Acceptance Rate
FY2017	3,173	N/A	82 %
FY2018	3,191	N/A	90 %
FY2019	3,928	N/A	87 %
FY2020	4,927	N/A	87 %
FY2021	3,558	6,359	94 %

The ASP transitioned to using LUMED as a dedicated ASP software system starting April 2020; initial configuration continued until July 2020. LUMED allows ASP to track all interventions at a patient-level, something we were not previously able to do. A breakdown of ASP audit and feedback interventions by type is shown in **Figure 1**.<sup>3</sup>

**Figure 1. ASP prospective audit and feedback interventions by type<sup>4</sup>**



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

<sup>4</sup> The intervention type categories in LUMED were not fully configured until July 15, 2020. Intervention types were extracted from LUMED from July 15, 2020 onwards for FY2020-21.

## Quality Improvement

### Asymptomatic bacteriuria (ASB)

Decreasing inappropriate antibiotic treatment for asymptomatic bacteriuria is an important goal for ASP. The literature has demonstrated that overuse of antibiotics for ASB can lead to adverse side effects, *C. difficile* infections and increased resistance to antibiotics, which ultimately prolong hospitalization. It may also inflate the rate of hospital-acquired urinary tract infections, which is a Fraser Health patient safety priority.

As a result, the ASP collaborated with the hospitalist group at Surrey Memorial hospital (SMH) to reduce unnecessary use of antibiotics for ASB as a quality improvement project from 2018 to 2020. Patients >18 years old with a positive urine culture > 48 hours after hospital admission and started on antibiotic(s) due to suspected or confirmed UTI were included. Patients in intensive care, psychiatric and maternity units were excluded. The pre- and intervention periods were from October 2018 to April 2019, and October 2019 to April 2020, respectively. The interventions included education sessions between periods, ongoing AMS pharmacist audit and feedback, and longitudinal peer feedback from two hospitalist champions. Definition of UTI was based on the "symptom-free pee: let it be" algorithm by the Association of Medical Microbiology and Infectious Disease Canada.<sup>5</sup> We compared the percentage of patients prescribed antibiotics for ASB during pre- and intervention periods.

Of the 57 cases treated pre-intervention, 16 (28%) were identified as ASB. This decreased to 16% (12/74 cases) in the intervention period. In the intervention period, documentation of UTI symptoms improved drastically from 50% to 88% of the cases, likely due to peer feedback from the hospitalist champions. Due to sample size constraints, results did not achieve statistical significance.

We concluded that collaboration with hospitalist champions successfully decreased the percentage of patients who received antibiotic(s) for ASB at SMH. Improved chart documentation of UTI symptoms may also improve continuity of care and reinforce not treating ASB. Through empowerment of one of the key stakeholders (i.e. hospitalists) in the change process, we preserved prescribers' autonomy as much as possible, while providing a sustainable effect.

### Point Prevalence Survey

Point prevalence surveys were deferred in FY2020-21 due to the COVID-19 pandemic. We plan to resume regular point prevalence surveys on an annual basis as the COVID-19 pandemic subsides. 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:

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<sup>5</sup> [https://www.ammi.ca/Content/AntibioticAwareness/AC-Algorithm\\_Eng\\_8.5x11\\_colour.pdf](https://www.ammi.ca/Content/AntibioticAwareness/AC-Algorithm_Eng_8.5x11_colour.pdf)



- Bacteremia – Enterococcus
- Bacteremia – S. aureus
- COVID-19 Guidelines (Spectrum only)

This adds to our previously released content on:

- Community-acquired pneumonia
- Aspiration pneumonia
- Hospital acquired pneumonia
- Ventilator-associated pneumonia
- Pathogen directed therapy for pneumonia
- Pleural infections
- COPD Exacerbation
- Pneumonia in Long Term Care
- Skin and soft tissue infections
- Diabetic foot infections
- Intra-abdominal infection
- C. difficile infection
- Urinary tract infections
- Central Nervous System infections
- Inpatient sepsis
- Sepsis in CPO Colonized Patients
- Penicillin allergies
- Pediatric infections
- Vancomycin dosing and therapeutic monitoring
- Aminoglycoside dosing and therapeutic monitoring
- Colistin dosing

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

### ASP Website

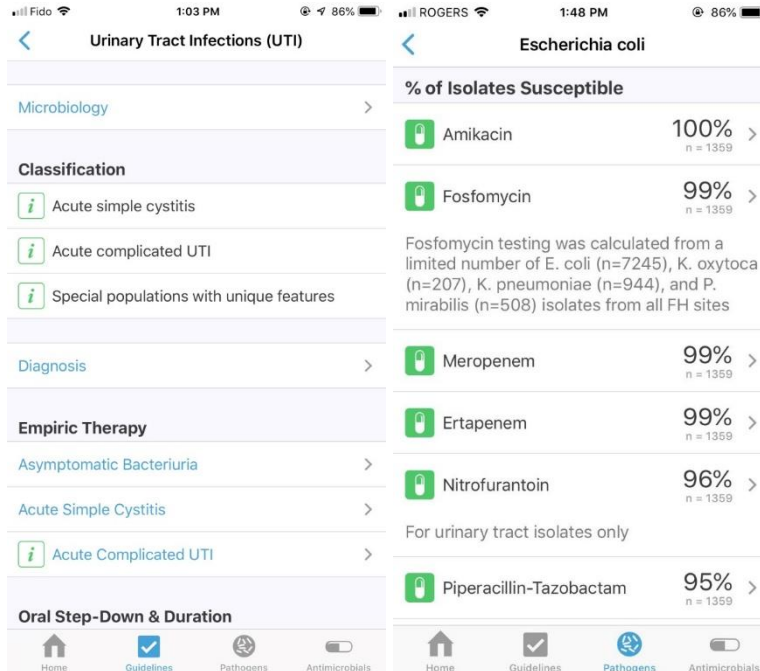
The ASP has a website on the Fraser Health intranet in order to improve visibility of our program and consolidate all our communication and reports in a single location. Our website includes our ASP Handbook, local antibiograms, our reports, and contact information for our clinical teams across the region.

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 1200 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:

- Suspected/Confirmed COVID-19 Treatment
- COVID-19 Confirmed or Presumed in Long Term Care
- Bamlanivimab trial
- Emergency Sepsis
- PD Peritonitis
- Antibiotic Lock Solutions for Catheter Related Bloodstream Infections in Hemodialysis
- CTU Admission and Triage
- COPD Exacerbation Discharge Prescription

## 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 continues to update this PPO 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 prospective 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.<sup>6</sup> 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. It is also sensitive to changes in both the numerator and denominator that may be independent of one other. However, it is a metric that accounts for hospital size and patient volume, and is used by many other institutions.

The inpatient DOT at the facility level were extracted from LUMED for FY2017-2021, and from Meditech for FY2013-2016. The patient days for units reportable by ASP were extracted from Meditech for FY2018-2021, from the Infection Prevention and Control CDI tool for FY2017, and from MicroStrategy for FY2013-2016.

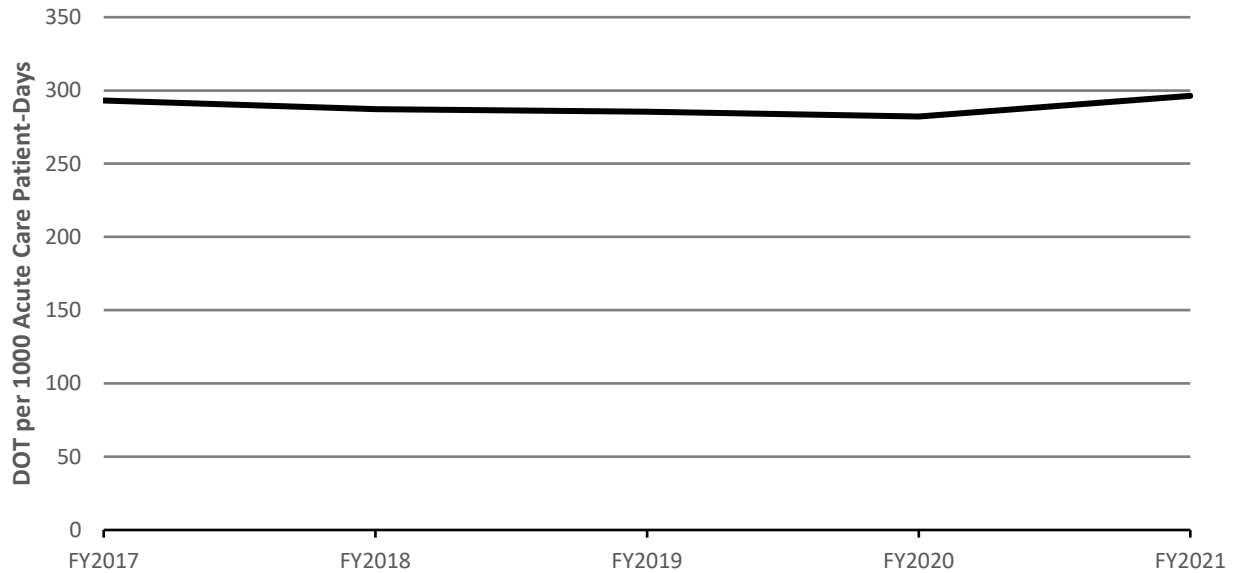
Usage data reflects admitted acute care inpatients only. It does not reflect treatment of non-inpatients through emergency departments, day-medicine/infusion centres, or the home IV program.

After several years of decline, overall inpatient broad-spectrum antibiotic usage significantly increased in FY2020-21 (**Figure 12**). A high density of inpatient antibiotic use is likely due to unprecedented shifts in case-mix as a result of the COVID-19 pandemic. The ASP will continue to monitor these trends closely.

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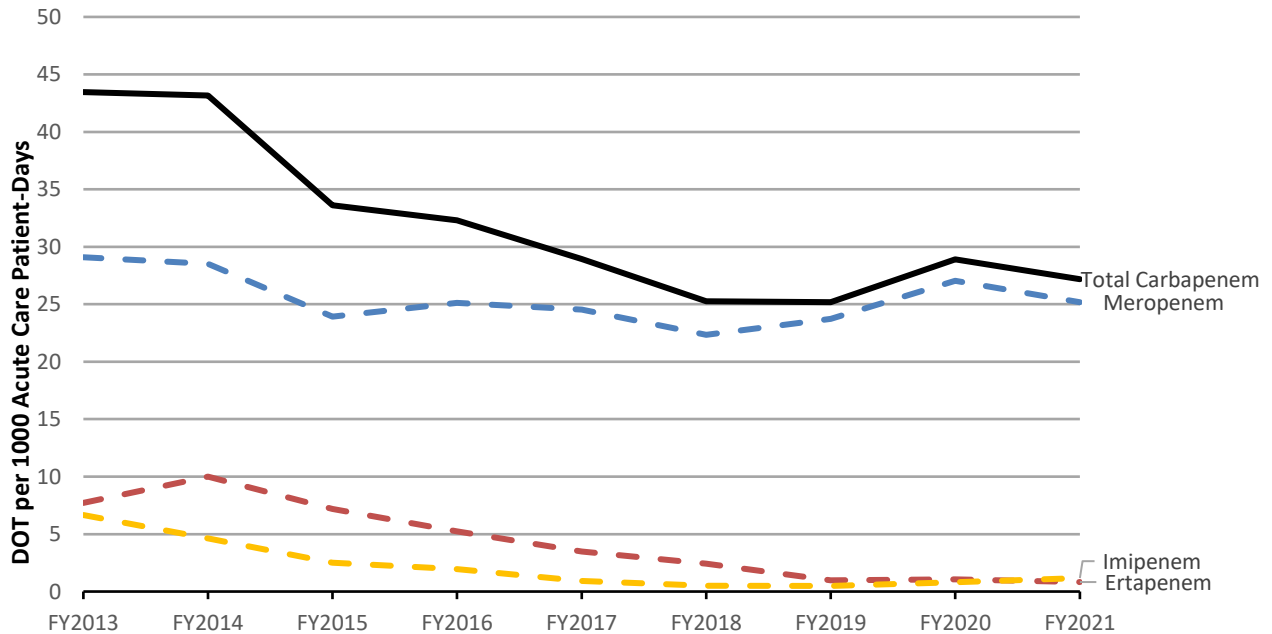
<sup>6</sup> [https://www.publichealthontario.ca/en/eRepository/Antimicrobial\\_Stewardship\\_Metrics\\_Evaluation\\_2014.pdf](https://www.publichealthontario.ca/en/eRepository/Antimicrobial_Stewardship_Metrics_Evaluation_2014.pdf)

**Figure 12. Inpatient broad-spectrum usage.**



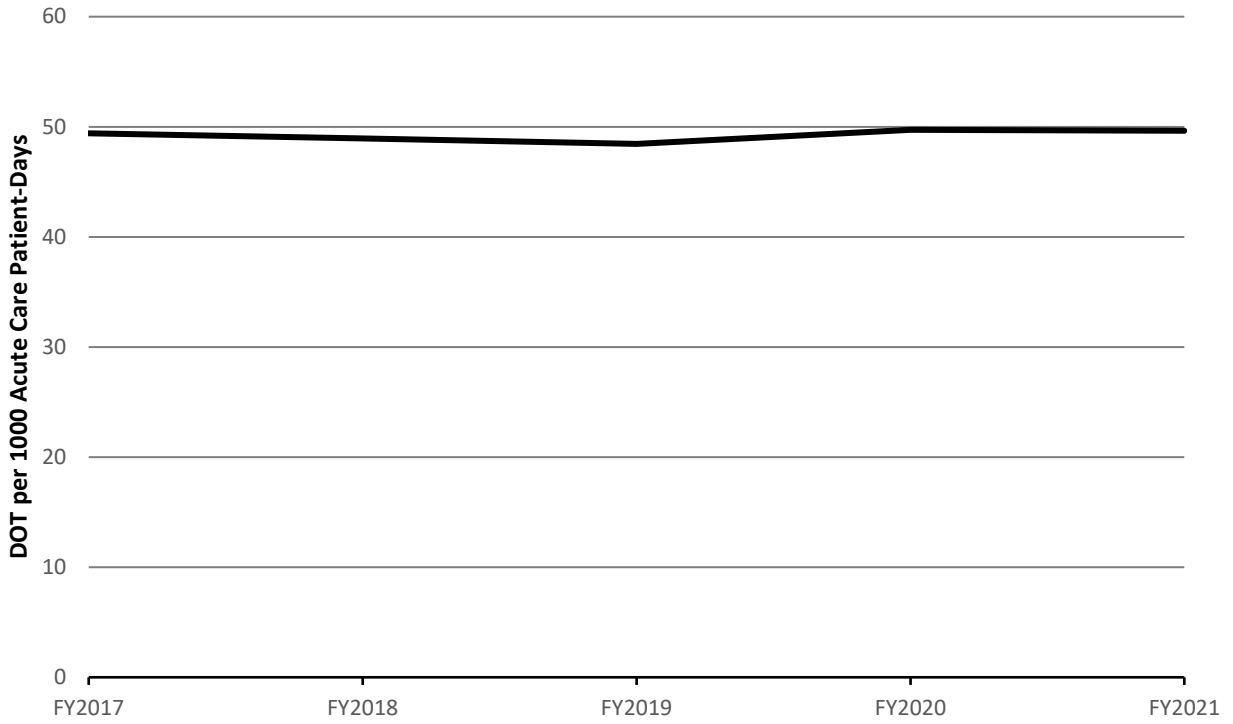
Carbapenems are one of our most potent class of antimicrobials. Resistance to carbapenems in gram-negative infections is a serious public health threat and a strong impetus for antimicrobial stewardship. Carbapenem usage decreased over the previous year (**Figure 13**), and remains significantly below pre-ASP trends.

**Figure 13. Inpatient carbapenem usage.**



The ASP also tracks agents used for treatment of resistant gram-positive infections (e.g., MRSA and VRE). Usage of these agents remains stable (**Figure 14**).

**Figure 14. Inpatient gram-positive agents usage.**



Please refer to the statistical appendix for hospital-specific antimicrobial usage.

## 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 antimicrobial agent with the highest expenditure (**Table 1**). Daptomycin is mostly used in the outpatient setting for treatment of resistant infections, or where alternative agents requiring multiple daily doses are logistically unfeasible. Ertapenem is also nearly exclusively used in the outpatient setting, as a therapeutic interchange to meropenem governs inpatient use. Decreased expenditures on daptomycin, ertapenem, meropenem, and linezolid have been the most prominent change from FY2020. Imipenem expenditures increased by a negligible amount. We suspect the COVID-19 pandemic has at least partly influenced these changes in expenditures because of altered case-mix and treatment preferences of patients and providers.

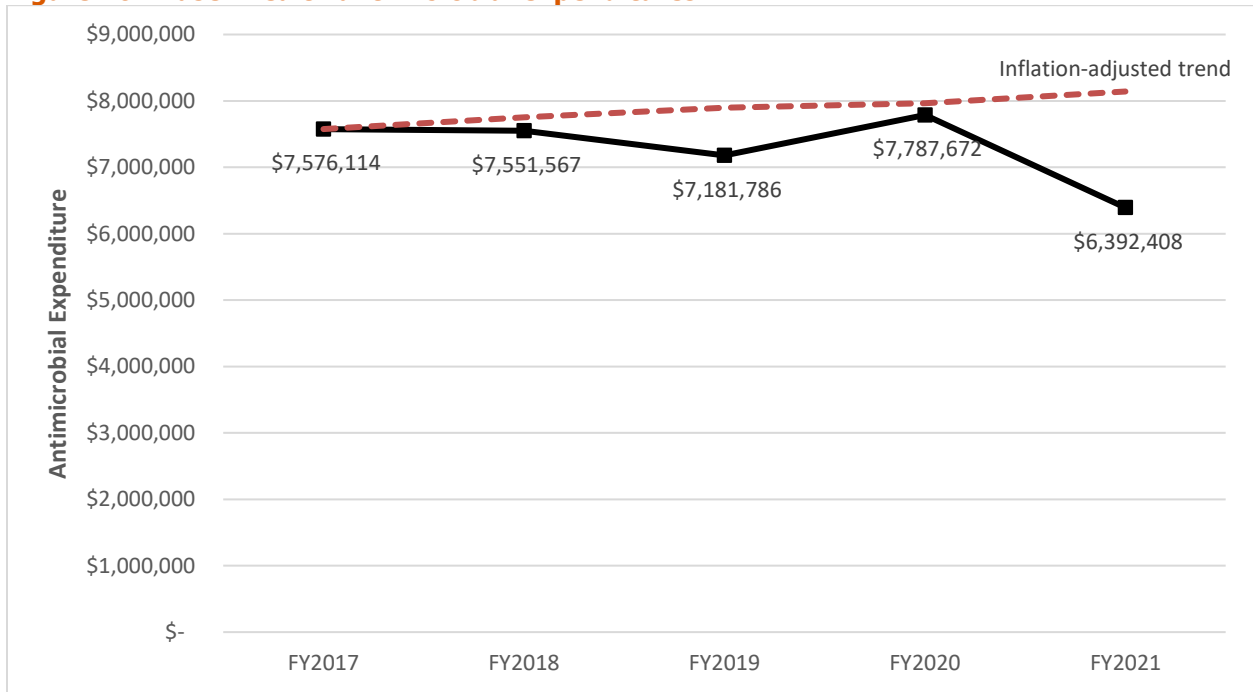
Overall antimicrobial expenditure in Fraser Health has remained below inflation-adjusted trends for the past several fiscal years (**Figure 16**). Over the past year, antimicrobial expenditures have decreased by \$1,395,264 (a 17.9% decrease). This disproportionate decrease is likely a result of COVID-19 pandemic-associated changes in case-mix and healthcare service delivery. Antimicrobial expenditures are expected to rebound as healthcare volumes increase once again.

**Table 1. Combined cost of five restricted antimicrobial drugs.**

Restricted Antimicrobials	Total Inpatient & Outpatient Expenditure (excluding Home IV supplied by Calea)			Difference (FY2021 vs. FY2020)
	FY2020	FY2021		
Daptomycin	\$1,790,117	\$1,341,855	↓	-\$448,262
Ertapenem*	\$930,332	\$552,648	↓	-\$377,684
Meropenem*	\$374,758	\$304,785	↓	-\$69,973
Linezolid	\$110,917	\$77,018	↓	-\$33,899
Imipenem*	\$34,641	\$37,380	↑	\$2,739
<b>Total</b>	<b>\$3,240,765</b>	<b>\$2,313,686</b>	<b>↓</b>	<b>-\$927,079</b>
*Carbapenems	\$1,339,731	\$894,813	↓	-\$444,918

Source: LMPS Datamart

**Figure 16. Fraser Health antimicrobial expenditures.**



**Source**

*Actual expenditures: LMPS Datamart. All Anti-Infective Agents by AHFS Classification.*

*Inflation-adjusted trend: Statistics Canada Table 18-10-0004-01 using All Items for Canada in March of every fiscal year. Baseline year FY2017.*

# Statistical Appendix

## Antimicrobial Aggregations

Throughout this report, the following antimicrobial aggregations are used to show overarching trends in antimicrobial usage.<sup>7</sup>

**Broad-spectrum antimicrobials** include all the following sub-groups:

1. Antibiotics used primarily to treat hospital-acquired infections: amikacin, aztreonam, cefepime, ceftazidime, gentamicin, imipenem-cilastatin, meropenem, piperacillin-tazobactam, tobramycin.
2. Antibiotics used primarily to treat community-acquired infections: cefixime, cefotaxime, cefprozil, ceftriaxone, cefuroxime, ciprofloxacin, ertapenem, levofloxacin, moxifloxacin.
3. Antibiotics used primarily to treat MDR infections: ceftazidime-avibactam, ceftolozane-tazobactam, colistin (colistimethate), tigecycline.
4. Agents used primarily to treat resistant gram-positive infections: ceftaroline, ceftobiprole, daptomycin, linezolid, vancomycin

**Gram-positive agents** include only the sub-group of antibiotics used primarily to treat resistant gram-positive infections (detailed above)

## 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.

## Data Sources

The inpatient DOT at the facility level for FY2017-2021 were extracted from LUMED. The patient days for units reportable by ASP were extracted from Meditech for FY2018-2021 and from the Infection Prevention and Control CDI tool for FY2017.

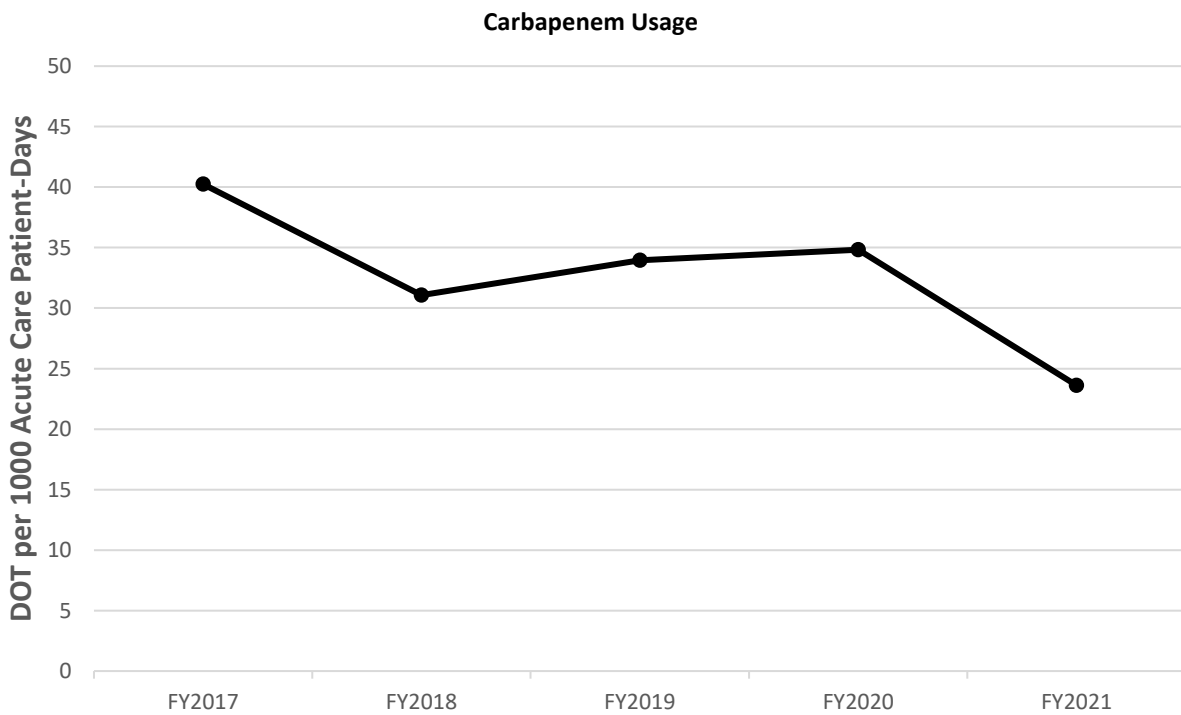
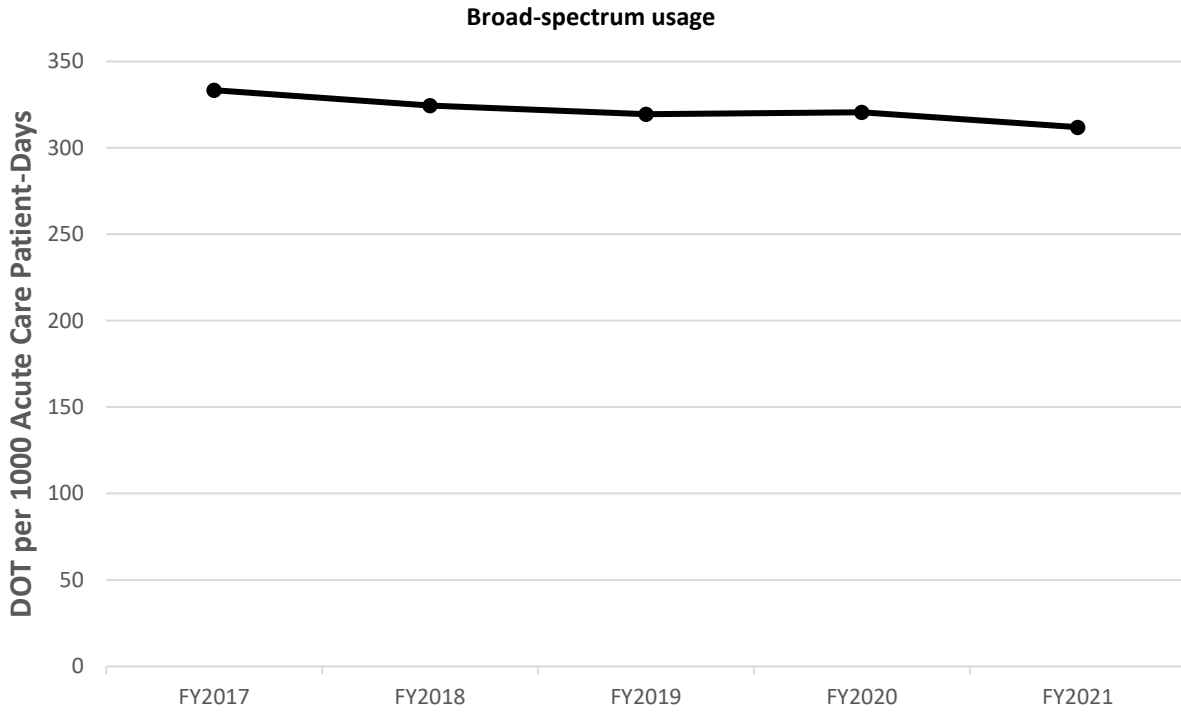
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<sup>7</sup> Antimicrobial groupings are derived from those used by the U.S. Centers for Disease Control and Prevention in their NHSN AUR Module. See <https://www.cdc.gov/nhsn/pdfs/pscmanual/11pscaurcurrent.pdf>.

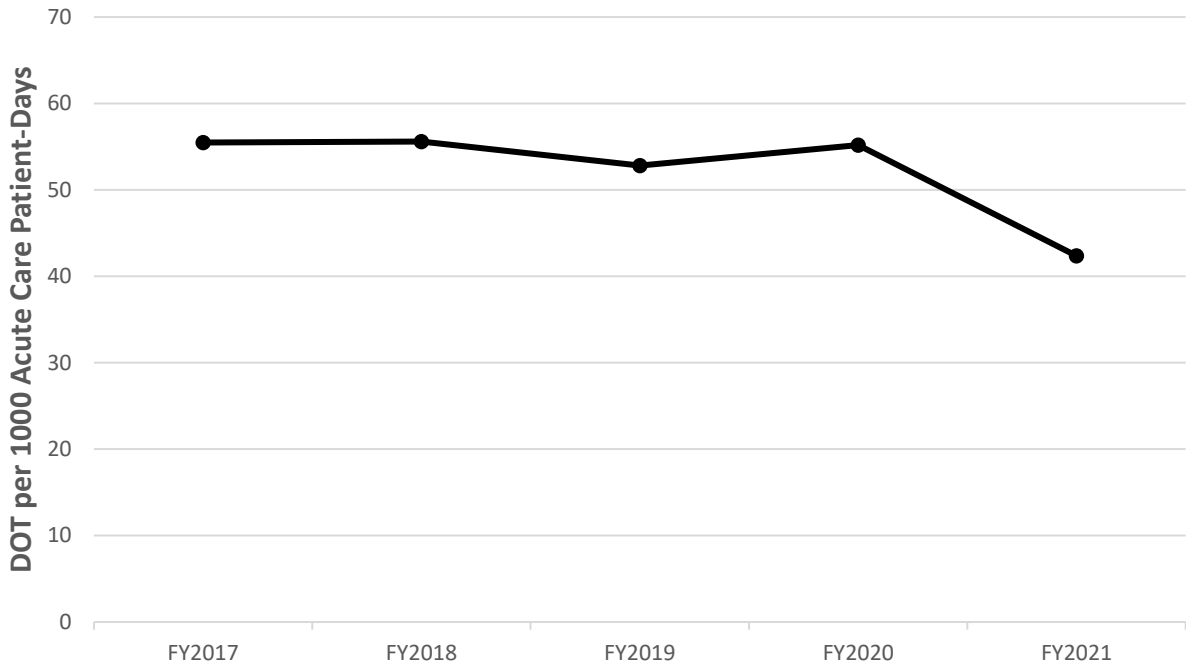


## Targeted Antimicrobial Usage by Site

ARH

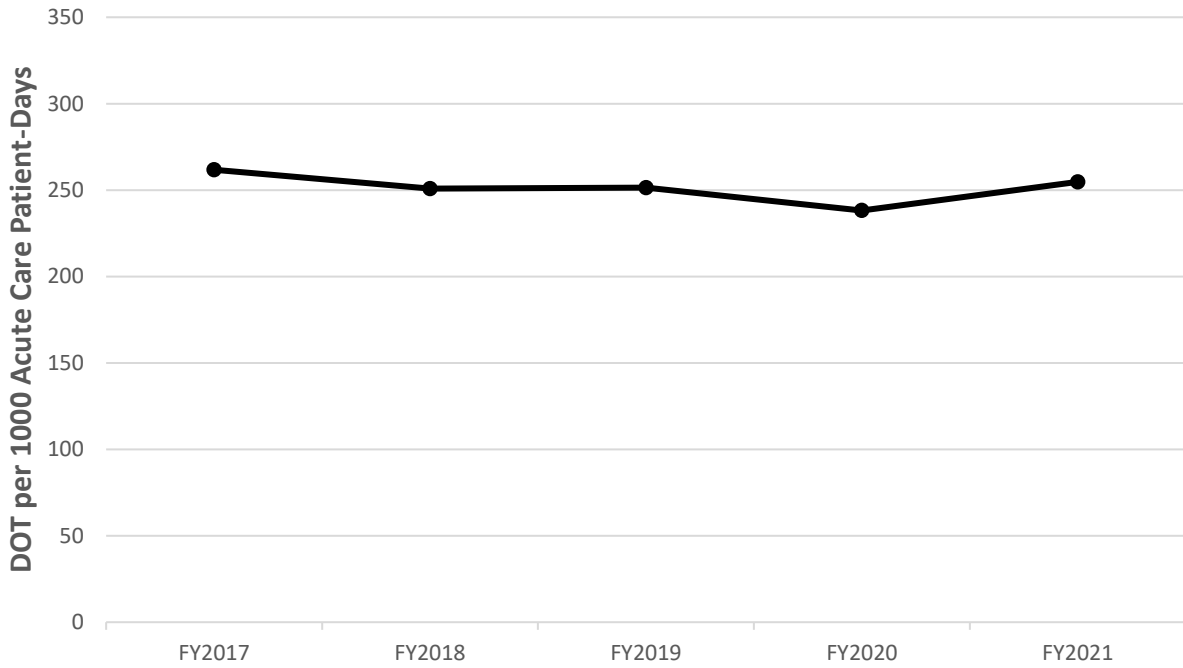


### Gram-positive Agents Usage

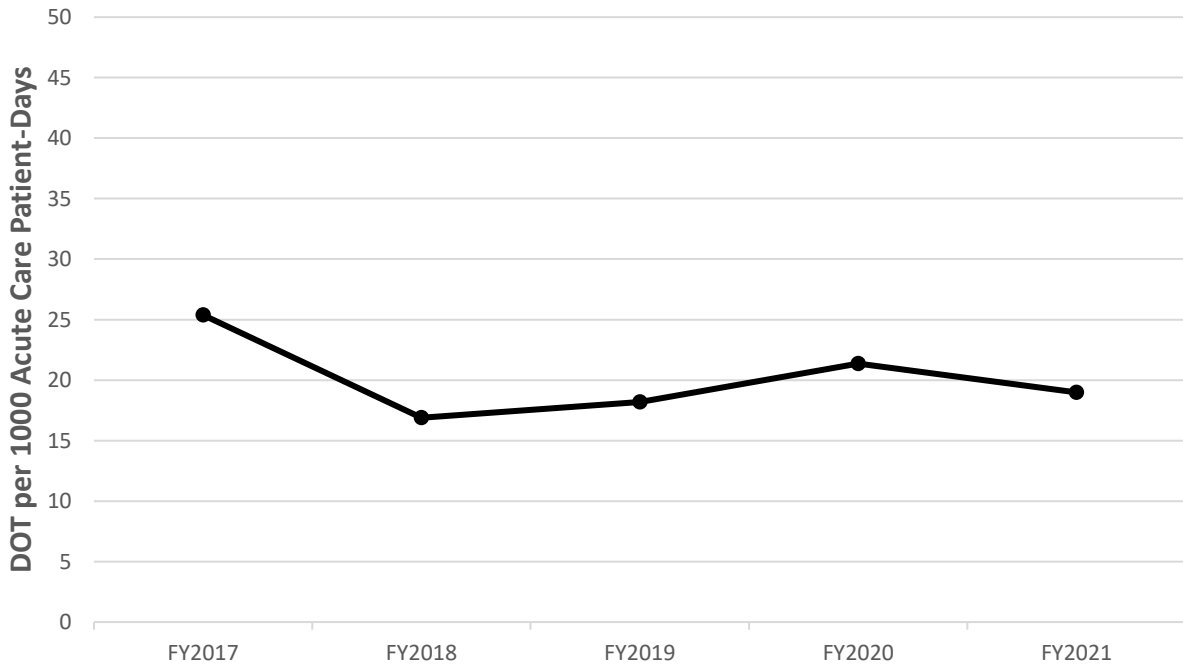


**BH**

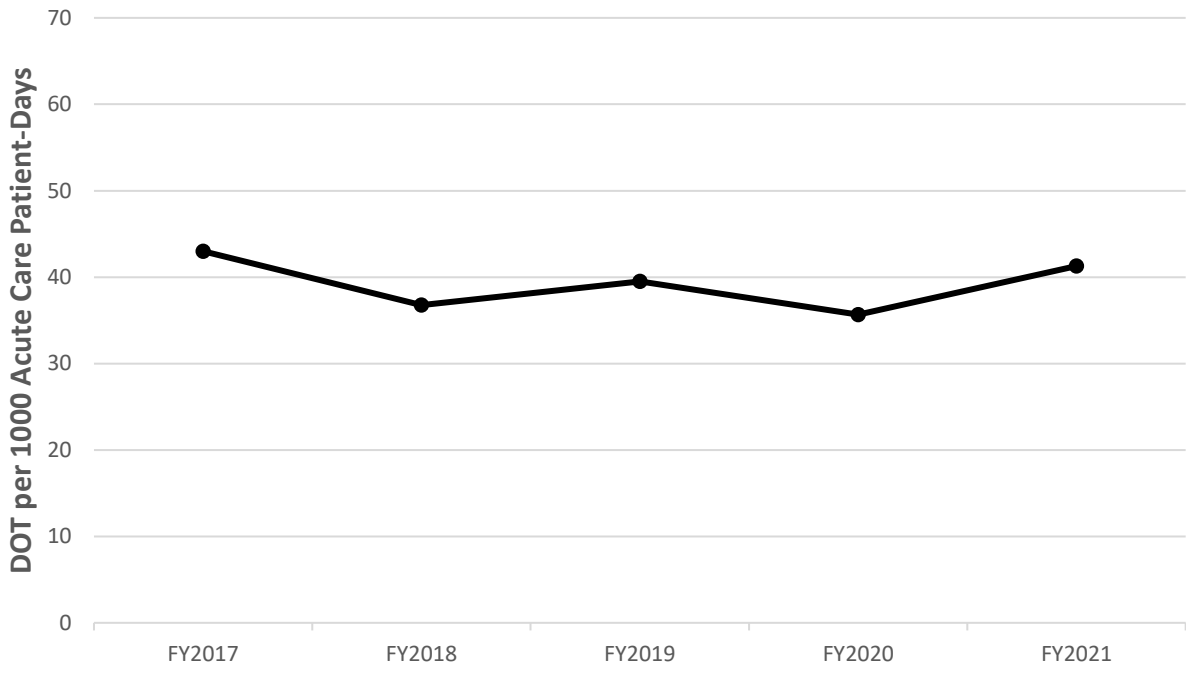
**Broad-spectrum usage**

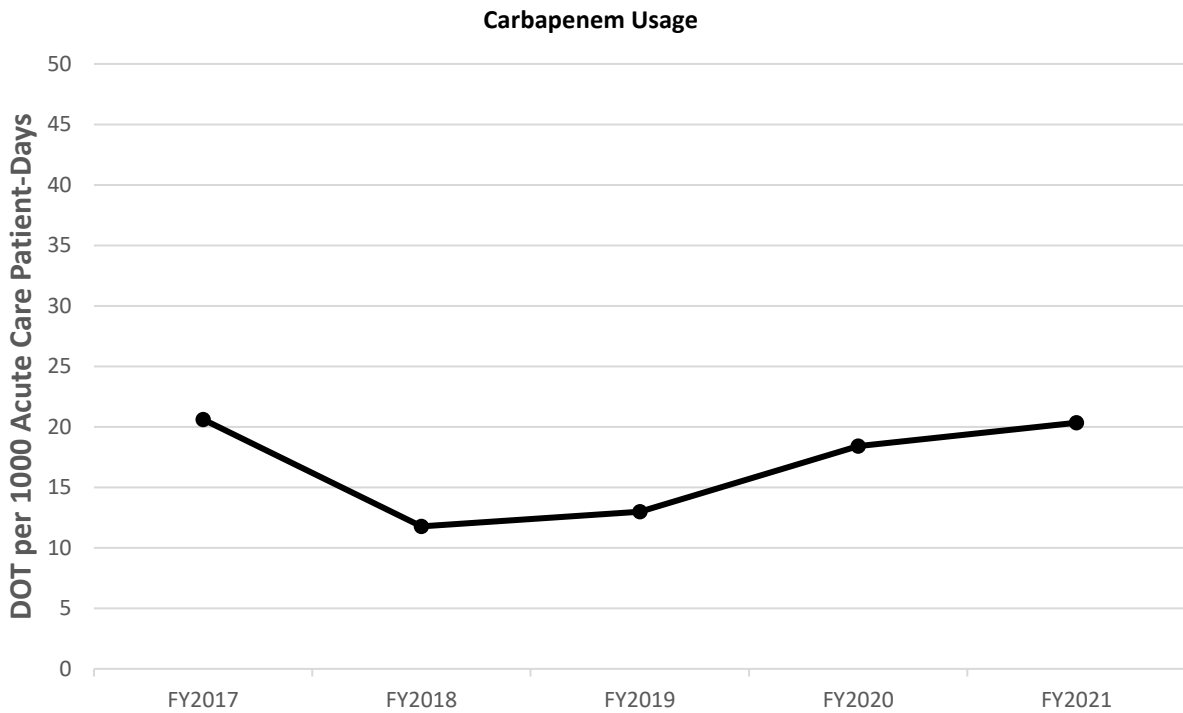
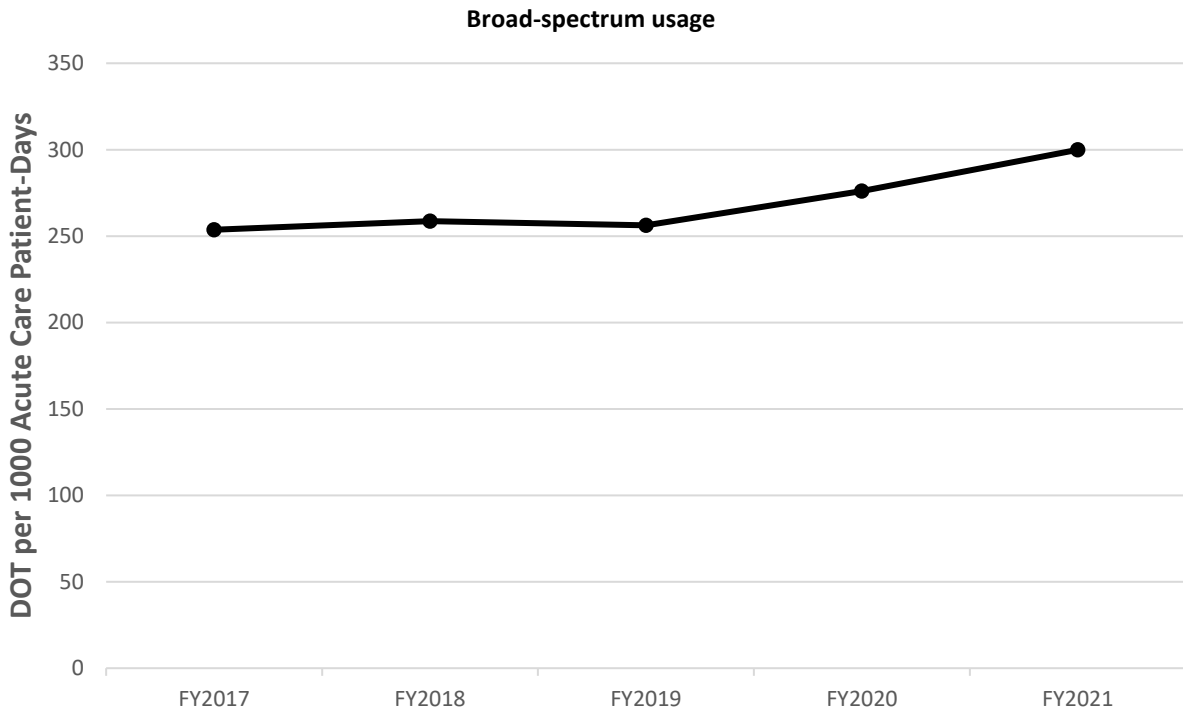


**Carbapenem Usage**

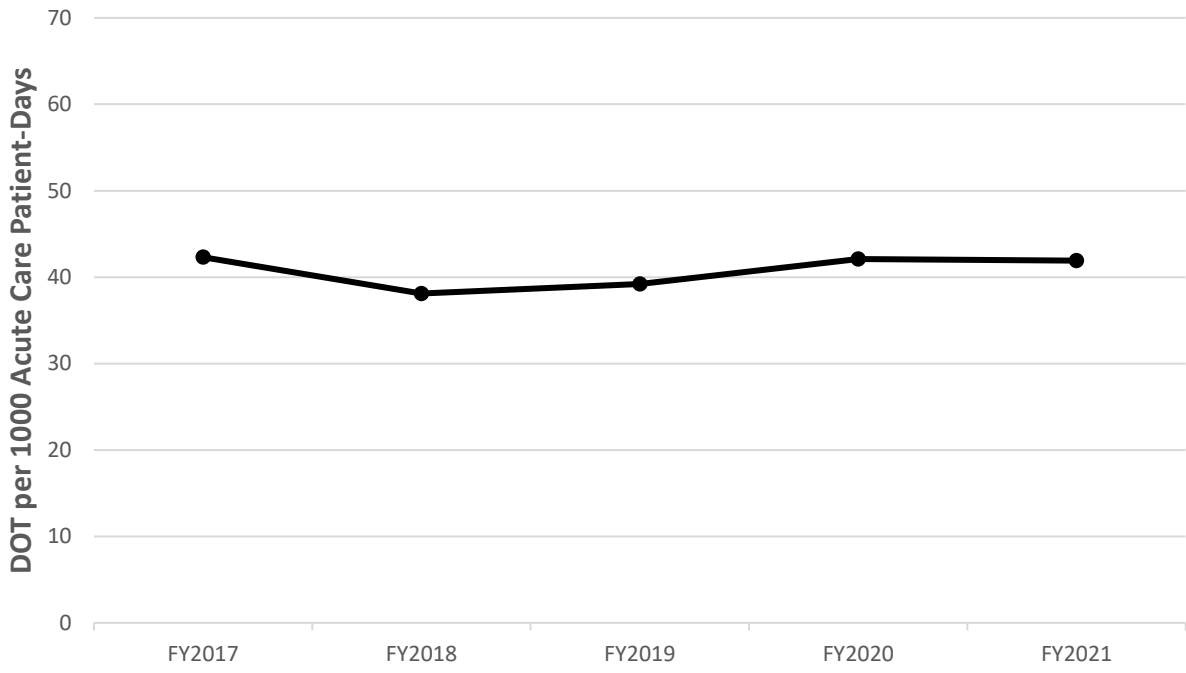


### Gram-positive Agents Usage

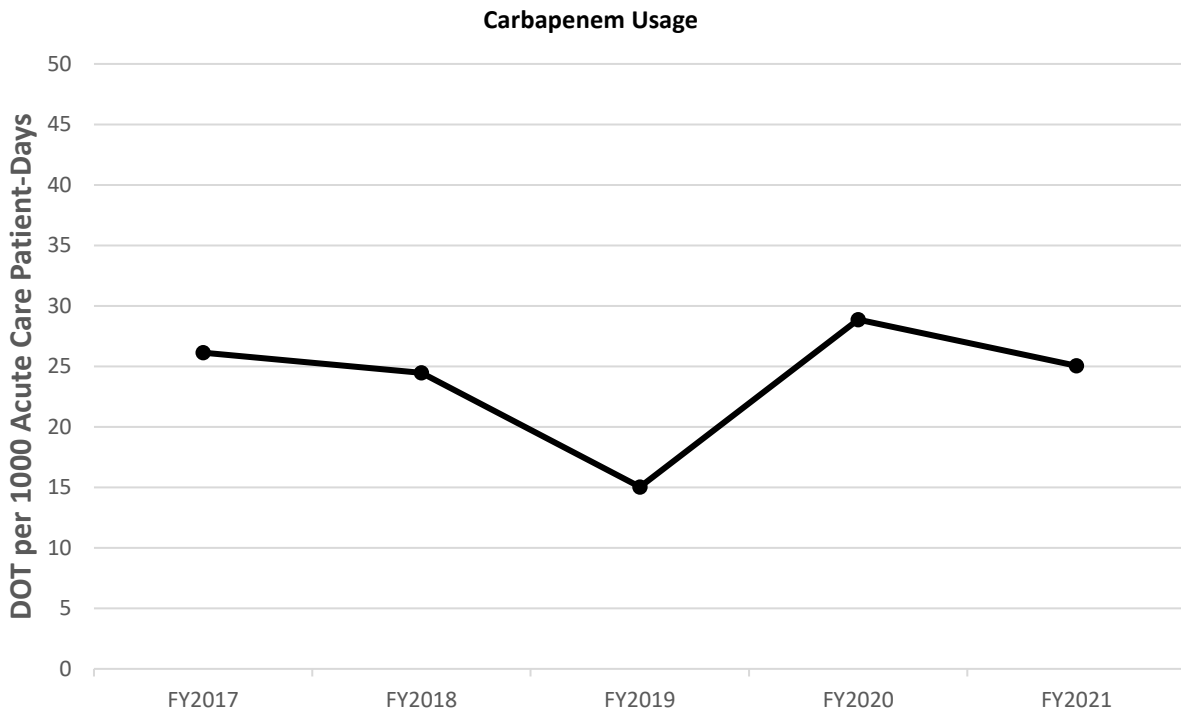
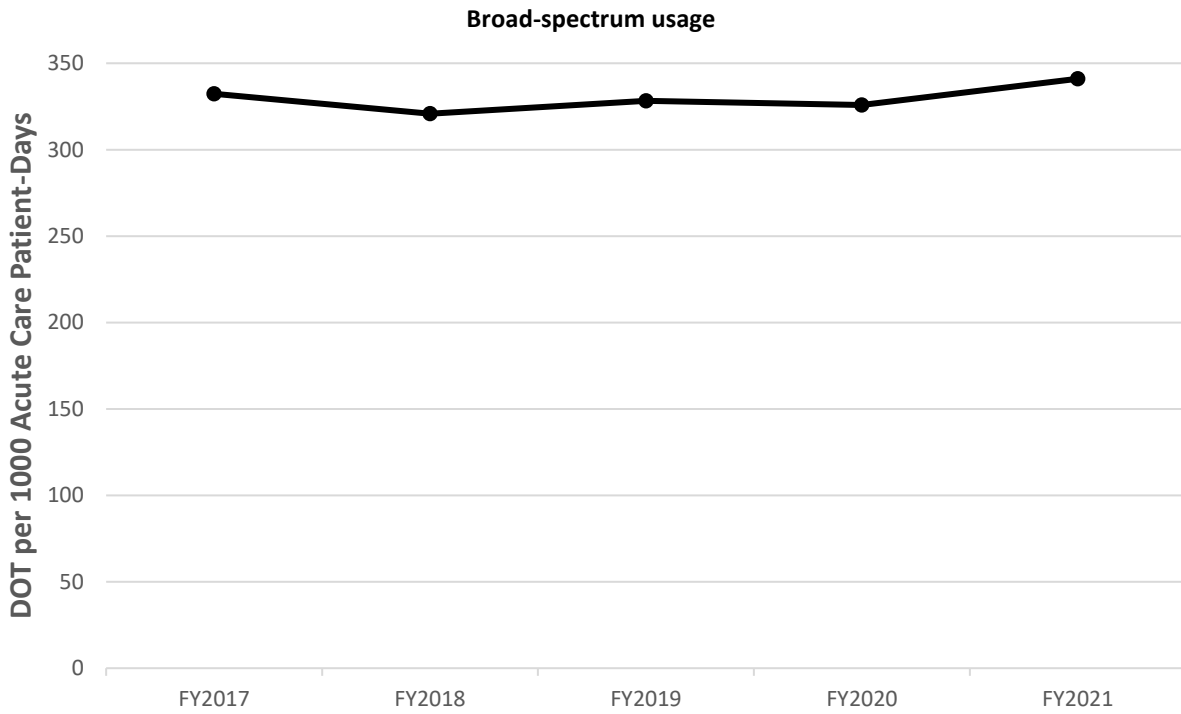




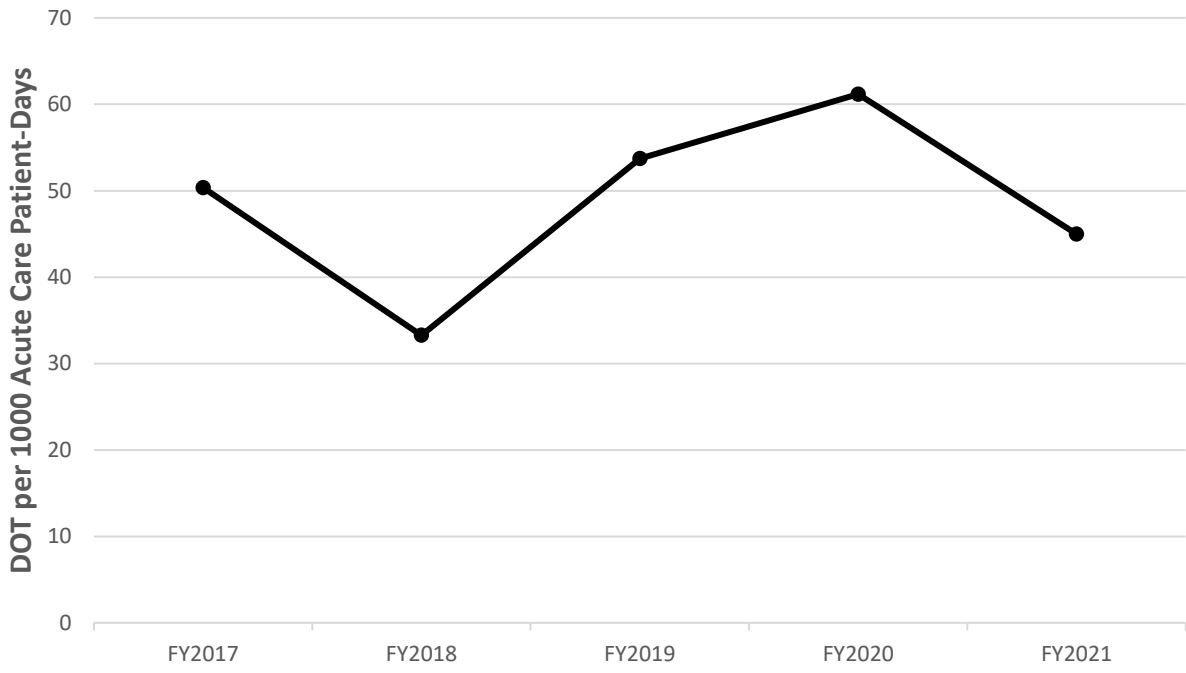
### Gram-positive Agents Usage



DH

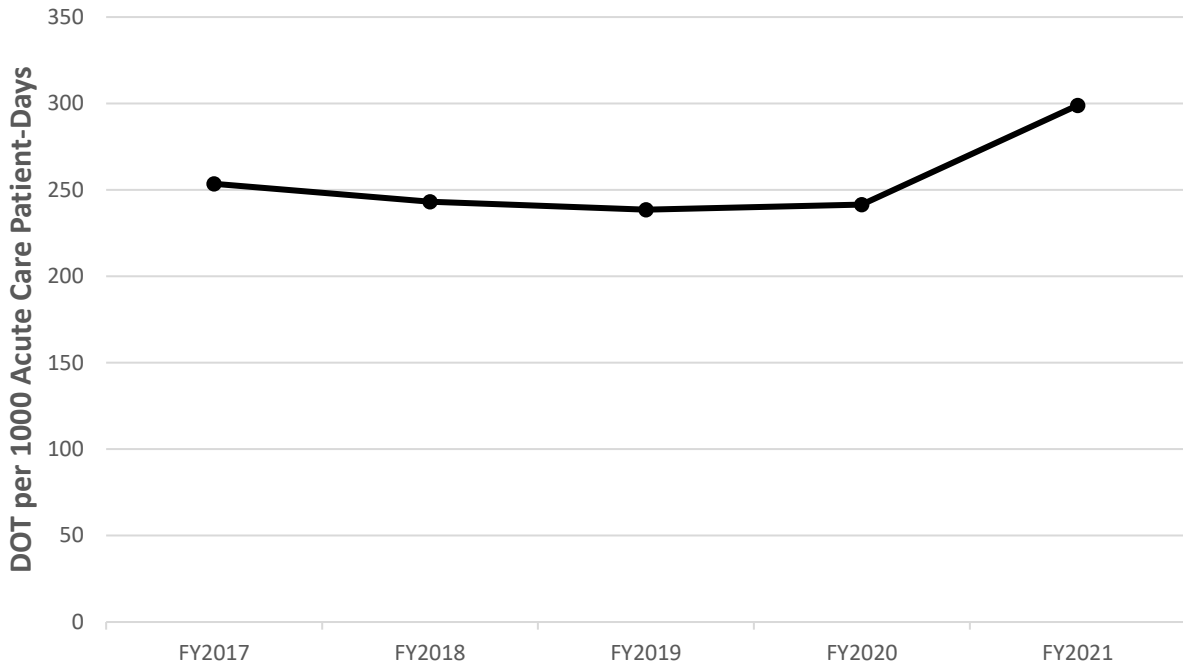


### Gram-positive Agents Usage

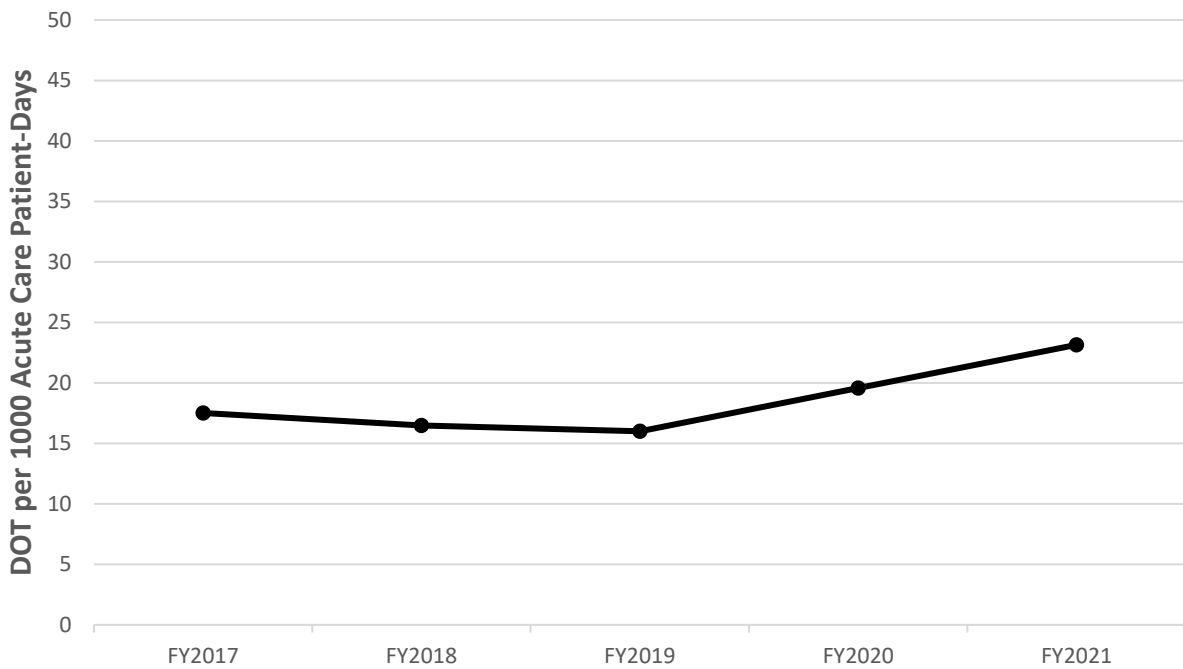




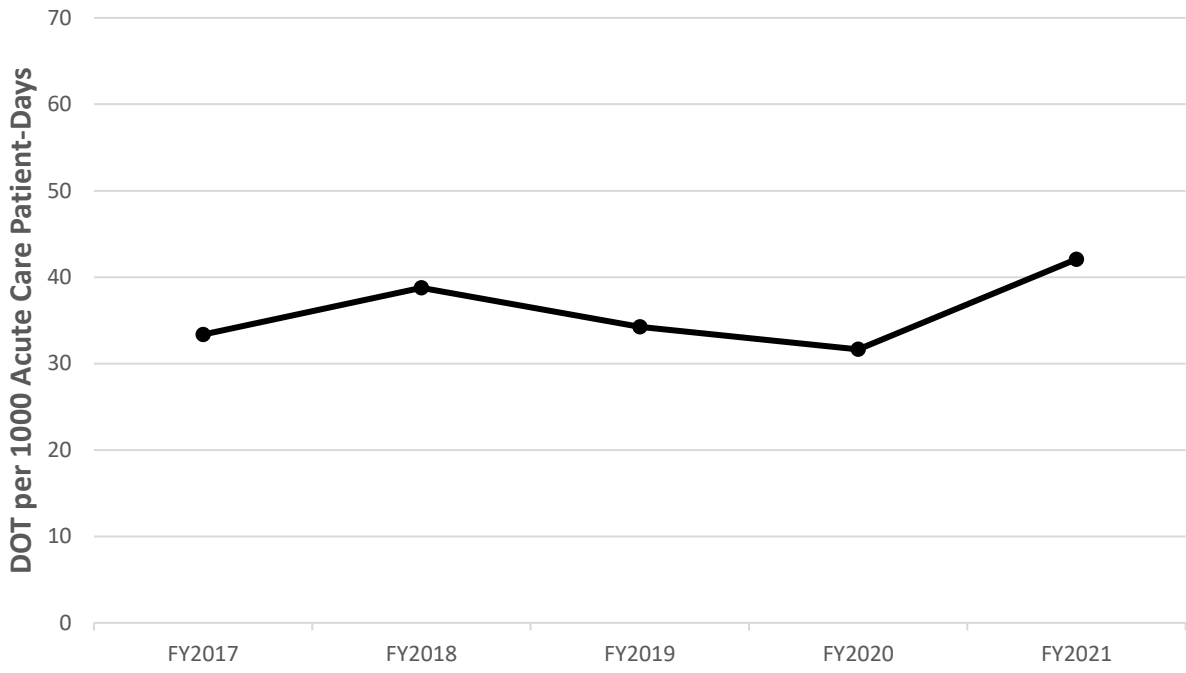
Broad-spectrum usage



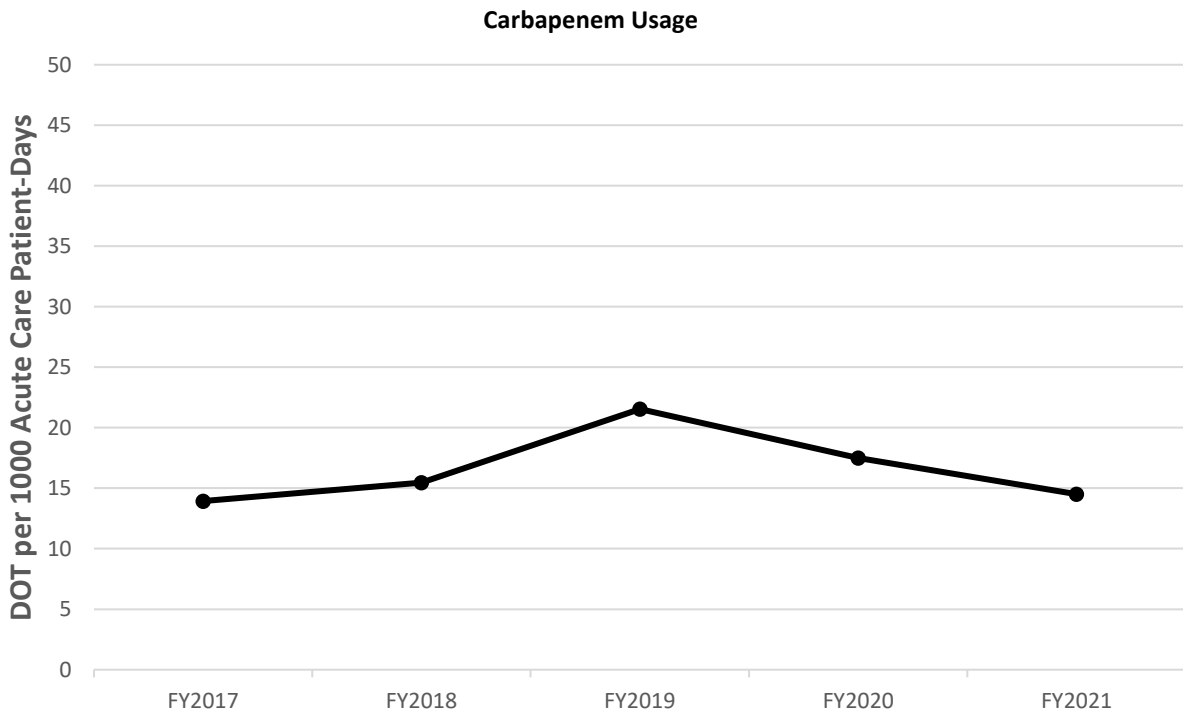
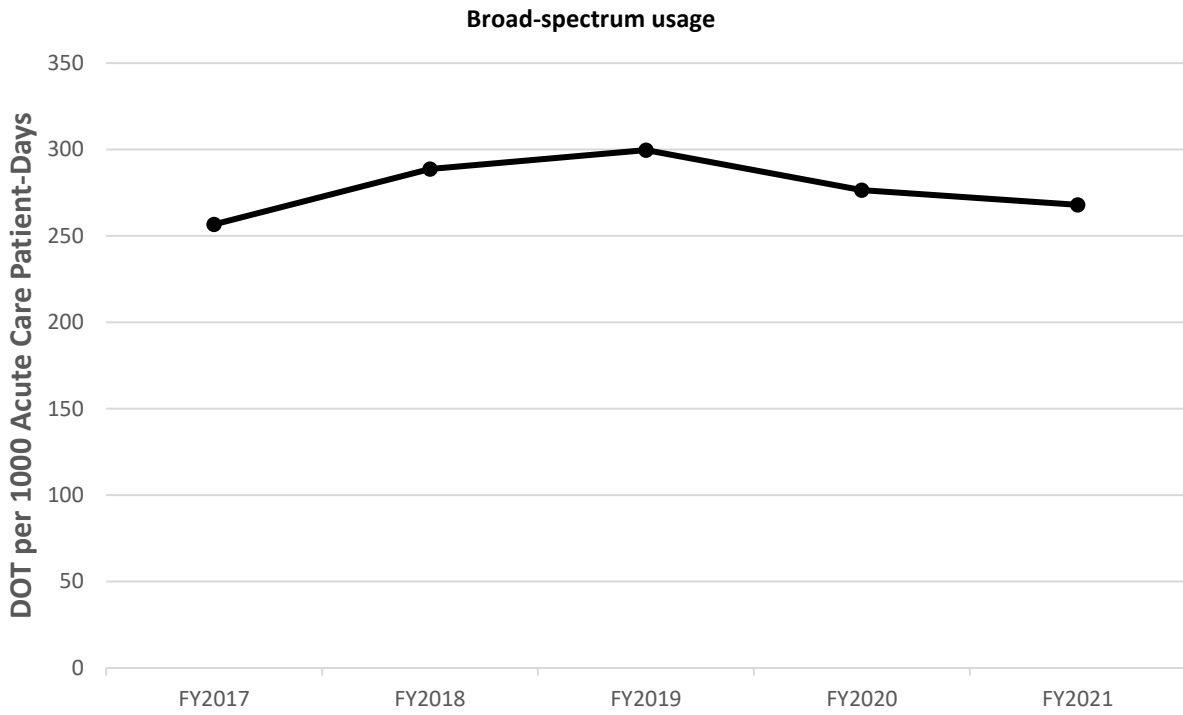
Carbapenem Usage



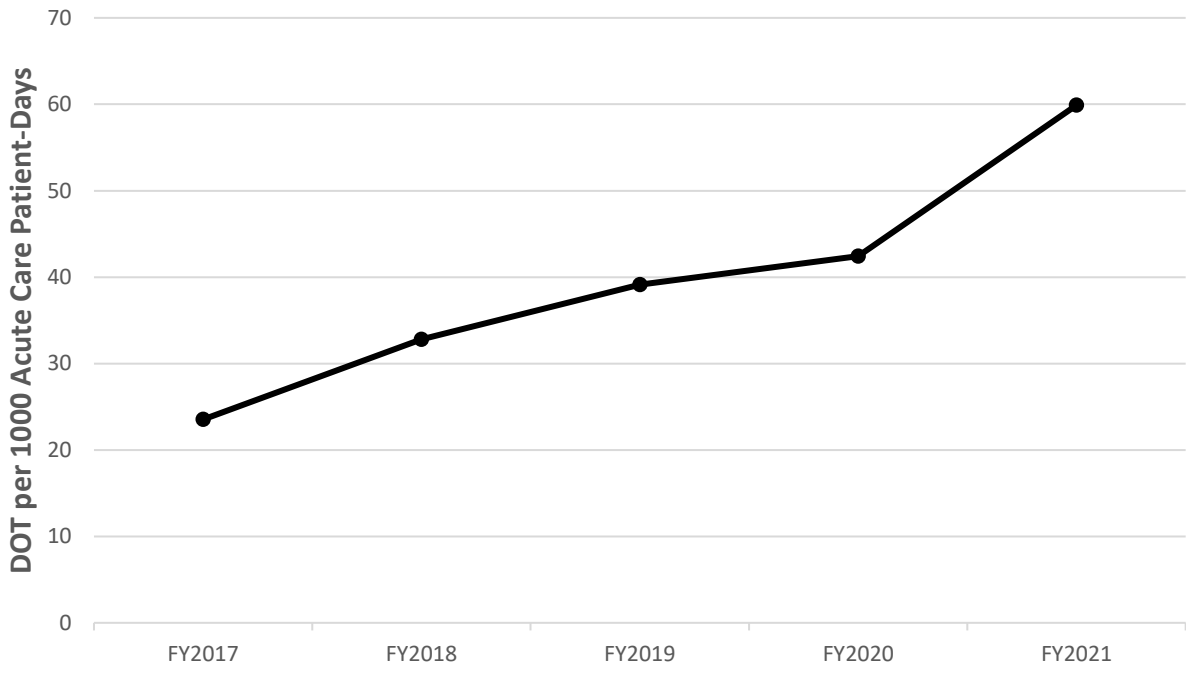
### Gram-positive Agents Usage



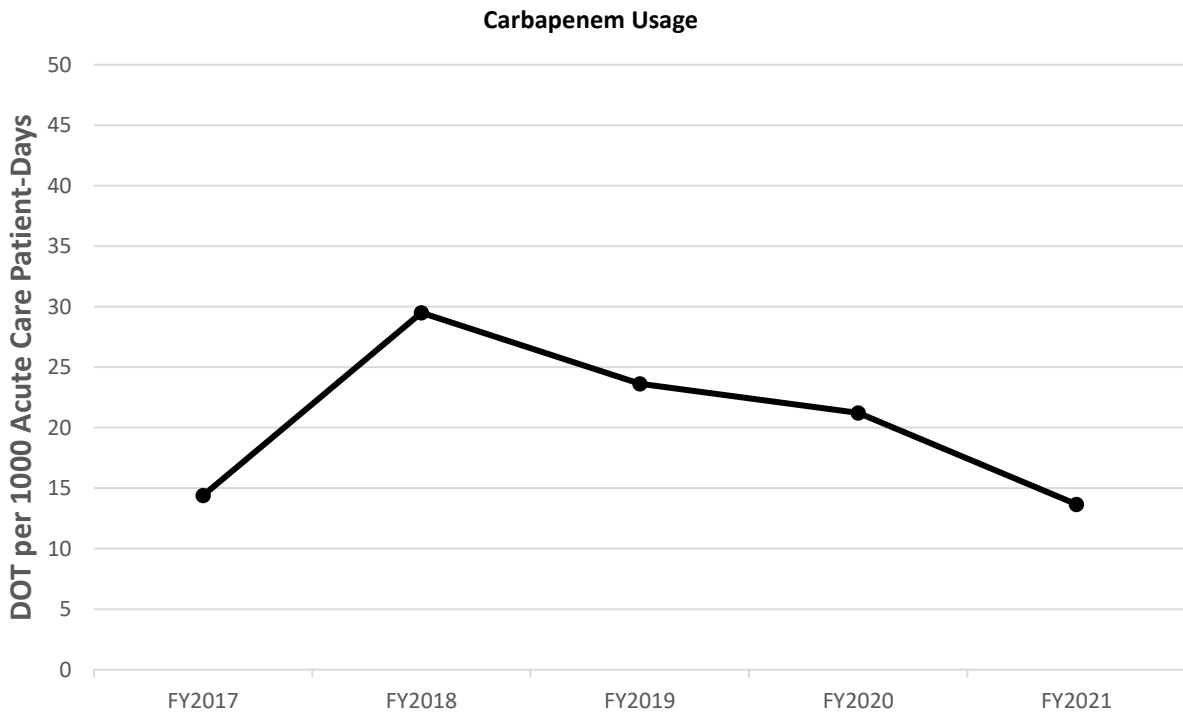
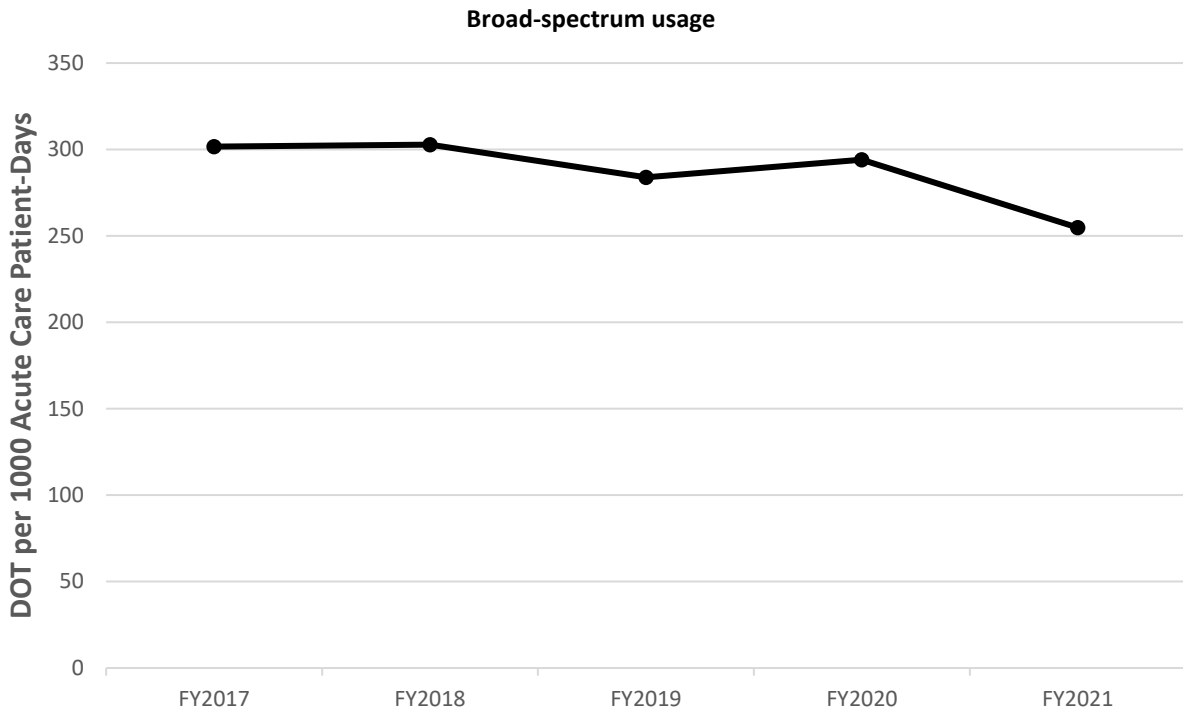
LMH



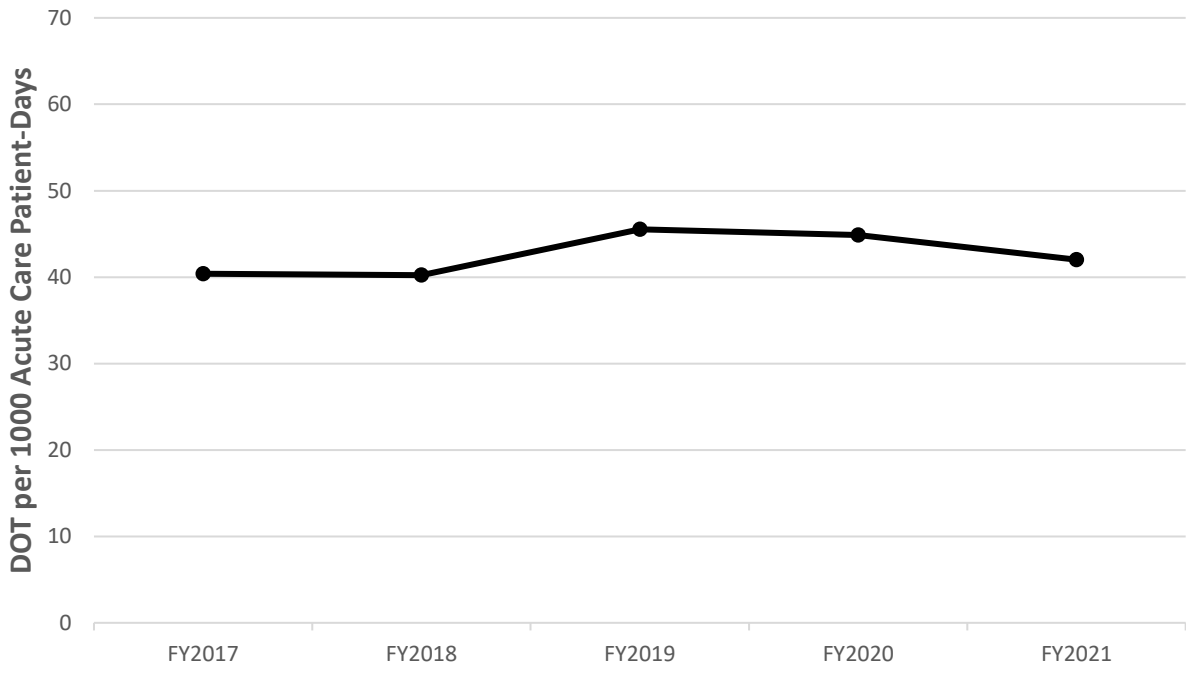
### Gram-positive Agents Usage



**MMH**

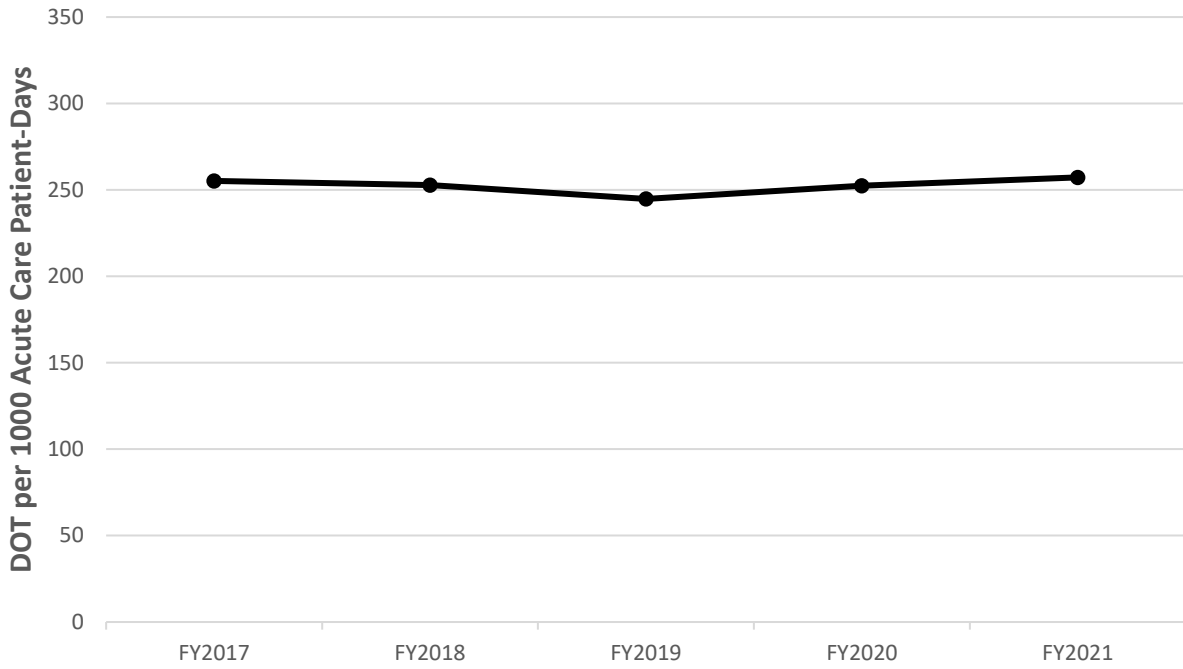


### Gram-positive Agents Usage

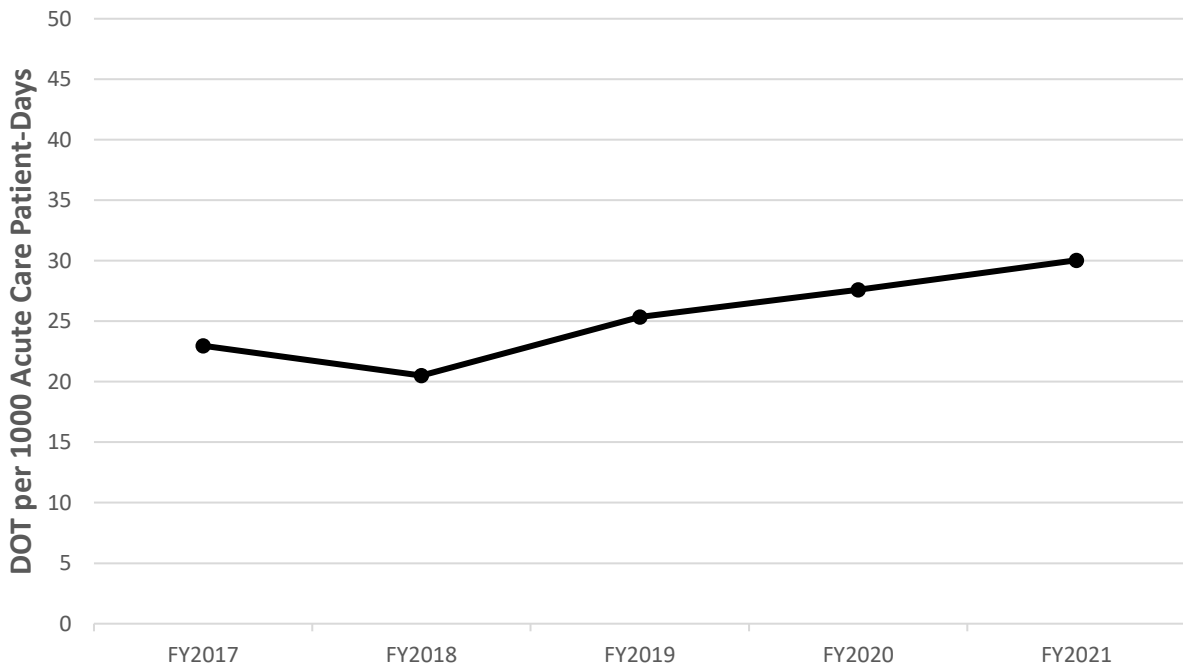


**PAH**

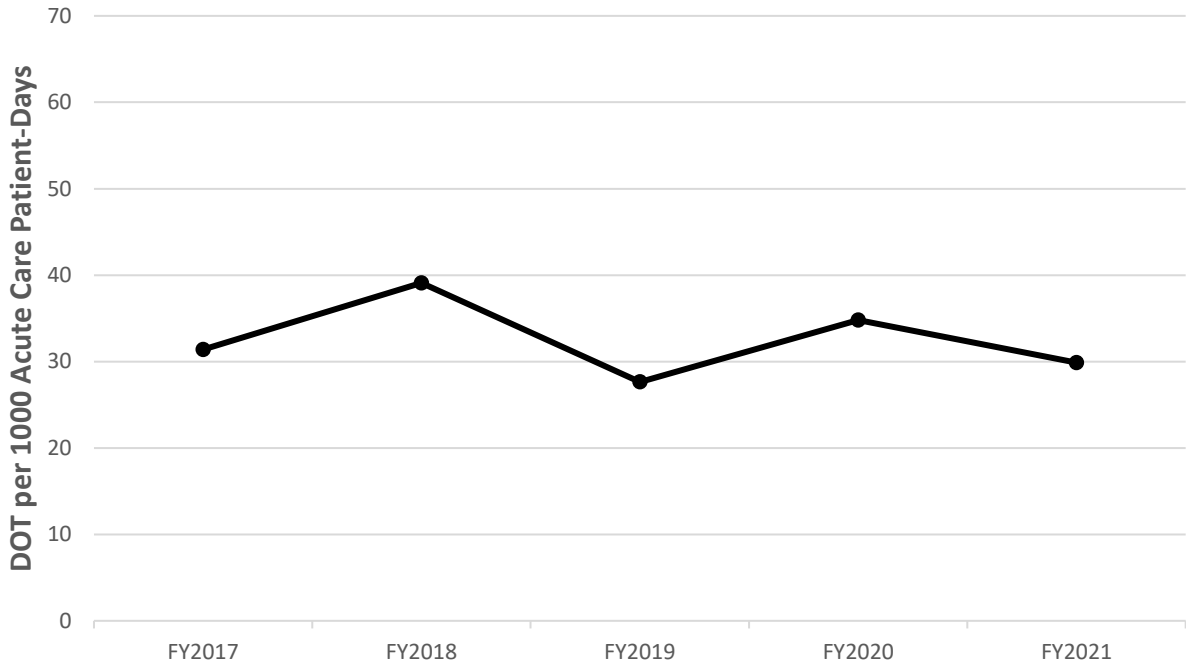
**Broad-spectrum usage**



**Carbapenem Usage**

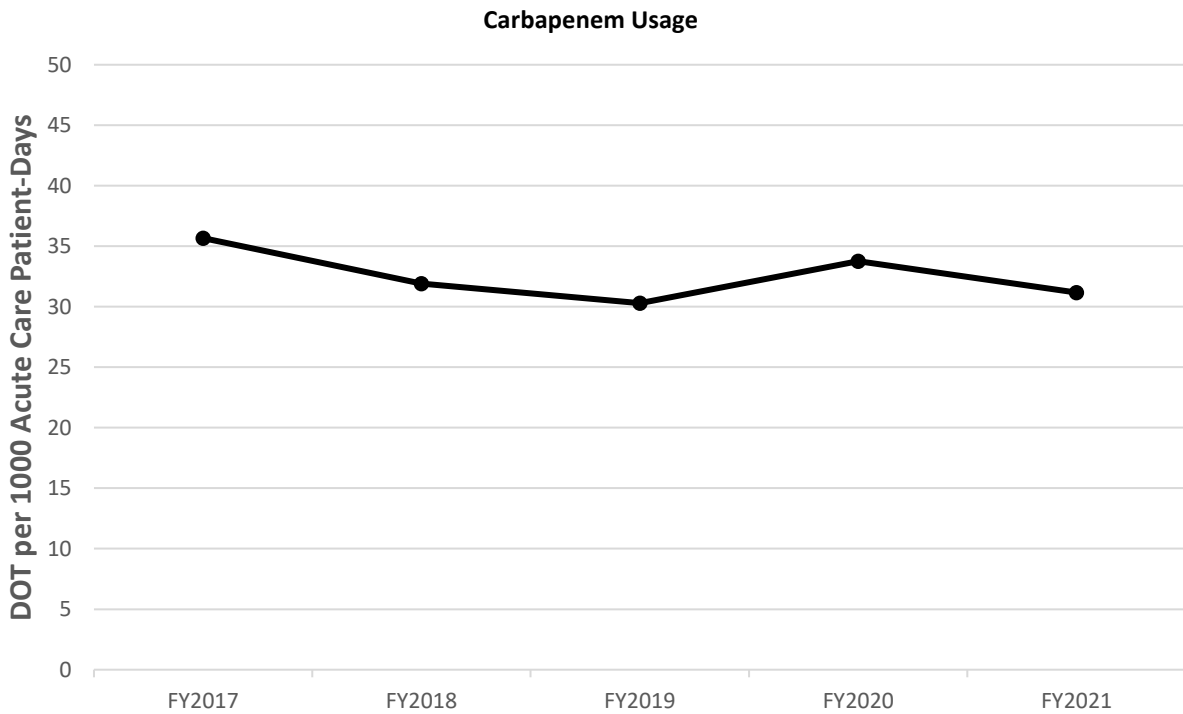
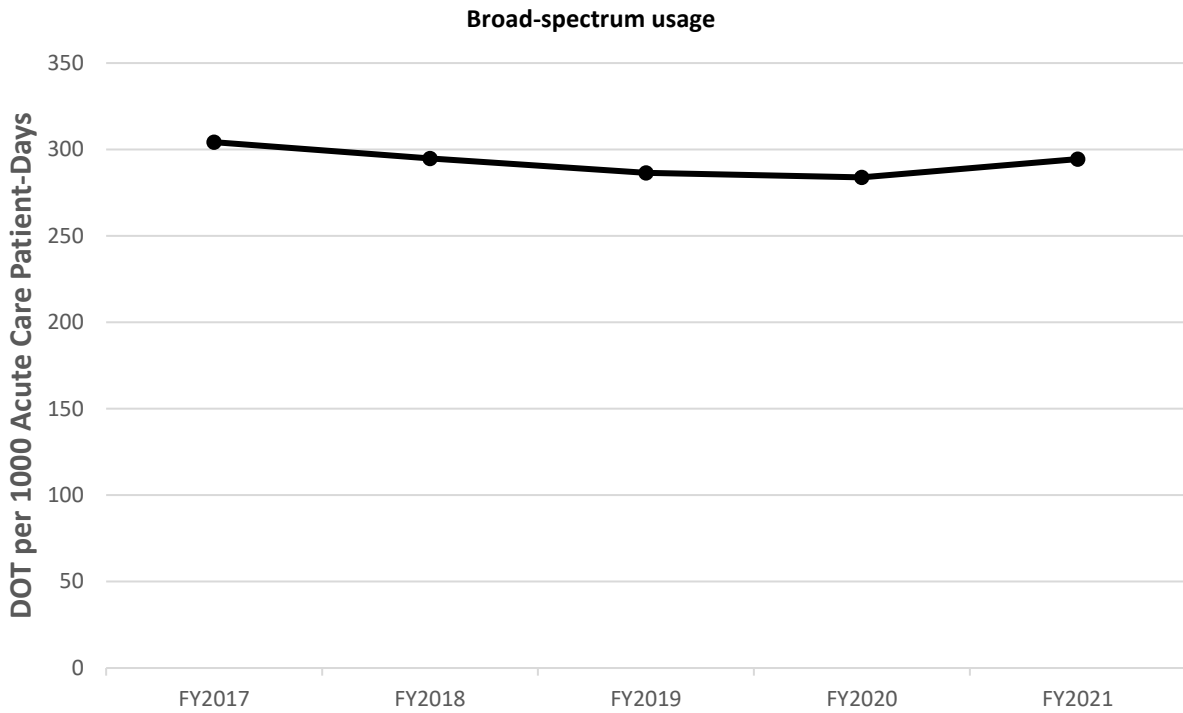


### Gram-positive Agents Usage

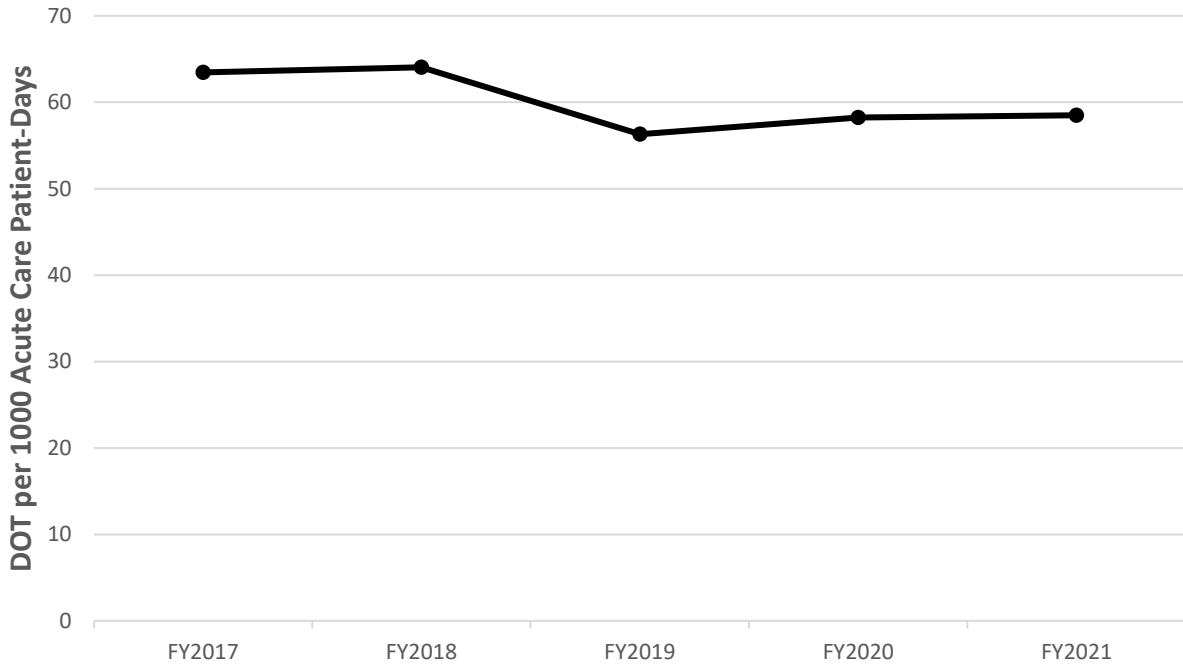




**RCH**

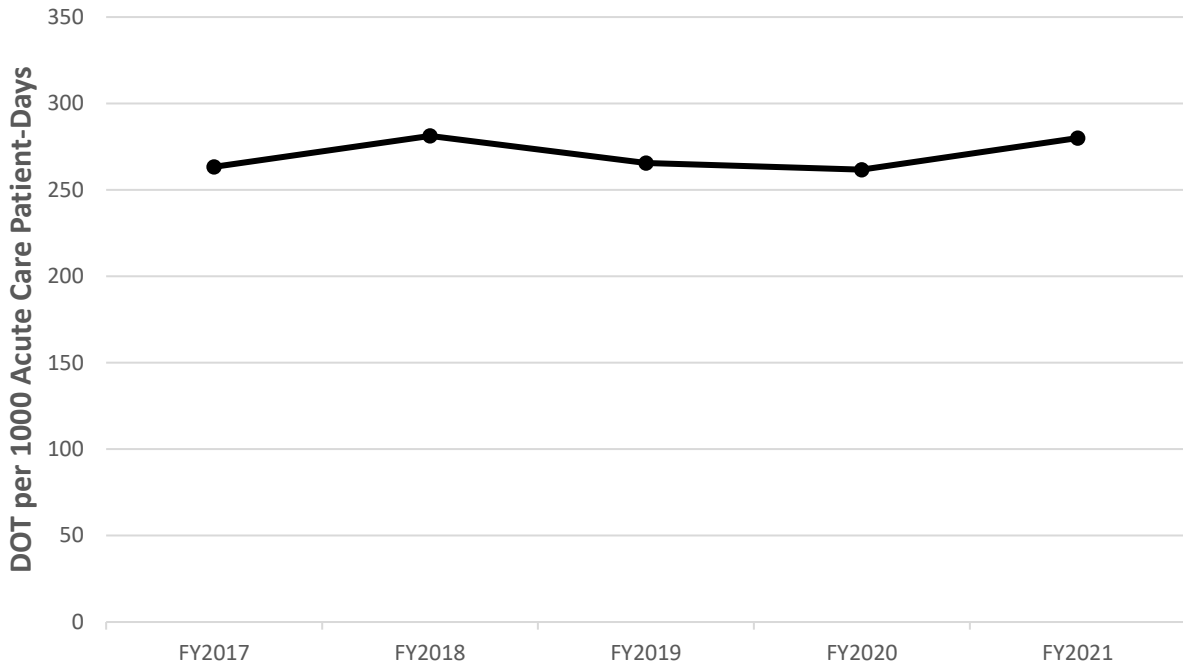


### Gram-positive Agents Usage

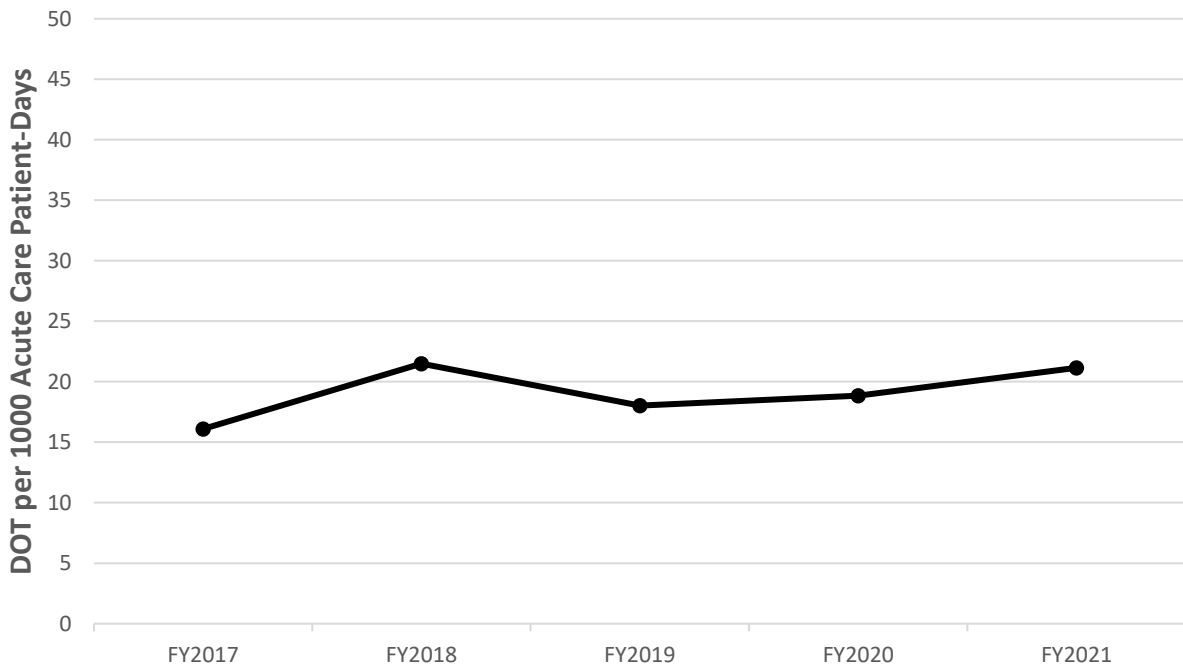


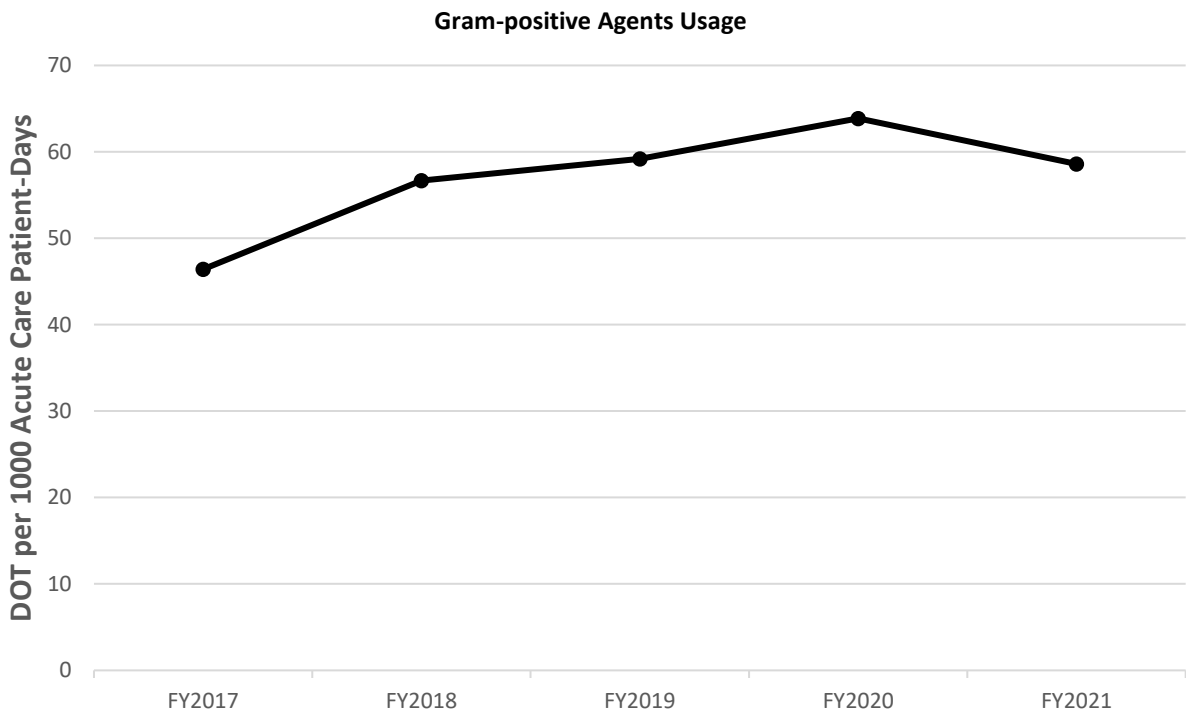
**RMH**

**Broad-spectrum usage**

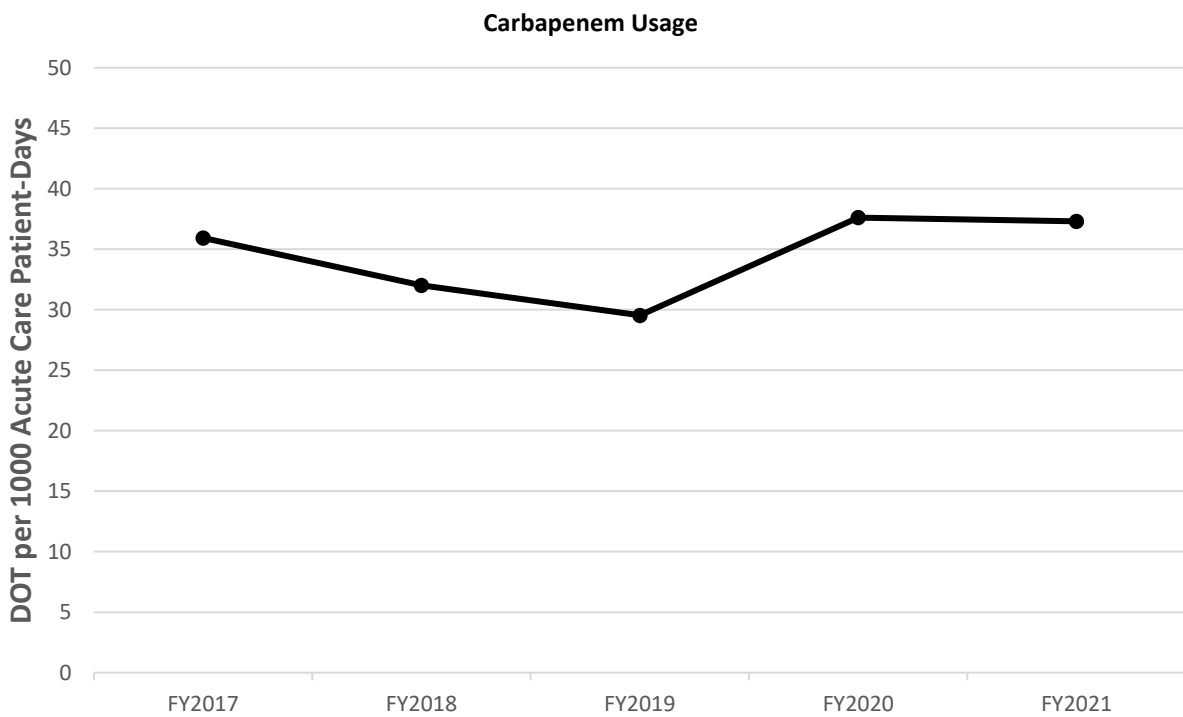
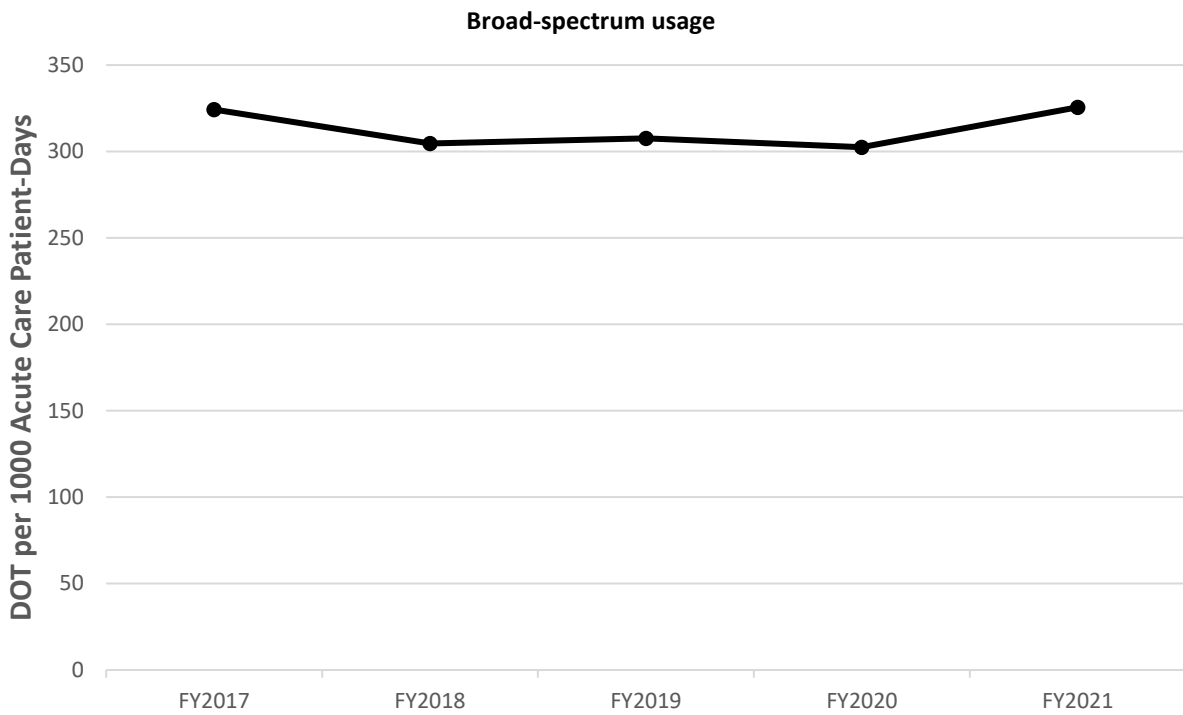


**Carbapenem Usage**





**SMH**



### Gram-positive Agents Usage

