



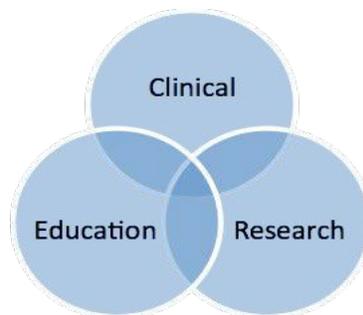
# **Antimicrobial Stewardship Program**

1<sup>st</sup> Quarter Report - Fiscal Year 2010-11  
*July 2010*

# “Getting patients the right antibiotics, when they need them.”

## Executive Summary

The Antimicrobial Stewardship Program (ASP) has been active at Mount Sinai Hospital (MSH) since February 2009, and at University Health Network (UHN) since December 2009. The MSH-UHN ASP uses a collaborative and evidence-based approach to improve the quality of antimicrobial use by getting patients the right antibiotics, when they need them. The ASP follows PDSA (Plan-Do-Study-Act) quality improvement methodology to pursue the best possible clinical outcomes for its patients, relying heavily on patient-centred data.



*The MSH-UHN ASP uses research and education (facilitated by Pfizer Canada’s financial support), alongside clinical care, to take a leadership role in increasing antimicrobial stewardship capacity and improving the quality of health care.*

The following table summarizes the activities of the MSH-UHN ASP, recognizing that the ASP has had the benefit of collaborating with numerous colleagues.

## Summary of Current ASP Activities and Results

Location/ Stakeholders	Methods	Start Date	Highlights
<a href="#">MSH Intensive Care Unit</a>	Prospective audit and feedback	February 2009	Quarterly defined daily dose (DDD) per 100 pt days: 112. (9.7% reduction from 2009-10 fiscal year quarterly mean.) Quarterly antibacterial costs per ICU bed-day: \$20.46 (27.5% reduction from 2009-10 FY quarterly mean.) <i>Pseudomonas</i> susceptibility continues to improve. Candidaemia cases half historical mean. Spearheaded by <b>Sandra Nelson</b> .
<a href="#">MSH/ Obstetrical and Paediatrics Programs</a>	Quality improvement; Before-and-after study	November 2009	Working with the obstetrical and neonatal teams, <b>Sandra Nelson</b> and pharmacy resident, <b>Jennifer Teng</b> , are studying the effect of changing the timing of antibiotic prophylaxis for C-section to pre-op (from post-cord-clamping). Recruitment (of 280 patients) is almost complete, with <b>Lucas Currah</b> (an undergraduate health sciences student) helping out.
<a href="#">MSH 14<sup>th</sup> Floor/ General Surgery</a>	Prospective audit and feedback	March 2010	14.5% reduction in antimicrobial use with quarterly DDD: 2784. (1 <sup>st</sup> quarter DDD 2009-10: 3256.) Slight increase (4.3%) in antimicrobial costs with quarterly costs \$29 253. (1 <sup>st</sup> quarter antimicrobial costs \$27 992.) Spearheaded by <b>Sandra Nelson</b> .
<a href="#">Outpatient Parenteral Antimicrobial Therapy Program</a>	Capture-and-follow	December 2009	Spearheaded by <b>Jim Brunton</b> and <b>Ron Fung</b> , OPAT case volume has been increasing (24 new referrals in June), primarily supporting GIM, Cardiac and Vascular Surgery at TGH, and Orthopaedics and Neurosurgery at TWH. Gaps and dangers for patients discharged on intravenous antibiotics have been identified, and solutions being developed. A database linked with the Electronic Data Warehouse is being developed by <b>Lopa Naik</b> .
<a href="#">PMH 14A &amp; 15B/Leukæmia and Immunocompromised Host Service</a>	Prospective audit and feedback	February 2010	Antimicrobial cost increase of \$2 922/week (or \$123 985 since beginning of prospective audit and feedback by <b>Linda Dresser</b> and <b>Andrew Morris</b> ). <b>Dr. Coleman Rotstein</b> chairs a Pulmonary Infiltrates in the Immunocompromised Host Working Group, supported by <b>Lucas Thung</b> .
<a href="#">TWH Intensive Care Unit</a>	Prospective audit and feedback	December 2009	Quarterly DDD per 100 pt days: 150. (14% increase over 1 <sup>st</sup> quarter 2009-10 fiscal year.) Quarterly antibacterial costs: \$12 650 (33% reduction over 1 <sup>st</sup> quarter 2009-10 FY.) No change in <i>Pseudomonas</i> susceptibility. Spearheaded by <b>Linda Dresser</b> .
Toronto/Toronto Central LHIN, Teaching Hospitals	Quarterly meetings; electronic communication	January 2010	Second meeting of <a href="#">TASC</a> held. Agreement to pursue an agenda of collaboration for research, educational and clinical purposes, and to begin developing a centralized antimicrobial handbook for common conditions (to be led by <b>Monique Pitre</b> ). Chaired by <b>Andrew Morris</b> and <b>Sandra Nelson</b> .
MSH and UHN	<a href="#">Retrospective Cohort Study</a>	April 2010	Research collaboration led by Research Pharmacist <b>Lisa Burry</b> and Clinician-Scientist <b>Chaim Bell</b> (involving Sunnybrook Hospital, St. Michael's, and Hospital for Sick Children) examining management and outcomes of <i>Staph. aureus</i> bacteraemia. Medical residents <b>Bryan Coburn</b> and <b>Adrienne Showler</b> , and infectious disease resident <b>Dan Ricciuto</b> have been involved in the study from conception. <b>Lopa Naik</b> and <b>Melanie Thomson</b> are assisting with design.
Toronto/Healthcare professionals throughout Canada	Education Course on Antimicrobial Stewardship	April 2010	With the goal of increasing stewardship capacity in Canada, <b>Linda Dresser</b> , <b>Tanaz Khory</b> , <b>Sandra Nelson</b> , <b>Melanie Thomson</b> , and <b>Lucas Thung</b> are planning and developing the <a href="#">1<sup>st</sup> course on antimicrobial stewardship in Canada: "Taking it to the Next Level"</a> , planned for June 2011.

## Looking Forward

The ICU leadership at MSH have invited the Immunocompromised Host Service to daily ASP rounds. This should help improve decision-making for the patients (primarily originating from PMH) whose care is not directly influenced by the ASP (because there was a decision for the ASP to not discuss immunocompromised patients in the ICU).

At TGH, the ASP plans to move forward with expansion of prospective audit-and-feedback in the TGH Medical-Surgical ICU, beginning October 2010. This is being coordinated with Dr. Neil Lazar (ICU Site Director), and Laura Hawryluck has been identified as a site leader for this initiative. Although the ASP is currently stretched (from a human resources perspective), it appears that having ASP Rounds in the afternoon will be a workable solution.

Dr. Niall Ferguson (Director, Critical Care Medicine) will be taking a lead in standardizing microbiology investigations in the ICU which might contribute to antimicrobial utilization (e.g. urine cultures). Linda Dresser will be playing a key leadership role in this initiative.

The OPAT Program will continue to expand its services and provide state-of-the-art care for our patients. The volume of clerical work required to meet the OPAT Program's quality of care objectives is currently a limiting factor. With the support of Lopa Naik and Lucas Thung, the OPAT Program is developing a variety of mechanisms (requiring electronic linkages) which will increase the program's capacity tremendously.

On the 14<sup>th</sup> Floor at MSH, although the ASP has been partially effective in optimizing antimicrobial use, there is still substantial room for improvement. Further, the 14<sup>th</sup> floor is shared between the General Surgery Program and Gastroenterology, urology and gynecology; working with the Gastroenterology Service is an opportunity worth exploring.

There continues to be room for improvement on the Leukæmia Service at Princess Margaret Hospital (which uses roughly 40% of all antimicrobial resources at UHN).

Linda Dresser will be taking a leading role in developing a "Sepsis Bundle" for patients brought to the ER with sepsis, septic shock, and the systemic inflammatory response syndrome (SIRS).

A data solution which will improve the ASP's efficiency and quality of care across sites remains elusive. The MSH-UHN ASP—in conjunction with Medical Informatics at MSH and SIMS at UHN—is exploring software solutions and possible business partnerships.

The ASP hopes to have an ASP "brand" over the next few months, which will standardize the look of all forms of communication, including a new website.

In an effort to improve communication and document archiving for the ASP and TASC (the Toronto Antimicrobial Stewardship Corridor), and to develop an educational outreach program for healthcare providers throughout Canada, the ASP will be working (with support from Pfizer Canada Inc.) to develop a website with resources for healthcare providers and administrators. This is anticipated to be up and running within the next 4-6 months.

With antimicrobial stewardship in its infancy, the ASP is using the Pfizer Canada investment to help pursue clinical knowledge and translate that knowledge to practice. In addition to the projects summarized in the summary table above (C-section prophylaxis, effect of antimicrobial stewardship in the ICU, *S. aureus* bacteræmia), the ASP (led by Lisa Burry and Chaim Bell) is planning to rigorously study antimicrobial measures, and the effects of antimicrobial use/ stewardship on antimicrobial resistance, and candidæmia and *C. difficile* rates.

The ASP will continue to forge linkages with local and regional stakeholders, as it continues to play a leadership role in antimicrobial stewardship. It will also expand its educational activities.

## Mount Sinai Hospital (Supported by Pfizer Canada Inc.)

### Intensive Care Unit

The Antimicrobial Stewardship Program (ASP) began working in the MSH ICU in February 2009. Please see prior quarterly reports for more details. Currently, Dr. Nelson (née Howie) rounds with the ICU team 4 days a week (Monday, Tuesday, Wednesday and Friday); Dr. Morris is present on Tuesdays and Fridays. Rounds take approximately 10 minutes. Drs. Morris and Nelson do not discuss immunocompromised patients (primarily from Princess Margaret Hospital (PMH)), but the Immunocompromised Host Service has been invited to participate in Antimicrobial Stewardship Rounds. Full results are in the [Appendix](#), but are summarized below:

- Quarter 1 FY 2010-11 antimicrobial use was extremely low, with 111.8 defined daily doses (DDD)/100 patient-days. (For FY 2009-10, the mean quarterly DDD/100 patient-days was 123.6; for FY 2008-9 it was 143.9.)
- Quarter 1 FY 2010-11 antimicrobial cost was at an historic low, with mean antibacterial costs per ICU bed-day of \$20.46. (For FY 2009-10, the mean quarterly costs per ICU bed-day was \$29.60; for FY 2008-9 it was \$35.82.) This translated to quarterly antibacterial costs of \$17 558. (Quarterly mean for FY 2009-10 was \$35 655; for FY 2008-9 it was \$42 950.)
- Following the release of the last Quarterly Report, antimicrobial utilization was further broken down to patients originating from PMH (i.e. ASP not involved) and other patients. As shown in the Appendix, there has been a reduction in antimicrobial costs of 65% (compared to FY 2007-8 and 2008-9) translating to savings of approximately \$125K for non-PMH patients. However, this has been offset by a similar increase in antimicrobial costs of 19%, translating to increased expenditures of \$66K. Currently, 76% of antimicrobial costs in the ICU are from patients originating from PMH; last fiscal year, PMH patients represented only 37% of total antimicrobial costs.
- *C. difficile* rate was 0.1/100 patient-days.
- *Pseudomonas aeruginosa* resistance rates continue to remain steady and low compared to historical values. For January-June, *Ps. aeruginosa* susceptibilities were (with July-December 2009 shown in parentheses):
  - ceftazidime was 89% (84%)
  - piperacillin-tazobactam 94% (100%)
  - meropenem 94% (89%)
  - tobramycin 89% (89%)
  - ciprofloxacin 61% (63%)

This past year is the first time in over 10 years when there was a six-month period when 4 anti-pseudomonal agents had susceptibilities to *Pseudomonas* above 80% in the past 5 years

- Candidaemia rates are half historical values: In the 8 years prior to the institution of the ASP, the ICU averaged 1 candidaemia/month. It is now approximately 0.5 candidaemias/month (with 2 in this quarter).

- Patient outcomes (e.g. mortality) remain favourable.
- Two abstracts were accepted for presentation at the upcoming European Society of Critical Care Medicine (ESICM) in October 2010:

“Evaluation of the introduction of an antimicrobial stewardship program to a medical-surgical ICU”

**Lisa Burry** PharmD, **Sandra Howie** PharmD, **Tanaz Khory** MBA, Stephen Lapinsky MD, Brian Minnema MD, Michael Christian MD, Thomas Stewart MD, Randy Wax MD, Sangeeta Mehta MD, **Melanie Thomson** BA, **Chaim Bell** MD, **Andrew Morris** MD MSc

“An antimicrobial stewardship program improves the quality of antimicrobial prescribing in an ICU.

**Christina Katsios** B.M.Sc, **Tanaz Khory** RN MBA, **Sandra Howie** PharmD, **Lisa Burry** PharmD, Stephen Lapinsky MD, Randy Wax MD, Michael Christian MD, Sangeeta Mehta MD, **Chaim Bell** MD, Thomas Stewart MD, **Andrew Morris** MD MSc

### **Cesarean Sections**

The ASP began working with Obstetrical and Neonatal Teams at MSH in the fall of 2009. Please see prior Quarterly Reports for more details. In response to a study by **Dr. Allison McGeer** from July-October 2008 (whereby post-C-section infection rates were 11.2%), the ASP worked collaboratively with nursing, obstetrics, anaesthesia and neonatology to change the timing of antibiotic prophylaxis from post-cord clamping to pre-incision in order to reduce post-operative infections. (Giving antibiotics prior to cord clamping had concerned some because of its theoretical effect on infant flora, and so has not been widely adopted.) Changing the surgical prep from povidone-iodine to chlorhexidine was also part of the C-section “bundle”. A target recruitment is 280 patients (for 80% power to detect a 50% difference in total post c-section infection with  $\alpha=0.05$ ). 240 patients have been recruited by **Ms. Jennifer Teng**, a Pharmacy Resident supervised by Sandra Nelson. Ms. Teng is carrying out this study as a before-and-after research protocol, and has REB approval. **Mr. Lucas Currah**, an undergraduate health sciences student at Queens University, is a summer student supervised by Andrew Morris and has been helpful with patient recruitment. Study completion is anticipated by the end of the 2<sup>nd</sup> fiscal quarter.

The ASP (and Ms. Teng) met recently with the Obstetrical Team to review preliminary findings. Based on an anticipated failure to show a 50% reduction in surgical site infections, the ASP is working with the obstetrical team to improve the entire C-section process. This will necessitate further collaboration, including with Infection Control.

### **General Surgery (14<sup>th</sup> Floor)**

The ASP began working with the General Surgery Teams at MSH in March 2010 after meeting with **Dr. Carol Swallow**. Dr. Nelson performs prospective audit and feedback, and meets with a surgical resident from each surgical team twice a week. Pre-implementation chart audit suggested that up to 45% of antimicrobial courses were inappropriate. Medical Informatics (Analyst: **Yoshiko Nakamachi**, Programmer: **Predrag Tisma**) performed significant database

customizations, to allow full data capture for the 14<sup>th</sup> floor. Outcome data are available in the [Appendix](#), but are summarized below:<sup>1</sup>

- 14<sup>th</sup> floor Quarter 1 FY 2010-11 antimicrobial usage (using March-May data) has dropped by 12% compared to the same quarter in FY 2009-10, and is now at 57.3 DDD/100 patient-days.
- 14<sup>th</sup> floor Quarter 1 FY 2010-11 antimicrobial costs per 14<sup>th</sup> floor bed-day (using March-May data) increased slightly by 8.2% compared to the same quarter in FY 2009-10 to \$6.08/patient bed-day. This translated to a quarterly increase in year-over-year costs of \$1261.

### **Surgical Prophylaxis**

Because of increased Group A streptococcus and *S. aureus* resistance to clindamycin, the ASP decided to change the second-line agent for gram-positive surgical prophylaxis (for penicillin-allergic patients) from clindamycin to vancomycin. Although this makes MSH's practice consistent with UHN's<sup>2</sup>, it also posed a logistical challenge, as vancomycin requires a prolonged infusion that must commence considerably earlier (almost 1 hour) than any other antibiotic infusion.

Dr. Nelson worked with **Nursing, Pharmacy, and Anæsthesia** to ensure that the necessary systems changes were in place prior to this high-risk implementation. She is collecting data on patients that are receiving vancomycin prophylaxis to assess the process.

Drs. Morris and Nelson have contributed to the 2010-11 version of the General Surgery Resident's Handbook, recommending evidence-based changes to the section on surgical antibiotic prophylaxis in collaboration with **Drs. Alexandra Easson, Robin McLeod, and Carol Swallow**.

### **Hospital Formulary**

Dr. Nelson is working to harmonize the MSH antimicrobial formulary with the UHN antimicrobial formulary. This included bringing ertapenem on formulary, which should prove cost-saving when replacing meropenem for the treatment of ESBL-producing organisms. When completed, it will also minimize the potential errors from inter-institutional transfer of patients and physicians.

### **Outpatient Parenteral Antibiotic Therapy (OPAT) Program**

Under the direction of Dr. Jim Brunton and Mr. Ron Fung, the Outpatient Parenteral Antibiotic Therapy (OPAT) Program follows patients who will require intravenous antibiotic administration after discharge from hospital. The OPAT Program is currently available at both TGH and TWH. Highlights of this new program (summarized in the [Appendix](#)) include:

- A new "OPAT consultation" order through EPR was developed and deployed that allows user-friendly ordering, provides a work queue to the OPAT team, allows tracking to analyze

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<sup>1</sup> Note that 14<sup>th</sup> Floor data is not restricted to the General Surgery service, but also includes patients under Gastroenterology, Gynecology and Urology. The ASP does not currently work with these services.

<sup>2</sup> UHN switched from clindamycin to vancomycin several years ago because of concerns regarding *C. difficile*, not because of antimicrobial resistance.

utilization, and provides an identifier for data in the electronic data warehouse (EDW). This process has served as a model for General Internal Medicine to access allied health services at UHN.

- Number of consults is currently 16-20 per month, which come almost exclusively from inpatients at TGH and TWH. As of June 29, 2010, a total of 95 patients have been referred since OPAT started seeing patients on a pilot basis in December 2009. We have analyzed the results of the first 72 patients (referred before May 31 2010). At TGH the main referral services have been cardiovascular and vascular surgery and general internal medicine. The most common problems have been endocarditis and pacemaker infections and vascular graft infections. At TWH the main referral services were Orthopaedics and Neurosurgery; the most common problems were deep surgical site infections and revision of infected artificial joints.
- While the vast majority of OPAT patients were cared for in the GTA, we supervised courses from the broad catchment area of UHN specialty programs including Thunder Bay, Timmins North Bay the Niagara Region and Kingston.
- As of May 31, 2010, 25 treatment courses of vancomycin were supervised: 16 dose changes were required in 12 patients. There were no readmissions to UHN for nephrotoxicity; 1 patient was readmitted to hospital in North Bay due to toxicity. Two cases of neutropenia, 2 cases of late allergy and 1 patient who failed to respond to vancomycin therapy were all managed successfully. This is especially noteworthy because the need for an OPAT service first became evident after 6 cases of vancomycin-related nephrotoxicity required readmission within a period of less than one year.
- OPAT delivers high quality patient-centred care. Close followup of patients has enabled other treatment changes that were essential to a successful and safe outcome. These have included recognition of and resolution of coexisting medical problems, institution of vacuum assisted wound closure and early recognition and resolution of venous thrombosis caused by central venous catheters used for prolonged intravenous therapy.
- The OPAT team has identified numerous quality improvement issues:
  - Efficiency of data collection and management
  - Communication between community bedside nurse and physician and back.
  - Efficiency of communication with community labs
  - Unnecessary use of prolonged intravenous antibiotics
  - Unacceptably slow turnaround time for vancomycin levels in some laboratories.
  - Vancomycin dosing practices at UHN should use a loading dose and take better account for body-weight and renal function
  - Processing of vascular surgery and orthopedic microbiology specimens.
  - Reduce and improve management of surgical site infections by development and standardized application best practices.

## Princess Margaret Hospital

### Leukæmia Service

The Antimicrobial Stewardship Program (ASP) began working with the Leukæmia Service in February 2010, after meeting with **Dr. Andre Schuh** (Service Chief), **Malcolm Moore** (Physician-in-Chief, PMH), and members of the clinical team. Historical microbiological, epidemiological and antimicrobial utilization data were shared. Drs. Dresser and Morris meet with the three clinical associates (**Drs. Andrzej Lutynski, Anna Rydlewski, and Ken Peckham**) once per week for approximately 10-15 minutes to review patients not being followed by the Immunocompromised Host Infectious Diseases Consultation Service. Staff physicians are encouraged to attend these meetings.

Additionally, **Dr. Coleman Rotstein**, Director of Infectious Diseases for Princess Margaret Hospital, has drafted a "Clinical Pathway for Treatment of Febrile Neutropenia", and chairs a broadly representative working group to develop best practices to the approach of the patient with febrile neutropenia and new pulmonary infiltrates.

Additional data for wards 14A and 15B (where most of the Leukemia Service patients are admitted) is available in the [Appendix](#) (although more complete outcome data will be available for the next Quarterly Report), but is summarized below:

- there were 54 positive blood cultures (out of 443 drawn) with 63 separate bloodstream isolates (including 22 coagulase-negative staphylococci, 8 viridans streptococci, 5 *E. coli*, 5 enterococci, 3 each of *Pseudomonas aeruginosa* and *Stenotrophomonas maltophilia*, and 2 *Staph. aureus* (1 MRSA) since initiating the ASP on February 22.
- In the same period in 2009, when there were 57 positive blood cultures (out of 542 drawn) with 47 isolates (20 coagulase-negative staphylococci, 5 enterococci, 4 each of viridans streptococci and *E. coli*.)
- since initiating the ASP, the mean weekly antimicrobial expenditures have increased \$2 922 from \$25 807 to \$28 729. This translates into total antimicrobial costs for 2010 of \$697 802, with a year-over-year increase of approximately \$124K.

## Toronto General Hospital

### Medical-Surgical Intensive Care Unit

The ASP has not actively been involved with the Medical-Surgical Intensive Care Unit at Toronto General Hospital, but are planned to begin prospective audit and feedback beginning October 2010. **Dr. Laura Hawryluck** has been designated the ICU physician-lead for this project. It is anticipated that the process (and success) will parallel the that at Mount Sinai and Toronto Western Hospitals.

## Toronto Western Hospital

### Medical-Surgical Intensive Care Unit

The Antimicrobial Stewardship Program (ASP) began working in the TWH ICU in December 2009. Please see prior quarterly reports for more details. Currently, Dr. Dresser rounds with the

ICU team on weekdays at noon and also gives a noon-hour teaching session to the ICU team on Fridays; Dr. Morris is present for ASP rounds on Mondays and Thursdays. Rounds take approximately 10 minutes. Full results are in the [Appendix](#), but are summarized below:

- Quarter 1 FY 2010-11 antimicrobial use was low, with 149.9 defined daily doses (DDD)/100 patient-days, but was higher than for the same quarter last year. (For quarter 1 FY 2009-10, the DDD/100 patient-days was 128.9.)
- Quarter 1 FY 2010-11 antimicrobial costs was extremely low, with at \$12 650. (For quarter 1 FY 2009-10, the antimicrobial costs were \$18 952.)
- From January-May, ICU antimicrobial costs are down 46% to \$28 045 (from \$52 196 for the same period last year).
- *Pseudomonas aeruginosa* resistance rates have not changed appreciably since the program started, with the possible exception of reduced susceptibility to tobramycin. For January-June, *Ps. aeruginosa* susceptibilities were (with July-December 2009 shown in parentheses):
  - ceftazidime was 88% (94%)
  - piperacillin-tazobactam 88% (89%)
  - meropenem 92% (89%)
  - tobramycin 84% (100%)
  - ciprofloxacin 75% (78%)
- Patient outcomes remain favourable.

## Toronto Antimicrobial Stewardship Corridor

The Toronto Antimicrobial Stewardship Corridor (TASC) is a relatively new collaborative endeavour between the ASP and like-minded individuals at the Hospital for Sick Children, St. Michael's, and Sunnybrook Hospital. Chaired by Drs. Morris and Nelson, TASC aims to share best practices and educational tools, while developing a research agenda. It has met twice, and already is beginning to show the fruits of its labour (see ASP Research below). Each of these hospitals either has the beginnings of an ASP or will be starting one up shortly. We feel strongly that the MSH-UHN ASP needs to help these programs in whatever manner possible to be strong and successful, which will help all hospitals in the long run.

**Monique Pitre**, a TASC member, will be leading an effort to develop a standardized antibiotic "handbook" (or electronic guide) that is applicable to all sites.

At the last meeting, there was unanimous agreement to invite community hospital members to join. There was remarkably strong interest to join shown by many of the hospitals around the Greater Toronto Area. Because of this, meetings (which are held quarterly) may need to be held in a larger venue (the Board Room at Mount Sinai Hospital seemed crowded at the last meeting with over 20 attendees) and may need to employ webinar technology.

Dr. Morris is currently exploring web-based solutions for the need to share documents and resources and to collaborate online. He will be using a significant portion of the generous donation from Pfizer Canada for this purpose, with the hopes of allowing other "stewards" of antimicrobials around Canada and internationally to tap into the expertise which we are rapidly developing and facilitating at Mount Sinai Hospital and University Health Network.

## Antimicrobial Stewardship Program Research

From the time the ASP was initiated, it has pursued the model that all of its activities should be based on the best available evidence, should be studies to observe real-world outcomes, and should contribute to modern medical practice with knowledge translation. For this reason, the ASP has asked for Research Ethics Board approval for evaluating almost every project it undertakes (with the intention to publish). Some of this research has been listed above.

In addition, the ASP has decided to use a significant portion of its funds generously donated by Pfizer Canada Inc. to pursue a formal, investigator-initiated research agenda that focuses on patient outcomes: mortality, length of stay (in the hospital or intensive care unit), and quality of life. Antimicrobial resistance and superinfections (e.g. *C. difficile* and candidæmia) are also important outcomes. This research agenda is being led by Drs. Chaim Bell and Lisa Burry.

### Antimicrobial Stewardship in the ICU

The first research project will be using the data accrued from the clinical activities of the ASP (Drs. Dresser, Morris and Nelson). Supported by Drs. Burry and Morris, Infectious Diseases and Critical Care resident **Dr. Brian Minnema** will be looking at clinical, microbiological and antimicrobial utilization outcomes in a “step-wedge” trial design. (That is, looking at the effects of sequentially introducing the ASP at each of the 3 MSH-UHN intensive care units.)

Much of the data has already been collected, although the study will be looking at data from all ICUs as far back as 2007, and following it forward to 2012.

Meanwhile, Dr. Burry will be working with **Mark McIntyre**, a pharmacist at MSH, to examine the relationship between antimicrobial use and candidæmia. (He had previously done a residency project on sepsis and candidæmia.)

### *Staphylococcus aureus* Bacteræmia

The second such project involves examining the management and outcomes of patients with *S. aureus* bacteræmia at all TASC member hospitals. It is an ambitious project being led by Dr. Burry, hoping to capture approximately 1000 episodes of *S. aureus* bacteræmia at the teaching hospitals. It will look at how patients are investigated and managed (including resource utilization such as echocardiography and length of stay), and will also be examining outcomes. Because *S. aureus* bacteræmia is such an important disease, the ASP hopes to use this study to springboard clinical trials into the best management of *S. aureus* bacteræmia.

The study is anticipated to take 15-18 months once started, although there are numerous logistical challenges (e.g. REB approvals at all sites, data-sharing agreements, standardizing methods, privacy issues, etc.) that need to be addressed. An infectious diseases resident (**Dr. Dan Ricciuto**) and two medical residents (**Drs. Bryan Coburn and Adrienne Showler**) will be having this project as major research projects.

The study protocol and data collection forms have been submitted to the respective Research Ethics Boards for approval, and Drs. Coburn (Supervisor: **Dr. Matt Muller**, St. Michael's) and Showler (Supervisor: Dr. Andrew Morris) have had their research blocks approved for this coming academic year.

## Antimicrobial Stewardship Program Education

One of the ASP's mandates is to increase the antimicrobial stewardship capacity locally, provincially, and nationally. All of the clinical members of the ASP play a role in stewardship education, giving one-on-one advice to healthcare providers, having teaching sessions within the hospitals, supervising trainees, giving rounds to colleagues at other institutions, or developing educational curricula.

### 1<sup>st</sup> Annual Course in Antimicrobial Stewardship

Members of the ASP (Linda Dresser, Sandra Nelson, Melanie Thomson, Lucas Thung) have been planning this course—slated for the first week of June 2011—that will target pharmacists, physicians, infection control personnel and hospital administrators. Its purpose is to help hospitals and their employees implement and/or develop their antimicrobial stewardship programs. Unlike some courses which focus on antimicrobial and infectious diseases content, this course will be focusing on developing the skills and knowledge required to get a stewardship program up off the ground and functioning. This course will be the first and only one of this kind in Canada, and will highlight the MSH-UHN ASP.

## Future Directions

### Intensive Care Units

The ICU leadership at MSH have invited the Immunocompromised Host Service to daily ASP rounds. This should help improve decision-making for the patients (primarily originating from PMH) whose care is not directly influenced by the ASP (because there was a decision for the ASP to not discuss immunocompromised patients in the ICU).

At TGH, the ASP plans to move forward with expansion of prospective audit-and-feedback in the TGH Medical-Surgical ICU, beginning October 2010. This is being coordinated with **Dr. Neil Lazar** (ICU Site Director), and **Dr. Laura Hawryluck** has been identified as a site leader for this initiative. Although the ASP is currently stretched (from a human resources perspective), it appears that having ASP Rounds in the afternoon will be a workable solution.

**Dr. Niall Ferguson** (Director, Critical Care Medicine) will be taking a lead in standardizing microbiology investigations in the ICU which might contribute to antimicrobial utilization (e.g. urine cultures). Linda Dresser will be playing a key leadership role in this initiative as it pertains to urine culture testing and management.

### Outpatient Parenteral Antibiotic Therapy Program

**Data collection and management:** Currently, Dr. Brunton and Mr. Fung enter all patient data by hand into a flat (Excel) file and type their notes fully, with no interface from the various data sources available. This issue is being addressed by our new database programmer and analyst Ms Lopa Naik who is working with all stakeholders to develop an efficient and robust relational database for the OPAT program. The goal is to extract information from the EDW, automating much of the clerical work. This is expected to significantly improve the capacity of the OPAT program, and will also better allow patient-focused outcome data to be analyzed, followed and acted upon, making UHN a world-leader in outpatient antimicrobial therapy.

**Lab test results:** We are working to improve IT-based infrastructure to improve the efficiency of the process for ordering laboratory tests and receiving the results from the community

laboratories that serve the OPAT patients. Measures include acquiring a dedicated Fax line for the program and working to send faxes directly from the computer. This will allow us to keep records of all communications and reduce clerical time needed to fax by hand. Finally we are working to make use of electronic lab result data feeds from Life Labs that are already being received by the UHN Multi-organ Transplant Program. This would allow automatic automatic entry of lab results into patient files in the database.

**OPAT – Bedside interprofessional communications:** In the longer term we are working with Dr Dante Morra of the Centre for Innovation in Complex Care (CICC) to explore secure wireless devices as a means to improving bi-directional communication between bedside nurse and physician and other members of the health care team. Models have already been developed including the “Virtual Ward“ project at St Michael’s Hospital, and a Palliative Care project currently being piloted and refined in the Niagara Region.

**Slow Vancomycin Turn-around Time:** Labs have been contacted and asked to improve performance of this test. In general we avoid using these labs unless absolutely necessary and are now aware of the problems in the event there is no other choice. We will re-audit performance and take additional steps to resolve this issue if necessary.

**Vancomycin dosing practice:** This initiative is being driven by Dr Linda Dresser and Mr Ron Fung. We now believe that vancomycin treatment would be better accomplished by using a loading dose together with use of accurate weight measurement and carefully calculated estimates of renal function to select initial maintenance doses. The dose will be refined based on blood levels using an established formula. These practices will be piloted with ward pharmacists, and will be generalized through EPR order entry if superior to current practice.

**Microbiology Results:** We identified several instances where cultures taken from sterile sites during an operation were processed – inappropriately – as if they were taken from a body surface site. This resulted in avoidable major infections. Vascular graft and orthopedic infections where artificial material cannot be removed may require life-long oral antibiotic suppression. Microbiology lab procedures need to be changed to report on a larger number of orally bioavailable antibiotics for these infections. We are working to identify the most cost-effective way of doing this.

**Management of Surgical site infections:** It has become apparent that complications of complex surgical procedures are an important cause of prolonged hospital stay. We believe that closer attention to early management of these problems would help reduce morbidity. In addition we need to be sure that best practice guidelines (both for surgical and antibiotic treatment) are established and used as much as possible. This will require extensive consultation with surgical subspecialty leaders together with monitoring risk-adjusted deep space infection rates and length of stay and outcomes.

### **Prospective Audit and Feedback in Non-ICU Areas**

At MSH, although the ASP has been partially effective in optimizing antimicrobial use, there is still substantial room for improvement. Further, the 14th floor is shared between the General Surgery Program and Gastroenterology; working with the Gastroenterology Service is an opportunity worth exploring.

There continues to be room for improvement on the Leukæmia Service at Princess Margaret Hospital (which uses roughly 40% of all antimicrobial resources at UHN).

Although there are definitely opportunities to improve antimicrobial prescribing at all the sites (especially with the surgical services and general internal medicine), human resources and the time required to perform prospective audit and feedback are currently the limiting factor. To properly review a case electronically takes anywhere from 1-5 minutes. Therefore, with a 25-patient clinical service, the time required to review is approximately 1 hour prior to discussing the cases with the physicians. A data solution which will improve the ASP's efficiency and quality of care across sites remains elusive. The MSH-UHN ASP—in conjunction with Medical Informatics at MSH and SIMS at UHN—is exploring software solutions and possible business partnerships. Dr. Morris is taking the lead on this initiative, with MSH Chief Information Officer **Prateek Dwivedi** and UHN Chief Information Officer **Lydia Lee**.

## **Sepsis**

The Ministry of Health and Long-Term Care is beginning to focus on sepsis care. **Dr. Paul Ellis**, an emergency physician at UHN, approached Linda Dresser with advice regarding empiric antimicrobials for patients presenting with sepsis. With the ASP's ambitions to standardize care, and study patient outcomes before and after a change in care, it hopes to collaborate with Dr. Ellis and **Dr. Howard Owens** to help develop best practices for sepsis. Dr. Dresser will be taking a leading role in developing a "Sepsis Bundle" for patients brought to the ER with sepsis, septic shock, and the systemic inflammatory response syndrome (SIRS).

## **Communication**

The ASP hopes to have an ASP "brand" over the next few months, which will standardize the look of all forms of communication, including a new website. The website will be used to improve communication and document archiving for the MSH-UHN ASP and also for TASC (the Toronto Antimicrobial Stewardship Corridor). It will also serve as an educational portal for healthcare providers throughout Canada, with antimicrobial stewardship tools and educational materials. This is anticipated to be up and running within the next 6-8 months.

## **Research**

With antimicrobial stewardship in its infancy, the ASP is using the Pfizer Canada investment to help pursue clinical knowledge and translate that knowledge to practice. In addition to the research studies summarized above (C-section prophylaxis, effect of antimicrobial stewardship in the ICU, *S. aureus* bacteræmia), the ASP (led by Lisa Burry and Chaim Bell) is planning to rigorously study antimicrobial measures, and the effects of antimicrobial use/stewardship on antimicrobial resistance, and candidæmia and *C. difficile* rates.

## **Education**

In addition to the planned course on Antimicrobial Stewardship in June 2011, the ASP hopes to be involved in formal medical and pharmacy education. Having a infectious diseases and pharmacy residents have a rotation in antimicrobial stewardship at MSH-UHN is a stated goal, although this will require development of objectives and a curriculum (with required reading). In addition to building stewardship capacity, having advanced trainees involved in stewardship would probably increase the ASP's capacity to perform audit-and-feedback.

Another ambition of the ASP is to be able to sponsor one pharmacy fellow and one infectious diseases fellow in Infectious Diseases. We are currently not in a position to support such a program, but hope to do so by the second quarter of fiscal year 2011-12.

## **Leadership and Collaboration**

Members of the ASP are leaders and innovators in the field, and we hope to leverage our experience and knowledge to improve antimicrobial prescribing practices throughout Toronto and beyond. We are just beginning to form linkages with the Toronto Central LHIN. Further, we plan to coordinate a Delphi panel on antimicrobial measurement with stakeholders from throughout Canada.

The 2<sup>nd</sup> Quarter Report - Fiscal Year 2010-11 will be available in October 2010.

## Appendix

### Mount Sinai Hospital

#### ICU

##### MSH ICU Antimicrobial Costs and Utilization, Quarterly

Antibacterial Utilization	Quarterly mean 2008-9	Quarterly mean 2009-10	Q1 2010-11	Difference (compared to 2009-10 quarterly mean)	
Costs/Pt-day	\$ 35.83	\$ 29.55	\$ 20.46	-30.8%	\$ (9.09)
DDD/100 patient-days	143.9	123.6	111.8	-9.5%	-11.8
Total costs	\$ 42,950	\$ 35,655	\$ 26,337	-26.1%	\$ (9,318)

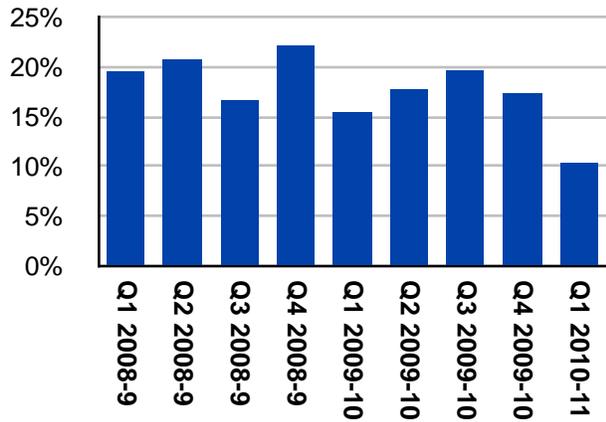
Notes: Q1 2010-11 data is based on April and May data only. Total costs were calculated by multiplying the total quarterly cost by 1.5, and so is subject to considerable variation. The ASP began work in the MSH ICU in Q4 2008-9.

##### Antimicrobial Costs in MSH ICU FY 2007-8 to 2009-10, according to PMH or non-PMH origin

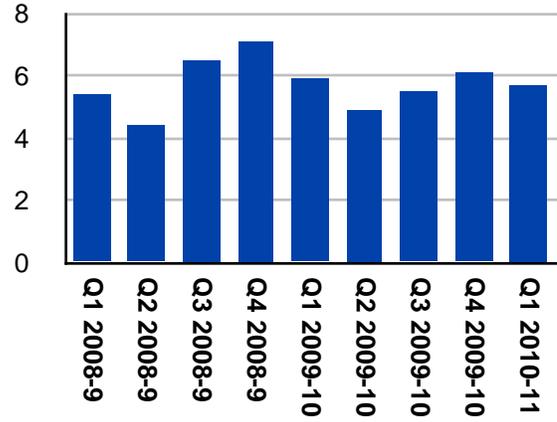
	2007-8	2008-9	2009-10 (annualized from 3 quarters)	% change (compared with mean two prior years)	\$ change (compared with mean two prior years)
<b>Total ICU antibacterial costs</b>	\$ 183,087	\$ 171,801	\$ 142,787	-19.5%	\$ (34,657)
<b>Non-PMH pts</b>	\$ 123,347	\$ 124,519	\$ 49,878	-59.8%	\$ (74,055)
<b>PMH pts</b>	\$ 59,740	\$ 47,282	\$ 92,909	+73.62%	\$ 39,398
<b>Total ICU Antifungal costs</b>	\$ 185,149	\$ 143,100	\$ 132,519	-19.3%	\$ (31,606)
<b>Non-PMH pts</b>	\$ 62,531	\$ 74,120	\$ 16,951	-75.2%	\$ (51,375)
<b>PMH pts</b>	\$ 122,618	\$ 68,980	\$ 115,568	+20.64%	\$ 19,769
<b>Total ICU antimicrobial costs (antibacterial + antifungal)</b>	<b>\$ 368,236</b>	<b>\$ 314,901</b>	<b>\$ 275,306</b>	<b>-19.4%</b>	<b>\$ (66,263)</b>
<b>Non-PMH pts</b>	<b>\$ 185,878</b>	<b>\$ 198,639</b>	<b>\$ 66,829</b>	<b>-65.2%</b>	<b>\$ (125,430)</b>
<b>PMH pts</b>	<b>\$ 182,358</b>	<b>\$ 116,262</b>	<b>\$ 208,477</b>	<b>39.6%</b>	<b>\$ 59,167</b>

Notes: 1. Above data may have some final adjustments, based on year-end adjustments/modifications that have yet to be realized. It is anticipated that these will be relatively minor. 2. For non-PMH patients, it would appear that approximately half of the antibacterial costs are for piperacillin-tazobactam. 3. For PMH patients, roughly two-thirds of the ICU antifungal costs are for caspofungin (and the remainder is split between Ambisome and voriconazole), and roughly two-thirds of the antibacterial costs are for meropenem.

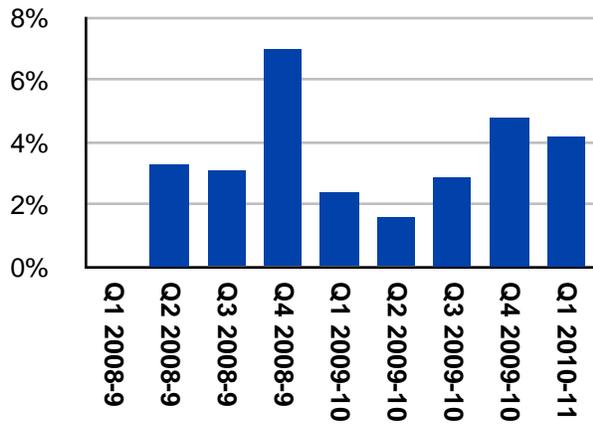
**MSH ICU Mortality**



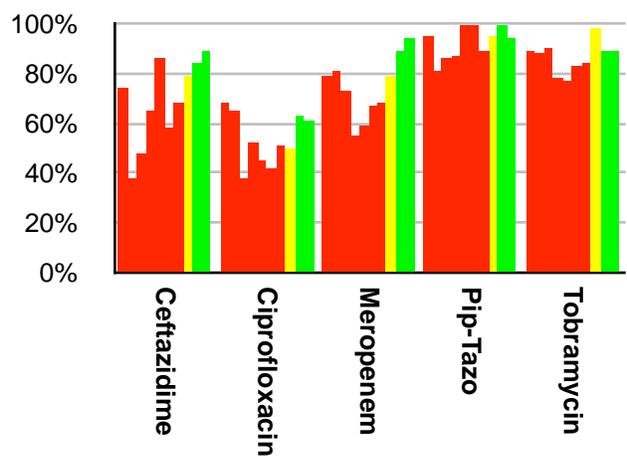
**MSH ICU Mean Length of Stay (days)**



**MSH ICU Readmission (% Readmitted to ICU within 48h of discharge)**



**MSH ICU Pseudomonas Susceptibility July 2005-present**



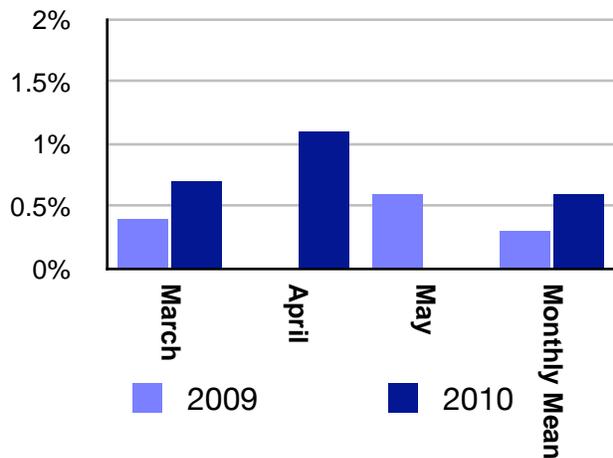
## 14<sup>th</sup> Floor

### MSH 14<sup>th</sup> Floor, Antimicrobial Costs and Utilization

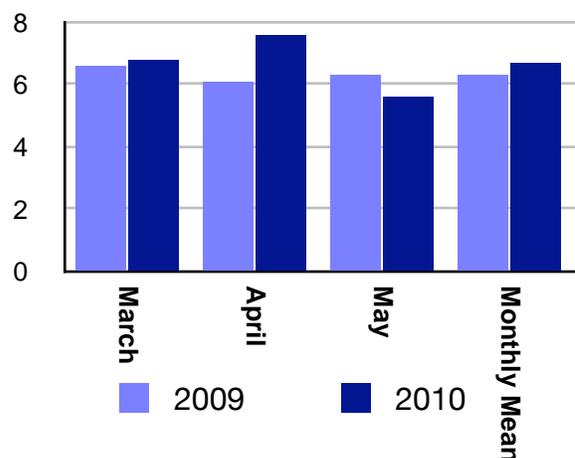
Antibacterial Utilization	March-May 2009	March-May 2010	Difference (compared to 2009-10 quarterly mean)	
Mean Costs/Pt-day	\$ 5.62	\$ 6.08	+8.2%	\$ 0.46
Mean DDD/100 patient-days	65.1	57.3	-12.0%	-7.8
Total costs	\$ 27,992	\$ 29,253	+4.5%	\$ 1,261

Notes: Q1 2010-11 data is based on April and May data only. Total costs were calculated by multiplying the total quarterly cost by 1.5, and so is subject to considerable variation. The ASP began work in the MSH ICU in Q4 2008-9.

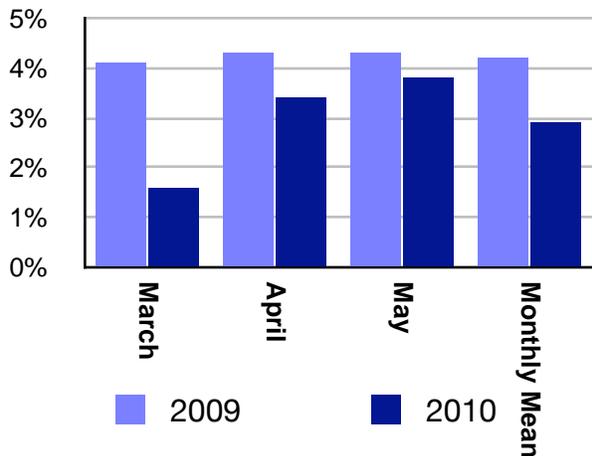
MSH 14<sup>th</sup> Floor Mortality



MSH 14<sup>th</sup> Floor Mean Length of Stay (days)

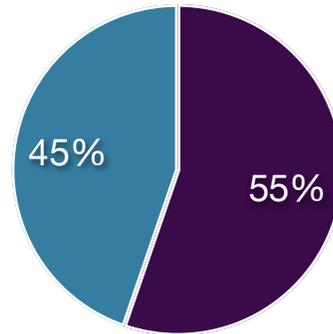
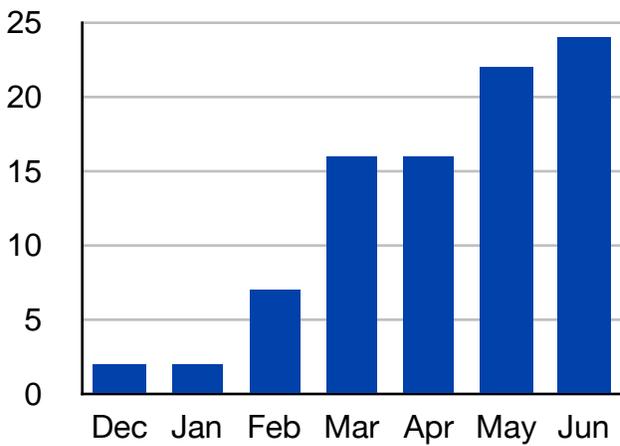


MSH 14<sup>th</sup> Floor Readmissions (% Readmitted to ICU within 48h of discharge)



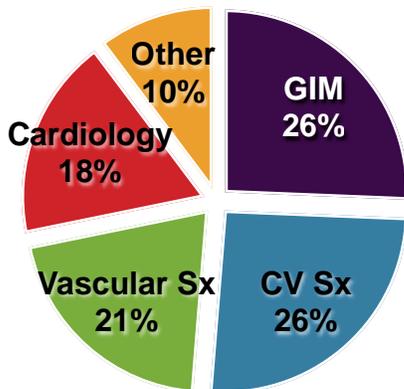
## Outpatient Parenteral Antibiotic Therapy (OPAT) Program

New Referrals to OPAT, by Month

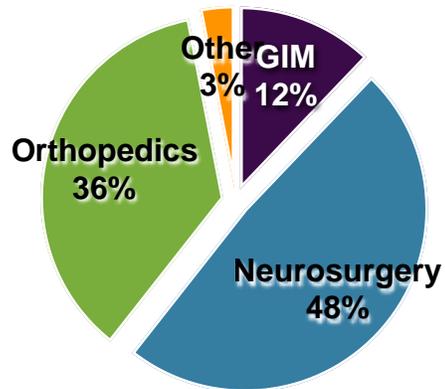


● TGH ● TWH

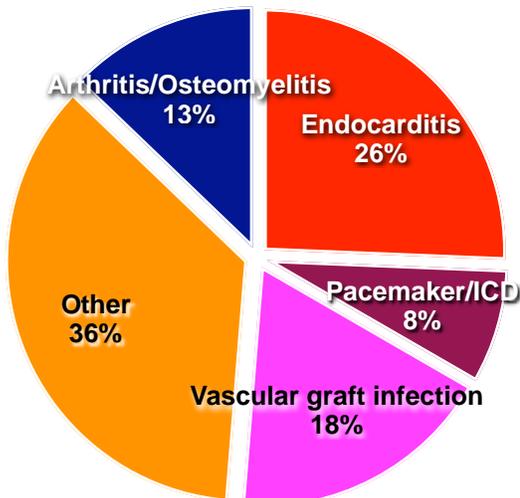
Referring Service, TGH



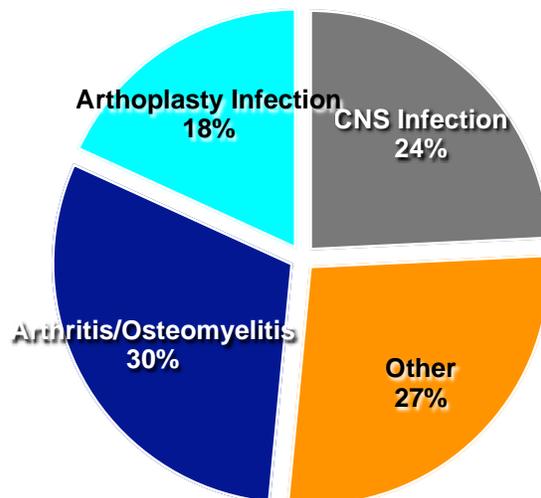
Referring Service, TWH



OPAT Diagnosis, TGH



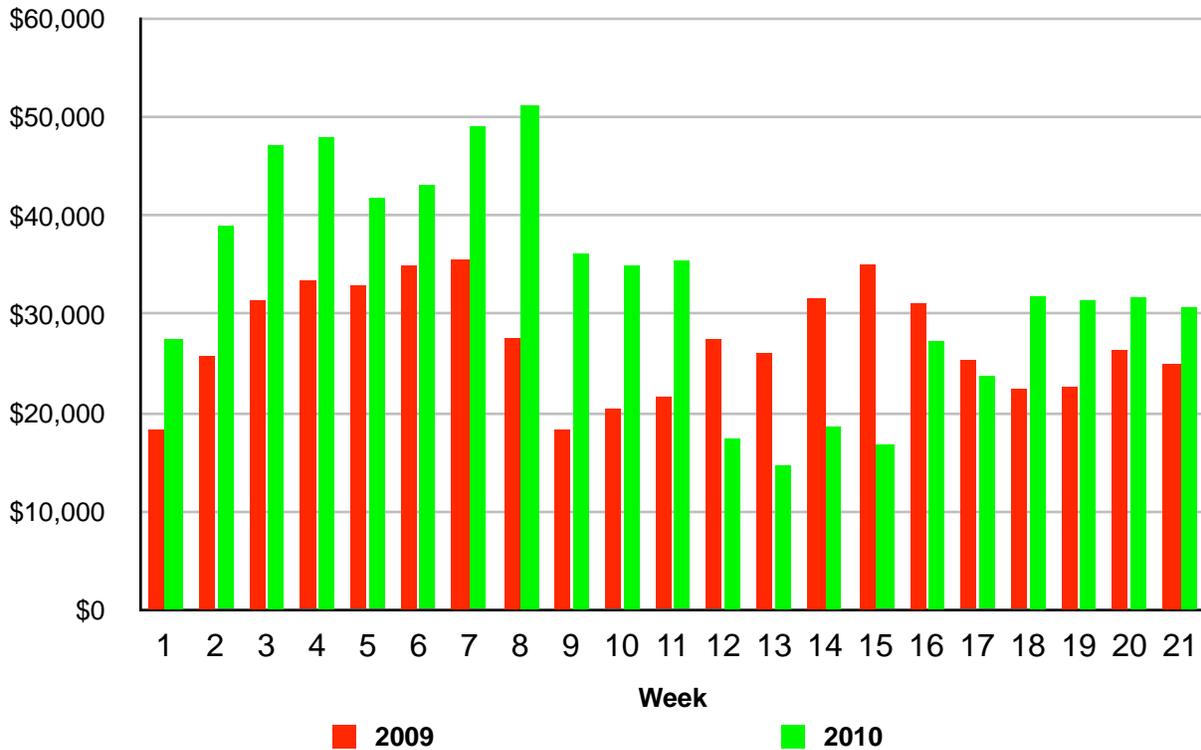
OPAT Diagnosis, TWH



## Princess Margaret Hospital

### Leukæmia Service: Wards 14A and 15B

Antimicrobial Costs, by Week, 2009 vs 2010



Antibacterial Utilization	Jan-May 2009	Jan-May 2010	Difference	
Mean Cost/Week	\$ 27,325	\$ 33,229	+21.6%	\$ 5,904
Total costs	\$ 573,823	\$ 697,802		\$ 123,979
Mean Cost/Week post-ASP	\$ 25,807	\$ 28,729	+11.3%	\$ 2,922

Notes: ASP was introduced after week 7.

### Blood Culture Isolates 2009 vs 2010, Weeks 8-21

2009 (N=47)

2010 (N=63)



● CNSt   
 ● Enterococcus   
 ● viridans Strep.   
 ● E. coli   
 ● Pseudomonas   
 ● Other

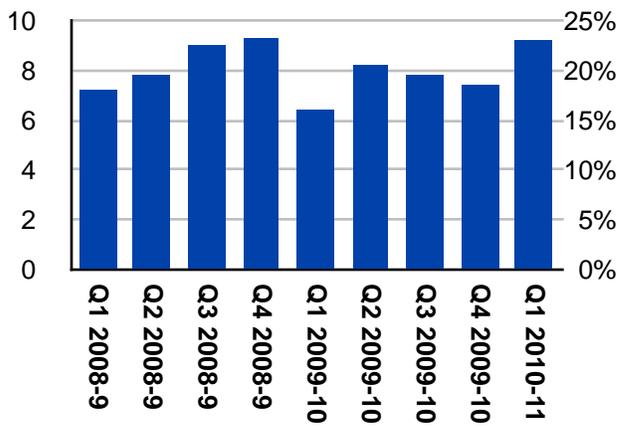
## Toronto Western Hospital

### Medical Surgical ICU

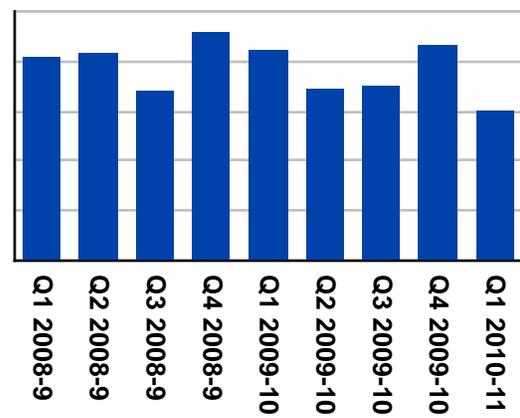
#### TWH ICU Antimicrobial Costs and Utilization Jan-May 2009 vs. Jan-May 2010

ICU Antibiotic Costs	FY 08/09	FY 09/10	Difference	
Antimicrobial Costs	\$ 52,196	\$ 28,046	-46.3%	\$ (24,151)
Antibiotic DDD/100 patient-days	484.1	389.0	-19.6%	-95.1

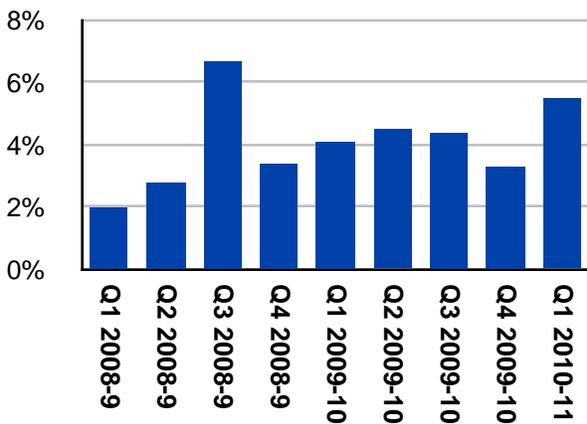
#### TWH ICU Mean Length of Stay (days)



#### TWH ICU Mortality



#### TWH ICU Readmission (% Readmitted to ICU within 48h of discharge)



#### TWH ICU Pseudomonas Susceptibility July 2005-present

