MUHC ASP | Antimicrobial Stewardship Program

# Report of Activities

2022-2023

## Executive Summary

The mission of the MUHC antimicrobial stewardship program (ASP) is to optimize antimicrobial use throughout the institution by reducing their inappropriate or excessive consumption, and thereby promote patient safety. The program is co-led by a clinical pharmacist with expertise in anti-infectives and a physician specialized in Infectious Diseases and Medical Microbiology.

Since the last report submitted in July 2022, we have added new clinical practice guidelines for the management of common infectious syndromes and revised previously posted guidelines, all of which continue to be freely available online for MUHC and external users. We have increased the volume and scope of our interventions (audit-feedback activities) by 12%, mainly through an expansion of our activities to internal medicine wards at RVH and MGH.
We note the proportion of antibiotic prescriptions rated as "appropriate" has increased by 10% compared to preceding years, potentially attesting to an improvement in prescriber knowledge and/or prescribing behavior. We also note a 10% increase in adherence to recommendations issues by the antimicrobial stewardship program.
Compared to 2020, consumption of antibiotics has decreased by 16%, but overall use has stabilized at the MGH and RVH since 2022 – while steadily increasing at the MNI where there is no stewardship presence. Despite the overall reduction in consumption of antibiotics across the institution, total expenditures for antimicrobials, has remained stable as these expenditures are predominantly driven by low-volume high-cost antifungals (and novel antibiotics of last resort).

We have advanced our academic mission. In addition to training of pharmacy residents and residents in infectious diseases/medical microbiology, we have implemented a 1-year clinical fellowship program (for MDs) in partnership with the McGill Infectious Diseases Training Program. Since 2022, we have had two clinical fellows and the first is currently implementing a similar program in their home institution.

Ongoing challenges remain the lack of dedicated budgetary support and the uncertainty regarding purchase of the software that has greatly facilitated all our activities including data compilation for surveillance and monitoring.

Respectfully submitted on Sept 26, 2024 by

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## Background

Resistance to antimicrobials continues to increase worldwide. In Canada, antimicrobial usage (AMU) appears to be trending downward with a 25% decrease in human healthcare sectors from 2017 to 2021, however nearly a quarter of antibiotic prescriptions in hospitals are considered inappropriate (Canadian Antimicrobial Resistance Surveillance System Report, https://doi.org//10.58333/e241022). Antimicrobial stewardship is a systems-wide approach focused on promoting appropriate AMU to preserve antimicrobial effectiveness, while ensuring patient safety. It is based on coordinated interventions designed to improve, monitor and evaluate antimicrobial prescriptions. This report outlines the core activities of the MUHC ASP for the period Jan 1-2022, to Dec 31-2023. The last report was submitted in July 2022.

## Core activities

### Guidelines and hospital drug formulary

We have continued to develop and update institution specific guidelines for the empiric management of infectious syndromes commonly encountered at the MUHC. Each guideline is drafted by a trainee or a member of the operational team, reviewed by the co-leads, circulated to selected stakeholders with expertise on the subject matter, presented to the multi-disciplinary ASP committee for approval, and finally endorsed by the P&T committee. All guidelines are based on best available evidence, local cumulative antimicrobial susceptibilities (community or hospital antibiograms as appropriate) and available antimicrobial in the institution.

New guidelines include *S.aureus* bacteremia, Central line associated bloodstream infections (CLABSI), Cytomegalovirus (CMV) infections and disease (under final revision) and Occupational post-exposure prophylaxis. Management of COVID-19 and of *C. difficile* infection have been revised. Management of RSV has been removed due to current lack of available treatments (removal of oral Ribavirin). We have reached an agreement with the Pediatric Antimicrobial Stewardship Program (Montreal Children's hospital) to add pediatric treatment guidelines on a common website (under development).

We have recommended addition of 2 new antimicrobials to the hospital formulary, Dalbavancin and fidaxomicin, and established appropriate use guidelines for these drugs.

### Website

Treatment guidelines, cumulative antibiograms, and the previous annual report remain publicly available at https://www.muhcasp.com/treatment-guidelines, https://www.muhcasp.com/antibiogram-grampositive; https://www.muhcasp.com/antibiogram-gramnegative, https://www.muhcasp.com/more.

During the reporting year, the website had 44,786 sites sessions from 16,199 visitors, representing a **75% increase in visits** and a **39% increase in visitors** compared to the previous 2 years/.

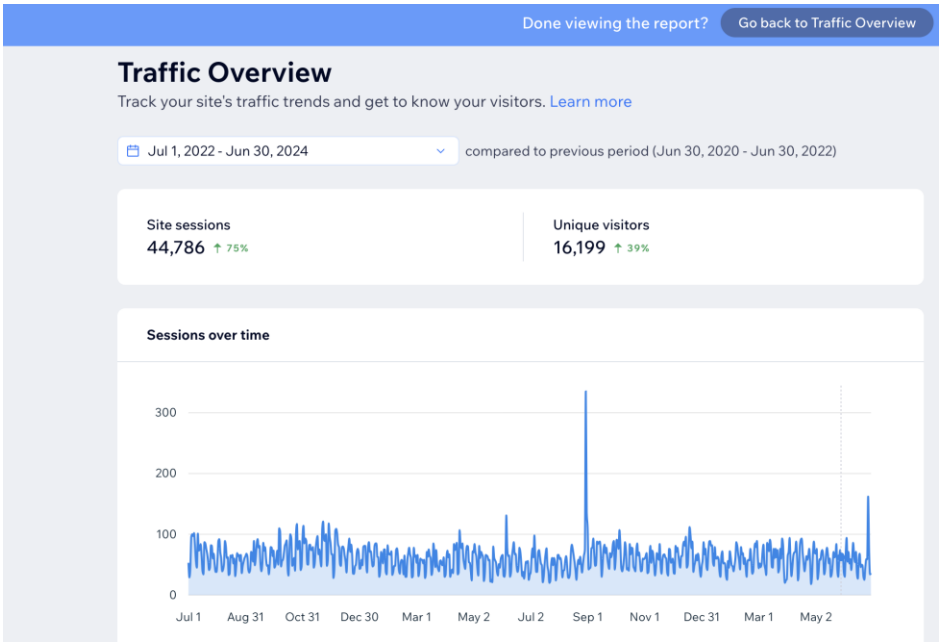


Figure 1: Traffic overview of the MUHC ASP website for 2023-2024

Most users are from Quebec (81%). Visitors from Canada represent 96% of all site visits, but we note traffic from the USA, Europe, the Middle East, Africa and Asia.

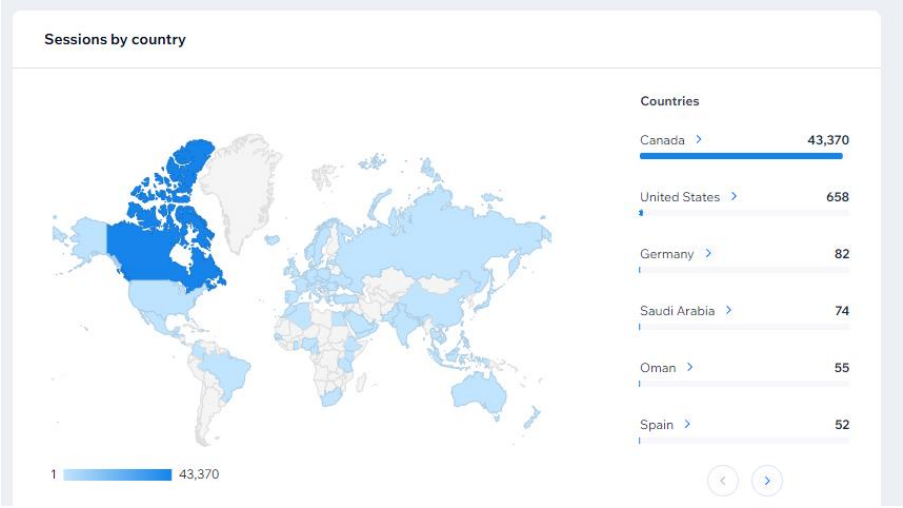


Figure 2: Global overview of website traffic for MUHC ASP website

## Audit-Feedback Interventions

### Description and frequency

Audits on the quality of antimicrobial prescription followed by immediate feedback are conducted weekly. Audits are based on data extracted from the APSS software (*Lumed*) and the medical chart. We prioritize intravenous antimicrobials and oral agents with broad spectrum

activity (eg. amoxicillin-clavulinic acid, fluoroquinolones). We exclude antimicrobials prescribed for prophylaxis (eg. septra prophylaxis for *Pneumocystis jiroveci*; pre-op surgical prophylaxis) and antimicrobial prescriptions for patients followed by any of the ID consultation services. Immediate feedback consists of a formal ASP consultation on O-Word, which is printed and flagged in the medical chart.

Recommendations can be to: i) continue antibiotic; ii) discontinue antibiotic (stop antimicrobials altogether or switch to a different antibiotic (option provided); iii) consult ID.

In the calendar year 2023 (Jan 1- Dec 31), we conducted 721 audit-feedback interventions on antimicrobial prescriptions from 561 unique patients. While the average number of antimicrobials per patient remains stable at 1.3 antimicrobials/patient, the total number of interventions increased by 12% compared to 2022 and 29% compared to 2021. A slightly higher number of interventions were conducted at the MGH given identified needs, notably a larger proportion of prescriptions without ID service involvement. More frequent interventions were made possible by greater availability of clinical pharmacists and a rotation of stewardship MDs at the MGH to meet these needs (Figure 3).

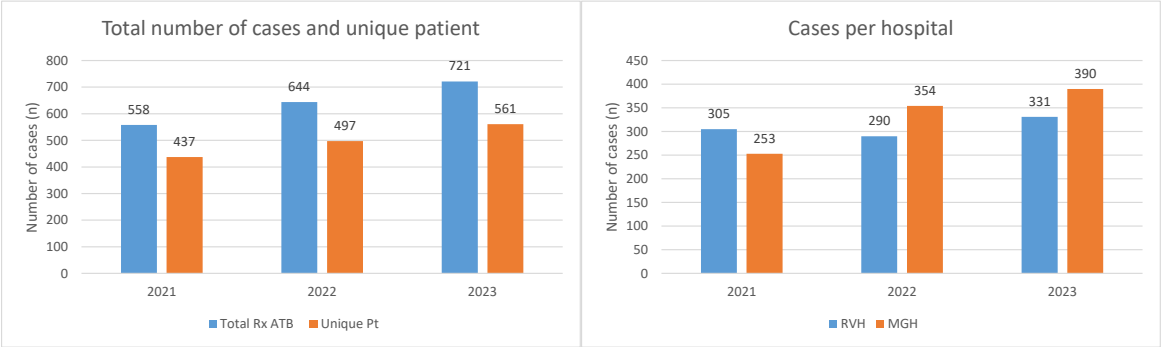



Figure 3: Audits of antimicrobial prescriptions (2021-2023) at the MUHC

The audits were conducted in General surgery, Internal medicine, Cardiology, Hematology-Oncology, Orthopedics, Thoracic Surgery (TSU) and Vascular surgery (VSU) wards (Figure 4 and 5).

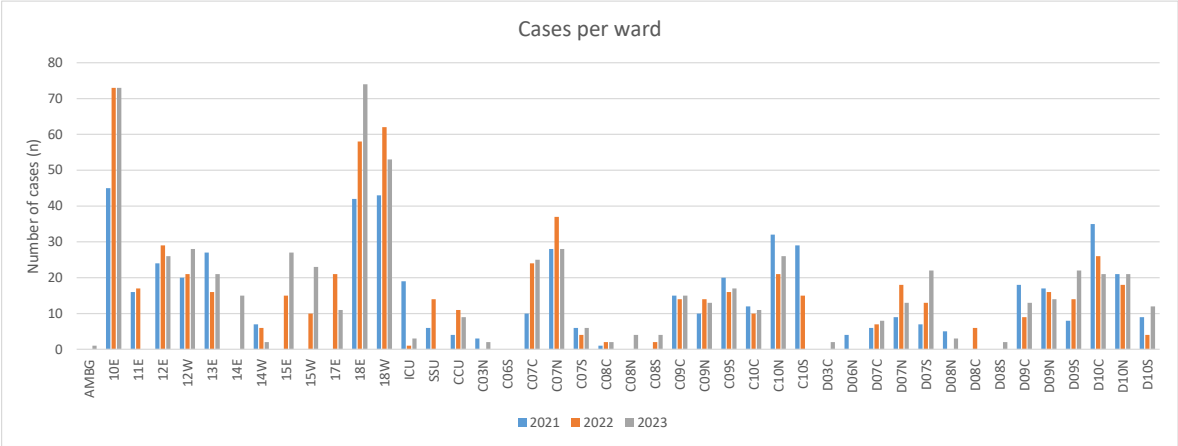



Figure 4: Number of antimicrobial audits per ward (RVH and MGH)

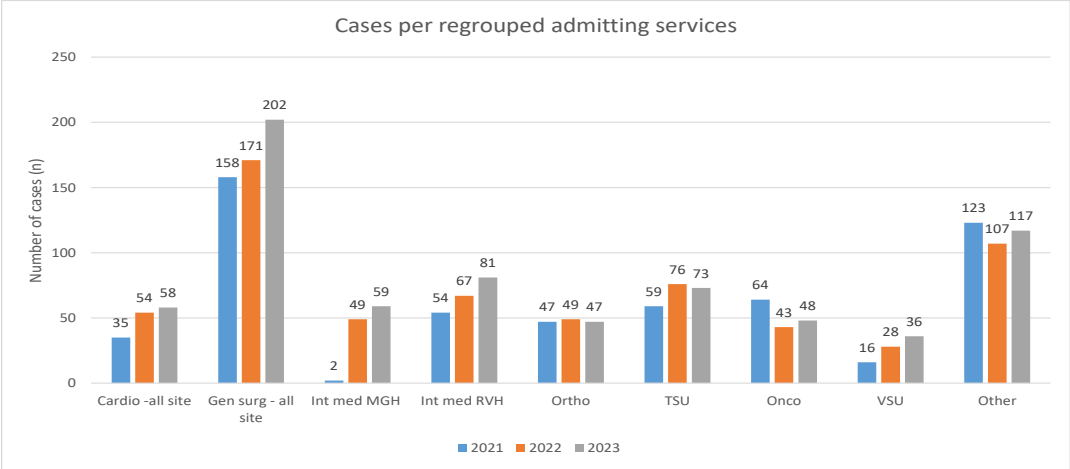



Figure 5: Number of antimicrobial audits per admitting service

The most frequently audited antimicrobial was Piperacillin-Tazobactam (nearly 50% of all audited antimicrobials in 2023, still the "workhorse" of the hospital), followed by Ceftriaxone, Vancomycin, Meropenem, Ciprofloxacin and Amoxicillin-Clavulanate (Figure 5). Few prescriptions for antifungal agents were audited since these generally involve the ID service.

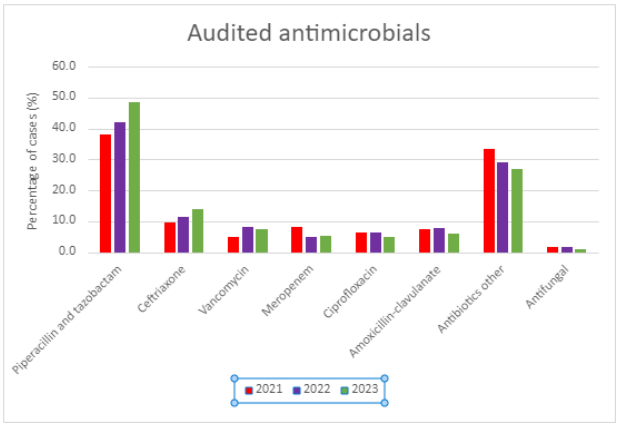



Figure 5: Antimicrobial audited (percentage) in 2021-2023

## Audits: ratings of prescription quality

Based on a review of the clinical information available in the APSS software as well as the medical chart (patient demographics, duration and reason for hospitalization, documented indication for antibiotic therapy, documented allergies, possible drug-drug interactions and contra-indications to specific antimicrobial; microbiological, laboratories results and other diagnostic data in support of the indication), the ASP team formulates a brief narrative of the case, and assigns a rating of the quality of the prescription using the following parameters:

- **Optimal**: antibiotics are clearly indicated AND the choice of antibiotic is optimal for this indication and for this patient (follows guidelines if empiric therapy; narrowest spectrum and least side effects if targeted therapy)

- **Appropriate**: antibiotics are clearly indicated AND the choice is acceptable BUT other options may be better (eg. Spectrum adequate but does not follow institutional guidelines; may be slight "over-treatment")
- **Inappropriate**: antibiotics are indicated or may be indicated (reasonable suspicion) BUT choice is clearly too broad spectrum, or duration is too long
- **Very inappropriate**: antibiotics are clearly not indicated, OR antibiotics may be indicated but the choice is clearly unacceptable (eg. clearly "under-treatment" for the indication, or the antibiotic poses a known risk to the patient)

Based on this grid, we note a slight improvement in the overall quality of prescriptions over time (Figure 6). In 2023, 70% of prescriptions were rated as either appropriate or optimal, an increase from 60% in 2021. This apparent improvement was noted at both sites (figure 7) and was particularly marked in hematology-oncology (>80% of prescriptions rated as appropriate in 2023 compared with 60% in 2021) and in General Surgery (75% appropriate in 2023 compared with 30% in 2021) (Figure 8).

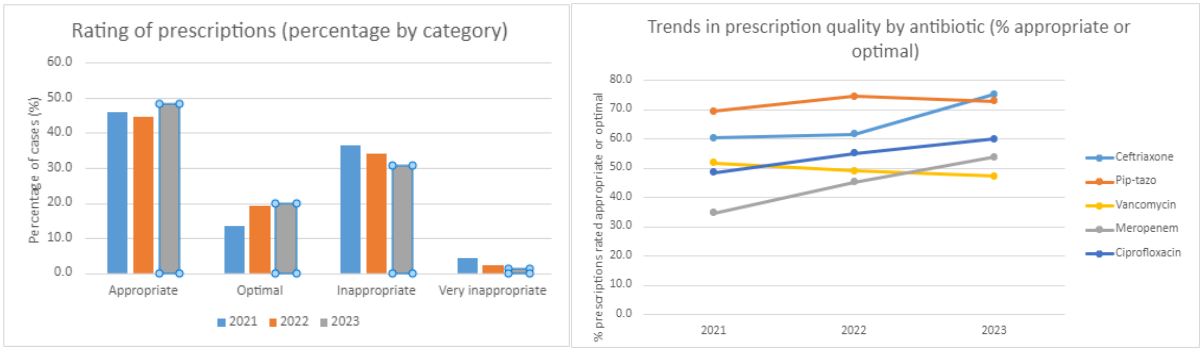



Figure 6: a) Rating of antimicrobial prescription quality in 2021-2023, b) Trends in appropriateness of prescriptions by antibiotic

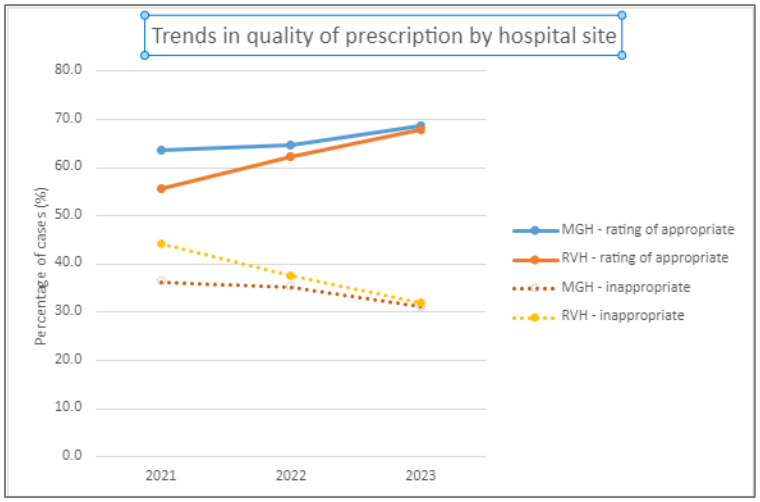



Figure 7: Trends in appropriateness of prescriptions by hospital site (2021-2023)

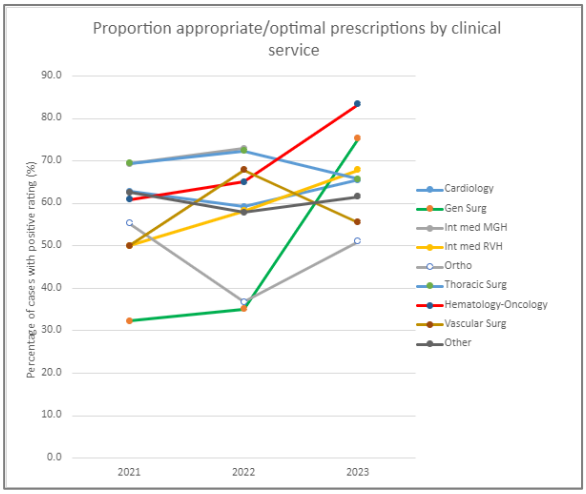



Figure 8: Trends in appropriateness of prescriptions by admitting service (2021-2023)

## Feedback and recommendations

In the stewardship O-word consultation, the stewardship team provides the treating team a prescription quality rating with a brief explanation of the rating, and a recommendation (immediate feedback) regarding the antibiotic prescription. Overall, the stewardship team recommended to discontinue antibiotic in 40% of cases (Figure 9). Though we note some differences between sites, particularly a decrease in recommendations to consult ID at the MGH, the trends are similar at the 2 hospital sites. This follows a deliberate effort to rotate stewardship teams across the 2 sites rather than have fixed teams at each hospital, which had previously led to site-specific tendencies.

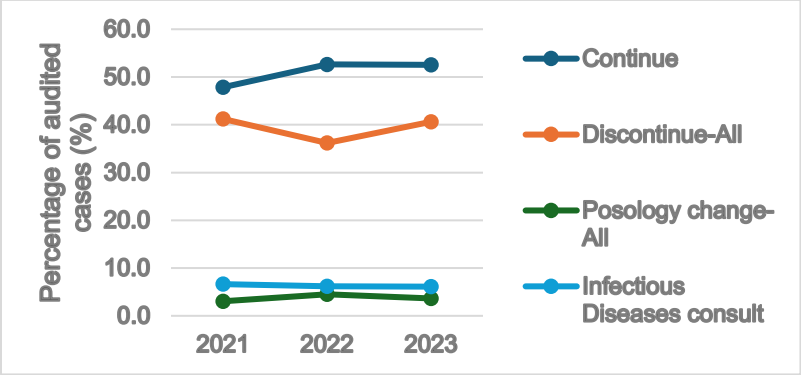
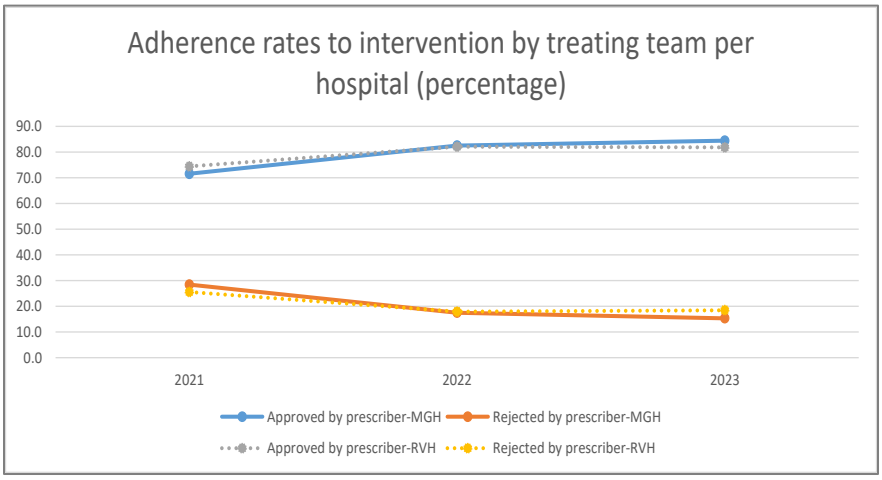



Figure 9: Trends in recommendations (immediate feedback) 2021-2023



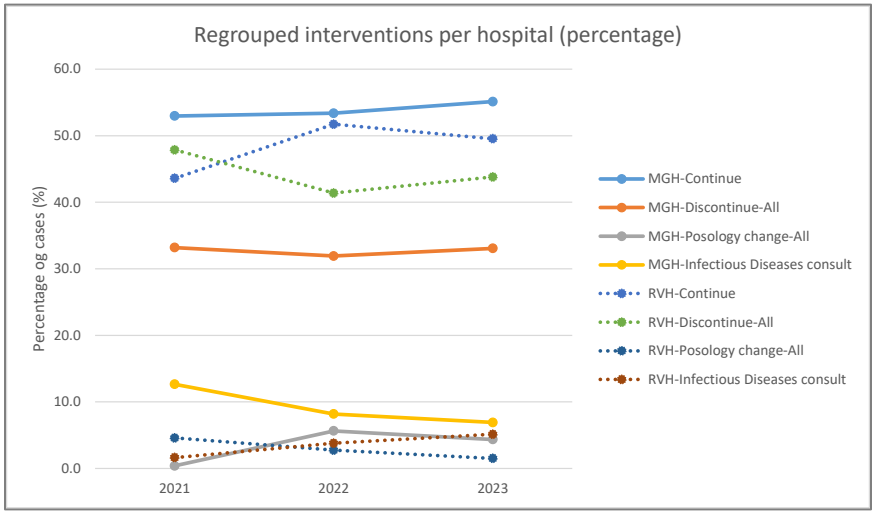




Figure 9: Type of recommendations (percentage) per site in 2021-2023

## Adherence to recommendations

Treating teams' adherence to ASP recommendations (defined as following the antibiotic treatment suggestion) improved over the last 3 years. Overall adherence to recommendations (continue same antibiotic with or without dosage or route change; discontinue antibiotic; consult ID) was 80% compared with 70% in 2021 (Figure 10).

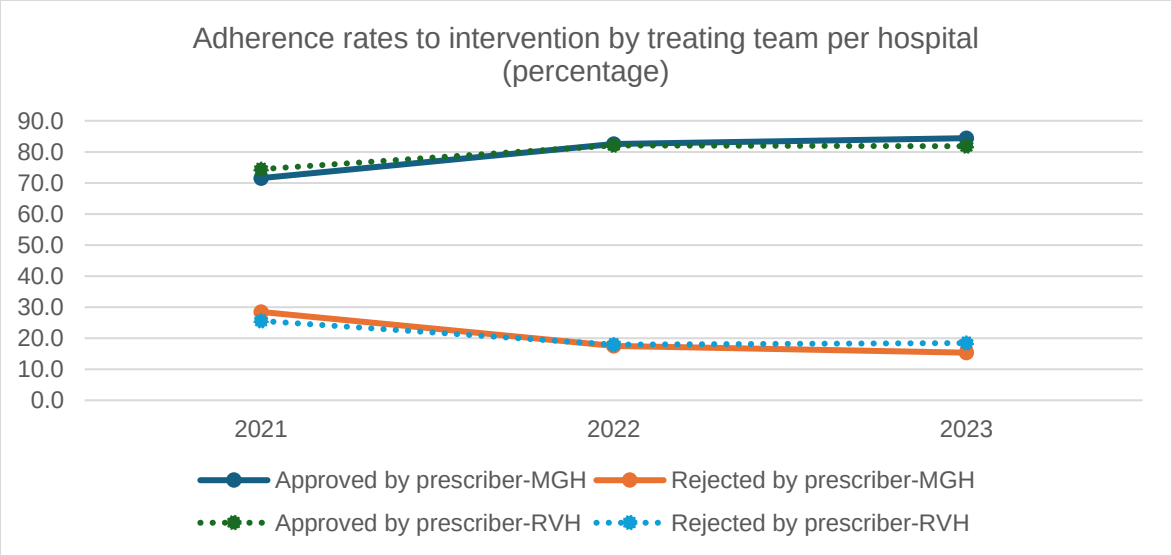



Figure 10: Overall adherence of treating teams to ASP recommendations (2021-2023)

While treating teams naturally will accept and follow recommendations when these are to *continue* antibiotic (100% adherence), adherence to recommendations to discontinue antibiotic(s) increased from 55% in 2021 to 70% of cases in 2023. For recommendations to consult ID, adherence was 65% in 2023 compared with 35% in 2021 (Figure 11). Combined, these suggest overall improved awareness/knowledge, and willingness to adhere to expert recommendations at the 2 sites.

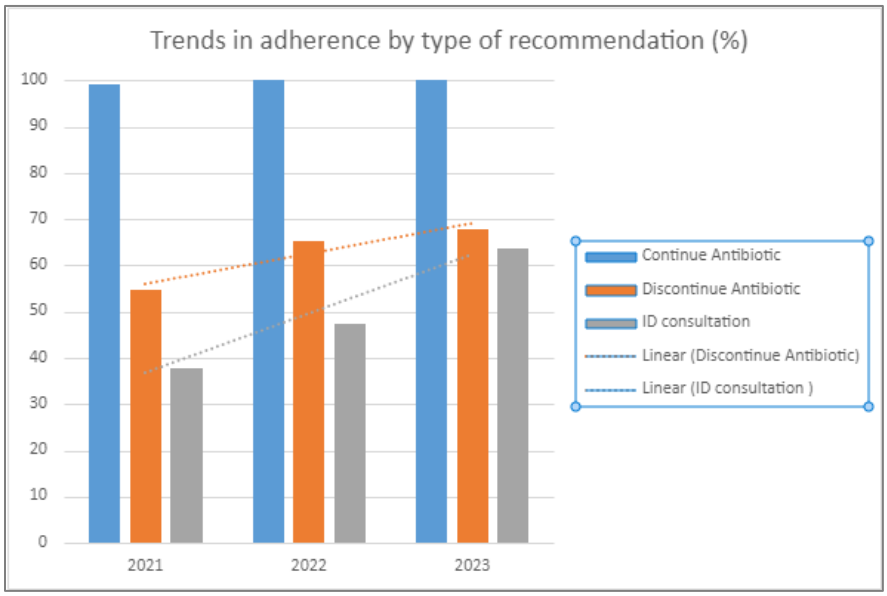



Figure 11: Trends in adherence by type of recommendation (2021-2023)

## Other activities

### Retrospective audit of Piperacillin-Tazobactam usage in the Emergency Department (ED)

We repeated retrospective reviews of Piperacillin-Tazobactam usage in ED, specifically assessing the quality of prescriptions for respiratory infections. This was done as a follow-up to prior audits conducted in 2021.

For cases prescribed piperacillin-tazobactam (by different services in the ED) with an indication of "respiratory infection", "pneumonia", or "Lower respiratory tract infection (LRTI)" between July-August 2021 and 2022, 65% of prescriptions were deemed inappropriate/very inappropriate in both years. Inappropriate prescriptions were attributed to ED, Respirology and ICU services (>65% of cases); internal medicine fared overall better with "only" 40% of prescriptions deemed inappropriate.

Table 1: Retrospective audit of the quality of piperacillin-tazobactam prescriptions for respiratory infections in the ED (July-Aug 2022)

| Service (% of Tazo started) | Appropriate + Optimal | % | Innapropriate + Very inappropraite | % |
|---|---|---|---|---|
| ED (40% ) | 7 | 35 | 13 | 65 |
| Resp (38% ) | 7 | 33.3 | 14 | 66.7 |
| Int med (9%) | 3 | 60 | 2 | 40 |
| ICU (11%) | 1 | 16.7 | 5 | 83.3 |

Encouragingly, the (inappropriate) use of this antibiotic for the specific indication of "aspiration pneumonia" decreased from 29% in 2021 to 11% in 2022, following an educational intervention (presentation to ED physicians and pharmacists and specific recommendations for treatment of aspiration pneumonia in the MUHC guidelines). Consumption of Piperacillin-Tazobactam decreased slightly in the ED from 21 Days of Treatment (DOT)/1000 patient-days in 2021 to 17 DOT/1000 patient-days in 2022.

### Assessment of inter-auditor variability in ratings of prescription quality

As a baseline determination of the differences between auditors' assessment of prescription quality, members of the operational stewardship team were asked to individually review 20 randomly selected cases. The cases were anonymized; only the original narrative of the case (without quality determination or feedback) was sent by email to the "raters" (MD members of the stewardship team involved in the weekly audit activities). It is important to note that the raters could not access additional information (such as lab and micro results on OACIS) as they normally would have if they were performing the audit in real time.

When assessing whether antibiotics were fully indicated, 3 of 5 raters gave same ratings for all 20 cases; 4 of 5 reviewers agreed on ratings of 16/20 cases; all 5 reviewers agreed on 10/20 cases

(Table 2). When assessing the quality of prescriptions, 3 of 5 raters gave the same rating for all 20 cases; 4 of 5 agreed in 10/20 cases; all reviewers agreed in only 4/20 cases (Table 3).

Table 2: Inter-auditor agreement: evaluation of indication

| % of MD agreeing on evaluation | Supported (N) | Not supported (N) |
|---|---|---|
| ≥60% (ie 3 MD at least) | 18 | 2 |
| ≥80% (ie 4 MD at least) | 14 | 2 |
| 100% (ie all 5 MD) | 9 | 1 |

Table 3: Inter-auditor agreement: evaluation of prescription quality

| % of MD agreeing on evaluation | Optimal + Appropriate (N) | Inappropriate + Very inappropriate (N) |
|---|---|---|
| ≥60% (ie 3 MD at least) | 12 | 8 |
| ≥80% (ie 4 MD at least) | 7 | 3 |
| 100% (ie all 5 MD) | 2 | 2 |

The disagreements between raters were reviewed in a subsequent in-person discussion. In all instances, these were attributed to differences in interpretation of the narratives, particularly in cases where the narrative description was considered vague and/or missing some critical pertinent (positive or negative) results. We conclude from this exercise the importance of the narrative structure and the need to continuously evaluate the quality assessment grid with periodic internal (and eventually external) validity assessments.

### CSNIP Acute Care Point Prevalence Survey

In collaboration with Infection Prevention and Control, we collected data on hospital associated/nosocomial infections and on antimicrobial usage from all wards of the MGH, RVH, MNI and Lachine Hospital during 2 days in April 2024, for the CNISP Point Prevalence survey. We expect to receive a report compiling antimicrobial usage data from all participating hospital sites across the country that will enable us to benchmark our antimicrobial consumption patterns compared to other tertiary care hospitals in Canada. These comparisons will in turn inform strategic priorities or areas of focus for next year.

## Antimicrobial use (AMU) and costs at the MUHC

### Trends in AMU for target antibiotics

Since 2019, we have specifically focused our efforts on agents in the Watch and Reserve Categories of the World Health Organization's 2019 AWaRe classification, notably: Piperacillin-Tazobactam, Ceftriaxone, Vancomycin, Ciprofloxacin and Meropenem (as well as special access agents such as ceftazidime-tazobactam and others, when appropriate).

To measure antimicrobial consumption, we have used the metric of Days of Therapy (DOT) normalized to 1000 patient-days. We determine this measure using electronic antimicrobial administration data (extracted from the software Lumed). DOT is defined as any amount of a specific antimicrobial administered in a calendar day to a patient regardless of the number of doses or the posology. Days present is determined by aggregating the number of patients in the facility throughout a calendar day.

We compared antibiotic consumption using DOT/1000 patient-days for all target antibiotics and in our main facilities, between 2021 and 2023.

Piperacillin-Tazobactam remains the most commonly prescribed antibiotic at RVH and MGH. We note a significant decrease in consumption (per patient-days) of Piperacillin-Tazobactam at both MGH and RVH over the last 3 years; consumption of Ciprofloxacin and Meropenem also appear to be trending down, while that of vancomycin has remained overall stable (Figure 12). Interestingly the consumption of ceftriaxone increased during the same period, suggesting a shift towards the use of this relatively narrower spectrum drug at the RVH and MGH. In contrast, AMU data for the MNI (where there are no stewardship activities and no interventions), consumption of Piperacillin-Tazobactam, Meropenem and Vancomycin is continuously increasing; vancomycin has the highest per-patient day consumption (Figure 12).

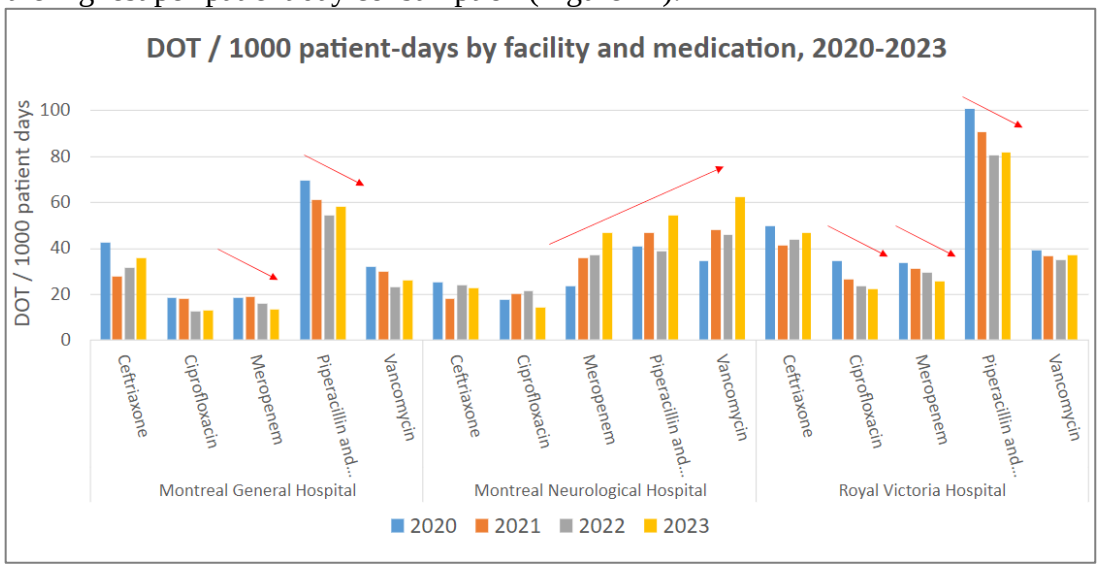



Figure 12: Days of therapy (DOT) normalized to patient-days (2020-2023)

It is important to note that while AMU per patient-days has been decreasing for most of the target antibiotics at the MGH and RVH, overall consumption (DOT) has increased, suggesting significant increase in numbers of patients on antibiotics and/or days in hospital (figure 13).

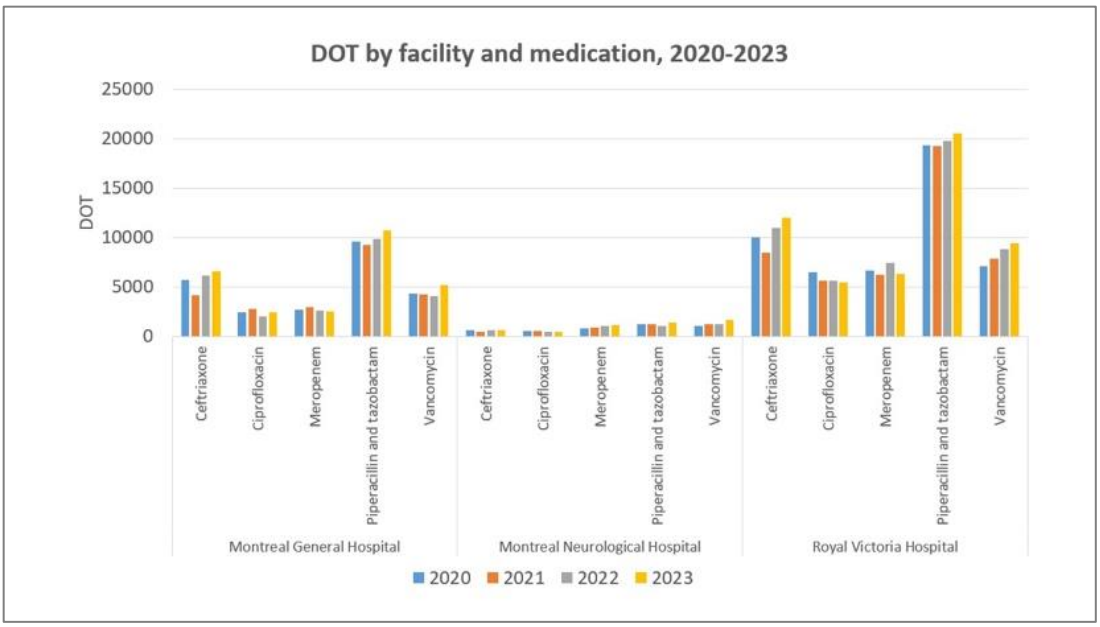


Figure 13: Days of therapy (DOT) – total consumption (2020-2023)

## Trends in AMU for all systemic antimicrobials

Total consumption of systemic antibiotics (approximately 335 DOT/1000 patient-days) has been trending down over the last few years (375 DOT/1000 patient-days in 2019 to 335 in 2023, a 10% reduction), while consumption of systemic antifungals and antivirals remain steady. Consumption of these groups of antimicrobials is 8 to 12-fold lower than consumption of antibiotics at the MUHC, and these agents are thus far not targeted in our stewardship interventions (Figure 14).

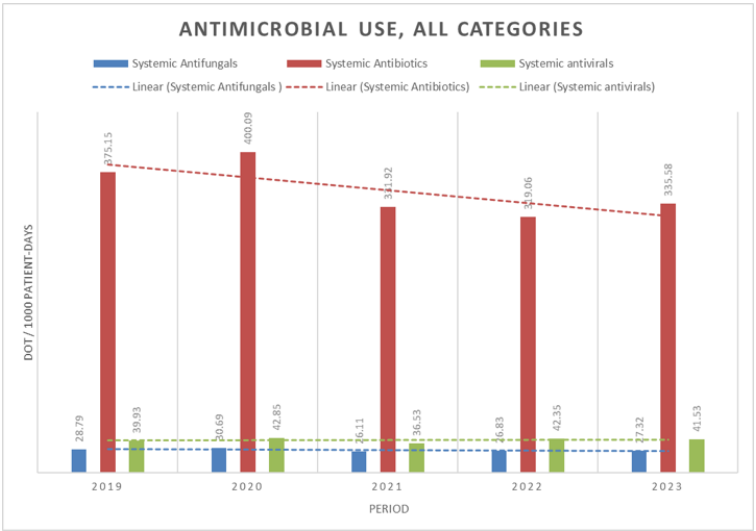


Figure 14: Antimicrobial use per class of antimicrobials, all sites (2019 – 2023)

## Costs of Antimicrobials

We collected costs for all antimicrobials (AFHS class 08) per fiscal year from the main pharmacy software (BDM). We note that costs for antimicrobials have remained stable between 2021-2023,in the range of 3.3-3.6 million Can$ per year for all antimicrobials (see Table 4). Antibiotics account for less than 50% of the total cost of antimicrobials, while antifungals account for 35% of the total budget but only 7% of the total consumption of antimicrobials.

Table 4: Costs for antimicrobials MUHC Adult sites (and % of total antimicrobial budget)

| | 2021 | 2022 | 2023 |
|---|---|---|---|
| **Antibiotics** | $1,511,549 (45.8%)* | $1,721,725 (47.5%) | $1,694,753 (48.0%) |
| **Antifungal** | $1,194,408 (36.2%) | $1,299,201(35.9%) | $1,205,539 (34.1%) |
| **Antiviral** | $553,083 (16.8%) | $546,517 (15.1%) | $537,196 (15.2%) |
| **Sum 3 classes** | $3,259,041 | $3,567,443 | $3,437,483 |
| **Total all** | **$3,301,566** | **$3,622,565** | **$3,530,360** |

*% represent the proportion of the antimicrobial budget

The antimicrobials accounting for the greatest overall costs are liposomal Amphotericin B (nearly 500 000$/year) followed by Piperacillin-Tazobactam (Table 5).

We also note that despite their very infrequent use, expenditures for the newest antibiotics with activity against extensively-drug resistant gram-negative infections, notably Cefiderocol and Ceftolozane-tazobactam, now account for nearly 10% of the total antimicrobial budget.

Table 5: Expenditures - Top 12 antimicrobial costs at the MUHC

| | 2021 | 2022 | 2023 |
|---|---|---|---|
| AMPHOTERICIN B LIPOSOMAL | $453,236.71 | $587,077.37 | $475,845.33 |
| PIPERACILLIN + TAZOBACTAM | $306,033.70 | $279,928.40 | $287,913.29 |
| VANCOMYCIN | $240,041.12 | $243,967.86 | $240,763.24 |
| ISAVUCONAZOLE | $209,501.40 | $258,923.35 | $204,085.12 |
| MEROPENEM | $195,145.71 | $202,275.61 | $183,087.52 |
| LETERMOVIR | $182,596.69 | $249,886.90 | $330,632.10 |
| POSACONAZOLE | $176,555.33 | $87,211.98 | $145,355.80 |
| CASPOFUNGIN | $147,287.41 | $166,188.23 | $172,839.89 |
| FOSCARNET | $121,421.41 | $49,489.78 | $17,395.56 |
| ATOVAQUONE | $99,316.35 | $90,640.81 | $98,186.68 |
| CEFIDEROCOL | $0.00 | $11,221.88 | $211,470.00 |
| CEFTOLOZANE + TAZOBACTAM | $69,687.57 | $276,687.83 | $79,791.06 |

## Trends in antibiotic susceptibility profiles (cumulative antibiograms)

We continue to monitor rates of antibiotic susceptibility of common organisms isolated from patient clinical samples, at all facilities. Cumulative antibiograms were compiled using the DATA application of the Lumed software.

## Cumulative antibiograms for common gram-negative bacteria

### *E. coli* (all isolates, all sites)

We note a small decrease in susceptibility to 3rd generation cephalosporins (ceftriaxone) (from 90% to 88%) and to piperacillin-tazobactam (from 95% to 93%) between 2021 and 2023, but overall susceptibility to beta-lactams is well maintained (Figure 15).

We also note that susceptibility to Ciprofloxacin appears to have decreased since 2021, in contrast to the preceding 2 years (2019-2021) during which we had reported a trend towards *increased* susceptibility. Given that breakpoints for susceptibility to ciprofloxacin were modified in January 2022 following recommendations from the 32nd edition of CLSI document M100, it is possible this does not reflect a true biological phenomenon of increasing resistance to ciprofloxacin, but rather simply that of different thresholds.

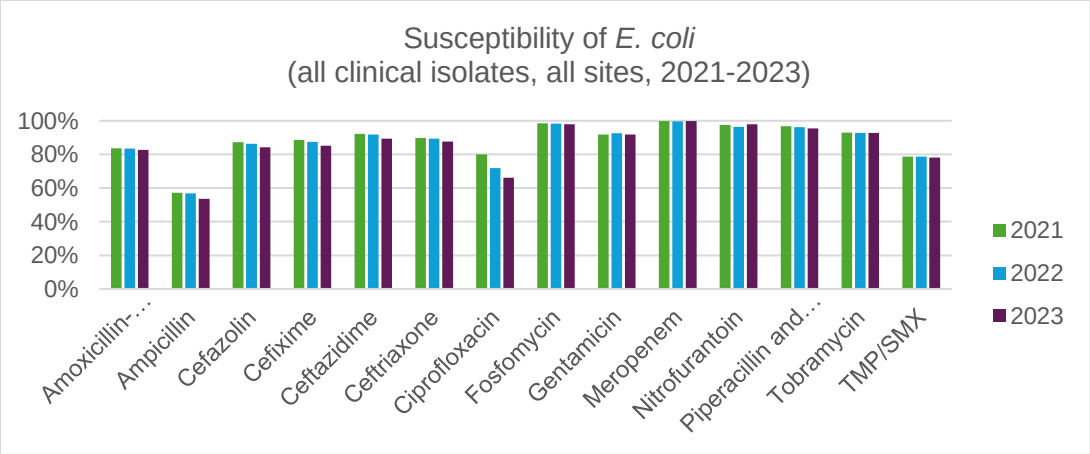



Figure 15: Cumulative antibiogram for *Escherichia coli* (% Susceptible) 2021-2023

### *Klebsiella spp* (all isolates, all sites)

Similarly, small decreases in susceptibility to beta-lactam antibiotics is observed but overall susceptibility of *Klebsiella oxytoca* and *Klebsiella pneumoniae* to this large class of antibiotics is well preserved (figure 16). Susceptibility to ciprofloxacin appears to have decreased since 2021 (again, possibly reflecting changes in susceptibility breakpoints and reporting).

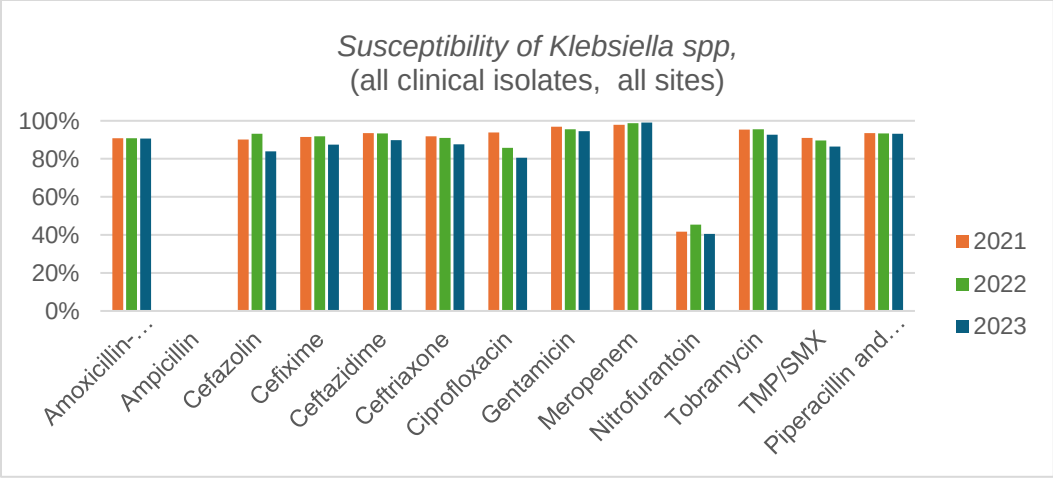



Figure 16: Cumulative antibiogram *Klebsiella spp* (% susceptible isolates), 2021-2023

## *Pseudomonas aeruginosa* (all isolates, all sites)

We note a drop in susceptibility to piperacillin-tazobactam from 94% to 90% (Figure 17). Susceptibility to meropenem remains around 85%, significantly lower than to piperacillin-tazobactam (as in previous years), and similar to that of ciprofloxacin.

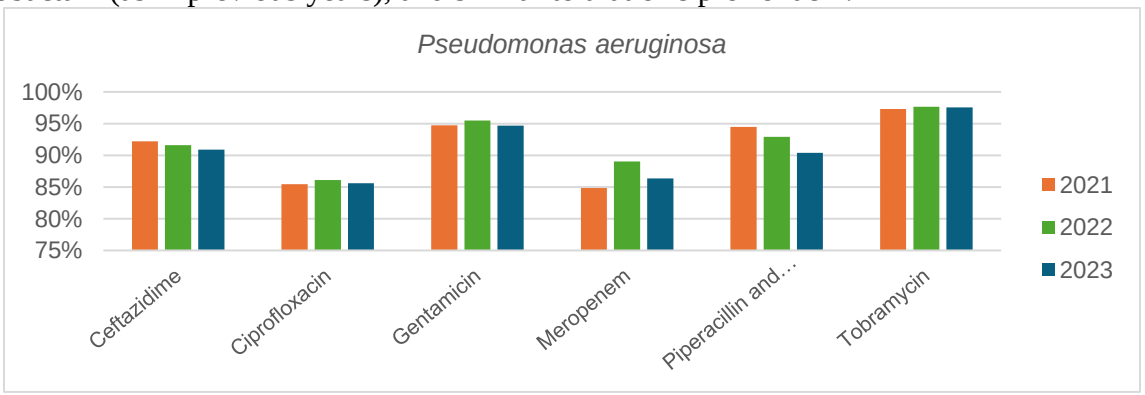



Figure 17: Cumulative antibiogram *Pseudomonas aeruginosa* (% susceptible isolates), 2021-2023

## Other gram-negative bacteria

The susceptibility of other gram-negative *Enterobacterales* (*Enterobacter spp, Proteus spp, Citrobacter spp, Morganella spp*) to beta-lactam antibiotics have also remained stable over time (data not shown).

Susceptibility of *Stenotrophomonas*, a highly resistant organisms and cause of pneumonia (HAP and VAP) in patients heavily exposed to antibiotics, was also assessed. Susceptibility to levofloxacin, TMT-SMX and to minocycline appear variable from year to year, and the number of isolates is too small to establish clear trends (Figure 18).

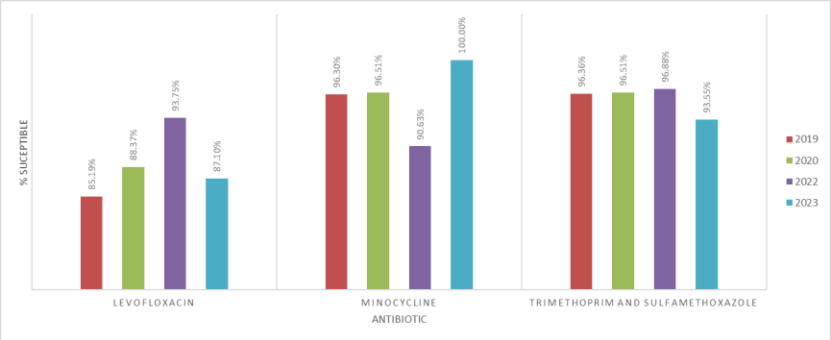
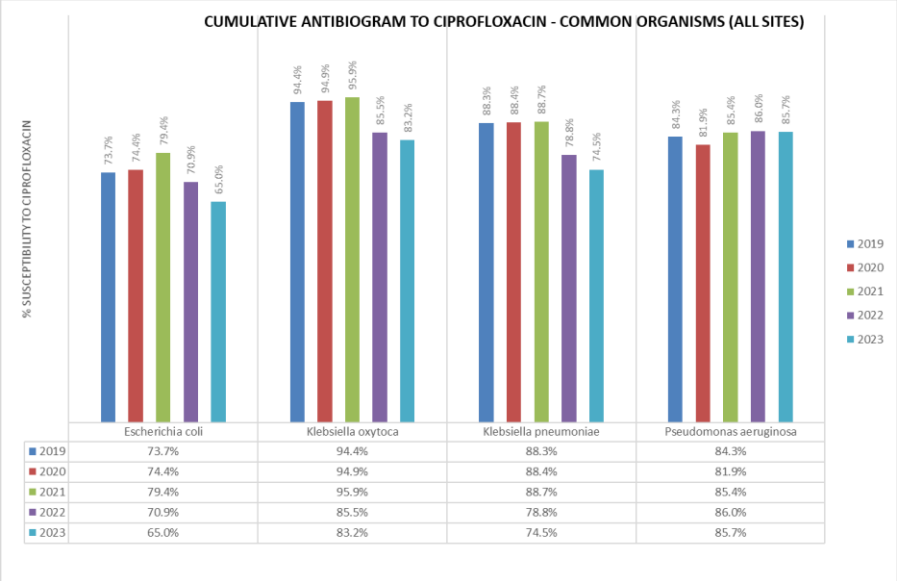



Figure 18: cumulative antibiogram for *Stenotrophomas maltophilia* (n = 54 in 2019; 86 in 2020; 32 in 2022; 31 in 2023)

## Ciprofloxacin susceptibility for common Gram-negative bacteria (all sites)

Considering the importance of preserving ciprofloxacin for management of infections caused by gram-negative organisms, we specifically extracted ciprofloxacin susceptibility data for common organisms between 2019 and 2023 (Figure 19).




| | Escherichia coli | Klebsiella oxytoca | Klebsiella pneumoniae | Pseudomonas aeruginosa |
|---|---|---|---|---|
| 2019 | 73.7% | 94.4% | 88.3% | 84.3% |
| 2020 | 74.4% | 94.9% | 88.4% | 81.9% |
| 2021 | 79.4% | 95.9% | 88.7% | 85.4% |
| 2022 | 70.9% | 85.5% | 78.8% | 86.0% |
| 2023 | 65.0% | 83.2% | 74.5% | 85.7% |

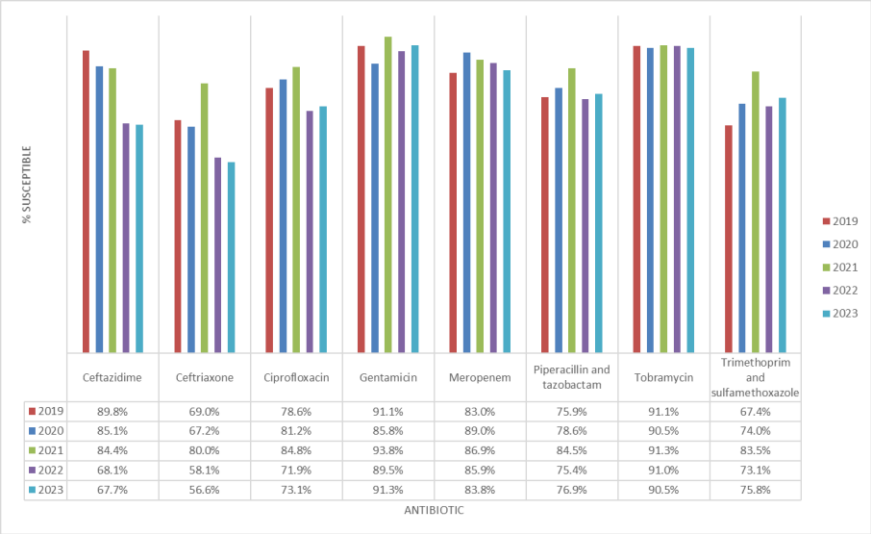
Figure 19: Susceptibility to ciprofloxacin (all isolates, all sites)

## Cumulative antibiograms ICU

Considering the high consumption of antibiotics in the ICU and the lack of stewardship activities in these units, we assessed trends in cumulative susceptibility profiles of common gram-negative organisms isolated from ICU patients at both MGH and RVH.

Rather than cumulative antibiograms for individual pathogens, we provide below aggregate cumulative susceptibilities for common gram-negative organisms.

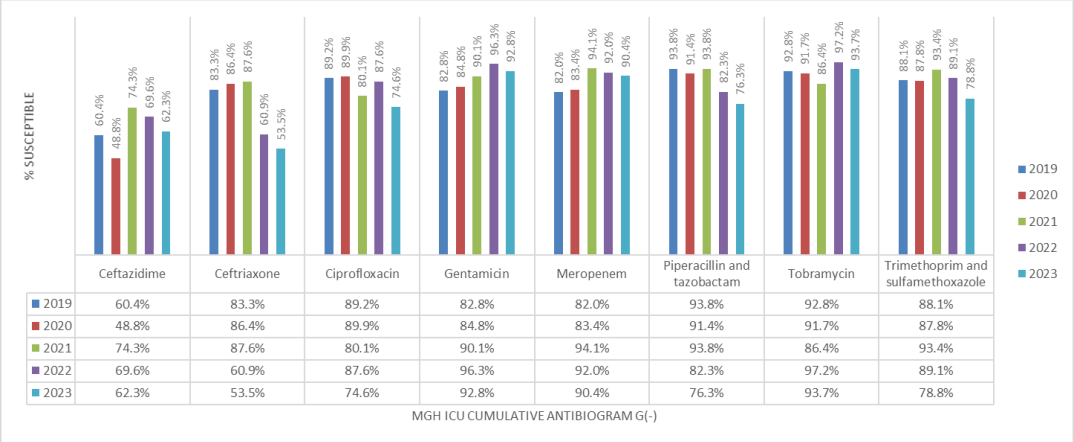
At the RVH, we note a significant decrease in overall susceptibility to 3rd generation cephalosporins since 2019, while susceptibility to piperacillin-tazobactam and to meropenem remain acceptable (between 75 – 85%) (Figure 20).




| | Ceftazidime | Ceftriaxone | Ciprofloxacin | Gentamicin | Meropenem | Piperacillin and tazobactam | Tobramycin | Trimethoprim and sulfamethoxazole |
|---|---|---|---|---|---|---|---|---|
| 2019 | 89.8% | 69.0% | 78.6% | 91.1% | 83.0% | 75.9% | 91.1% | 67.4% |
| 2020 | 85.1% | 67.2% | 81.2% | 85.8% | 89.0% | 78.6% | 90.5% | 74.0% |
| 2021 | 84.4% | 80.0% | 84.8% | 93.8% | 86.9% | 84.5% | 91.3% | 83.5% |
| 2022 | 68.1% | 58.1% | 71.9% | 89.5% | 85.9% | 75.4% | 91.0% | 73.1% |
| 2023 | 67.7% | 56.6% | 73.1% | 91.3% | 83.8% | 76.9% | 90.5% | 75.8% |

Figure 20: ICU RVH cumulative antibiogram gram-negative organisms (*E. coli*, *Klebsiella*, *Enterobacter*, *Pseudomonas*)

At the MGH, susceptibility to 3rd generation cephalosporins and to Piperacillin-tazobactam appear to be decreasing over time, while susceptibility to meropenem seems preserved (Figure 21)




| | Ceftazidime | Ceftriaxone | Ciprofloxacin | Gentamicin | Meropenem | Piperacillin and tazobactam | Tobramycin | Trimethoprim and sulfamethoxazole |
|---|---|---|---|---|---|---|---|---|
| 2019 | 60.4% | 83.3% | 89.2% | 82.8% | 82.0% | 93.8% | 92.8% | 88.1% |
| 2020 | 48.8% | 86.4% | 89.9% | 84.8% | 83.4% | 91.4% | 91.7% | 87.8% |
| 2021 | 74.3% | 87.6% | 80.1% | 90.1% | 94.1% | 93.8% | 86.4% | 93.4% |
| 2022 | 69.6% | 60.9% | 87.6% | 96.3% | 92.0% | 82.3% | 97.2% | 89.1% |
| 2023 | 62.3% | 53.5% | 74.6% | 92.8% | 90.4% | 76.3% | 93.7% | 78.8% |

Figure 21: ICU MGH cumulative antibiogram gram-negative organisms (*E. coli*, *Klebsiella*, *Enterobacter*, *Pseudomonas*)

## Cumulative Susceptibility of selected gram-positive bacteria

For *S.aureus* (all isolates), we do not detect any significant changes in susceptibility to oxacillin or other agents since 2021, in all hospital sites; this was true for all clinical isolates (Figure 22) as well as for blood culture isolates (Figure 23).

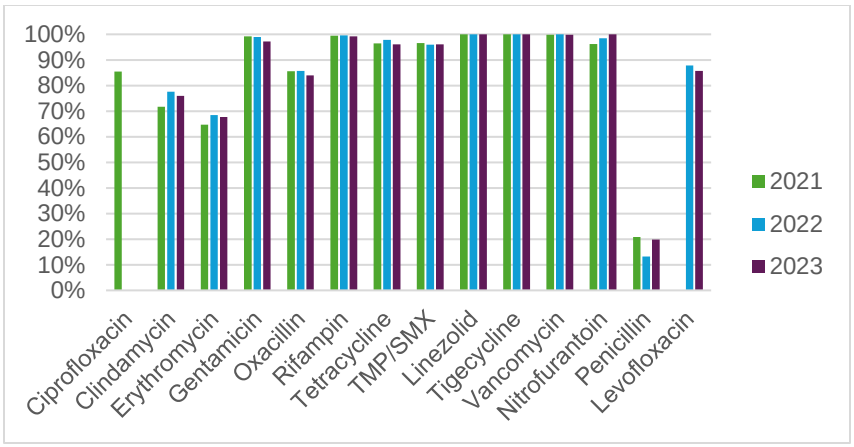



Figure 22: Cumulative antibiogram for *S.aureus* – all isolates, 2021-2023

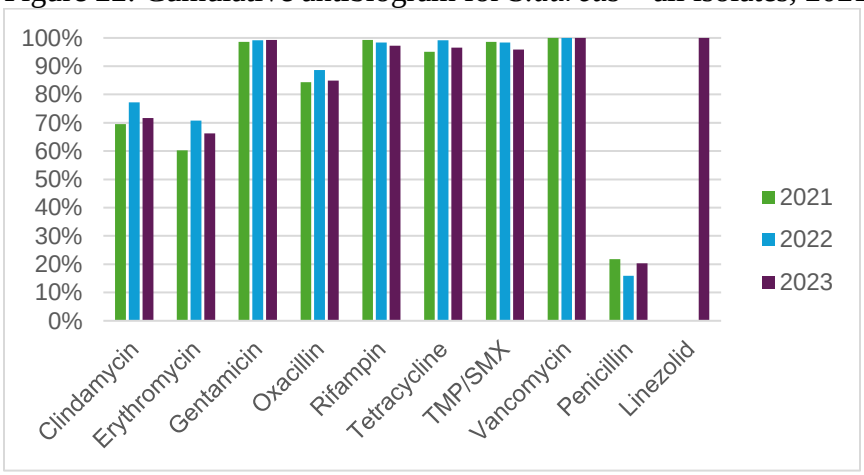



Figure 23: Cumulative antibiogram for *S.aureus* - blood culture isolates, 2021-2023

For *Enterococcus* spp., > 95% remain susceptible to vancomycin and 75% susceptible to ampicillin. There were no significant differences between sites and over time.

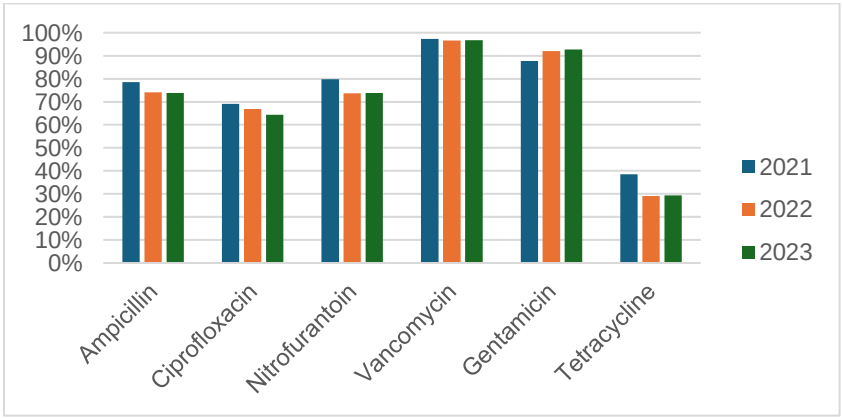



Figure 24: Cumulative antibiogram *Enterococcus spp* - all isolates, 2021-2023

## Educational activities

### Teaching and other presentations

We continue to provide stewardship-specific didactic teaching sessions to pharmacy students (2nd and 4th year undergraduates), residents in pharmacy, and medical residents in Infectious Diseases. We have additionally delivered several presentations specifically on antimicrobial stewardship to a variety of audiences (intra- and extra-mural).

| Topic | Given by | Audience | Date / frequency |
|---|---|---|---|
| Intra-abdominal infection<br><br>MDR gram negative infections<br><br>HAP, VAP and empyema<br><br>Meningitis | Alexandre Rivard<br><br>Marc Dobrescu<br><br>Francois Bourdeau | pharmacy residents | YEARLY since 2021 |
| The ABC of antibiotics | Francois Bourdeau | pharmacy students (2nd and 4th year) | YEARLY since 2020 |
| Pharmacokinetics of Vancomycin, Aminoglycosides and Azole | Francois Bourdeau | ID residents | Twice a year since 2020 |
| Antibiotic treatment duration: a stewardship practitioner's perspectives on 'shorter is better' | Makeda Semret | Frankfurt Infectious Diseases Forum, Germany | March 2023 |
| All things stewardship: antimicrobials | Makeda Semret | High Value Care symposium, MUHC | June 2023 |

### Invited speaker during World Antimicrobial Awareness Week (November 2023)

In partnership with the McGill AMR Centre, we invited Dr Andrew Morris, Director of the Antimicrobial Stewardship Program of University Health Network in Toronto and Chair of the Canadian Council of Academics report on "Overcoming Resistance", for a seminar coinciding with WAWW 2023. Dr Morris gave a presentation entitled "This is why we can't have nice things; how to get novel antimicrobials in Canada". The seminar (hybrid) was followed by a panel discussion with members of the McGill Trottier institute for Science and Public Policy, and was attended by members of the McGill AMR Centre, members and trainees from the MUHC and the RI-MUHC.

### Clinical fellowship training program

In partnership with the McGill Infectious Diseases Training Program, we have implemented a one-year clinical fellowship program in Antimicrobial Stewardship, co-directed by Dr Makeda

Semret and Dr Marty Teltsher (Antimicrobial Stewardship medical lead at the Jewish General Hospital). The inaugural fellow Dr Asem A. Allam (MD specialist in Infectious Diseases, King Abdullah bin Abdulaziz University Hospital, Saudi Arabia) completed his fellowship in June 2022 and is currently practicing at his base institution. Dr Siti Zuleikha Zakariah (MD specialist in clinical Microbiology from University Putra Malaysia) is currently enrolled in the fellowship program and is scheduled to achieve certification in September 2024. Further, in partnership with the McGill AMR Centre and the MUHC foundation, we can now offer the option of a competitive scholarship for clinical fellows applying to this program. The inaugural recipient of this scholarship is set to begin Antimicrobial Stewardship training in July 2024.

## Research Activities

Though we remain a predominantly clinical unit focused on pragmatic interventions to optimize antimicrobial use at the MUHC sites, we have begun to map out research priorities and thus solidify our academic mission.

### Impact of clinical care pathways and clinical practice guidelines: COVID-19

We conducted a study to describe clinical outcomes of high-risk (immunocompromised) patients infected with SARS-CoV2 and managed through a clinical care pathway established by members of the Infectious Diseases division and the COVID-19 management guidelines working group. Considering these patients' high risk of developing severe COVID-19 disease, the care pathway consisted of an early notification system, a nursing, pharmacy and medical screening protocol, rapid assessment, and a monoclonal antibody administration protocol in the Infectious Diseases Medical Day hospital. The goal of this study was to gain insights on the real-world effectiveness of this form of therapy for high-risk patients, and on the practicality and physician adherence to the clinical practice guidelines. We demonstrated that local guideline-supported care was associated with favorable outcomes in a very-high risk patient population compared to historical controls. We conclude that pragmatic multidisciplinary care pathways can facilitate physician adherence to recommendations and that such pathways can be a useful model to guide management of future infectious disease emergencies. A research article (authored by Dr Keely Hammond, PGY5 resident in Infectious Diseases, with co-authors F. Bourdeau, M. Klein, D.C. Vinh and M. Semret) describing the results of this study is currently in-press at the Journal of Medical Microbiology and Infectious Diseases Canada (JAMMI).

## Summary highlights and challenges

Highlights:

- Increased volume and scope of stewardship interventions resulting in a reduction of the consumption of broad-spectrum antibiotics at the MGH and RVH; in contrast with MNI (no stewardship presence) where consumption of antibiotics is increasing
- Improvement in the quality of antibiotic prescriptions particularly in some clinical services (Hematology- oncology, General Surgery)

- Significant improvement in treating teams' adherence to antimicrobial stewardship recommendations, particularly when recommendations are to stop antimicrobials
- Stability in rates of resistance to drugs in the Watch category for bacteria commonly isolated from inpatients, except in ICU where resistance to Watch and Reserve antibiotics is steadily increasing.
- Clinical fellowship program in Antimicrobial Stewardship now operational
- Creation of an antimicrobial stewardship pharmacist coordinator position

Challenges:

- Lumed software still not purchased by MUHC and continuing uncertainty on the long-term availability of this critical tool (in use since 2019)
- Lack of dedicated administrative support and ASP budget (described in previous annual report), leading to delays in issuing unit-specific report cards of prescription quality and other quality initiatives

## Priorities for 2024-beyond

- Reporting:
  - Align our annual reporting period to hospital reporting, April 1 to March 31.
  - Seek feedback from CEO, CPDP of this report to address weaknesses and opportunities
- Clinical:
  - Maintain audit-feedback activities on all inpatient wards at MGH and RVH
  - Develop unit-specific report cards of antibiotic prescription quality
- Scholarly:
  - ICU focus: evaluate treatment decision matrix through BAST-ICU trial
  - Verification project on stewardship quality indicators
- Administrative:
  - Revise terms of Reference for ASP team
  - Establish autonomous cost centre for operational costs (website maintenance, teaching materials)

Planned activities:

| Objectives | Activity | ONGOING | PLANNED | Output | Responsible | Estimated time (Hours/month) |
|---|---|---|---|---|---|---|
| Advise (on best practices, policy, guidelines) | Treatment Guidelines | ✓ | ✓ | Guide for prescription | FB, MS, trainees | 3 |
| | PPO review | ✓ | ✓ | Guide for prescription | FB, MS | 0.5 |
| | New Drugs formulary | ✓ | ✓ | restrict access to novel drugs | ASP team | 0.5 |
| | Prescription forms | | ✓ | Documentation and quality | ASP team | 1 |
| | P&T meeting | ✓ | ✓ | Consensus, stakeholder reach | MS | 2 |
| | WEBSITE | ✓ | ✓ | Reach, dissemination | FB, MS | 8 |
| | Pharmacokinetics | ✓ | ✓ | Dose adjustment | ASP Pharmacists | 16 |
| Educate (on appropriate use of AMU and on AMR) | Teaching pharm residents | ✓ | ✓ | Knowledge/awareness/expertise | FB, MS, DT | 5 |
| | Teaching ID residents | ✓ | ✓ | Knowledge/awareness/expertise | FB, MS | 5 |
| | ASP clinical fellow | ✓ | ✓ | Knowledge/awareness/expertise | MS | 8 |
| | Extramural talks | ✓ | ✓ | Knowledge/awareness/expertise | MS | 1 |
| Track (surveillance within institution) | Weekly audit-feedback | ✓ | ✓ | Improving prescription quality | ASP team | 16 |
| | Mero use in ICU | | ✓ | Improving prescription quality | FB, MS, trainees | 16 |
| | Pip-tazo use in ER | ✓ | ✓ | Improving prescription quality | FB, MS, trainees | 16 |
| | Antifungal use | | ✓ | Improving prescription quality | ASP team | 4 |
| | Expand Lumed | | ✓ | Increase number of interventions | FB | 8 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Report | Annual report | ✓ | ✓ | Inform stakeholders, policy | FB, MS | 0.5 |
| | Unit-specific report cards | | ✓ | Benchmarking | FB, MS | 1 |
| (feedback info on AMR and AMR to relevant clinical staff and admin) | AMU monitoring over time | ✓ | ✓ | Benchmarking | FB, MS | 0.5 |
| | Antibiogram | ✓ | ✓ | Benchmarking | FB, MS | 0.5 |
| | Validation of appropriateness scoring scheme | | ✓ | Practice changes | FB, MS, trainees | 16 |
| Research | Collaboration on RCT platforms | | ✓ | Practice changes | MS | 8 |
| (impact of specific interventions on AMU and AMR) | Outcomes based on adherence to guidelines | | ✓ | Practice changes | FB, MS | 8 |
| | Data collection for evidence of harm | | ✓ | Practice changes | FB, MS | 8 |
| ADMIN | ASP meetings (preparation, minutes, meetings) | ✓ | ✓ | Consensus-building, stakeholders | FB, MS | 3 |
| | | | | | | |
| **✓: new activity** | | | | | **Total time:** | **155.5** |

## Acknowledgements

We thank all the members of the ASP core team for their dedication, professionalism, rigor, and availability.
Our very special thanks to:
Infectious Diseases specialists Dr Charles Frenette, Dr Anne-Marie Bourgault, Dr Ruth Horn, Dr Ewa Rajda;
Clinical pharmacists Van Nguyen, Kym Archambault; Derek Lee; Sebastien Landry; Marc Dobrescu; Alexandre Rivard ; Daniel Thirion ; Raphaelle Lauly
Clinical Stewardship fellows Asem A. Allam and Siti Z. Zakariah
Rotating residents in Infectious Diseases/medical microbiology and pharmacy residents

All ASP core team members and trainees have tremendously contributed to guidelines, audits, special projects, and teaching activities

We also extend our gratitude to ASP committee members for their engagement and contribution to strategic planning, and their generous advice on all programmatic aspects

Thank you to Lolia Muhdi Al Tounsi for her help with ASP committee minutes, hoping for continued support

Finally, our thanks to ID Division Director Marcel Behr, and Pharmacy Director Andre Bonnici, for their support of Stewardship activities.

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