Introduction

Mission

The Pharmacy Department’s mission is to provide evidence-based, cost-effective and safe drug therapy, with the purpose of attaining optimal patient care outcomes. To achieve this, maximization of technology and the emphasis on education, training, and development of pharmacy staff are prioritized.

About the Pharmacy Department

Mount Sinai Hospital’s pharmacy department has rapidly expanded its level of clinical services and scope of practice over the past 8 years. The previous pharmacy model focused on the distribution of medications and the pharmacists were primarily centralized in the pharmacy. Today, pharmacists practice on patient units where the focus is on direct patient care and providing evidence-based recommendations to prescribers and other healthcare professionals. This change in MSH pharmacy practice was a multi-year process that required a high level of staff engagement and was guided by leadership vision.

The growth of pharmacy clinical services was accomplished through hiring of knowledgeable, skilled, residency-trained pharmacists. Pharmacy residencies require at least one year of intense pharmacy practice training which is considered professionally to be equivalent to 3 years of hospital practice. In 2007, the pharmacy department had only one residency-trained pharmacist. Today, there are over 30 residency-trained pharmacists on staff. In addition to residency training, the majority of our pharmacists obtained board certification through examinations; certification formally confirms a pharmacist’s strong fundamental understanding of drug therapy across multiple diseases. The pharmacy department acquired exceptional depth: a decade ago, there were no board certified pharmacists on staff and now, in 2017, we have over 25 board-certified pharmacists. Further, several pharmacists have become double-certified or even triple-certified. Importantly, pharmacists with certification(s) greatly enhance the level of clinical practice for our patients, definitively elevate the level of practice of our multi-disciplinary teams and have a significant impact on the learning of our residents. Eleven of the fourteen graduates from the class of 2015-16 have sought and attained board certification.

The motivated, knowledgeable, skilled, and engaged pharmacists on staff at MSH have expanded the level of pharmacy-provided clinical services by ensuring quality patient outcomes and improving patient safety. The clinical staff pharmacists are situated on general medicine floors where they provide direct pharmacy guidance to physicians, medical residents, nurses and other healthcare providers. They are also responsible for implementing pharmacy-driven initiatives designed to provide evidence-based medication management strategies to each patient. Some of these roles...
include anticoagulation management, antimicrobial stewardship, disease state management, bedside discharge counseling, and therapeutic drug monitoring.

The scope of pharmacy practice has grown into high-risk areas where a medication specialist is needed. At MSH, the first clinical pharmacist hired in 2009 specialized in critical care medicine. Since then, the role of pharmacy specialists has expanded to other high-risk areas such as emergency medicine, surgical intensive care unit, oncology, infectious diseases, and pediatrics. Clinical specialists are invaluable to the hospital not only for their depth of knowledge but also for their ability to develop hospital-wide guidelines, order sets, and procedures in their specialized areas.

Pharmacy is at the forefront of medication safety. The pharmacy department has acquired new technologies that improve workflow efficiencies and automate processes to prevent errors from reaching the patient. Some recent technology implementation includes: two-way wireless smart pumps, MedMined™ clinical surveillance application, DoseEdge™ IV workflow manager, Baxter Exactamix™ TPN compounder, and McKesson™ automation, including 30 Omnicell™ machines, 2 MedCarousels™, 1 PACMed™, and 3 Narcotic Towers. Together, these technologies improve the accurate dispensing and safe administration of many medication formulations. Automation has also allowed for pharmacists to focus on providing clinical services to the patients on the units.

The development of MSH’s pharmacy PGY1 residency program was the culmination of the growth, success, and stability of the department. A strong residency program requires two key components: reliable operations and a variety of clinical learning experiences. These elements are required to create a learning environment in which a resident receives a well-rounded experience. Consequently, several of MSH’s resident graduates have stayed within our system. Since the start of the residency program in 2011 - 12, 9 of 18 graduates have been hired by SHS. They required minimal training and immediately enhanced the level of pharmacy clinical services. Also, several graduates pursued advanced training, completing PGy2 programs in specialties. The residency program has also been invaluable in developing future department leaders: MSH and HCH have hired operations managers who were past MSH residents. The current MSH Operations Manager is a graduate of the inaugural MSH PGY1 class.

Mount Sinai Hospital has facilitated the development of a highly-trained pharmacy staff that far surpasses the traditional inpatient pharmacy model. Mount Sinai’s pharmacy department provides for patients in a wide variety of services that differentiate it from its peers and bring incredible value to the hospital. The pharmacy department has embraced the vision and mission of Sinai Health System and will continue to bring a high level of service to its patients.
<table>
<thead>
<tr>
<th>Year</th>
<th>Project name</th>
<th>Resident</th>
<th>Preceptor</th>
<th>Brief Project Description</th>
<th>Impact or Practice Change</th>
</tr>
</thead>
</table>
| 2016-17 | Efficacy and safety of inhaled nitric oxide compared to inhaled epoprostenol in patients with acute respiratory distress syndrome | MinHa Kim          | Basirat Sanuth        | - Baseline Evaluation, with follow-up  
- P&T Formulary review  
- ICU Order Set & Guidelines  
- Comprehensive clinical staff education  
  o MD, RNs, Respiratory Therapists, Pharmacists, Pharmacy Techs  
- Enactment of major crit care practice change, then ensuring integration into actual practice: follow-up, ongoing assessment | Critical Care Practice Change: Change from Nitric Oxide to Epoprostenol in management of adult ARDS, with comprehensive clinician education. Spared hospital > $ 250K in first year |
| 2016-17 | Impact of ambulatory care pharmacy services on human immunodeficiency virus (HIV) patients with concomitant diabetes, hypertension, or both in a safety-net clinic | Diebh Faraj        | Sharon Sam Thomas Yu  | - Baseline Evaluation, with evaluation post incorporation of a pharmacist in HIV clinic  
- Outcomes  
  o A1c and BP in HIV patients with DM and/or Hypertension | Demonstration of benefit of clinical pharmacist in an ambulatory care HIV ID clinic |
| 2016-17 | Medication administration through enteral feeding tubes: a quality improvement project | Katherine Wang     | Karen Trenkler Dallas Scheipers | - Evaluation of baseline vs. subsequent to resident’s multi-disciplinary efforts  
- P&P and Guideline development  
- Meditech (EMR) enhancement  
- Comprehensive clinical staff ed  
| 2016-17 | Gentamicin Utilization as Infection Prophylaxis in Open Fractures              | Tanya Abi-Mansour  | Kuntal Patel Marc McDowell | - Evaluation of Open Fracture Anti-infective Prophylaxis  
- Development of MSH Guideline on Prophylaxis in Open Fracture Anti-infective | A study of aminoglycoside use in fracture prophylaxis identified potential for quality improvement in documentation of bone fracture scores |
| 2015-16 | Implementation of a behavioral pain score in a community teaching hospital    | Darah Preston      | Basirat Sanuth        | - Baseline Evaluation, with follow-up  
- Comprehensive clinical staff education  
  - MD, RNs, Resp Therapist, Pharmacists, Pharm Techs  
- Enactment of major crit care practice change, then ensuring integration into actual practice: follow-up, ongoing assessment  
- Meditech Enhancement | Critical Care Practice Change: Change in pain assessment from FLACC to BPS, with demonstration of improved criteria and outcomes |
| 2015-16 | Evaluation of transition from patient controlled analgesia to oral analgesia in post surgical patients | Alok Salgia        | Dallas Scheipers Tejal Patel | - Baseline MUE, with follow-up MUE  
- Development / Implementation of Order Set to Transition Patients off PCA  
- Comprehensive Clinical Education  
  - Surgeons, Nurses, Pharmacists | - Study of opportunities for improvement in the “post-PCA” period post-op  
- Development of an Order Set to facilitate the transition |
| 2015-16 | Patient characteristics impacting understanding, retention, and demonstration of inhaler technique in an underserved population | Alika Moitra       | Karen Trenkler        | - Baseline evaluation, with follow-up  
- Study of patient literacy, inhaler knowledge and skill  
- Optimization of patient education materials  
- Development of enhanced educational material for pharmacy students: “train the trainer” method | - Enhancement of inhaler patient instructional materials, improvement in patient skills and process for ‘training the trainers’  
- Train the Trainer: education of pharm students (w skill competency) to educate pts. |
<table>
<thead>
<tr>
<th>Year</th>
<th>Project Title</th>
<th>Authors</th>
<th>Key Points</th>
<th>Notes</th>
</tr>
</thead>
</table>
| 2014-15 | Evaluation of opportunities for pharmacist integration into the discharge process | Diane Cluxton, Karen Trenkler | - Project: resident functioned as TOC pharmacist x 2 months  
- Adm & Disch Med Hx, Pt Counseling  
- Comparison of readmission rates prior to resident project to those patients with admissions during resident project (those patients benefiting from resident service)  
- Readmission rates tracked | Demonstration of an expanded role for pharmacists at discharge – based on resident effort. Highlighted significance of accurate ADM Med History. Also, resulted in eventual hire of 2 TOC pharmacists  
***One of TOP 4 RESIDENCY PROJECTS of 2015, ICHP *** |
| 2014-15 | Clinical and economic outcomes of diabetes management at an outpatient clinic within an urban community hospital system | Irvin Lau, Anupa Patel | - Baseline evaluation vs. FOLLOWING addition of pharmacist to Chronic Disease Amb Care Clinic, focus on DM  
- Outcome: A1c | Study of the impact of clinical pharmacist to DM outcomes (A1c) in the Ambulatory Care setting resulted in doubling of FTE allocation to Ambulatory Care, from 0.5 to 1.0  
***AWARDED ICHP Best Practice for 2015*** |
| 2014-15 | Impact of modified American Academy of Pediatrics guideline implementation on osteopenia of prematurity markers | Kuntal Patel, Pavel Prusakov | - Baseline evaluation vs. subsequent to Bone Round Implementation | Improvement in Bone Care & Outcomes for NICU preemies  
***AWARDED ICHP Best Practice for 2015*** |
| 2013-14 | Management of alcohol withdrawal syndromes (AWS) at an urban teaching hospital | Jacqui Aroworade, Adrienne Perotti, Jillian Szseziul | - Baseline MUE, follow-up MUE  
- Revision of AWS Order Set | Optimization of AWS Order Set  
| 2013-14 | A retrospective analysis of vancomycin dosing and monitoring in patients on hemodialysis | Tyler A Bickel, Karen Trenkler, Basirat Sunuth | - Baseline MUE demonstrating opportunities for improvement  
- Development / Implementation of Guideline, then Protocol, for Vancomycin Dosing in HD | Development of Guidelines for dosing & monitoring of Vancomycin in hemodialysis patients  
| 2013-14 | Utilization of a patient monitoring program to improve patient safety | Maureen Ebo, Zahra Khudeira | - Customization of MedMined (surveillance software) for MSH  
- Implementation of MedMined  
- Comprehensive Pharmacist Educatioooon | Implementation of surveillance software system (Medmined)  
| 2013-14 | Management of sickle cell crisis in an urban teaching hospital | Uzoma Okeagu, Karen Trenkler | - MUE  
- Education of Pharmacists | Analysis of Efficacy of Analgesia – Design of Guidelines for Sickle Cell patients  
| 2012-13 | Pharmacist initiative to optimize medication therapy at transitions of care: a focus on human immunodeficiency virus (HIV) patients in an underserved population | Andrea Bidlencik, Karen Trenkler | - Baseline MUE, Follow-up MUE  
- Development and Implementation of MSH's initial inpatient HIV medication guidelines  
- Meditech EMR automated alerts enhancements | Pharmacist Education and Development of automated alerts to facilitate safe/ effective order review by pharmacists. Initial start of MSH's HIV Stewardship Program  

<table>
<thead>
<tr>
<th>Year</th>
<th>Project Description</th>
<th>Healthcare Professionals</th>
<th>Additional Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012-13</td>
<td>Evaluation of the potential use of Hydroxyethyl starch 130/0.4</td>
<td>Andrew Volk, Karen Trenkler</td>
<td>Formulary evaluation &amp; analysis for P&amp;T MUE</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cost – Efficacy review of Plasma Volume Expanders</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Implementation of Empiric Antibiotic Treatment Guidelines for Obstetrics and Gynecologic (Ob-Gyn) Infections</td>
</tr>
<tr>
<td>2011-12</td>
<td>Adherence of Patient-Controlled Analgesia Order Form on an Oncology Unit</td>
<td>Tejal Patel, Zahra Khudeira</td>
<td>Baseline MUE, Development/Implementation of PCA Orderset, EMR (Meditech) Enhancements, Comprehensive clinical staff education, Physicians, pharmacists, PCA Order Set, PCA Dosing Card, Automated Nursing Assessments, EMR (Meditech) Enhancements</td>
</tr>
</tbody>
</table>
Strategic Plan 2015 – 2017

1. **Defining and measuring pharmacy productivity allows operational adjustments to further impact positive outcomes and increase direct patient care**
   - Identifying patient care priorities at Mount Sinai Hospital, Schwab Rehabilitation Hospital and Sinai Medical Group that can be advanced by redeployment of pharmacists
   - Focusing on data-mining for the purposes of performance improvement and to assist in operational and clinical decision-making
   - Developing expertise in data analytics to ensure the best use of data to improve individual patient and population-based care
   - Creating cascading goals dashboard in alignment with Sinai Health System Key Performance Indicators (KPIs) to assess progress

2. **Creating an inpatient medication therapy management program to expand Ambulatory Care and Transitions of Care program services within Mount Sinai Hospital Medical Center and Sinai Medical Group**
   - Establishing close alliances with organizational leaders by contributing to initiatives in population health, risk contracting, and strategic partnerships

3. **Limiting expected growth of drug expenditures through multiple departmental initiatives**
   - Performing medication utilization evaluations of high cost drugs identified through the 80/20 report along with diligent and often daily support from clinical pharmacists guiding day-to-day medication management through appropriate order sets and guidelines
   - Optimizing inventory management, reducing waste, and eliminating non-urgent low volume usage products from the drug formulary

4. **Maximizing revenue opportunities through our 340B drug pricing program, specialty pharmacy program, and on-site outpatient retail pharmacy**
   - Meeting regulatory compliances surrounding the 340B program with appropriate oversight and program compliance responsibilities

5. **Continuing to professionally engage our staff**
   - Leveraging and increasing the utility of pharmacists, APPE students and pharmacy technicians to provide more direct patient care through patient education, medication histories and medication reconciliation
   - Establishing a sound process for identifying the competency requirements of pharmacists and technicians for specific responsibilities and assessing every staff member for compliance with competency requirements
   - Encouraging continuous professional development of each pharmacist and technician related to competency requirements surrounding increased direct patient care and medication safety initiatives
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Clinical Services

Clinical Interventions

Overview
The American College of Clinical Pharmacy describes clinical pharmacists as practitioners who provide comprehensive medication management and related care for patients in all health care settings. Clinical pharmacists collaborate with physicians, other health professionals, and patients to ensure that prescribed medications contribute to the best possible health outcomes. They also participate in the assessment of care, including medication history intake, reconciliation, counseling patients, supporting the health care team, and monitoring and evaluating therapies for appropriateness and effectiveness. (American College of Clinical Pharmacy. Standards of practice for clinical pharmacists. Pharmacotherapy. 2014;34(8):794-797)

MSH pharmacists have expanded from traditional pharmacy practice to comprehensive pharmacotherapy individualization & optimization. Most recently, to direct interactive patient care (i.e., medication histories/reconciliation, HCAHPS improvement initiatives including disease state counseling, participation in geographical rounds, disease management patient counseling). Direct patient care activities insert the pharmacist at the front lines of patient care and provide opportunity for pharmacists to improve clinical outcomes and increase patient satisfaction.

We track all pharmacist clinical interventions in aggregate to demonstrate the impact of pharmacy on the patient over the course of the hospitalization. Rounding in critical care areas had been established over six years ago and is an essential element of practice here. In contrast, rounding on the general medicine units was initiated relatively late, in spring 2017; this routine, multi-disciplinary activity provides a strategy for the general medicine pharmacists to more readily impact a patient’s care and to foster professional relationships with the medical teams.

Documented clinical interventions (CI) are evidence of the daily actions a pharmacist performs for individual patients. Pharmacists document a variety of interventions, spanning multiple services: medication therapy management, direct patient care, medication error reduction/avoidance, workflow streamlining, and optimization of care at the transitions. The recent establishment of geographical rounding on the general medicine units facilitated pharmacist interventions by providing an organized structure for routine pharmacist face-to-face meetings with other members of the health care team.
Considerations
Due to the often hectic hospital workflow, clinical interventions are under-reported. Consistently, our goal is quality rather than quantity.

Background
- Clinical interventions (CI) represent the daily clinical activities a pharmacist performs on individual patients
- Pharmacists provide a wide range of interventions that span diverse areas such as medication therapy management, direct patient care, medication error reduction, or improving workflow

Documented Clinical Interventions in 2016

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Patient Care (DPC)</td>
<td>25%</td>
</tr>
<tr>
<td>Antimicrobial Stewardship</td>
<td>13%</td>
</tr>
<tr>
<td>Allergy</td>
<td>1%</td>
</tr>
<tr>
<td>AntiCoag &amp; TDM</td>
<td>6%</td>
</tr>
<tr>
<td>Emergent</td>
<td>3%</td>
</tr>
<tr>
<td>Pharmacotherapy Optimization</td>
<td>13%</td>
</tr>
<tr>
<td>Correction-Clarification</td>
<td>9%</td>
</tr>
<tr>
<td>Monitoring</td>
<td>5%</td>
</tr>
<tr>
<td>Other Dose Rec</td>
<td>4%</td>
</tr>
<tr>
<td>Streamlining</td>
<td>4%</td>
</tr>
<tr>
<td>IV to PO</td>
<td>2%</td>
</tr>
<tr>
<td>Other</td>
<td>5%</td>
</tr>
<tr>
<td>Geo Rounding on General Units</td>
<td>10%</td>
</tr>
<tr>
<td>Jan-16 Jan-17 March April May June July Aug Sept Oct Nov Dec</td>
<td></td>
</tr>
</tbody>
</table>
I. Direct Patient Care (DPC)
   a. Patient Education
   b. Warfarin Education
   c. Disease Management Interventions
      (i.e., Diabetes, Heart Failure, COPD, Asthma)
   d. Patient Education and Counseling
   e. Medication History and Medication Reconciliation
      • pharmacy student
      • pharmacist
   f. HCAHPS Improvement Pilot
   g. Pharmacist Pain Rounds

II. Optimization of Medication Therapy
   a. Drug – Disease Mismatch
      - Drug with no disease, Disease w no drug
   b. Dose
   c. Regimen
   d. Route

III. Monitoring of Medication Therapy
   a. Prophylactic anticoagulation
   b. Therapeutic anticoagulation
   c. Therapeutic drug monitoring – PK / PD

IV. Antimicrobial Stewardship
   a. Selection – either empiric & culture result - based
   b. Antimicrobial dose optimization - PK / PD
   c. Duration

V. Other Dosing Recommendations
   a. End Organ Failure (e.g., renal or hepatic) dosing
   b. TPN / Nutrition

VI. Streamlining and Workflow
   a. Chemotherapy waste tracking
   b. Other (i.e. non-formulary alternatives, cost saving initiatives)

VII. Clarification of Physician Orders

VIII. Allergy Clarification

IX. TOC Interventions – Patient Interactive
   a. Discharge Reconciliation
   b. Discharge Counseling
   c. Follow-up Phone Calls
Hospital-Wide Order Set and Guideline Development

Background
Pharmacists provide leadership in the development of standardized hospital-wide protocols and procedures to ensure each patient is treated with the most up to date evidence-based recommendations.

- Order sets - a standardized list of orders for a specific diagnosis.
  - Carefully developed through extensive research of medical literature for evidence-based standards
  - Guidelines - recommendations for clinicians about the care of patients with specific conditions.
- Based upon the best available research evidence and practice experience
- Formulary review - addition or deletion of medication from the drug formulary requires pharmacy-driven research of clinical outcomes and cost-benefit analysis
- Class Review - research of clinical outcomes and cost-benefit analysis
- Interchange – a policy that allows for one medication to be automatically switched to another (addressing multiple, similar medications in a drug class) for the purposes of decreasing drug spend and minimizing inventory
- Medication Use Evaluation - performance improvement method that focuses on evaluating and improving medication-use processes with the goal of optimizing patient outcomes

2013

Order Sets
- Severe HTN in the Third Trimester of Pregnancy
- Critical care cardiology admission
- Critical care infusion parameters
- Dexmedetomidine guidelines
- Chest pain – Code Heart (STMI)
- Chest pain – NSTEMI/UA
- Alcohol withdrawal
- Seizures & Phenytoin
- Heparin protocol (update)
- Standard
- Specialty
- Sepsis order set
- SRH TPN order forms
- Critical care HF admission
- tPA eligibility & initial orders
- tPA floor admission
- Ischemic stroke/TIA floor admission (patient not receiving tPA)
- Postpartum order for vaginal deliveries
- Postoperative C-section orders
- Non-ICU Insulin order set
- COPD admission orders
- NICU TPN
- Pavilizumab – pediatrics
- Hyperkalemia
- Contrast allergy pre-medication

Guidelines
- Severe HTN in the third trimester of pregnancy
- Alcohol withdrawal
- Sepsis guidelines
- Critical care HF admission (guideline & pathway)
- Insulin infusion protocol for CABG and traumatic brain injury
- Non-ICU Insulin guidelines
- Albumin & tetrastarch guidelines
- Rasburicase guidelines
- Heparin & enoxaparin reversal
- Bivalirudin use guidelines

Formulary Review
Additions
- Epzicom (abacavir/lamivudine)
- Quinupristin/dalfopristin
- Ciprofloxacin (oral)
- Valacyclovir (oral)
- Tranexam acid
- Isentress (raltegravir)

Removals
- Oxazepam
- Glyburide micronase
- Calcium gluconate (oral)
- Magnesium gluconate (oral)

Interchanges
- ACE inhibitor and ARBs class review(update)
- Inhaled corticosteroids class review(update)
- Bacitracin to Ervthromvcin ointment
# Hospital-Wide Order Set and Guideline Development

## 2014 Considerations

- Each hospital-wide intervention requires coordination and input from pharmacy management, physicians, nursing, and other key stakeholders
  - Development over several months, in general, followed by eventual presentation to P&T for final approval
- Policies and procedures involving medications or pharmacy services are also reviewed and approved at P&T

## Order sets
- Sexual assault – ED
- Hyperglycemic hyperosmolar syndrome – MICU
- Code sepsis order set
- Neuromuscular blockade
- Adult procedural sedation
- Pediatric procedural sedation
- Heparin for vascular procedure patients
- Post-exposure prophylaxis
- Sepsis order set
- Diabetic ketoacidosis
- VTE prophylaxis
- Pediatric pneumonia – ED
- Newborn HIV
- Analgesia & sedation – MICU
- Pediatric admission

## Medication Use Evaluations
- Vancomycin in HD
- Simvastatin
- Medication use in COPD patients

## Formulary Review
### Additions
- Paliperidone (oral)

### Removals
- Ibutilide
- Methyldopa IV
- Nesiritide
- Inamrinone
- Atracurium
- Urokinase
- Miscellaneous Ophthalmic Products

## Interchanges
- Statin class review
- Combivent® to Duoneb®

## Guidelines
- Sexual assault
- Sexually transmitted diseases
- Post-exposure prophylaxis
- Sodium Bicarbonate – adult
- NICU Surfactant
- Neuromuscular blockade
- Procedural sedation
- Anti-Xa level ordering
- Analgesia & sedation – MICU (review)
- Aminoglycosides (update)
### Hospital-Wide Order Set and Guideline Development 2015

<table>
<thead>
<tr>
<th>Order sets</th>
<th>Guidelines</th>
</tr>
</thead>
</table>
| 1. Adult – general | • Albumin Guidelines  
• Therapeutically Monitored Drugs, Ranges  
  o Anti-infective  
  o Non Anti-infective  
• Extravasation Management Guidelines |
| 2. Cardiac Cath | | |
| | • Post Cath Diagnostic Order – for Cath Lab Use  
• Post Cardiac Cath Intervention Order Set |
| | 3. Emergency Department | • Reference Book – update  
• Hypoglycemia with Insulin Infusions  
• Chest Pain Guidelines  
• Therapeutic Hypothermia  
• Mannitol & Hypertonic Saline Guideline |
| | | 4. Pediatrics / NICU | • Procedural Sedation Medication Guidelines  
• Seizure Management  
• Pregnancy Nausea & Vomiting |
| | | • Pediatric HIV  
• Neonatal Procedural Sedation  
• Pediatric Procedural Sedation |
| | | 5. Critical Care | • Procedural Sedation Medication Guidelines  
• Seizure Management  
• Pregnancy Nausea & Vomiting |
| | | • Hypertonic Saline for ICH  
• Mannitol for ICH  
• HYPOglycemia Orders with ICU insulin Infusion Protocol |
| | | 6. L&D | • Albumin MUE ➔ Guidelines  
• Collagenase (Santyl) MUE ➔ Guidelines  
• Palivizumab (Synagis) |
| | | • Post C-section Orders  
• L&D Orders |
| | | 7. Adult Interventional Radiology | • MUEs  
• PPIs  
• Filgrastim (Neupogen)  
• Post-Intubation Sedation & Analgesia in ED  
• Cisatracurium  
• Eptifibibide  
• Enoxaparin Administration Site  
• Dextrose 50% in Hypoglycemia  
• Albumin  
• Collagenease  
• Medication Reconciliation |
| | | • Post-Uterine Artery Embolization |

- Each hospital-wide intervention requires coordination and input from pharmacy management, physicians, nursing, and other key stakeholders  
  o Development over several months, in general, followed by eventual presentation to P&T for final approval  
- Policies and procedures involving medications or pharmacy services are also reviewed and approved at P&T
Hospital-Wide Order Set and Guideline Development
2016

<table>
<thead>
<tr>
<th>Order sets</th>
<th>Guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Adult – general</td>
<td>Order Entry Criteria – PPI</td>
</tr>
<tr>
<td>• Heparin Protocol - update</td>
<td>Aminoglycoside Extended Interval Dosing – update to inclusion/exclusion criteria</td>
</tr>
<tr>
<td>• Liposomal Amphotericin B - new</td>
<td>AntiCoagulation Reversal Guidelines</td>
</tr>
<tr>
<td>• Argatroban Protocol 0 new</td>
<td>Argatroban Protocol Order Set Guideline</td>
</tr>
<tr>
<td>• SRH – SubAcute Admission</td>
<td>Management of Severe Hypertension in Ob</td>
</tr>
<tr>
<td>2. GI</td>
<td>Transition from PCA to Oral Opioid Analgesia Guidelines</td>
</tr>
<tr>
<td>• Endoscopy</td>
<td>Surgery</td>
</tr>
<tr>
<td>3. Cardiac Cath</td>
<td>Critical Care</td>
</tr>
<tr>
<td>• Post Cath Diagnostic Order – for Cath Lab Use</td>
<td>• Adult Sepsis Guidelines</td>
</tr>
<tr>
<td>• Post Cardiac Cath Intervention Order Set</td>
<td>• Adult Therapeutic Hypothermia</td>
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<tr>
<td>4. Emergency Department</td>
<td>• Prostacyclin (epoprostenol) use Guidelines</td>
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<tr>
<td>• STROKE – multiple order sets</td>
<td>Quality – Initiatives</td>
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<tr>
<td>• Triage Order Set</td>
<td>• Antiretroviral Medication Orders – Lab Values</td>
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<tr>
<td>• Therapeutic Hypothermia</td>
<td>• Vaccine Meditech Enhancement</td>
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<tr>
<td>• Sepsis</td>
<td>Cost – Initiatives</td>
</tr>
<tr>
<td>• Code Sepsis</td>
<td>• Magnesium Rider Evaluation Analysis → Meditech Entry Changes</td>
</tr>
<tr>
<td>• Pediatric UTI</td>
<td>MUEs</td>
</tr>
<tr>
<td>• Pediatric Dehydration</td>
<td>• Adult TPN – Short (&lt; 5 day) Duration</td>
</tr>
<tr>
<td>• Pediatric DKA</td>
<td>• Peri-partum PAIN Mgt</td>
</tr>
<tr>
<td>5. Surgery</td>
<td>• Levitiracetam IV Appropriateness</td>
</tr>
<tr>
<td>• Transition from PCA to Oral Opioid Analgesia</td>
<td>• Post-Intubation Sedation &amp; Analgesia in ED</td>
</tr>
<tr>
<td>• SICU Common Infusions</td>
<td>• Electrolytes</td>
</tr>
<tr>
<td>• PACU Anesthesia Order Set</td>
<td>o KCl Rider Evaluation</td>
</tr>
<tr>
<td>6. Pediatrics / NICU</td>
<td>o Magnesium Rider Evaluation</td>
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<tr>
<td>• Pediatric HIV</td>
<td>8. OB-Gyne</td>
</tr>
<tr>
<td>• L&amp;D – Admission Order Set – Newborn</td>
<td>• Severe Hypertension</td>
</tr>
<tr>
<td>• Pediatric UTI</td>
<td></td>
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<tr>
<td>• Pediatric TPN</td>
<td></td>
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<tr>
<td>• Pediatric DKA</td>
<td></td>
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<tr>
<td>7. Critical Care</td>
<td></td>
</tr>
<tr>
<td>• Impella Order Set</td>
<td></td>
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<tr>
<td>• Therapeutic Hypothermia</td>
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<tr>
<td>• Sepsis</td>
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<tr>
<td>• Code Sepsis</td>
<td></td>
</tr>
<tr>
<td>• Inhaled Prostacyclin - epoprostenol</td>
<td></td>
</tr>
</tbody>
</table>
## Hospital-Wide Order Set and Guideline Development
### 2017 (through August)

### Order sets

1. **ED**
   - Long Bone Fracture ED triage
   - Alcohol Withdrawal
   - STEMI
   - NSTEMI

2. **OB**
   - Epidural Orders for L&D – Anesthesia

3. **PED**
   - Pediatric Sepsis
   - Neonatal MRI, CT Sedation
   - Neonatal – Management of Hypoglycemia

4. **ICU**
   - CV Post Impella Placement HEPARIN Orders
   - Alcohol Withdrawal for ICU
   - Adult Pain, Agitation & Delirium

5. **Surgery**
   - ERAS – PreOp Ortho
   - ERAS – PostOP Ortho

### Guidelines

**ICU**
- CV Post Impella Placement HEPARIN
- Vasopressor Guidelines – maximum doses
- Alcohol Withdrawal Guidelines
- Adult Pain, Agitation & Delirium

**ED**
- Emergency Reversal of AntiCoagulation

**Ped**
- Sepsis Guidelines
- NICU – Vasopressor Medication Titration

**Onco**
- Carboplatin Dosing Guideline

**Onco / General Medicine**
- Hypercalcemia of Malignancy Guidelines

**Trauma**
- Massive Transfusion Protocol

**Antibiotic Stewardship**
- Empiric Antibiotic Guidelines
  - Pneumonia
  - Meningitis
  - UTI

**Usage Evaluations**
- Acetaminophen IV - peri-Op
- Denosumab
- Kcentra
- Calcitonin

**Residency Projects**
- Inhaled No vs Epoprostenol in Adult ARDS
- Med Administration through Feeding Tubes
- Impact of Amb Care Pharm Services on HIV patients with DM, HTN, or both
Vancomycin Dosing and Monitoring

Background
Mount Sinai Hospital implemented guidelines for the dosing and monitoring of vancomycin in the Spring of 2011 to improve clinical outcomes of complicated infections. The implemented changes reflect the recommendations provided by the joint consensus statement authored by the Infectious Diseases Society of America (IDSA), the American Society of Health-System Pharmacists (ASHP), and the Society of Infectious Diseases Pharmacists (SIDP) 2009 guidelines.

- Serum drug level monitoring is done for medications with a narrow therapeutic index to established ranges
- Obtaining therapeutic serum levels for vancomycin can help improve clinical outcomes and reduce medication errors and patient costs
- Highlights of the IDSA/ASHP/SIDP 2009 consensus statement for vancomycin include:
  - Adequate initial doses for the attainment of serum concentrations of at least 10 mcg/mL
  - Trough levels of 15-20 mcg/mL

Services Provided
- Medication management by pharmacists
  - Initial mg/kg dosing provided
  - Serum trough levels ordered and monitored by the pharmacist
  - Dosing adjustments made to achieve desired trough levels
  - Documentation in patient chart and electronic health record via progress notes

Study Outcomes
Retrospective review completed to compare vancomycin dosing and serum level monitoring in the adult SHS population pre- and post-implementation of guidelines.

![Initial Trough Levels Pre- and Post-Implementation of Pharmacist-Managed Guidelines](chart.jpg)
Vancomycin Dosing and Monitoring

- Guideline implementations resulted in a 35.2% increase in the number of patients with initial serum concentrations within therapeutic levels
  - 29 patients with therapeutic levels post-implementation vs. thirteen pre-implementation

- Guideline implementations also resulted in a decrease of patients with vancomycin serum concentrations with subtherapeutic levels, thus inadequately managed infections
  - Despite more aggressive dosing, there was no significant sustained increase in serum creatinine
  - Results also demonstrated improvement in attainment of therapeutic trough range

% Initial Trough Range

- Overall fewer drug levels ordered
- Fewer canceled levels
- Fewer unnecessary levels drawn and resulted
- Decrease of missed ‘recommended’ level draws, i.e. no long periods of time without monitoring drug levels or serum creatinine

Considerations

- Guideline implementation for vancomycin dosing and monitoring by pharmacy, had a positive impact on patient care
  - Improved quality
    - Attainment of therapeutic levels
      - Greater percent of initial therapeutic levels
      - Decrease in percent of levels in the subtherapeutic range
    - Less needle-sticks/draws for patients
    - Decrease costs for inpatient visit due to decreased lab draws
  - Reduced cost / waste
Medication Histories Completed by Pharmacy

Trend line demonstrates steady growth: improvement in patient safety

- Obtaining an accurate admission medication history is essential in ensuring optimal admission orders, hospitalization and discharge. Studies previously at our institution demonstrated that medication histories, conducted primarily by emergency department technicians and nurses, were suboptimal. MSH pharmacy acted to change the existing practice. A residency project had illuminated the issue, identifying the need and providing the first impetus for change. Initially, pharmacy-provided medication histories were completed on inpatient units, after patient admission to the hospital. Relatively few were completed by emergency department (ED) pharmacists. After our secondary analysis (published as ASHP Poster), a shift of Medication Histories to the ED occurred.

- Medication Histories (and the subsequent Reconciliation) is an example of a pharmacy task based on the foundations of students. As a component of their learning process, students work towards discrete, defined, limited goals & objectives, thus assisting the pharmacist and ultimately facilitating improved patient outcomes. Students, in effect, act as pharmacist “extenders” …. Increasingly, pharmacy is emulating the Medical Model of clinical education.
  - We strive to maintain a high percentage of medication histories by pharmacy for medium to high risk patients; however, at certain points in the year, APPE Pharmacy student availability decline substantially. We are working with schools of pharmacy to ensure robust, consistent coverage – focusing on Spring semesters, consistently a time period of low student numbers.
The graph below depicts the steady increase in interventions, overall, and specifically, patient encounter interventions which significantly reflects the increased exposure that MSH patients have had to MSH pharmacists. These interventions include: patient counseling of Disease Management patients (e.g., HF, COPD, Asthma, DM), other counseling, inhaler instruction, patient introductions and medication history interviews and, finally, discharge counseling. Greatly increasing over the years, MSH now approximates 1000 patient encounter interventions monthly. Globally, the objective of the Pharmacy Department is to positively impact HCAHPS (Hospital Consumer Assessment of Healthcare Providers and Systems) scores.

Direct patient interactive encounters are a relatively new approach of hospital pharmacists. Historically, the initial transition to clinical functions involved issues such as pharmacokinetics, duration, therapy selection and timing/administration issues – discussions that clearly involved prescribers and nurses. Relatively recently, shifts in practice have occurred. Interactions WITH patients and families, often at the bedside, are encouraged and even required!

**OVERALL vs. ENCOUNTER Interventions**
**January 2015 thru August 2017**
The graph, below, depicts MSH’s focus on the transitions and reconciliation; depiction illustrates the admission and discharge interfaces. By chance, admission medication histories / reconciliations and discharge reconciliation intersect in August 2017. Not happenstance, however, is attaining 400 such direct patient interactions monthly!
Cost-Effective Quality Improvement Effort

IV Magnesium Replacement: Process Improvement

In Fall of 2014 several pharmacists noted excessive usage of magnesium sulfate premade infusions. After analyzing the common prescribing habits, they identified the increase in drug utilization was likely caused by the following factors:

1. Serum magnesium was reported by MSH lab as “mEq/L” and not “mg/dL”
   a. Upper limit of normal is 2.1 in mEq/L and 2.5 for mg/dL
   b. Commonly, medical residents order magnesium sulfate if a patient’s level is less than 2 mg/dL
   c. Most institutions report serum magnesium as mg/dL
   This array of factors led to increased use since residents did not recognize that magnesium was being reported in mEq/L
2. Magnesium was being administered too rapidly at 2 grams/hour – effectively “reducing” the dose that was administered
   a. Magnesium is regulated by the kidneys
   b. Rapid increases in serum levels and levels above normal limits cause the kidneys to increase excretion
   The above effect can cause up to 50% of the infused magnesium being removed by the kidneys almost immediately

Action

Two changes were made in October 2014 to counteract the aforementioned issues. The first was that lab was requested to modify the report, so that magnesium was reported in mg/dL instead of mEq/L, and the second was that the default infusion time was doubled for both the 2 and 4 gram magnesium sulfate intravenous infusions.

Result

A retrospective analysis was performed in December 2015 to confirm that the changes were effective in reducing overuse of magnesium sulfate infusions. Compared to the previous year, the total number of magnesium doses decreased from 10,198 to 4,684. This led to savings of approximately $22,996 and would have likely been even more if the cost of magnesium sulfate had not increased from 2014 to 2015.

Table: Inpatient Pharmacy – Magnesium Costs

<table>
<thead>
<tr>
<th></th>
<th>Average Cost per Dose</th>
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<tbody>
<tr>
<td></td>
<td>Pre-Switch</td>
</tr>
<tr>
<td>Magnesium 2 G IVPB</td>
<td>$6.65</td>
</tr>
<tr>
<td>Magnesium 4 G IVPB</td>
<td>$5.87</td>
</tr>
</tbody>
</table>

Figure 1.

![Number of Magnesium Doses](image1.png)

Figure 2.

![Annual Cost of Magnesium Doses](image2.png)
Cost-Effective Quality Improvement Effort

Proton Pump Inhibitor Use Reduction: Quality/Safety/Toxicity/Cost Process Improvement

Background
PPI agents, once deemed relatively innocuous, have been definitively associated with risk, including of C. difficile infections; pneumonia, hypomagnesemia and (for use that is more prolonged than occurs during hospital stay): fractures of the hip, wrist, or spine. The significant pH buffering ability of these agents enhances their efficacy over a similar GI-active class, the H2-blockers; however, this enhanced efficacy does not come without an adverse impact on the safety profile.

Concerned about toxicity and the apparent over-use casually observed at MSH (in conjunction with rather frequent published reports of over-use and toxicities), the MSH clinical pharmacists conducted a Medication Usage Evaluation which determined that approximately 50% of patients on pantoprazole and famotidine (for GI prophylaxis) were inappropriately receiving the agents.

55% of patients were discharged home with a pantoprazole prescription; however, they had not taken the medication prior to admission: these patients had been newly started during the hospitalization. Further concerning is that 70% of patients on either pantoprazole or famotidine should have had the medication discontinued at some point prior to being discharged (referring to GI prophylaxis and unknown indications).

Intervention
Administration criteria for PPI CPOE were developed by pharmacists, approved by P&T, and then implemented.

IMPACT

Oral and IV 30-day Administrations for Pantoprazole

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Pantoprazole – IVP</td>
<td>791</td>
<td>469</td>
<td>- 292 (41.2)</td>
</tr>
<tr>
<td>Pantoprazole – infusion</td>
<td>105</td>
<td>86</td>
<td>- 19 (18.1)</td>
</tr>
<tr>
<td>Pantoprazole – PO</td>
<td>1389</td>
<td>950</td>
<td>- 439 (31.7)</td>
</tr>
</tbody>
</table>
Projected Annual Pantoprazole Cost

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Vials Administered (40 mg/vial)</td>
<td>1,001</td>
<td>641</td>
<td>- 360</td>
</tr>
<tr>
<td>Projected Vials – Annually</td>
<td>12,178</td>
<td>7,798</td>
<td>- 4,380</td>
</tr>
<tr>
<td>Projected Vial Cost – Annually</td>
<td>$38,604.26</td>
<td>$24,722.30</td>
<td>- $13,881.96</td>
</tr>
<tr>
<td>Oral doses administered</td>
<td>1,389</td>
<td>950</td>
<td>- 439</td>
</tr>
<tr>
<td>Projected oral doses – Annually</td>
<td>16,899</td>
<td>11,463</td>
<td>- 5,436</td>
</tr>
<tr>
<td>Projected oral dose cost – Annually</td>
<td>$2,365.86</td>
<td>$1,604.82</td>
<td>- $761.04</td>
</tr>
</tbody>
</table>

Discussion
Since implementation of the PPI administration criteria, pantoprazole IV push usage decreased by 41% and oral usage by 31%; this decrease is annualized to a cost-savings of $14,643. Beyond mere cost-savings, improvement in quality was demonstrated: after the implementation of the pantoprazole administration criteria, 28/33 (85%) had the correct indication listed and 32/33 (97%) orders were appropriate based on the criteria. When comparing all pantoprazole and famotidine orders for December and April, there was a significant decrease in orders with an unknown indication or inappropriate GI prophylaxis (58% to 28%).

Proton Pump Inhibitor Utilization
Days of Therapy per 1,000 Days at Risk

National Comparison by Teaching Status

This chart displays your institution’s Proton Pump Inhibitor Utilization Rate compared nationally to other Teaching and Non-teaching hospitals.

Proton Pump Inhibitors include dexlansoprazole, esomeprazole and combinations lansoprazole, omeprazole, pantoprazole, and rabeprazole.

Day of Therapy (DOT): patient days in which one or more doses of a drug was ordered.

Day at Risk (DAR): days present in hospital during analysis period.
Cost-Effective Quality Improvement Effort

Albumin Use Surveillance: Cost-Effective, Rational Therapy through Vigilance

In Quarter IV of 2014, the pharmacy department had observed that the number of albumin orders, especially 25% albumin, had increased dramatically (Figure below). An ad hoc meeting of clinical specialists and key general medicine pharmacists was convened. The increase was attributed to confusion during POM ordering (mL vs grams of albumin e.g. ordering 100 g instead of 25 g (100 mL) of albumin); the 100gm doses were ordered as routine at a frequency of q 6 – 8 hrs. An order for 100 g of albumin is not costly—but also presents a therapeutic concern at such an excessive dose. A formal DUE was not conducted at this time.

MSH Albumin Purchases in 2014

<table>
<thead>
<tr>
<th>2014 Albumin Expenditures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qtr I</td>
</tr>
<tr>
<td>$0.00</td>
</tr>
</tbody>
</table>

Action

1. The somewhat abrupt surge in use prompted an ad hoc General Medicine Pharmacist / Critical Care Pharmacist Meeting - convened in early January 2015.
2. Subsequent to getting intensivist ‘buy-in’ the recommended actions were presented to P&T on 1/14/15.
3. Execution of specified changes in Information System on 1/15/15:
   a. Changed POM order entry screen to indicate the amount of albumin in both g and mL.
   b. Modified default duration in Meditech – from unlimited to 24 hours. Longer durations can be specified by a prescriber; however, the default must be deliberately modified.
   c. Changed albumin view in POM: 25% albumin limited to 12.5 g and 25 g doses in drop down menu view. (Previously doses up to 200mL were available on the drop down menu and thus possibly interpreted as routine by prescribers. Also, historically, free texting was an option).
4. Addition of explicit dosage recommendations to existing MSH Albumin Use Guidelines
Cost-Effective Quality Improvement Effort

Albumin Use Surveillance: Cost-Effective, Rational Therapy through Vigilance

**Discussion**

Surveillance by pharmacists identified a trend of excessive albumin prescribing – this heightened use was not only wasteful, in terms of cost, but potentially a medication safety issue. Targeted pharmacist-led actions, focusing on Meditech, have reversed the surge in excess use. Further optimization of prescribing was facilitated with revision of the MSH Albumin Guidelines (addition of common dose ranges for appropriate indications, facilitated by the critical care specialist in May 2015).
Antibiotic Stewardship: Established Routine of Clinical Staff Pharmacists

**Background**
Ensuring appropriateness of antibiotic therapy is at the forefront of the national conversation. Antibiotic use was the focus of JC’s relatively recent action - the new Antibiotic Stewardship Medication Management standard (MM.09.01.01) was mandated Jan 1, 2017. In 2016, the Centers for Disease Control and Prevention (CDC) identified that 20%–50% of all antibiotics prescribed in US acute care hospitals are either unnecessary or inappropriate. [http://www.cdc.gov/getsmart/healthcare/implementation/core-elements.html](http://www.cdc.gov/getsmart/healthcare/implementation/core-elements.html) accessed 9/14/17

**MSH**
All anti-infective interventions for the month of August were reviewed and categorized. Of the total interventions for August (n = 4031), 455 interventions addressed anti-microbials, 11.3%. The graph, below, depicts the breakdown of intervention types:

The initial antibiotic step, often empiric, is crucial as that ‘starts ‘ the process of optimal treatment. Based on their setting, the E.D. pharmacists play a major role, providing the great majority of empiric recommendations. Further treatment are handled by inpatient pharmacists.

Interventions are not always documented due to time constraints / priorities, so the actual number of pharmacist actions taken on behalf of patients is likely higher. The interventions range from pharmacodynamic optimization to duration limitation. Multiple benefits are provided to MSH by improving outcomes for individual patients, curbing development of resistance, and containing costs.

Rational antibiotic use, though often associated with reduced cost, has much more far-reaching benefits in terms of susceptibilities retained and resistance avoided.
Background
Among all of the complications encountered in the management of preterm infants, osteopenia, a metabolic bone disease, is often overlooked in its early stages. The true incidence of osteopenia of prematurity (OP) is unknown up to 20% of infants born at a birth weight of < 1000 g go on to develop radiographic changes consistent with osteopenia. Early gestation, concomitant disease states such as bronchopulmonary dysplasia and necrotizing enterocolitis, and exposure to medications such as loop diuretics and corticosteroids are additional risk factors for osteopenia. Radiographic changes are typically identified 10 to 16 weeks following birth, when at least 20% bone demineralization has occurred, often delaying the diagnosis of OP. Regular surveillance of biochemical markers becomes an important strategy in managing preterm infants at high-risk for developing OP.

Intervention/Methods
In April of 2014, a multidisciplinary service entitled “Bone Rounds” (BR) was implemented in the neonatal intensive care unit (NICU); this service is led by a clinical pharmacist and clinical dietitian in collaboration with the neonatology group. The multidisciplinary team evaluated patients on a weekly basis. This service entails identification of infants at high risk for osteopenia, monitoring of serum biochemical markers related to bone mineral disease, optimizing calcium, phosphorus, and vitamin D intake on a patient specific basis. Oral intake goals for calcium, phosphorus, and vitamin D are based on American Academy of Pediatrics recommendations. Goals for parenterally fed infants are extrapolated from these recommendations and are based on average oral absorption of calcium, phosphorus, and vitamin D.

Outcomes
The primary outcome of the study was radiographically confirmed osteopenia. Secondary outcomes included osteopenia-related bone break on radiograph and a laboratory diagnosis of osteopenia. Laboratory diagnosis of osteopenia was defined as alkaline phosphatase > 600 units/L along with serum phosphorus < 4.5 mg/dL or serum calcium < 8.0 mg/dL. An independent radiologist read available radiographs.

Results
Sixty-seven patients met the criteria for analysis in this study, 42 patients in the pre-BR group and 25 patients in the BR group. Patient characteristics were not significantly different between study groups at baseline and are summarized on Table 1. The median gestational age and birth weight of our study population were 29 weeks and 1125 g, respectively.

<table>
<thead>
<tr>
<th>Table 1 Patient Characteristics</th>
<th>Pre-BR (n=42)*</th>
<th>BR (n=25)*</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestational Age (weeks)</td>
<td>29 (27-31)</td>
<td>30 (28-31.5)</td>
<td>0.3689</td>
</tr>
<tr>
<td>Birth weight (kg)</td>
<td>1.0 (0.8-1.44)</td>
<td>1.20 (1.03-1.45)</td>
<td>0.3057</td>
</tr>
<tr>
<td>Male (%)</td>
<td>16 (38.1)</td>
<td>10 (40)</td>
<td></td>
</tr>
<tr>
<td>Calcium (mg/dL)</td>
<td>9.4 (9.1-9.72)</td>
<td>9.44 (9.28-9.44)</td>
<td>0.5418</td>
</tr>
<tr>
<td>Phos (mg/dL)</td>
<td>5.15 (4.44-5.9)</td>
<td>5.29 (4.56-5.25)</td>
<td>0.9897</td>
</tr>
<tr>
<td>Vitamin D (ng/mL)**</td>
<td>49 (47-80)</td>
<td>37.25 (24-36.5)</td>
<td>n/a</td>
</tr>
<tr>
<td>Furosemide (mg/kg/day)</td>
<td>1.22 ± 0.47</td>
<td>1.13 ± 0.24</td>
<td>0.9575</td>
</tr>
<tr>
<td>Furosemide duration (days)</td>
<td>18 (1.4-8)</td>
<td>18 (1.5-14)</td>
<td>0.8246</td>
</tr>
<tr>
<td>Hydrocortisone (mg/kg/day)</td>
<td>2.08 ± 0.51</td>
<td>2 ± 0.12</td>
<td>1.0</td>
</tr>
<tr>
<td>Hydrocortisone duration (days)</td>
<td>6.5 (3-10.75)</td>
<td>11.5 (7-16)</td>
<td>0.2371</td>
</tr>
<tr>
<td>Dexamethasone (mg/kg/day)</td>
<td>0.16 ± 0.05</td>
<td>0.29 ± 0.17</td>
<td>0.1172</td>
</tr>
<tr>
<td>Dexamethasone duration (days)</td>
<td>4 (1.5-9.6)</td>
<td>6 (4.5-5.5)</td>
<td>0.7378</td>
</tr>
<tr>
<td>TPN Duration (days)</td>
<td>29.5 (23-47.75)</td>
<td>21 (15-21)</td>
<td>0.0799</td>
</tr>
</tbody>
</table>

* Values are reported as median (interquartile range) or as mean ± standard deviation
** Vitamin D values were available for 3 and 18 patients in the Pre-BR and BR groups, respectively
Calcium & Phosphorus Supplementation

There was a mean of 46.68 mg/kg/day of elemental calcium in parenteral nutrition for the pre-BR group compared to 66.96 mg/kg/day in the BR group, and this difference was statistically significant (p=0.0012). The amount of elemental phosphorus was not significantly different between study groups. These results are summarized on Table 2.

<table>
<thead>
<tr>
<th></th>
<th>Pre-BR (n=42)*</th>
<th>BR (n=25)*</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALP (units/L)</td>
<td>318 (242.5-399.5)</td>
<td>246 (186.75-243.5)</td>
<td>0.0431</td>
</tr>
<tr>
<td>Peak ALP (units/L)</td>
<td>486 ± 243</td>
<td>386 ± 167</td>
<td>0.0382</td>
</tr>
<tr>
<td>Tbil (mg/dL)</td>
<td>4.14 (3.2-6.21)</td>
<td>4.4 (3.45-4.33)</td>
<td>0.907</td>
</tr>
<tr>
<td>AST (units/L)</td>
<td>32.5 (26-41.25)</td>
<td>28 (20.5-27.5)</td>
<td>0.1341</td>
</tr>
<tr>
<td>Elemental Calcium IV to PO (mg/kg/day)</td>
<td>46.68 ± 17.29</td>
<td>66.96 ± 21.85</td>
<td>0.0012</td>
</tr>
<tr>
<td>Elemental Phos IV to PO (mg/kg/day)</td>
<td>45.8 ± 14.97</td>
<td>42.39 ± 17.68</td>
<td>0.5974</td>
</tr>
</tbody>
</table>

* Values are reported as median (interquartile range) or as mean ± standard deviation

There were 3 (7.1%) patients identified with a laboratory diagnosis of osteopenia compared to none in the BR group. Laboratory identification of osteopenia in these patients occurred at a median of 75 days from birth. Of the 67 patients in the study, there were 37 (55.2%) patients with available radiographs for analysis. There were 25 from the pre-BR group and 12 patients from the BR group included in our radiographic analysis. In the pre-BR group, there were 8 (32%) patients identified with osteopenia on radiograph compared to 2 (16.7%) patients in the BR group (p=0.445). These changes were seen at a median of 47 and 44.5 days after birth in the pre-BR and BR groups, respectively. There were 2 (8%) patients identified in the pre-BR group with bone breaks on radiograph. Bone breaks in the pre-BR were identified at a median 118.5 days after birth. No bone breaks were identified in the BR group. These results are summarized on Tables 3 and 4.

**Discussion**
A monitoring service for infants at high-risk for developing osteopenia was implemented, led by a clinical pharmacist and clinical dietitian. The BR service, integrated into daily NICU functions, consists of serial monitoring of biochemical markers, and increasing utilization of enteral and parenteral nutrition in order to meet calcium, phosphorus and vitamin D intake goals. In the study, a trend towards a decrease in osteopenia, bone breaks on radiographs, as well as osteopenia laboratory diagnosis with the implementation of BR service was identified.
The pre-BR group represented the year preceding the implementation of regular monitoring and targeting specific intake goals. The BR group represented the outcomes following implementation of said monitoring and subsequent intervention.

A statistically significant difference in radiographic outcomes was not found, likely due to a small sample size. There were no significant differences in serum calcium and phosphorus values between groups: significantly improved calcium utilization in our BR group. The results highlighted the inappropriateness of monitoring serum calcium as a marker for bone turnover. The study showed that serum calcium values were not influenced by the amount of calcium supplementation provided, and it can be hypothesized that much of this calcium was being utilized for bone mineralization.

The above study was initially presented as a residency project; subsequently submitted to ICHP for consideration for the ICHP Annual Best Practice Award.
Emergency Department Pharmacy Services

Pharmacist Integration into the ED Team
A patient’s stay in the Emergency Department (ED) can ‘establish the tone’ and set up the patient for successful hospitalization. Clearly, initiating the most appropriate therapy at the START of hospitalization is optimal for the patient and process of hospital flow. For acute scenarios, the selection of appropriate antimicrobial, vasopressor or sedative/analgesic optimizes care and ensures cost-effective treatment. For chronic situations, optimization of pharmacotherapy (e.g., major disease including hypertension, diabetes, thromboembolic disorders), identification of drug-disease mismatches; currently, 18 - 22% of ED patients are admitted, many others benefit from pharmacotherapy modification. Appropriate medication history/reconciliation is always required to transition the patient; the ED has been identified as the preferred setting for pharmacy-provided medication histories – as valid, optimal admission orders are facilitated. The MSH ED pharmacists collaborate with health care team in multiple ways to provide care to ED patients, both those hospitalized and those discharged home directly. The portfolio, below, is a summary of their efforts.

ED Pharmacist Interventions

Documented interventions by ED pharmacists overall AND those involving urgencies/emergencies have increased dramatically over the last 18 months. A second ED pharmacist was added in August 2016.
Analysis of ED Urgent/Emergent Interventions

Pharmacist participation is vital in multiple urgencies/emergencies, including Code Stroke, Code Sepsis, Intubation, Hypertensive Urgencies, Seizures. Of utmost important is a pharmacist’s knowledge and skills which enable them to rapidly identify drug-related causes or ‘exacerbations’ of issues and to help ensure that the optimal pharmacotherapy is implemented. The ED pharmacists are the predominant pharmacists involved with urgencies/emergencies; however, other pharmacists play a role – including critical care, and to a lesser extent, general pharmacists. The graph, below, depicts the heavy ED impact on pharmacotherapy in urgencies / emergencies.

Examine ED pharmacists participation in urgencies/emergencies since Jan 2016 – excluding Code Trauma – the workload distribution (in percentage of such interventions) is depicted below:
Analysis of the Typical Month for ED Pharmacist Activities

This graph, below, illustrates the range (and number) of routine ED pharmacist services – from the management of routine admission medication history intake to pharmacotherapy recommendations for chronic diseases to participation in urgencies/emergencies.

The hospital was recently JC Stroke Center certified in November 2016. Pharmacy efforts at process improvements were instrumental in ensuring the outstanding clinical results.

Although opportunity for improvement still exists, this data reflects the value of staffing a pharmacy specialist in the ED – not only in that the median Door-To-Needle time (DNT) is significantly decreased, but, also that variability is minimized.

<table>
<thead>
<tr>
<th>Distribution of ED Pharmacist Documented Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antimicrobial Selection, 78</td>
</tr>
<tr>
<td>PK, 51</td>
</tr>
<tr>
<td>IV to PO, 13</td>
</tr>
<tr>
<td>RRT, 6</td>
</tr>
<tr>
<td>CODE HEART, 3</td>
</tr>
<tr>
<td>CODE INTUBATION, 17</td>
</tr>
<tr>
<td>CODE SEPSIS, 6</td>
</tr>
<tr>
<td>CODE BLUE, 22</td>
</tr>
<tr>
<td>TRAUMA, 115</td>
</tr>
<tr>
<td>DKA, 8</td>
</tr>
<tr>
<td>HTN Emergency, 1</td>
</tr>
<tr>
<td>Procedural Sedation, 8</td>
</tr>
<tr>
<td>MED Hx/REC, 402</td>
</tr>
<tr>
<td>Without PharmD Present</td>
</tr>
<tr>
<td>SEIZURE, 34</td>
</tr>
<tr>
<td>Other, 142</td>
</tr>
<tr>
<td>With PharmD Present</td>
</tr>
</tbody>
</table>

Pharmacy Alteplase Data January 2015 through August 2017

<table>
<thead>
<tr>
<th>Door-To-Needle Time (DNT) in minutes *</th>
<th>Number of Patients Analyzed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>65 (54 – 84)</td>
</tr>
<tr>
<td>Without PharmD Present</td>
<td>77 (58 – 113)</td>
</tr>
<tr>
<td>With PharmD Present</td>
<td>61 (51 – 73)</td>
</tr>
</tbody>
</table>
Process Improvement Over Time

Comparing two time increments, pre and post-Stroke Accreditation, a decrease in overall DNT is demonstrated during the post-survey period, in addition to a decrease in variability. Clearly, improvements have been demonstrated in the process; notably presence of the pharmacist in the ED during the latter time period is associated with the lowest DNT.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Door-To-Needle Time (DNT) in min</td>
<td>Door-To-Needle Time (DNT) in min</td>
</tr>
<tr>
<td>Overall</td>
<td>68 (57 - 93)</td>
<td>55 (43 – 61)</td>
</tr>
<tr>
<td>Without ED PharmD Present</td>
<td>78 (60 - 115)</td>
<td>61 (56 – 78)</td>
</tr>
<tr>
<td>With ED PharmD Present</td>
<td>65 (55 – 84)</td>
<td>52 (39 -56)</td>
</tr>
</tbody>
</table>

The following graph depicts the above table, visually demonstrating the value of the pharmacist on the Core Stroke Measure of 60 minutes Door to Needle Time (DNT) AND the improvement (reduction) in the DNT over the two time periods. DNT times only meet the JC goal of < 60 when a pharmacist is staffed in ED.
The last graph illustrates the impact of the ED pharmacist, over the two time periods, on % compliance with the Stroke Core Measure AND the improvement in the DNT process, over time. With a pharmacist in the ED, the % compliance with the JC Core Measure approaches 90%.

**ED Medication Histories**

The Emergency Department, although containing the word emergency, does indeed involve medical emergencies, but, must also manage chronic diseases. Accurate Medication Histories are vital – whether the patient is in acute exacerbation or whether the patient requires routine chronic disease management. A MSH poster presented at ASHP MCM 2015 demonstrated that the ED is the preferential site of medication history intake for most hospitalized patients. Additionally, medication histories are essential to ensure optimal pharmacotherapeutic care for those patients being discharged directly from the ED. As a consequence, Medication History intake by pharmacists (or their students) is prioritized to the ED at MSH.
During most rotations, the general medicine hospital students & pharmacists substantially outnumber the ED pharmacy students & pharmacists; however, the ED staff has contributed significantly to medication history completion by the department as a whole!

Routinely, in summer, we are confronted with relatively low number students; therefore, we have developed a summer internship program to facilitate Medication History participation in the ED.

**Cost Savings Initiative: Prothrombin Complex Concentrate (PCC)**

Beyond quality, the ED continually focuses on cost-efficacy; a recent initiative is described below.

ED pharmacists retrospectively evaluated MSH KCentra (an expensive, vital, blood factor) use over a one year period and, in conjunction with their knowledge of the literature, determined that in certain scenarios, fixed dose FEIBA would be an appropriate, evidence-based alternative. (FEIBA has cost-advantages over KCentra in specific scenarios).

The study at MSH use showed that KCentra was utilized as an antidote for warfarin, the FDA-approved indication, only 27% of the time. The other uses (for the majority of the time) managed bleeding related to Direct-acting Oral AntiCoagulants (DOACs).

Analysis of the past year’s expenditures compared “Fixed-Dose” FEIBA pricing to KCentra: a net savings of $31,000 annualized was observed for that period. Therefore, a savings of in excess of $31,000 annually will be realized secondary to use of ‘fixed-dose’ FEIBA use for DOAC reversal.

**An important note is that the actual savings realized is virtually certain to well exceed this number, as the use of DOACs is expected to continue to expand significantly.**

DOACs are an alternative to the traditional vitamin K antagonists (VKA) for the prevention and treatment of patients-at-risk of thrombotic events. With recent new US approvals, continued study of DOACS (with demonstration of advantages over warfarin) and with the ‘aging’ of the population (and commensurate increase in cardiology diagnoses which warrant anticoagulant use), increased use of DOACs is expected. Increased use confers risk of more bleeding events.

Annual Savings > $31,000
An algorithm was devised to guide appropriate use of blood factors in reversal in major life-threatening bleeding.

**Major Life Threatening Bleeding**

Bleeding into a Vital Organ that would be imminently Life-Threatening (Heart, Brain, Lung)

Bleeding Leading to Hemodynamic Changes That Is Not Responsive to Resuscitative Measures, Bleeding Resulting in ≥4 gm/dL Hemoglobin Drop

- **Vitamin K Antagonist (Warfarin)**
  - Hold Warfarin
  - Administer phytonadione 10mg IV slowly once (Over 30-60 min)
  - FEIBA dose based on Appendix A
  - Repeat INR at 30 min and 4 hr, then redose as needed

  - **INR ≤1.5**
    - Phytonadione alone

  - **INR >1.5 to <5**
    - FEIBA 500 units
    - Phytonadione 10mg IVPB

  - **INR ≥5**
    - FEIBA 1000 units
    - Phytonadione 10mg IVPB

- **Anti-Xa Inhibitor (Apixaban, Rivaroxaban, Edoxaban)**
  - Discontinue Anti-Xa Inhibitor
  - FEIBA 20 IU/kg IV Once (max dose 5000 units) ($8200/max dose)

- **Direct Thrombin Inhibitor (Dabigatran)**
  - Discontinue Direct Thrombin Inhibitor (Dabigatran)
  - Idarucizumab 5 gm IV once (Administer as 2 x 2.5gm doses) ($3582.50/dose)
Antimicrobial Stewardship: ED Pharmacists Essential as Initial Gatekeepers

The two ED pharmacists provide more empiric antimicrobial selection recommendations than the other pharmacists, combined: 60 empiric interventions in ED vs. 43 in hospitalized patients, total. Always, it is imperative to initiate therapy as quickly as possible in treatment of infection.

**Empiric Antibiotic Recommendations (excluding Pharmacokinetic Dosing), August 2017**

The following graph depicts a typical ED distribution of antibiotic interventions.
Antibiotic Stewardship Initiative: Focus on UTI Culture Results of Patients Discharged from ED

In this era of growing antibiotic resistance and continued reports of antibiotic over-use, the ED pharmacists identified the need to act on UTI culture results that are reported by the lab (typically 2 – 3 days after a patient is ‘discharged-to-home’ from ED). The ED pharmacists acted pro-actively to achieve optimal outcomes for patients.

Pro-Active Stewardship Intervention

- Starting July 1, 2017, an ED Pharmacist and Pharmacy intern reviewed positive urine cultures (of patients that had been discharged from the ED), their prescribed antibiotics, and pertinent clinical data on a twice weekly basis over a period of 45 days. (The comparison was halted at 43 patients).
- In collaboration with the medical team, revisions to therapy were determined
- Those patients for whom therapy change was required
  - Pharmacist called discharged patient at home and instructed patient on changes to therapy
  - Pharmacist contacted outpatient pharmacy to relay the new prescription

The Types of Stewardship Changes affected by Pharmacists: note that some patients required multiple interventions
41 interventions were made for 33 of 43 patients (77%). Ten (10) cultures / patients, 23%, required no action.

Types of Changes:

- Optimization: Optimization of dose or frequency was another major intervention type – again, over one third.
- Duration: Halting inappropriate antibiotic orders prevents unnecessary antibiotic exposure: over one third had their antibiotics discontinued! Beyond care of the individual patient, these duration interventions actually decrease days of antibiotic exposure – thus decreasing the duration of selective pressure in the community and the associated promotion of resistance: 54 days of antibiotic therapy were avoided
Discussion
ED pharmacists proactively demonstrated the results of their efforts in antibiotic stewardship by ensuring that patients who had been discharged home from the ED and who had cultures resulted were receiving optimal anti-infective therapy. Over the course of 45 days, the records of 43 patients were reviewed for anti-infective appropriateness: a total of 41 modifications were made to therapy of 33 patients. All of these patients were contacted at home, helping to emphasize MSH’s commitment to their care.

Quality Initiative: DKA Analysis
DKA is a critical condition, not commonly seen in ED. Correction of fluid and electrolyte loss must be closely scrutinized immediately after a patient’s arrival. Hyperglycemia and acidosis must be gradually normalized. Typically, correction of fluid loss clarifies the clinical picture and may markedly normalize acidosis. MSH has a comprehensive DKA Order set.

- Retrospective analysis of 34 patients (44 patients were excluded)
  - Period: 5/1/15 – 5/1/17
- Objective: To compare ED DKA management with and without pharmacist in the ED
  - Primary endpoint: Time to anion gap closure
  - Secondary endpoints: Appropriate addition of potassium; appropriate addition of dextrose
  - Other endpoints: Administration of appropriate amount of IV fluids, ICU length of stay, total length of stay
  - Safety endpoints: Hypoglycemia (accucheck < 70 or administration of D<sub>50</sub>), hypokalemia
- Inclusion: Adult > 18, positive BHB, treated with IV insulin infusion for DKA
- Exclusion: ED time < 4 hours, cardiac arrest, patients requiring vasopressors, ESRD on HD

Result Overview

<table>
<thead>
<tr>
<th>PRIMARY Outcome</th>
<th>No PharmD</th>
<th>PharmD</th>
<th>% Difference with PharmD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to anion gap closure (hr)</td>
<td>13</td>
<td>9</td>
<td>31% ↓</td>
</tr>
</tbody>
</table>

Other Outcomes

<table>
<thead>
<tr>
<th>Other Outcomes</th>
<th>No PharmD</th>
<th>PharmD</th>
<th>% Diff w PharmD</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICU LOS (days)</td>
<td>1</td>
<td>0.8</td>
<td>20% ↓</td>
</tr>
<tr>
<td>Time to K+ addition (hours)</td>
<td>6</td>
<td>0.8</td>
<td>80% ↓</td>
</tr>
</tbody>
</table>
Adverse Events, measured by Lab Markers

<table>
<thead>
<tr>
<th></th>
<th>No PharmD</th>
<th>PharmD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypokalemia %</td>
<td>24%</td>
<td>6%</td>
</tr>
<tr>
<td>Hypoglycemia %</td>
<td>18%</td>
<td>0%</td>
</tr>
</tbody>
</table>

- No difference was seen in time to addition of dextrose or amount of fluid, or OVERALL LOS

Discussion of Results

- Presence of pharmacist in ED did impact the primary outcome, with resolution of anion gap occurring, on average, in 9 hours with Pharmacist in the ED vs 13 hours, without. Further, examining direct impact on hospital costs: presence of a pharmacist reduced ICU LOS by 20% (from 1 day to 0.8 days); total hospital stay, however, was not impacted. Small patient numbers are a limitation to this study.

- Specifically, time to start KCl treatment occurred substantially earlier when the pharmacist was on duty: 0.8 vs 6 hours. Safety endpoints were also markedly different: hypoglycemia occurring in 0% vs 18% and hypokalemia occurring in 6% vs 24% in the pharmacist, vs no pharmacist in ED, groups.

(No difference was observed for other criteria: time to addition of dextrose or amount of fluid administered).

Action in Progress: Review of existing Order Set, identifying areas of improvement
Process Improvement: Preliminary Evaluation of Phenytoin Loading Dose and Follow-Up

The ED pharmacists are in the process of evaluating the attainment of Phenytoin therapeutic range for patients loaded with phenytoin in the Emergency Department.

The recommended phenytoin dose for adult patients in status epilepticus is 15–20 mg/kg; similarly, for maintenance doses, adults may be loaded at 15–20 mg/kg. In non-urgent scenarios, the oral route is optimal; however, in urgencies, the goal is attainment of therapeutic level as soon as can be safely done.

Span of study: May 2015 – May 2017

Many patients were excluded due to lack of follow-up serum level. Nonetheless, from the data collected thus far (with similar baseline characteristics in each group), the dosing (with pharmacists present in the ED) was substantially better than that with no pharmacist.

Preliminary Results

<table>
<thead>
<tr>
<th></th>
<th>No PharmD (n=11)</th>
<th>PharmD (n=8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow-up PHT level in Therapeutic Range, n (%)**</td>
<td>5 (45%)</td>
<td>6 (75%)</td>
</tr>
<tr>
<td>Phenytoin Dose (mg/kg)</td>
<td>11.3 (4.8-15)</td>
<td>13.3 (8.6-17.1)</td>
</tr>
</tbody>
</table>

![Attainment of Therapeutic Level](chart.png)
Spectrum of Critical Care Pharmacist Interventions

A relatively short-lived specialty of medicine (first formal recognition of the subspecialty of critical care medicine occurred in 1986), critical care pharmacists began emerging in the 1970’s. Since then, the positive impact of critical care pharmacists on patients has been demonstrated. A brief overview of the studies show a reduction in medication errors, reduced cost & waste, improved outcomes, decrease in mortality among patients with thromboembolic disease or infections. MSH’s critical care pharmacists are integral members of the respective critical care team – Medical and Surgical – ICU. Both are double certified in pharmacotherapy and in critical care medicine (BCPS and BCCCP), with the SICU pharmacist triple-certified, with an additional certification in nutrition (BCNSP).

Although urgencies (cardiorespiratory arrests, RSIs (Rapid Sequence Intubations)) do occur in the ICU, most critical care pharmacist efforts target management of routine medication issues, antibiotic stewardship (selection, duration and kinetics), dose individualization, optimization of patient sedation / analgesia. In terms of time, a major proportion of the day is dedicated to multi-disciplinary team rounding. The most significant use of their documented time is dedicated to ‘correction’ of the multitude of orders generated per patient and of further individualization of a patient’s pharmacotherapy by identification of medication – disease state ‘mismatches’ identification of drugs that should be added or withdrawn from patient.

Distribution of Documented Critical Care Interventions

- Medication - Dz State Mismatch: 51%
- Order Correction: 11%
- Sedation / Analgesia: 7%
- Antibiotic - Selection or Duration: 6%
- TDM: 3%
- AntiCoagulation: 3%
- PK: 8%
- IV to PO: 2%
- Drug info Other: 3%
- Cost Avoidance: 2%
- RRT / Intubation: 0%
- Renal Dosing: 2%

Efficacy and safety of inhaled nitric oxide compared to inhaled epoprostenol in patients with acute respiratory distress syndrome

Background
Acute respiratory distress syndrome (ARDS) is a clinical syndrome that may lead to respiratory failure and increased mortality. The management of ARDS consists of supportive care including the treatment of underlying causes, use of prone positioning, mechanical ventilation, fluid restriction and neuromuscular blockers. Salvage pharmacotherapy includes inhaled vasodilators such as nitric oxide and epoprostenol. In patients with ARDS, inhaled nitric oxide (iNO) has demonstrated significant improvement in oxygenation without benefit in mortality. Inhaled epoprostenol (iEPO) has been proposed and studied as an alternative agent to iNO due to a similar efficacy and adverse event profile. In December 2016, Mount Sinai Hospital implemented iEPO as a replacement to iNO.

Objective of MSH Critical Care (MICU) Residency Project:
Compare the efficacy and safety of iNO versus iEPO in adult medical intensive care unit (MICU) patients with ARDS.

Methods
The study retrospectively reviewed the use of iNO compared to iEPO in patients admitted to the MICU between January 2014 and April 2017. iNO data was collected between January 2014 and December 2016. iEPO data was collected after implementation in December 2016. The primary outcome of the study was number of ventilator-free days post-initiation of iNO and iEPO. This was defined as the number of days from 1 to 28 that a patient breathed without assistance for at least 48 consecutive hours after initiation of iNO or iEPO. The secondary outcomes included change in partial pressure of oxygen in arterial blood (PaO₂), PaO₂ over fraction of inspired oxygen (PaO₂/FiO₂) ratio, mortality, and cost.

Result
A total of 55 patients were screened for the study and 20 patients were excluded due to incomplete documentation. Of the thirty-five patients included in the analysis, 28 patients were in the iNO group and 7 patients in the iEPO group. The two groups were similar at baseline with regards to age, weight, PaO₂/FiO₂ ratio, sequential organ failure assessment (SOFA) score.

<table>
<thead>
<tr>
<th>Primary Outcome</th>
<th>iNO</th>
<th>iEPO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventilator-free days, mean (range)</td>
<td>2.6 (0-24)</td>
<td>9.1 (0-21)</td>
</tr>
<tr>
<td>Secondary Outcomes</td>
<td>iNO</td>
<td>iEPO</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>----------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>PaO₂ change (mmHg)</td>
<td>22 (0 – 47.4)</td>
<td>38 (6.1 – 54.4)</td>
</tr>
<tr>
<td>PaO₂/FiO₂ ratio change (mmHg)</td>
<td>22 (0 - 61)</td>
<td>72.7 (5.9 – 106.1)</td>
</tr>
<tr>
<td>Dose of medications</td>
<td>15 (10 – 20) b</td>
<td>0.05 c</td>
</tr>
<tr>
<td>Duration of therapy (hours)</td>
<td>51.3 (21.5 – 94.5)</td>
<td>20 (18 – 65)</td>
</tr>
<tr>
<td>Tracheostomy, n (%)</td>
<td>4 (14)</td>
<td>1 (14)</td>
</tr>
<tr>
<td>Mortality, n (%)</td>
<td>17 (60.7)</td>
<td>2 (42.8)</td>
</tr>
<tr>
<td>Cost ($/person)</td>
<td>7,695 (3,225 – 14,175)</td>
<td>370 (259 – 1,221)</td>
</tr>
</tbody>
</table>

*Nominal data presented in n (%) and continuous data in median (IQR) b (ppm), c mcg/kg/min
IQR: interquartile range

**Discussion**

In this study, iEPO group had a higher ventilator-free day (9.1 compared to 2.6). For the secondary outcomes, both groups demonstrated significant increase in PaO₂/FiO₂ ratio. The doses of the medications were 15 ppm in the iNO group and 0.05 mcg/kg/min in iEPO group. Duration of therapy was 51.3 hours in the iNO group and 20 hours in the iEPO group. Both groups showed similar tracheostomy but there were higher mortality rate in the iNO group. There was significantly lower cost in iEPO group: $370 per person compared to $7,695. There were several limitations in the study. The study was retrospective data collection and incomplete documentation led to large portion of patient to be excluded. The unequal number of patients in each group and small sample size limited data analysis to evaluate magnitude of differences between two groups. The methemoglobin monitoring was not adequately documented for iNO group. In the future, larger sample size including patient who received either iNO or iEPO in SICU should be collected in iEPO group for statistical analysis and evaluation of further financial benefit.

**Conclusion**

Both iNO and iEPO group improved ventilator-free days and oxygenation in ARDS patients; however, use of iEPO projected significant cost reduction approximating $200,000 annually. iEPO was determined to be an appropriate replacement therapy for iNO, with no adverse effects and safety impact.

Addendum: a savings of $300,000 was realized following conversion.
The graph, below, depicts Nitric Oxide use (both adult and pediatric) over the last several years.
Implementation of the Behavioral Pain Scale in Intensive Care Units

Background
Pain is difficult to quantify and treat. Intensive care unit (ICU) patients experience pain frequently: over 30% of patients have significant pain at rest while approximately 50% have significant pain during routine care. Society of Critical Care Medicine (SCCM) Pain, Agitation, Delirium (PAD) Guidelines recommend that routine pain assessments be done in these patients. Normally, the gold standard for pain assessment is the patient self-report. Unfortunately, many ICU patients are unable to communicate. Therefore, the PAD guidelines recommend the use of the Behavioral Pain Scale (BPS) or the Critical Care Pain Observation Tool (CPOT) to assess pain in these patients.

Previously at Mount Sinai Hospital (MSH), the Face, Leg, Activity, Cry, Consolability (FLACC) scale was used to assess pain in ICU patients unable to communicate. This scale was not recommended by the guidelines; therefore, this purpose of this project was to implement an evidence-based, guideline-based pain assessment scale on the MSH critical care units.

In order to implement this scale, multiple methodologies of education were used. The nursing staff was educated in small groups, one-on-one, an online learning module was created, and a practice alert was sent out to all staff.

Methods
To assess the efficacy of the implementation of the BPS, a retrospective, pre- and post-BPS implementation study was conducted. Reports were generated through the electronic medical record for patients in the medical ICU (MICU) requiring opiate analgesia. Patients included were: 18 years of age or older, had an ICU stay > 48 hours, were mechanically ventilated and required the use of opiate analgesia. Excluded were quadriplegic patients, patients with traumatic brain injury and patients who received neuromuscular blocking agents.

The primary outcome was the change in analgesia requirement. The secondary outcomes included: percentage of time within targeted pain scores, change in sedative requirement, presence of delirium, duration of mechanical ventilation, ICU and hospital stay, and mortality.

In the pre-BPS implementation group, 153 patients were screened, 90 were excluded mostly due to incomplete documentation and 63 were included. In the post-BPS implementation group, 96 patients were screened, 27 were excluded primarily due to ICU stay < 48 hours and 69 were included. Baseline characteristics were similar – except SOFA Score, which was higher in the post-BPS group.

Results:

<table>
<thead>
<tr>
<th>Primary Outcome</th>
<th>Pre-BPS (n=63)*</th>
<th>Post-BPS (n=69)*</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Opioid Analgesic Requirement Per Day, mcg of Fentanyl Equivalent</td>
<td>1235 [72-3850]</td>
<td>1726 [563-4570]</td>
<td>0.01</td>
</tr>
</tbody>
</table>
Secondary Outcomes - Pain

<table>
<thead>
<tr>
<th></th>
<th>Pre-BPS (n=63)*</th>
<th>Post-BPS (n=69)*</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLACC Scale</td>
<td>0.55 [0-5.53]</td>
<td>--</td>
<td>N/A</td>
</tr>
<tr>
<td>BPS</td>
<td>--</td>
<td>3.52 [3-7.4]</td>
<td>N/A</td>
</tr>
<tr>
<td>% of Time Within Target BPS, (BPS &lt; 5)</td>
<td>--</td>
<td>94 [0-100]</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Secondary Outcomes - Sedation

<table>
<thead>
<tr>
<th></th>
<th>Pre-BPS (n=63)*</th>
<th>Post-BPS (n=69)*</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Sedative Requirement Per Day, mg of Midazolam Equivalent</td>
<td>138.3 [0-452]</td>
<td>106.3 [0-468]</td>
<td>0.36</td>
</tr>
<tr>
<td>Average RASS&quot;</td>
<td>-2.7 [-5-1.25]</td>
<td>-2.82 [-5-0.71]</td>
<td>0.62</td>
</tr>
<tr>
<td>% of Time Within Target RASS, (RASS 0 to -2)</td>
<td>27.8 [0-93]</td>
<td>36.2 [0-100]</td>
<td>0.14</td>
</tr>
</tbody>
</table>

Secondary Outcomes - Delirium

<table>
<thead>
<tr>
<th></th>
<th>Pre-BPS (n=63)*</th>
<th>Post-BPS (n=69)*</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAM-ICU Positive, n (%)</td>
<td>5 (8)</td>
<td>7 (10)</td>
<td>0.66</td>
</tr>
<tr>
<td>Initiation of Atypical Antipsychotic, n (%)</td>
<td>20 (40.8)</td>
<td>4 (6)</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

Secondary Outcomes – Miscellaneous

<table>
<thead>
<tr>
<th></th>
<th>Pre-BPS (n=63)*</th>
<th>Post-BPS (n=69)*</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical Ventilation, days</td>
<td>9.3 [2-29]</td>
<td>8.3 [2-44]</td>
<td>0.42</td>
</tr>
<tr>
<td>ICU Stay, days</td>
<td>9.6 [2-31]</td>
<td>8.2 [2-53]</td>
<td>0.26</td>
</tr>
<tr>
<td>Hospital Stay, days</td>
<td>15.2 [2-46]</td>
<td>16 [2-66]</td>
<td>0.71</td>
</tr>
<tr>
<td>Mortality, n (%)</td>
<td>15 (24)</td>
<td>37 (54)</td>
<td>0.0005</td>
</tr>
</tbody>
</table>

Conclusion:
The pre- and post-BPS implementation groups were similar except for the SOFA score (mortality predictor). The post-BPS implementation group seemed to have a sicker population. In conclusion, there was more analgesia used, less sedative use, less atypical antipsychotic use, decreased duration of mechanical ventilation and ICU stay, and higher mortality shown in the post-BPS implementation group.

With these results, it may appear that the implementation of the BPS promoted analgosedation (analgesia first before sedation), which led to more analgesia use and less sedative use. Although there was a higher mortality rate, this may have been attributable to the higher SOFA scores at baseline.

There were some limitations to this study: it was a retrospective chart review with a small sample size. Also, adjustments for pain and sedation scores outside of the specified target range were not taken into account. In addition, bolus doses of analgesia or sedative may not have been documented due to the patient already maintained on the infusion and therefore not taken into account.
Summary

MSH Practice Change in critical care pain assessment yielded improved quality - likely resulting in superior analgesia – as demonstrated by greater opioid use, reduced sedative and antipsychotic use.

Cost Efficacious Use of a Limited Resource: Albumin

Background

Albumin, a major plasma protein, is essential for maintaining oncotic pressure in the vascular system. Albumin rapidly and effectively expands intravascular volume and does not freely cross the capillary membrane into the interstitial space. Albumin is not innocuous: as it is derived from human plasma, it has a theoretical risk of transmission of infection, and its use is associated with a risk of hypersensitivity. Also, intermittent supply issues have led to increase in the acquisition cost of albumin over time.

Action

To analyze suspected inappropriate use / over-use of albumin in 2011, the critical care pharmacist conducted a baseline Medication Usage Evaluation in 25 patients who received albumin in either the MICU or SICU. The universally-accepted UHC (University Hospital Consortium) guidelines were used as a guide: only 24% of the use was determined to be appropriate.
The most common indication for use was diuresis (not a UHC indication). Breakdown of use, as follows:

- Diuresis with furosemide in 14 patients with acute renal failure (56%)
- Resuscitation in 8 patients (32%)
- Bleeding - 1 patient (4%) and
- Tachycardia - 1 patient (4%)

Albumin use as a diuretic is not part of the UHC guideline; indeed, the MUE demonstrated the lack of benefit / poor results with its use for diuresis. The conclusion of the MUE was that UHC guidelines should be followed at MSH.

**Follow-Up**

In lieu of simply referring to UHC guidelines, the MICU Critical Care pharmacist, in collaboration with intensivists, adapted the UHC guidelines for MSH-specific use, so that the guidelines could be more readily incorporated into daily, routine practice and taught.

**Result**

Decreased albumin purchases.

Addendum: The MSH-specific Albumin Guidelines were updated in 2015, primarily with the addition of dosing – with the intention of minimizing inappropriate doses. The clinical portfolio demonstrates the dramatic impact of this 2015 revision.

**Cost Efficacy: Evaluation of Pharmacotherapy in Acute Coronary Syndrome (ACS)**

Thrombus formation plays a major role in the pathogenesis of ischemic complications during acute coronary syndromes (ACS). Therapies used in ACS management include anticoagulants and anti-platelet agents. One of the anti-platelet agents used at MSH is eptifibatide. It is a selective high-affinity inhibitor of the platelet glycoprotein IIb/IIIa receptor which leads to the inhibition of platelet aggregation. It has been established that platelet glycoprotein IIb/IIIa receptor inhibitors such as eptifibatide have incremental benefit when added to heparin and aspirin; they reduce the frequency of adverse events after percutaneous coronary intervention (PCI). Eptifibatide is one of the top 10 medications on the 80/20 report with an annual expenditure of approximately $80,000. It is administered as a 180 mcg/kg intravenous bolus dose immediately followed by a second bolus of 180 mcg/kg 10 minutes after the first bolus before PCI. Afterwards, a continuous infusion of 2 mcg/kg/min is recommended for up to 18 to 24 hours.

Trauma-related arterial thrombogenicity persists for up to 18 to 24 hours after percutaneous coronary intervention (PCI). Glycoprotein IIb/IIIa inhibitors such as eptifibatide reduce the trauma-mediated ischemic complications of PCI. However, the standard 18- to 24-hour infusion duration of eptifibatide was established before oral dual-antiplatelet therapy loading became standard practice.
Action
A decision was made to evaluate/study use of eptifibatide at MSH was evaluated since opportunities to improve usage and limit waste were suspected. From January through June 2015, 39 patients that underwent cardiac catheterization received eptifibatide. The types of ACS patients experienced are shown below in the table below:

<table>
<thead>
<tr>
<th>Type of ACS</th>
<th>Number of Patients (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEMI</td>
<td>27 (69.2%)</td>
</tr>
<tr>
<td>NSTEMI</td>
<td>8 (20.5%)</td>
</tr>
<tr>
<td>Unstable angina</td>
<td>2 (5.1%)</td>
</tr>
<tr>
<td>Atrial flutter</td>
<td>1 (2.6%)</td>
</tr>
<tr>
<td>Unspecified</td>
<td>1 (2.6%)</td>
</tr>
</tbody>
</table>

Twenty-seven patients (69.2%) underwent non-elective cardiac catheterization. The average number of cardiac catheterizations per patient was 1.9. Twelve patients (30.8%) did not have a stent placed. Of the 27 patients who had stents placed, 5 patients (12.8%) had a bare metal stent placed while 22 patients (56.4%) had one or more drug-eluting stents placed. The ejection fraction was < 40% in 14 patients (36%), ≥ 40% in 23 patients (59%) and unavailable in 2 patients (5%).

Evaluation of eptifibatide dosing showed that 34 patients (87.2%) received a double bolus of 180 mcg/kg; 38 patients (97.4%) were started on drip at a rate of 1 or 2 mcg/kg/min. All patients started on infusion should have received a double bolus. Six patients (15.4%) did not receive an appropriate dose of eptifibatide based on renal function. Analysis of creatinine clearance showed the average baseline was 83 mL/min. The average duration of eptifibatide therapy was 20.1 hours.

Bleeding was also evaluated while on the eptifibatide infusion. One patient (2.6%) experienced bleeding from the femoral artery. The average decrease in hemoglobin was 1.88 g/dL while the average platelet decrease was 41 x 10^3/microliter. One patient (2.6%) required a blood transfusion and another patient (2.6%) required a platelet transfusion.

Cost Analysis
Multiple opportunities for limiting waste of eptifibatide were identified. The interventional cardiology group was approached based on the data generated by this analysis; they agreed to round down dosing if ≤ 15 mg (20 mL) of eptifibatide is needed. This was expected to prevent opening a new bottle which may result in wastage if most of the bottle is not used. This strategy was presented at the P&T Committee. Currently, eptifibatide is available as 20 mg/10 mL vial for bolus doses and 75 mg/100 mL bottle for infusion. Table, below, shows the amount per vial or bottle and the total cost of eptifibatide used in the 6 month time frame of this drug use evaluation.
Based on the studied pattern of use (bolus dose followed by infusion doses - in separate vials or bottles), rounding down the vial/bottle size was projected to yield a cost savings of $13,600 per year.

Also, the study identified more cost-efficacy opportunity regarding duration: it was noted that 10 patients (25%) received eptifibatide for longer than 24 hours, with a maximum of 55 hours. Eptifibatide use is not recommended for greater than 24 hours; clearly, there is opportunity for improvement in the duration of therapy.

**Based on results of this DUE, the following changes were agreed on by Cardiology, presented to P&T and then implemented:**

- Eptifibatide bolus doses are rounded down to the nearest vial size using the 20 mg/10 ml vials in the cardiac catheterization lab (as approved by interventional cardiology service). The nursing staff was serviced about plan.
- Eptifibatide infusion doses are rounded down to the nearest bottle size using the 75 mg/100 mL bottles if ≤ 15 mg is needed before opening a new bottle (as approved by interventional cardiology service).
- Eptifibatide was removed from the ADM machines in the MICU/CCU and subsequently sent from the main pharmacy with pharmacist oversight on the total number of doses/bottles needed.
- Monitoring
  - Duration: the total duration of Eptifibatide should be limited to no more than 24 hours
    - Pharmacy to scrutinize duration
- Future Directions identified:
  - Patient-specific doses dispensed from the main pharmacy should be considered
Focus on Quality Improvement: Evaluation of the Efficacy of Transitioning from Continuous Insulin Infusion to Subcutaneous Insulin in the MICU

There is significant association between hyperglycemia and higher mortality in intensive care unit (ICU) patients. Several guidelines and recommendations suggest changing from insulin infusion to subcutaneous insulin to control hyperglycemia during post-acute stage. There are limited data regarding the efficacy and safety of insulin transition protocols in MICU patients.

Action
Unit-specific performance was evaluated in a total of 37 MICU patients.
- The primary objective of the study was to assess glycemic control post-transition from continuous infusion insulin (CII) to subcutaneous long-acting insulin (SI).
- The secondary objective of the study was to identify the dose of insulin that resulted in appropriate glycemic control post-transition from CII to SI.

Results
This retrospective study demonstrated that the existing insulin transition from CII to SI did not provide adequate glycemic control in MICU patients: the BG post-transition trended up, increasing with time. Common reasons identified for suboptimal glycemic control were long gap times pre-transition and inadequate dose of SI post-transition from CII.
- No guidelines for transitioning from CII to SI are contained in existing MSH Adult ICU Insulin Infusion Protocol

Follow-Up: Transition guidelines were developed and Order Set was modified.
Focus on Quality Improvement: Evaluation of Code Sepsis

On a national level, mortality rates due to sepsis remain high, at 20 – 30%, despite significant advances in the management of sepsis. Multiple studies have demonstrated that early goal-directed therapy significantly reduced sepsis-related mortality. In April 2014, Mount Sinai Hospital (MSH) initiated Code Sepsis (CS) to identify patients with suspected sepsis who would benefit from early initiation of the Sepsis treatment bundles.

Action
The pharmacist, in collaboration with the MICU team, decided to evaluate the appropriateness of Code Sepsis initiation in patients with sepsis at MSH. The primary objectives were evaluation of adherence to the CS treatment bundle, length of hospital stay and mortality. 31 patient records were retrospectively reviewed.

Results
The brief evaluation (status check) revealed that the criteria for initiation of Code Sepsis were not followed: fluid resuscitation during the first hour was inadequate in all patients. This may have increased use of vasopressors. Also, inappropriate empiric antibiotic therapy was commonly started due to selection of antibiotic treatments for community infection treatments for hospital-acquired infections. Further, antibiotics were not initiated in a timely manner. In summary, improvement was determined essential in terms of the following criteria results:
- Lactate was not measured within one hour
- Cultures were not obtained within one hour
- Empiric antibiotic selection was not consistently appropriate
- Antibiotics were started before cultures obtained
- Antibiotics not started within one hour

Enhancement
- Order Set and Guidelines were updated.
- Multi-disciplinary Code Sepsis Committee was developed.
- MediTech
  - Physician and Nursing Documentation was updated.
  - Order Entry for Antimicrobials and Laboratory Tests (i.e., Lactate) were updated
- Sepsis Education for providers was planned and is being provided routinely
Focus on Quality Improvement: Evaluation of MICU Anti-Delirium Medication Use on Discharge

Background
- Intensive care unit (ICU) delirium is a recognized complication of critical illness.
- The prevalence of delirium has been reported as high as 60% - 80% in mechanically ventilated ICU patients and 20% - 50% in non-ventilated ICU patients.
- ICU delirium is a predictor of higher cost of care, a 3-fold higher mortality over 6 months and significant ongoing cognitive impairment among survivors.
- It is also a significant factor in prolonged ventilation, development of hospital-acquired pneumonia and increased hospital length of stay.
- There is evidence suggesting that ICU sedatives and analgesics may contribute to the development of delirium.
- Several small studies have used both typical and atypical antipsychotics in managing ICU delirium. Results from larger studies are pending.

Action
The pharmacist, in collaboration with the MICU team, decided to evaluate the appropriateness of MICU anti-delirium medication use on discharge, as a primary objective. The secondary objective of their study was to evaluate the indication for use of anti-delirium medication in the medical ICU. A retrospective cohort study was conducted: 77 patient medical records were reviewed, 30 were excluded.

Results
Appropriateness of MICU Anti-delirium Use at Discharge

![Bar chart showing appropriateness of MICU anti-delirium medication use at ICU and hospital discharge]

Discussion
This study demonstrated that anti-delirium medications are not continued inappropriately after delirium resolution in most patients on either MICU and/or hospital discharge. Likely, the routine rounding by the multi-disciplinary MICU team minimized inappropriate continuation on discharge (80 and 84% appropriate). Other pertinent information was identified in the study:
- Majority of ICU patients on anti-delirium medications were discharged to long term acute care facilities.
- Most commonly used anti-delirium medications continued on ICU and/or hospital discharge were quetiapine, olanzapine and haloperidol.
- Hyperactive delirium was the most common indication for anti-delirium medication initiation and found in 75% of the patients.
Focus on Quality Improvement: Evaluation of Continuous Infusion Neuromuscular Blockers for Shivering Prevention during Therapeutic Hypothermia in Post-Cardiac Arrest Patients

Background
• Cardiac arrest, subsequent ischemia, and resuscitation trigger various temperature-dependent mechanisms leading to brain injury. These factors are significant contributors to morbidity and mortality in patients who initially achieve return of spontaneous circulation (ROSC).
• Therapeutic hypothermia (TH) is used to prevent or mitigate neuronal injury
  o Intentional reduction of a patient’s core temperature to 32-34°C
• Shivering, a natural reaction to cold, raises body temperature. It is counterproductive to TH and detrimentally increases the body’s metabolic demands.
• Various agents including intravenous magnesium, sedatives, and neuromuscular blockers (NMBs) can be used to prevent or reduce shivering during TH.
• 2008 International Liaison Committee in Resuscitation (ILCOR) Recommendations
  o TH for 12-24 hours in unconscious patients
  o Sedation and analgesia for shivering
  o NMBs for refractory shivering
    ▪ Bolus NMB is generally adequate though continuous infusion may be necessary
• 2015 ILCOR Recommendations
  o Maintain constant temperature between 32-36°C for at least 24 hours

Action
• The MICU pharmacy specialist, in collaboration with the intensivists and nursing practice leaders retrospectively evaluated the use of NMBs in the MSH MICU for use in preventing shivering during TH induction for in-hospital cardiac arrest patients. The secondary objective was to evaluate the functional outcomes of patients post-cardiac arrest.
• The evaluation:
  o Patients treated with TH were compared to those who did not receive TH
  o MSH Adult ICU Hypothermia Guideline
    • Cooling temperature target of 32-34°C
    • Attainment of target temperature within 2 hours and maintain for 24 hours
    • Rewarming of patient after 24 hours at a rate of no more than 0.25°C/hour
  o Shivering prevention and treatment strategies
    • Magnesium 4 g IV x 1
    • Sedation and analgesia
    • NMB continuous infusion
  o Post-arrest functional outcomes were retrospectively scored using the Modified Rankin Scale (mRS)

Discussion
The evaluation gleaned valuable information and facilitated major changes in the MSG TH Order Set and Guideline.
• Based on the mRS scores of surviving patients, the TH group had better functional outcomes.
• TH group, however, also had higher mortality rate and incidence of seizures. This may have been confounded by longer down times and suppression of seizure activity by NMBs.
• Changes made to the MSH guidelines include addition of meperidine and buspirone, elimination of continuous infusion NMBs, and implementation of the Bedside Shivering Assessment Scale.
Bedside Discharge Prescription Concierge Service

Background
- Medication therapy must be continued as soon as possible after discharge
- Interruptions in medication therapy during transitions of care can negatively impact patient outcomes and increase hospital readmissions
  - Failure or delays in filling prescriptions at the time of hospital discharge
  - Patients may not be aware of purpose of medication or the necessity of medication adherence
- Patients are more likely to continue treatment after discharge if they have medications in hand

Concierge Service
- Fill prescriptions and hand-deliver to patients at bedside before they are discharged
  - Improved adherence
  - Decreased barrier for receiving medication
- Pharmacist-led discharge medication counseling
  - Explain to patients why they are taking certain medications
  - Educate patients on how to take and manage their medications
  - Discuss potential medication adverse events and self-monitoring parameters
- Answer any questions they may have about their medications

Goals
- Reduce readmissions
- Decrease ED visits due to a lack of medication
- Improve medication adherence & patient education
- Improve patient satisfaction

Considerations
- Patients have positively responded to bedside discharge concierge service
  - Majority of patients consulted choose to partake in discharge program
- On average, 200 to 250 patients utilize the service monthly
  - Each patient averages 3-6 medications filled per visit
- December 2014 to January 2015 saw a 100+ increase of prescriptions filled due to a pharmacy resident project to see the impact of having a transitions of care pharmacist.. After implementation of our TOC program, our monthly fill averages have grown from 200 prescriptions per month in 2014 to 800 prescriptions and growing per month mid-2017, currently servicing roughly 35% of our general medicine patient discharges.
Medication Reconciliation
2014-2015 Resident Project – The Basis for Addition of 2 Transitions of Care Pharmacists

Background
- Poor communication of medical information at transitions of care (TOC) is responsible for ~50% medication discrepancies and 20% of adverse drug events
- Medication reconciliation (MR) across the continuum is a national patient safety goal cited by The Joint Commission
- Hospital discharge is a critical transition due to limited patient monitoring
- Pharmacist assisted medication reconciliation at discharge has been demonstrated to reduce preventable adverse drug events up to 40% prior to discharge

Resident-led Pilot
From December 8, 2014 to February 5, 2015, a pharmacy resident-led pilot program was developed to identify safety benefits of having a pharmacist incorporated in the medication reconciliation and transitions of care process

Intervention Process

<table>
<thead>
<tr>
<th>Medication history at admission</th>
<th>Inpatient counseling</th>
<th>Discharge medication reconciliation</th>
</tr>
</thead>
</table>
| • Acquire and document complete accurate medication history and reconciliation at admission | • Provide disease state counseling  
• Medication education  
• Bedside discharge services | • Review medications before a patient is sent home  
• Contact physician to correct any errors  
• Deliver medications at bedside and counsel |

Results
- 56 complex patients were included in the study (who had either COPD, CHF, diabetes, coronary artery disease, cerebrovascular accident, or thromboembolism)
- 2959 routine medications were reviewed
  - Average 11.2 medications per patient
  - Average 2.1 medications were added from admission to discharge
  - Average 1.9 medication discrepancies per patient (107 total discrepancies found)

<table>
<thead>
<tr>
<th>Type</th>
<th>Percent (%)</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Omission</td>
<td>57</td>
<td>Beta blocker for CHF</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rescue inhaler for COPD</td>
</tr>
<tr>
<td>Wrong Dose</td>
<td>21</td>
<td>Insulin for DM</td>
</tr>
<tr>
<td>Duplication</td>
<td>11</td>
<td>2 statins for CAD</td>
</tr>
<tr>
<td>No Indication</td>
<td>8</td>
<td>PPI</td>
</tr>
<tr>
<td>Drug/Disease</td>
<td>3</td>
<td>Ibuprofen in CHF</td>
</tr>
</tbody>
</table>
- 35 prevented errors could have caused moderate to critical patient harm
- Prevention of approximately 1 potential adverse drug event per patient

**30 Day Readmissions**

<table>
<thead>
<tr>
<th></th>
<th>PRE-Intervention</th>
<th>POST-Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 Day Readmissions</td>
<td>18</td>
<td>11</td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td>39%</td>
</tr>
</tbody>
</table>

- 18 of the 56 patients were “frequent flyers” and were readmitted in the past within 30 days
- After receiving pharmacist-led intervention, only 11 patients were readmitted (39% reduction)
- Since this was an observational study, it cannot be proven that pharmacists was the factor in 30 day readmission

**Considerations**

- Medication errors resulting from inaccurate medication histories are abundant from admission through discharge
- Pharmacists provide positive value for inpatients to prevent medication reconciliation errors that can cause harm
- Reducing harm and education could result in reducing 30 day readmission
Inhaler Teaching Technique – Asthma/COPD Management

Background
Sinai Health System’s inpatient education program incorporated inhaler teaching in January 2014 to ensure COPD patients who were prescribed inhalers were given the necessary teaching required to use the inhalers appropriately and effectively.

- Management of chronic airway disease has been said to be “10% medication, 90% education”
- Patients hospitalized for COPD exacerbations have many modifiable risk factors, including poor inhaler technique
- Placebo inhaler teaching is facilitated by advanced pharmacy practice experiential (APPE) students under clinical pharmacist oversight
- Per expert guidelines, all patients receiving new prescriptions for inhalers should have initial training
  - Reassessments should be given regularly to ensure retention of education

Teaching Method

Study Outcome

- 276 patients assessed initially from January 15, 2014 to May 15, 2014
- 86 patients completed follow-up assessments

Figure 2: Assessment scores at baseline and follow-up

Budesonide/formoterol: increase 52%
Tiotropium: increase 24.5%
Albuterol: increase 50.7%
Considerations

- Failure to educate the hospitalized patient can result in inappropriate use after discharge, potentially resulting in re-admission
  - Readmission rates for COPD decreased from the 2013 baseline average of 21.5% to 11.0% in the first 6 months of 2014
- Significant improvements were seen in patients’ inhaler technique
Oncology Pharmacy Services

Introduction
Oncology pharmacists have historically played a role in the delivery of care to cancer patients, focusing on operations, with an emphasis on dispensing accurate and safe medications. However, as cancer regimens continue to increase in complexity, as the oncology population expands and increases in age, and as the oncology medications become increasingly more numerous and variable, the need for knowledgeable & skilled oncology pharmacists has grown, as the role of oncology pharmacist has evolved.


Between 2010 and 2020, the CDC reports that the number of new cancer cases in the United States is expected to increase to about 24% in men to more than 1 million cases annually, and by about 21% in women to more than 900,000 cases annually.

The types of cancer expected to increase the greatest extent are
- Prostate, kidney, liver, and bladder cancers in men.
- Lung, breast, uterine, and thyroid cancers in women.
- Melanoma in white men and women.

Over the next decade, the CDC expects cancer incidence rates to stay about the same, but the number of new cancer cases to rise, primarily because of demographic shifts: an aging white population and a growing black population (with the latter being more of an issue at MSH).

Focusing on the cancer types expected to rise, MSH Oncology Clinic heavily manages patients with the cancers listed in the first two bullets and these numbers can be expected to grow over the coming years.

Assuming a pro-active stance, MSH oncology pharmacists have acted strategically to avert some of the aforementioned issues – working with Oncologists to develop guidelines, protocols and order sets.

Roles and Responsibilities
Pharmacist Led Chemotherapy Services have impacted patient care and outpatient oncology services tremendously. In the last year, the oncology pharmacist drug-specific interventions include:
- Chemotherapy dose rounding
- First dose chemotherapy patient counseling for all patients
- Pharmacist order writing
- Chemotherapy preparation
- Guideline development
- Policy & procedures implementation
MSH Chemotherapy Process

Pharmacist receives a consult from MD to write a chemotherapy order

Pharmacist verifies allergies, labs, drug interactions, dosing, and other clinical parameters and writes order for physician verification

After a double check has been obtained the pharmacist prepares the chemotherapy medication

Once the chemotherapy is prepared, the pharmacist counsels the patient for side effects and compliance

After physician verification, pharmacist enters order into MediTech for a double check for safety

Once the chemotherapy is prepared, the pharmacist counsels the patient for side effects and compliance
Calcitonin Initiative

A calcitonin medication usage evaluation demonstrated potential for improvement in quality (administration of appropriate, evidence-based medication therapy) AND cost-avoidance through reduction in unnecessary doses.

Background
Calcitonin-salmon is a synthetic peptide hormone that antagonizes the effects of parathyroid hormone (PTH) and parathyroid hormone-related protein (PTHrP). Administration of calcitonin results in inhibition of osteoclastic bone resorption as well as renal excretion of calcium, phosphate, sodium, magnesium, and potassium. This medication is used as an adjunct to intravenous fluids and bisphosphonates for the management of malignancy-induced hypercalcemia. Tachyphylaxis typically develops within 24-48h, limiting the efficacy of long-term treatment.

Hypercalcemia of malignancy (HCM) is an oncologic emergency that can occur in up to 20-30% of patients at some point throughout the course of their disease. It is the most common cause of hypercalcemia in the inpatient hospital setting. It occurs in patients with both solid tumors and hematological malignancies. The most common cancers associated with hypercalcemia are breast, lung, and multiple myeloma. The occurrence of hypercalcemia typically signifies advanced disease and thereby confers a poor prognosis, with a 50% mortality rate at 30 days. Hypercalcemia occurs through a variety of mechanisms including tumor-produced parathyroid hormone-related protein (PTHrP), local osteolysis induced by bone metastases, and tumor production of 1,25-dihydroxyvitamin D or parathyroid hormone (PTH).

Results
Below, the results of the MUE of patients who received calcitonin between January 2016 and January 2017.

<table>
<thead>
<tr>
<th>January 2016 – January 2017</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients Reviewed</td>
<td>11</td>
</tr>
<tr>
<td>Total Calcitonin Doses Administered</td>
<td>46</td>
</tr>
<tr>
<td>Inappropriate/Extra Doses Administered</td>
<td>31</td>
</tr>
<tr>
<td>Cost Associated with Extra Doses ($2164/vial)</td>
<td>$41,108</td>
</tr>
</tbody>
</table>

Only 33 % of calcitonin orders were appropriate.

Action
To ensure optimal pharmacotherapy and cost-effectiveness, guidelines for use of calcitonin were developed. Further, comprehensive guidelines for the management of hypercalcemia of malignancy were developed, to ensure that first line of therapy was fully trialed prior to calcitonin. The guidelines address appropriate lab ordering, appropriate fluid replacement, avoidance of drugs exacerbating hypercalcemia, and pharmacotherapy and its monitoring.

Anticipated Benefit: Approximately $30,000 will be spared annually.
Pegfilgrastim Initiative

Pegfilgrastim is approved by the U.S. Food and Drug Administration (FDA) to enhance neutrophil recovery in patients with nonmyeloid malignancies undergoing myelosuppressive chemotherapy. Neutropenia, defined as an absolute neutrophil count (ANC) of < 500 neutrophils/mcL or an ANC of < 1000 neutrophils/mcL and a predicted decline to < 500 neutrophils/mcL over the next 48 hours, can progress to febrile neutropenia (> 38.3°C orally or > 38.0°C over 1h) and necessitate the need for treatment delays or dose reductions which may compromise clinical outcome. Both the National Comprehensive Cancer Network (NCCN) and the American Society of Clinical Oncology (ASCO) have published evidence-based, clinical practice guidelines on the use of myeloid growth factors for their prevention of febrile neutropenia. The recommendations are summarized in the table below.

<table>
<thead>
<tr>
<th>Risk for Febrile Neutropenia</th>
<th>Curative Intent</th>
<th>Palliative Intent</th>
</tr>
</thead>
<tbody>
<tr>
<td>High (&gt; 20%)</td>
<td>Indicated</td>
<td>Indicated, but prefer to use lower risk regimen instead</td>
</tr>
<tr>
<td>Intermediate (10-20%)</td>
<td>Indicated if at least 1 risk factor** present</td>
<td>Must demonstrate need; consider dose reduction before adding GCSF</td>
</tr>
<tr>
<td>Low (&lt; 10%)</td>
<td>Not indicated</td>
<td>Not indicated</td>
</tr>
</tbody>
</table>

Medication Use Evaluation
The scope was limited to adult oncology patients on FOLFOX, FOLFIRI, or FOLFIRINOX regimens between January and June 2016. These regimens are considered to be at an intermediate risk for causing febrile neutropenia.

Results

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Total Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients Reviewed</td>
<td>26</td>
</tr>
<tr>
<td>Total Pegfilgrastim Doses Administered</td>
<td>168</td>
</tr>
<tr>
<td>Patients with Inappropriate Initiation of GCSF</td>
<td>18 (69%)</td>
</tr>
<tr>
<td>Resulting Pegfilgrastim Doses administered</td>
<td>83 (49%)</td>
</tr>
</tbody>
</table>

A total of 83 doses that could have been avoided if guideline recommendations were followed. At a cost of $2,180.19 per unit dose, this translates to $180,955.77 in additional drug spend over a period of 6 months.

Impact
Approximately 1 million dollars of Mount Sinai Hospital’s annual drug spend was attributed to pegfilgrastim. Therefore, ensuring appropriate use was of the utmost importance. A majority of the pegfilgrastim use at our outpatient oncology infusion center was not shown to be consistent with NCCN and ASCO guidelines in the snapshot MUE. The estimated $180K in additional drug spend between January and June 2016 translated to a projected savings of $361,911.54 over 12 months. This represents approximately 30% of MSH’s annual drug spend on pegfilgrastim. The MSH oncology pharmacist discussed results with oncologists: pegfilgrastim was removed from all FOLFOX, FOLFIRI, and FOLFIRINOX chemotherapy order templates as initial therapy. For stage IV patients, it will only be added once they demonstrate need. An annual $360 K of cost-avoidance was anticipated.

$360,000 Annual Savings
Denosumab Initiative

The increasing use and cost of the monoclonal antibody denosumab (Xgeva®, Amgen) in our outpatient oncology infusion center prompted this medication use evaluation (MUE).

Denosumab is a fully human monoclonal antibody directed against nuclear factor-kappa ligand (RANKL) to prevent osteoclast activation. This leads to decreased bone resorption and an increase in bone mass. Xgeva is approved by the Food and Drug Administration (FDA) for the prevention of skeletal-related events (SREs) (ie: pathologic fracture, spinal cord compression, bone pain requiring surgery or radiation, hypercalcemia) in patients with bone metastases from solid tumors (ie: breast, lung, prostate).

Without treatment, Skeletal Related Events (SREs) will occur in up to 64% patients with metastatic breast cancer and up to 44% in patients with metastatic prostate cancer. SREs, particularly pathological fractures, are associated with increased healthcare costs and a decreased quality of life. For patients with solid tumors and bone metastases, the National Comprehensive Cancer Network (NCCN) and the American Society of Clinical Oncology (ASCO) recommend that a bisphosphonate (zoledronic acid, pamidronate) or denosumab (both Category 1 options) be given in combination with calcium and vitamin D supplementation for the prevention of SREs. The use of bone modifying agents in these patients is a palliative care measure and no studies to date have shown an impact on overall survival (OS).

Medication Use Evaluation

This MUE sampled a snapshot of patients receiving active treatment with Xgeva over a 6 month period between August 2016 and February 2017. Data collected included diagnosis, indication, and renal function.

<table>
<thead>
<tr>
<th>Results Timeframe: August 2016 – February 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients Reviewed</td>
</tr>
<tr>
<td>Total Xgeva Doses Administered</td>
</tr>
<tr>
<td>Total Xgeva Drug Spend ($2400/unit dose)</td>
</tr>
<tr>
<td>Patients Eligible for Conversion</td>
</tr>
<tr>
<td>Patients Not Eligible for Conversion to bisphosphate</td>
</tr>
<tr>
<td>Projected Xgeva Drug Spend After Conversion</td>
</tr>
</tbody>
</table>

Summary

Significant cost savings, an estimated 55% reduction in expenditure, was projected achievable through the use of zoledronic acid over denosumab. Denosumab has a higher drug acquisition cost, marginal benefit with reduction in SREs, and no added overall survival or disease progression benefit compared to zoledronic acid.

The MSH Oncology pharmacist collaborated with oncologists to develop a treatment algorithm: zoledronic acid was designated the preferred agent for treating patients with bone metastases from solid tumors and denosumab was reserved for the following cases:
1) Documented allergy to zoledronic acid
2) CrCl < 30 mL/min or borderline renal function (CrCl 30-40 mL/min)
3) Treatment failure on intravenous bisphosphonates

$188,000 Annual Savings
Other Oncology Cost Savings Measures

Dose Rounding
Current MSH policies allow dose rounding within 10% of the original calculated dose for both traditional chemotherapy and immunotherapy. This practice aligns with the most recent HOPA position statement on dose rounding.

Continued savings are realized through dose rounding, as approved by Chief Oncologist. From June through December 2016, in excess of $19,000 was spared.

Anticipated Benefit: Approximately $40,000 will be spared annually through order rounding

Oncology Quality Projects

Carboplatin Dosing Guidelines
Identifying need to standardize dosing for a drug with a very unusual dosing strategy, the MSH oncology pharmacist developed an easily usable guideline for dosing of carboplatin.

This guideline outlines principles of the Calvert Formula. For overweight or obese patients, the guideline provides guidance on when to use actual versus adjusted body weight for the creatinine clearance calculation. If not done correctly, this can greatly impact the calculated carboplatin dose and lead to unnecessary toxicities.

Non-Chemotherapy
The MSH Oncology pharmacist assumed responsibility for originating all orders for ancillary, non-chemotherapy agents in addition to chemotherapy.

This has allowed the oncology pharmacist to identify areas for improvement with regard to prescribing and monitoring of ancillary medications such as iron products, medications for bone health, erythropoiesis-stimulating agents, etc.
**Introduction**

Ambulatory Care Pharmacy services at Sinai Health System started slowly in 2012, with a sole pharmacist in a sole primary care clinic two afternoons weekly. In part, expansion of this service occurred as a consequence of results of a 2014-15 residency project addressing diabetic outcomes, with and without the services of a pharmacist.

Currently, we staff Ambulatory Care primary care with a pharmacist a full five days weekly – the two pharmacists cover three clinics, Lawndale Plaza, Antillas, and South State. Further, we also staff an HIV/Hepatitis C Clinic with an Infectious Diseases pharmacist four days weekly.

**Vaccinations**

Ensuring immunoprotection is an essential function of ambulatory care pharmacists. A pharmacist was integrated at Lawndale Plaza Clinic in January 2016 and in Antillas Clinic in May 2016. The pharmacist tailored patient immunization education at each visit AND provided continuous immunization education to the clinic staff. The graph, below, depicts the number of vaccination doses administered at the two clinics, combined, during 2015 and 2016, respectively.

Efforts to immunize a population, are front-loaded ... the initial work is the most challenging ... Of course, there are exceptions, such as annual influenza and milestone events, such as a 65th birthday. The graph, below, depicts:
Another key vaccine with dramatic increased vaccination rates: the pneumococcal conjugate vaccine (PCV 13)

Similarly, TDAP rates exponentially increased, also.
Process Improvement: Accurate Documentation
The pharmacist, inserted in the clinics, identified medical record documentation issues with vaccinations that had been ordered for patients. A significant percentage of vaccines not documented properly was noted by pharmacist: 19% in 2015 and 29% in 2016.

This lack of documentation could have affected a loss of almost $10,000 in reimbursement. Although the lack of documentation could simply signify that the vaccine was actually given, but, not documented and thus result in revenue loss; conversely, it could also signify that the order for vaccine was not acted upon (ignored), with no follow-up, and therefore potentially adversely impacting the health outcomes of the patient

- Ambulatory Care Pharmacists are committed to collaboration between clinic management / staff, physicians and quality department personnel.
  - They provide continuous education to staff / clinic
- The Pharmacists are now magnifying their effect beyond their clinics by seeking to resolve documentation issues in other system Clinics, and provide education/tools to facilitate the assurance of appropriate immunization.
Residency Project 2014-2015: Study of Impact of Ambulatory Care Pharmacist Actions on Diabetic Patients

Background
Community surveillance revealed diabetes prevalence of 29.1% in the Sinai System community. A 0.5 FTE ambulatory care pharmacist position was created to improve care and become an integral member of the diabetes management team.

- Every 1% increase in A1c leads to 18% increase in risk of cardiovascular disease (CVD)
- Improvement in A1c control (≤9%) associated with annual average of 2% decrease in hospitalization days
- Hazard ratio for mortality associated with poor A1c control (defined as HgbA1C > 9%) 1.78

Services Provided
- Medication management
  - Dose titrations for improving efficacy and decreasing adverse events (hypoglycemia)
  - Optimization of affordable medications
  - Drug interaction management
- Ensuring components of Comprehensive Diabetes Evaluation are followed
  - A1c results within past 2-3 months
  - Annual fasting lipid profile, including LDL-C
  - Annual urine microalbumin screen
  - Annual comprehensive foot examination including pulse palpation and monofilament exam
  - Annual retinal or dilated eye exam
- Customized diabetes education
- Facilitating access between patients, medical visits and medications
- Same-day appointments as physician visits
  - Only the treatment group met with members of the diabetes disease management team
  - Control group was restricted to patients who only met with the physician

In one year, patients with additional diabetes management had a 15% decrease in baseline HbA1c vs 5.6% decrease in patients with only physician visits

Patients in the diabetes management group had higher index of co-morbidities vs. the control group (5.4 vs. 2.8)
The diabetes management group outperformed the control group on all comprehensive diabetes evaluation measures:

- Patients in the treatment group had an average of 4.2 additional visits with the pharmacist
- Compared to an average of 3 visits with dietitian, 2 visits with social worker, and 2.2 visits with nurse
- Follow-up telephone calls - 66 were performed by the pharmacist out of 189

Considerations:

- Ambulatory care pharmacist had a positive effect on patient care:
  - Greater improvement in HbA1c levels (10% more than doctor visits alone) – decreases risk of cardiovascular disease
  - Patients were more likely to follow-up with other exams
  - Demonstrated great leadership and production - highest number of average visits and handling a third of all follow-up phone calls
- Patients followed by the pharmacist were often sicker with more comorbidities
- Improvement in HbA1c has shown to decrease risk of cardiovascular disease, hospitalization days, and mortality
Current State: Impact of Ambulatory Care Pharmacist Actions on Diabetic Patients

Significant improvement in diabetic management was detailed in the above residency project; subsequently, expansion occurred in pharmacist ambulatory care services at Sinai. Pharmacy services, to varying degrees, are available at 3 distinct clinics. Focusing on one clinic, a total of 937 visits with a pharmacist have been documented; these visits cover 604 patients. One hundred sixty-two of these patients have DM.

As delineated in the residency project, above, the ambulatory care pharmacists have confirmed their ‘value added’ to the process by continuing to impact A1c levels.

Current State: Care Distribution of Ambulatory Care Pharmacists

The services currently provided at the 3 primary care clinics are broad and comprehensive. In fact, over the course of 16 months, 1510 patients were seen and 3831 actions taken on behalf of those patients, a rate of 2.5 actions per patient encounter and 3.9 actions per each individual patient! Clearly, the pharmacist is an integral provider in the clinic setting!

The table, below, details the breakdown of the 2.5 actions per clinic encounter and 3.9 actions per individual patient.

<table>
<thead>
<tr>
<th></th>
<th>Education</th>
<th>M</th>
<th>T</th>
<th>M</th>
<th>Preventative Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL Actions per 3831 Clinic Encounters</td>
<td>1921</td>
<td>1619</td>
<td>291</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Action per Patient Clinic Encounter Ratio</td>
<td>1.3</td>
<td>1.1</td>
<td>0.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Action per Individual Clinic Patient Ratio</td>
<td>1.9</td>
<td>1.7</td>
<td>0.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The graph, below, illustrates the distribution of ambulatory care direct patient care actions by pharmacists, on limited days, in 3 distinct clinics over a 16 month period.

- **Education**
  - Disease Management
  - Medication Education
  - Medical Device Education

- **Medication Management**
  - New Medication Start
  - Medication Stop
  - Care Guideline Update
  - Medication Therapy Adjustment
  - Medication Access
    - Managed Refill Request – resulting in Refill or Deny
    - Prescription Medication Verification
    - Prior Authorization

**Ambulatory Care Pharmacist Actions**
May 16 - Aug 17, n = 3831 for 1510 Pt Encounters

- **Preventive Actions** 8%
- **Medication Therapy Management** 42%
Ambulatory Care: HIV

Background: HIV and the co-morbidities of Hypertension (HTN) and Diabetes Mellitus (DM)

Metabolic syndrome in HIV patients is associated with five- to eightfold increase in DM. Protease Inhibitors (PIs) are associated with a threefold increase in DM. PIs inhibit uptake of glucose by insulin-sensitive tissues and inhibit the glucose transporter GLUT-4. HTN affects 36.5% of persons living with HIV compared with 31.0% of the general population. HTN increases the risk for cardiovascular disease. There is no direct association of ARVs with HTN. Prolonged use of ARVs has been theorized to induce HTN due to a pro-inflammatory environment.

There have been multiple studies evaluating the impact on DM or HTN outcomes in patients receiving pharmacist management or usual care. Studies have shown statistical significance with pharmacist management on the decrease in A1c and the percentage of patients meeting DM treatment goals. Similarly, studies have shown statistical significance with pharmacist management on blood pressure achievement in HTN patients. Conversely, limited studies have been published evaluating the impact of ambulatory care pharmacy services on the outcomes of diabetes and hypertension in HIV positive patients and the correlation of HIV viral suppression with DM and HTN outcomes.

HIV ambulatory care pharmacists have many roles included but not limited to, initiate and modify ARV regimens, identify and assist with medication access, treatment adherence and counseling, disease state education, monitor adverse effects, most accessible health care professional. Mount Sinai Hospital (MSH) Infectious Diseases (ID) Clinic serves an indigent, underserved population in a safety-net hospital and provides disease state management services for HIV, hepatitis, sexually transmitted infections (STIs) as well as other infectious diseases. In October 2015, ID ambulatory care pharmacy services were implemented in a clinic primarily managed by ID physicians and case managers. Pharmacy services in the ID clinic include medication services (reconcile home medications, identify and assess medication access, avoid medication interruptions, initiate and modify ARV regimens, counsel on new medications or medication changes), education (disease state, nutrition, physical activity, safe sex practices) and assist in treatment adherence (one week follow up phone calls, weekly or monthly adherence visits).

PGY1 Residency Project
The primary objective was to retrospectively evaluate clinical outcomes in HIV positive patients with diabetes, hypertension or both before and after the implementation of ID ambulatory care pharmacy services. The secondary objectives were to correlate virologic suppression with controlled DM, HTN or both and to analyze the types of pharmacists’ interventions. Hemoglobin A1c and blood pressure goals will follow the American Diabetes Association (ADA) and the Eighth Joint National Committee (JNC 8) Hypertension Guidelines. The ADA defines goal A1c to be < 7%. A total of 38 and 31 similar patients were assigned too Phase I and Phase II, respectively.
Primary Outcome:

![Patients Who Achieved Treatment Goal](chart1.png)

Secondary Outcomes:

**Virologically Suppressed Patients Who Met Treatment Goal**

![Pharmacist Interventions](chart2.png)

**Conclusions**

A pharmacist staffed in the HIV Clinic led to improved DM and HTN outcomes in HIV patients. Twenty-five percent more patients achieved goal A1c. Thirty-seven percent more patients achieved goal BP. Twenty-seven percent more patients achieved goal A1c and BP. In phase II patients who virologically suppressed were more likely to achieve DM and HTN goal.
Transitions of Care

Evolution of TOC

2010 - 11
- HP [Project Red]
  - Readmission Reduction Pilot
  - with APPE students
- Focus HF & Medication Ed with post-discharge phone calls
- Started late 2010

2011 - 12
- HP [Project Red]
  - Readmission Reduction with PGIY residents in TOC longitudinal rotation
- Focus HF & Medication Ed with post-discharge phone calls

2012 - 13
- Continuation HF
  - Project: Readmission Reduction, with PGIY residents in TOC longitudinal rotation
- Focus HF & Medication Ed with post-discharge phone calls

2014 - 15
- Project: resident functioned as TOC pharmacist x 2 months

2016 - 17
- Late 2016: Hiring of 2 TOC Pharmacists & Discharge Technician

Background
- In 2012, the Centers for Medicaid and Medicare Services (CMS) launched the Hospital Readmissions Reduction Program (HRRP). Under this program, hospitals were penalized for patient readmissions within 30 days for the same medical condition for the following conditions:
  - Acute myocardial infarction (AMI), Heart failure (HF), Pneumonia (PNA), Acute exacerbation of chronic obstructive pulmonary disease (COPD), Elective total hip arthroplasty (THA) and knee arthroplasty (TKA)
- Transitions of Care (TOC) is the movement of a patient from one setting of care to another, representing a vulnerable period where medication errors are likely to occur.
- In order to address the HRRP, MSH implemented a Discharge Prescription Program led by an inpatient pharmacist with the help of a discharge technician. The discharge technician was informed of any potential discharges and was responsible for patient recruitment into the program. Unfortunately, there was suboptimal program participation and no TOC program was formally developed.

Objective
Assess the impact of pharmacists’ role in care transitions and reduction of 30-day hospital readmissions as compared to a technician based bedside discharge medication service alone.
METHOD: A retrospective, observational chart review after the development and implementation of a TOC program.

PRIMARY OUTCOME: Impact of TOC pharmacists on 30-day readmission rates as compared to only technician-based discharge medication services over a 3 month period.

INCLUSION CRITERIA: An admission to an inpatient medicine floor, >7 chronic medications at home, chronic comorbidities of DM, HF, and COPD.

STUDY INTERVENTIONS:
- TOC pharmacist documentation in the form of a discharge medication reconciliation.
- Post-discharge phone calls on days 3 and 14 with a repeat phone call the following day if no initial answer.
- Multiple no answers were documented in the same intervention to limit any inflation of interventions.

TOC DESIGN AND IMPLEMENTATION:

Create a TOC Team of 2 full time pharmacists and 1 discharge technician

TOC Service Design
- Weekly/bi-weekly meetings led by PGY2 resident and TOC pharmacists to discuss:
  - Triaging workflow with concise patient listing (IT), creating a phone call spreadsheet, logging interventions, APPE rotation, intervention templates/development, stratification of workflow, discharge rounds

Discharge medication reconciliation
Discharge prescription program
Post-discharge phone calls (days 3 and 14)

Planned Points of TOC Contact
### Pharmacy Discharge Prescription Program Alone: RESULTS

<table>
<thead>
<tr>
<th>DURATION</th>
<th>Oct 2015 – Dec 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall 30-day readmission rate</td>
<td>22%</td>
</tr>
<tr>
<td>Participation in discharge program + readmission rate</td>
<td>17%</td>
</tr>
<tr>
<td>Total # of discharges during study period</td>
<td>3904</td>
</tr>
<tr>
<td>Prescriptions collected over study period</td>
<td>264 (30.3% of all general medicine prescriptions)</td>
</tr>
</tbody>
</table>

### Current TOC Service - Phone Calls: RESULTS

<table>
<thead>
<tr>
<th></th>
<th>3 Day Phone Call</th>
<th>14 Day Phone Call</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N = 145 (%)</td>
<td>N = 145 (%)</td>
</tr>
<tr>
<td>Completed</td>
<td>74 (51)</td>
<td>65 (44.8)</td>
</tr>
<tr>
<td>Readmitted</td>
<td>11 (14.9)</td>
<td>10 (15.4)</td>
</tr>
<tr>
<td>Attempted (left voicemail)</td>
<td>49 (33.8)</td>
<td>39 (26.9)</td>
</tr>
<tr>
<td>Readmitted</td>
<td>9 (18.4)</td>
<td>6 (15.4)</td>
</tr>
<tr>
<td>Missed</td>
<td>15 (10.3)</td>
<td>29 (20)</td>
</tr>
<tr>
<td>Readmitted</td>
<td>4 (26.7)</td>
<td>8 (27.6)</td>
</tr>
<tr>
<td>Readmitted</td>
<td>7 (4.8)</td>
<td>12 (8.3)</td>
</tr>
</tbody>
</table>

### Current TOC Services: RESULTS

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Overall N = 145</th>
<th>3-Day Completion N = 74</th>
<th>14-Day Completion N = 65</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (SD)</td>
<td>59 (14)</td>
<td>61 (14)</td>
<td>60 (13)</td>
</tr>
<tr>
<td>Male (%)</td>
<td>64 (44.1)</td>
<td>32 (43.2)</td>
<td>30 (46.2)</td>
</tr>
<tr>
<td>Race (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>African American</td>
<td>91 (62.8)</td>
<td>43 (58.1)</td>
<td>36 (55.4)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>44 (30.3)</td>
<td>26 (35.1)</td>
<td>22 (33.8)</td>
</tr>
<tr>
<td>Caucasian</td>
<td>10 (6.9)</td>
<td>5 (6.8)</td>
<td>7 (10.8)</td>
</tr>
<tr>
<td># of Comorbidities (IQR)</td>
<td>4 (3,6)</td>
<td>4 (3,5)</td>
<td>4.5 (3,6)</td>
</tr>
<tr>
<td># of Chronic Meds (IQR)</td>
<td>8 (6,11)</td>
<td>8 (6,11)</td>
<td>9 (6,11)</td>
</tr>
<tr>
<td>Admission Reason (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COPD</td>
<td>28 (19.3)</td>
<td>17 (23)</td>
<td>16 (24.6)</td>
</tr>
<tr>
<td>Heart Failure</td>
<td>27 (18.6)</td>
<td>14 (18.9)</td>
<td>13 (20)</td>
</tr>
<tr>
<td>Chest Pain</td>
<td>24 (16.6)</td>
<td>8 (10.8)</td>
<td>6 (9.2)</td>
</tr>
<tr>
<td>Asthma</td>
<td>17 (11.7)</td>
<td>7 (9.5)</td>
<td>8 (12.3)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>10 (6.9)</td>
<td>6 (8.1)</td>
<td>2 (3.1)</td>
</tr>
<tr>
<td>Infection</td>
<td>10 (6.9)</td>
<td>6 (8.1)</td>
<td>6 (9.2)</td>
</tr>
<tr>
<td>Other</td>
<td>29 (20)</td>
<td>7 (9.5)</td>
<td>14 (21.5)</td>
</tr>
<tr>
<td>Readmitted 30 days post discharge (%)</td>
<td>32 (22.1)</td>
<td>11 (14.9)</td>
<td>10 (15.4)</td>
</tr>
</tbody>
</table>
Value-Added Services
Antimicrobial Stewardship

Background
Antimicrobial stewardship programs (ASPs) improve patient safety, quality of care, and significantly reduce the rate of hospital-acquired of *Clostridium difficile* infection (CDI).
- ASPs are endorsed by the CDC, IDSA, ASHP, and the Joint Commission

**Pharmacy-Led Antimicrobial Stewardship Program**
- Prior to the recent Joint Commission Medication Management (MM) standard for hospitals (Standard MM.09.01.01 which addresses antimicrobial stewardship) that became mandated on January 1, 2017, MSH had several important stewardship strategies in place that were supervised by ID specialized pharmacist and implemented by decentralized pharmacists. During MSH’s Joint Commission survey in June 2017, the surveyor did not address any compliance issues with our current program and praised our group for the processes currently in place.
- Pharmacy interventions
  - Recommend cost-saving alternative antimicrobials when high-cost antibiotics are ordered
    - Limiting use of IV route by recommending IV to PO conversion of antimicrobials when appropriate
    - Strategic restriction of high-cost and broad spectrum antimicrobials including daptomycin, piperacillin-tazobactam, carbapenems, liposomal amphotericin B, etc.
  - Re-evaluation of antimicrobials within 48 hours of antimicrobial initiation
    - Ensure appropriate microbial coverage based on indication
    - Evaluate microbiology, imaging, kidney function, lab values and vital signs and assessing the appropriateness of continuing antimicrobials
    - De-escalate antimicrobials as appropriate based on culture results
  - Antimicrobial optimization
    - Clinical follow-up notes to address antimicrobial adjustments based on drug-levels and site of infection
    - Use extended-infusion piperacillin-tazobactam, extended-interval aminoglycosides, and adequate dosing based on patient weight and infection type to optimize antimicrobial pharmacokinetic and pharmacodynamic parameters
    - Monitor duration of antimicrobials to ensure consistency with IDSA guidelines in order to prevent adverse effects, decrease costs, and reduce rates of resistance
    - Identify and prevent clinically significant drug-drug interactions with antimicrobials
    - Educate medical personnel on appropriate antibiotic regimens and stewardship interventions
- Utilizing MedMined® technology to aid in stewardship
  - Triggers created by the medication safety and ID pharmacist
    - De-escalation of therapy
    - IV to PO conversion
    - Bug-drug mismatch

**Drug Savings from Pharmacy-Led Antimicrobial Stewardship**
MSH overall antimicrobial use from 2015 through 2016 is significantly lower than teaching and non-teaching hospitals on a national and Midwest regional level.

**Total antibacterial utilization** (Days of therapy per 1000 days at risk)
- In 2015, 2016, and so far in 2017, MSH consistently has significantly lower rates of overall antibiotic use compared to teaching and non-teaching hospitals on a national and Midwest regional level (Figure 1)
Figure 1. Overall Antibiotic Utilization on a National Level

**Piperacillin/tazobactam**
- MSH exhibits considerably lower usage rates of piperacillin/tazobactam, a commonly used broad-spectrum antibiotic among national teaching and non-teaching hospitals (Figure 2)
  - At MSH, piperacillin/tazobactam maintains a remarkable 97% susceptibility to *Pseudomonas aeruginosa* isolates, a potentially life-threatening hospital-acquired organism known for antibiotic resistance
**Gram-positive antimicrobials**

- MSH use of high-cost gram-positive agents, such as daptomycin and linezolid, is significantly lower than other US institutions (Figures 3 and 4)
- Systemic vancomycin is a commonly prescribed antibiotic for empiric treatment of suspected gram-positive infections. When compared to other institutions, MSH uses vancomycin less often than other teaching hospitals and the institution has shown significant decreases in utilization within the last two quarters (Figure 5)
- Oral vancomycin, which is used for infections due to *Clostridium difficile*, is utilized significantly less compared to other U.S. institutions (Figure 6)

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**Figure 3. Daptomycin Utilization**

**Figure 4. Linezolid Utilization**
Other antibiotic drug class comparisons

MSH’s antimicrobial stewardship program has yielded multifaceted reduction in antibiotic utilization. Across multiple antibiotic drug classes, MSH is treating patients more efficiently with less treatment days compared to the rest of the nation.

- With 3rd and 4th generation cephalosporins, MSH is above current utilization rates of other U.S. hospitals and is a significant focus of our stewardship program. This increased utilization is due to our formulary restriction on piperacillin-tazobactam and thus heavier reliance on broad spectrum cephalosporins (Figure 7)
- Quinolone utilization has been a major success of our stewardship program in terms of decreasing overall in-house utilization rates and focusing efforts to decrease discharge prescriptions as well (Figure 8)
- Carbapenem utilization is closely scrutinized with its ID-restricted status, and thus utilization rates are significantly below other U.S. hospitals (Figure 9)
- Aztreonam use has been another target of this stewardship program given its high cost and suboptimal efficacy. From 2017 Q1 to 2017 Q2, there has been a marked decrease in utilization rates to levels similar to other U.S. hospitals (Figure 10)

Antimicrobial Stewardship

**Figure 7. 3rd/4th Generation Cephalosporin Utilization**

**Figure 8. Fluoroquinolone Utilization**
CDI is a serious adverse effect caused by improper antimicrobial usage that increases patient length of stay and healthcare costs.

- MSH’s ASP outperforms both teaching and non-teaching hospitals nationally in terms of low antibiotic use.
  - Appropriate antibiotic duration results in lower CDI rates.
- Additionally, proton pump inhibitor (PPI) usage is another risk factor for CDI, and MSH has demonstrated significantly lower PPI usage compared to other hospitals (Figure 12).
Mount Sinai stool nosocomial infection markers (NIMs) (surrogate for hospital-onset C diff) as % of all admissions is 44.1% lower than rates at teaching hospitals (0.24% of admissions at Mount Sinai vs. 0.44% of admissions nationally) - Figure 12A

- Each additional stool NIM costs Mount Sinai an additional $12,318 and 9.3 days length of stay.
- Current additional cost of CDI (Q3 2016 to Q2 2017) at MSH is $531,014 at MSH Stool Rate of 0.24%.
- Extrapolated to an Academic Hospital Average (0.44%) the cost would be $973,526 – Figure 12B
- This represents a cost avoidance of $442,512 at MSH in preventing C. difficile infections.

Figure 12A. MSH stool NIMs: Q3 2016 to Q2 2017
Figure 12B. Costs due to stool NIMs: Q3 2016 to Q2 2017

Figure 12. PPI Utilization
Considerations

- Antimicrobial stewardship is implemented by all pharmacists in coordination with infectious diseases specialists.
- Appropriate antimicrobial therapy provides excellent outcomes while saving money on the drug budget.
- The 2016 IDSA Guideline for Antimicrobial Stewardship Program Implementation emphasized the importance of ASP interventions in order to improve patient outcomes, reduce adverse events including *Clostridium difficile* infection, improve rates of antibiotic susceptibilities to targeted antibiotics, and decrease overall hospital costs and antimicrobial spending (Clin Infect Dis. 2016;62(10):e51-e77).
- In a cost analysis study by the University of Maryland Medical Center (UMMC), the implementation of an antimicrobial stewardship program showed a 7-year decrease in antimicrobial spending of roughly $17,000,000. The year after the program was discontinued, antimicrobial spending increased by over $1,000,000. Although the type of hospital services and size of UMMC is very different than MSH, this study provides important evidence of the benefits of antimicrobial stewardship on antimicrobial spending (Infect Control Hosp Epidemiol. 2012; 33(4): 338-345).
- Educational programming focused on antimicrobial stewardship (i.e. grand rounds, medical resident conference, pharmacy development sessions) are utilized to spread knowledge and awareness as well as transform MSH practitioners into stewardship-minded individuals.
- An antimicrobial stewardship task force was created in order to facilitate stewardship-related projects and endeavors, track progress on current interventions, and identify areas for improvement of antimicrobial use. The stewardship taskforce consists of the inpatient infectious diseases pharmacist, infectious diseases attending physicians, infectious diseases outpatient pharmacist, microbiology supervisor, infection control supervisor, and other support members as needed.
- Outcomes of the antimicrobial stewardship program (drug utilization rates, CDI rates, cost-savings) will be tracked on a regular basis in order to identify areas for improvement and quantify the benefits of the program.
This table measures your institution’s oral administration for certain drugs and compares your institution’s rates against other teaching and non-teaching facilities in the US. Medication Stewardship Advisor can be utilized to alert you to IV to PO conversion opportunities. Contact your Account Manager for more information.

<table>
<thead>
<tr>
<th>Drug/Category</th>
<th>Your Institution</th>
<th>Teaching</th>
<th>Non-Teaching</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quinolones*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Azithromycin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluconazole</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linezolid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metronidazole</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voriconazole</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proton Pump Inhibitors*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 13. IV to PO Comparisons
Timeline of Recent Major Antibiotic Stewardship-Related Activities

12/5/16
Rapid Blood Culture Identification (Biofire) Implemented

2/2017
Creation of Antimicrobial Stewardship Rotation for Pharmacy Residents

6/22/17
Joint Commission Survey on Antibiotic Stewardship Policy and Procedure

1/1/17
Mount Sinai Antimicrobial Stewardship Policy Approved through P&T

4/2017
P&T approval of Updated Empiric Pneumonia and Meningitis Guidelines

7/2017
IM Grand Rounds Abx Stewardship SMG/PHO Monthly Meeting Abx Use in Bronchitis

Stewardship Activities:
- Utilize MedMined reports and decentralized pharmacists to identify and subsequently intervene on inappropriate or suboptimal antibiotic use (drug-bug mismatch, de-escalation, IV to oral conversion)
- Formulary restriction requiring ID Attending approval
- Antibiotic stewardship education to providers, pharmacists, etc.

Current/Upcoming Stewardship Projects:
- Dan Carlsen, PGY1 Pharmacy Resident: Clinical Outcomes in Blood Stream Infections Associated With Implementation of BioFire’s PCR-Rapid Diagnostic Tool
- MSH Empiric Antibiotic Guidelines
- Medication Use Evaluations: Aztreonam, vancomycin usage and dosing, abx duration of therapy
Medication Assistance Program

Background
- Medication assistance or drug replacement program is designed to assist indigent populations in filling their prescriptions
  - Medication assistance program – manufacturer patient assistance programs and other cost-savings programs designed to ease the burden of affordable medication for patients
  - Drug replacement program – manufacturer programs that allow for replacement of medications used on indigent patients
    - Directly decreases overall pharmacy drug costs

Medication Assistance Process

Referral
- MD enters referral for medication assistance program

Assistance
- Social worker and pharmacy technician help fill out manufacturer assistance forms for patient
- Explore Medicaid enrollment, 30 day trials

Enrollment
- Patient able to continue medication regimen
- Avoid large financial burdens
- Improved adherence

Considerations
- Investigating stent recovery for indigent patients and high dollar inpatient drug recovery
- Current position also includes pharmacy operation and leadership responsibilities
  - Assists with maintaining pharmacy automation
  - Trains new employees on how to use pharmacy automation
  - Assists pharmacists working in clinics with medication assistance process
  - Bills anticoagulation clinic patient visits
  - Assures compliance with the drug recall policy and utilizes the Drug Recall software for completion and documentation of tasks
  - Ensures that all pharmacy areas at Schwab Rehabilitation Hospital that contain drug inventory will be inspected and maintained on a monthly basis
Insulin Dispensing Procedure

Background
Insulin is one of the top five high-alert medications. The consequences of an error with a high risk medication are more devastating to patients.

- Insulin has a low therapeutic index and complex dosing.
- Safe insulin storage practices are necessary to reduce such errors from occurring

Safety Issue
- Hospitals often store insulin vials on the nursing units (i.e. “floor stock”) for ease of use.
- Long-acting and intermediate-acting insulin are not emergently needed on the units
- Storing all short and long-acting insulins on the units may create a situation for a nurse to choose the wrong insulin for administration
- The MSH Medication Safety Committee agreed to remove long-acting and intermediate-acting insulin from the nursing units to improve patient safety

Intermediate and Long-Acting Insulin Dispensing Procedure

Financial Impact
- Before the dispensing procedure was implemented, MSH was purchasing 28 vials of insulin glargine per month or 336 vials per year
- In 2014, MSH purchased just 99 vials
- At $151 per vial, MSH saw a cost savings of $36,000 in reduced waste from one insulin alone
- $10,000 savings was observed with the intermediate and mixed insulins

Conclusion
- Pharmacy reduced drug spend and improved patient safety
Palivizumab Monitoring Program

Background
- Respiratory syncytial virus (RSV) is a respiratory virus that will cause a pulmonary disease in up to 80% of children by the time they turn 2 years old
  - Children with certain conditions may need to be hospitalized, but the treatment is supportive
- Palivizumab (Synagis®) is used for prophylaxis of eligible infants from a severe viral infection caused by RSV
  - Prevents re-hospitalizations soon after discharge
- Its use is considered a standard of care but published guidelines from the American Academy of Pediatrics may change patient eligibility on a yearly basis
  - New research clarifying appropriate indication and outcome benefits
  - High cost ($1,200 per 50 mg)
- Prior to implementation of guideline usage, all neonates born less than 35 weeks of gestational age received a dose of palivizumab (majority of NICU patients)

Pharmacy-Led Palivizumab Monitoring Program
- Palivizumab monitoring program was implemented by the pediatric pharmacy specialist in coordination with neonatology
- On daily basis, a clinical pharmacist facilitates proper utilization of the guideline
- Pediatric pharmacist follows up with residents and attending physicians on potential discharges
- All eligible patients are tracked in a systematic way to ensure accuracy
- In order to reduce medication waste, eligible patients to be discharged in the same timeframe are also given a dose

Drug Savings from Pharmacy-Led Palivizumab Monitoring Program

<table>
<thead>
<tr>
<th>Vial Size</th>
<th>Vial Cost</th>
<th># of Vials</th>
<th>Cost</th>
<th># of Vials</th>
<th>Cost</th>
<th># of Vials</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 mg</td>
<td>$1,242.70</td>
<td>18</td>
<td>$22,368.60</td>
<td>7</td>
<td>$8,698.90</td>
<td>14</td>
<td>$17,397.80</td>
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<tr>
<td>100</td>
<td>$2,348.46</td>
<td>28</td>
<td>$65,756.88</td>
<td>27</td>
<td>$63,408.42</td>
<td>13</td>
<td>$30,529.98</td>
</tr>
<tr>
<td>Subtotal</td>
<td>$88,125.48</td>
<td>$72,107.32</td>
<td>$47,927.78</td>
<td>$13,258.88</td>
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<tr>
<td>Pre OS Spending</td>
<td>$160,232.80</td>
<td>Post OS Spending</td>
<td>$61,186.66</td>
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</tr>
</tbody>
</table>

Total Savings + $99,046.14

Considerations
- Appropriate palivizumab therapy reduces admissions with RSV while saving money on the drug budget
- Since the implementation of the guideline by pharmacy in the fall of 2013, Mount Sinai Hospital has saved approximately $100,000
Drug Spend Report

Background

- 3 drug accounts with AmerisourceBergen
  - Group purchasing organization (GPO) - inpatient account for medications used in-house
  - 340B – account for medications used on the outpatient level
    - Mostly consists of expensive oncology and dialysis medications
  - Wholesale acquisition cost (WAC) – medications must be purchased in this account before receiving discounts on GPO and 340B accounts
    - WAC prices are more expensive than GPO and 340B
    - GPO Prohibition in August 2013 may
- FFF enterprise – blood, plasma, vaccine, and factor products are bought from here
- Compounding pharmacy – purchase compounded IV drugs for commonly used medications
  - Extended beyond use dating
  - Reduce medication errors
  - Allows staff to focus on immediate, STAT IV medications
**Benchmarking Data by Drug Class**

Facility Supply Chain Performance  
Data from OPERATIONSADVISOR® and SUPPLYFOCUS®

Pharmacy Expense by Therapeutic Class  
Quartile figures are threshold values.  
Reporting Period: 7/1/2014 - 9/30/2014 - 3Q

<table>
<thead>
<tr>
<th>Pharmacy Expense Indicators</th>
<th>Quartile</th>
<th>Opportunity to Next Quartile</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti-infective $ per AAD</td>
<td>1</td>
<td>$0</td>
<td>Daily pharmacist involvement</td>
</tr>
<tr>
<td>Anti-infective $ per AAPD</td>
<td>1</td>
<td>$0</td>
<td>Daily pharmacist involvement</td>
</tr>
<tr>
<td>Antihemorrhagic $ per AAD</td>
<td>1</td>
<td>$0</td>
<td>Rarely used medications - pharmacist act as gatekeepers</td>
</tr>
<tr>
<td>Antihemorrhagic $ per AAPD</td>
<td>1</td>
<td>$0</td>
<td>Rarely used medications - pharmacist act as gatekeepers</td>
</tr>
<tr>
<td>Blood Deriv &amp; IVIG $ per AAD</td>
<td>1</td>
<td>$0</td>
<td>Rarely used medications - pharmacist act as gatekeepers</td>
</tr>
<tr>
<td>Blood Deriv &amp; IVIG $ per AAPD</td>
<td>1</td>
<td>$0</td>
<td>Rarely used medications - pharmacist act as gatekeepers</td>
</tr>
<tr>
<td>Antifungal $ per AAD</td>
<td>2</td>
<td>$1,142</td>
<td>Daily pharmacist involvement</td>
</tr>
<tr>
<td>Antifungal $ per AAPD</td>
<td>2</td>
<td>$1,467</td>
<td>Daily pharmacist involvement</td>
</tr>
<tr>
<td>Antineoplastic $ per AAD</td>
<td>3</td>
<td>$213,343</td>
<td>Includes outpatient purchases - not reflective of inpatient practice</td>
</tr>
<tr>
<td>Intra-op CNS drug $ per AAD</td>
<td>3</td>
<td>$5,652</td>
<td>Anesthesia medications - physician operated</td>
</tr>
<tr>
<td>Intra-op CNS drug $ per AAPD</td>
<td>3</td>
<td>$7,578</td>
<td>Anesthesia medications - physician operated</td>
</tr>
<tr>
<td>Antineoplastic $ per AAPD</td>
<td>4</td>
<td>$17,318</td>
<td>Includes outpatient purchases - not reflective of inpatient practice</td>
</tr>
<tr>
<td>Blood Coag &amp; Thromb $ per AAD</td>
<td>4</td>
<td>$14,481</td>
<td>Data needs to examined further - potential area of improvement</td>
</tr>
<tr>
<td>Blood Coag &amp; Thromb $ per AAPD</td>
<td>4</td>
<td>$14,357</td>
<td>Data needs to examined further - potential area of improvement</td>
</tr>
<tr>
<td>Hematopoietic $ per AAD</td>
<td>4</td>
<td>$35,352</td>
<td>Includes outpatient purchases - not reflective of inpatient practice</td>
</tr>
<tr>
<td>Hematopoietic $ per AAPD</td>
<td>4</td>
<td>$51,810</td>
<td>Includes outpatient purchases - not reflective of inpatient practice</td>
</tr>
<tr>
<td>Toxoid &amp; Vaccine $ per AAD</td>
<td>4</td>
<td>$88,486</td>
<td>Nursing driven protocol - area of improvement</td>
</tr>
<tr>
<td>Toxoid &amp; Vaccines $ per AAPD</td>
<td>4</td>
<td>$106,973</td>
<td>Nursing driven protocol - area of improvement</td>
</tr>
<tr>
<td>Intra-op CNS drug $ per OR Case</td>
<td>-</td>
<td>-</td>
<td>Anesthesia medications - physician operated</td>
</tr>
</tbody>
</table>
Executive Summary

- MSH/SRH has very favorable benchmarking against like hospitals with regard to drug expenses and staffing → almost at 25% percentile for non-teaching and well below 25th percentile for teaching hospitals.
- Labor represents only 21% of the total pharmacy budget (inpatient, oncology, dialysis, spasticity, fluids).
- CMI - We will compare ourselves against community and teaching.
  - The 75th percentile community facility has a CMI of 1.8 and Mount Sinai Hospital CMI is 1.7.
  - The 25th percentile teaching facility has a CMI of 1.9 and at Mount Sinai Hospital CMI is 1.7.
- Drug price per admission $397 is ranked 30th percentile for community hospital and performing better than 25th percentile for teaching hospitals.
- The median facility in the community group reports that pharmacy is responsible for 6.0% of total hospital expense and the 25th percentile facility on this metric reports that pharmacy operations are accountable for 5.1% of total expense. At Mount Sinai, the pharmacy department is responsible for 4.0% of total hospital cost.
- Going from 30th percentile to 50th percentile in drug cost per admission will cost $1.6 million in additional drug expenses.
- Removing critical staffing (technicians and pharmacists) will result in higher drug expenses due to elimination of intricate drug saving strategies associated with the individual pharmacist and technician positions.
- Multi-disciplinary rounds with clinical pharmacists are an integral component to quality outcomes and cost-effective therapeutic streamlining.

The Lazarus Report

The 2017 Lazarus Report benchmarks MSH pharmacy performance against both community and teaching hospitals in staffing measures, ambulatory services, and cost measures using data from 2015-2017. Although not perfectly aligned for comparison with national benchmarks against community or teaching hospitals, MSH pharmacy continues to reduce drug costs and outperform in both categories.
This data represents budget reductions already made for FY18

<table>
<thead>
<tr>
<th>LAZARUS REPORT</th>
<th>Non-Teaching/Community Group</th>
<th>MSH Community Results</th>
<th>Teaching Group</th>
<th>MSH Teaching Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25&lt;sup&gt;th&lt;/sup&gt; %ile</td>
<td>50&lt;sup&gt;th&lt;/sup&gt; %ile</td>
<td>75&lt;sup&gt;th&lt;/sup&gt; %ile</td>
<td>25&lt;sup&gt;th&lt;/sup&gt; %ile</td>
</tr>
<tr>
<td><strong>Staffing Measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pharmacists per 100 beds</td>
<td>5.6</td>
<td>7.4</td>
<td>10.4</td>
<td>11.4</td>
</tr>
<tr>
<td>Non-pharmacists per 100 beds</td>
<td>3.3</td>
<td>5.1</td>
<td>7.2</td>
<td>5.3</td>
</tr>
<tr>
<td>Admin per 100 beds</td>
<td>0.5</td>
<td>1.1</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>% of Beds ICU</td>
<td>7%</td>
<td>10%</td>
<td>12%</td>
<td>10%</td>
</tr>
<tr>
<td><strong>Cost Measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drug cost per admission</td>
<td>$336</td>
<td>$494</td>
<td>$629</td>
<td>$397</td>
</tr>
<tr>
<td>Drug cost per patient day</td>
<td>$81</td>
<td>$103</td>
<td>$129</td>
<td>$76</td>
</tr>
<tr>
<td>Pharmacy Cost as % of Hospital Cost</td>
<td>5.1%</td>
<td>6.0%</td>
<td>6.8%</td>
<td>4.0%</td>
</tr>
<tr>
<td>Case Mix Index (CMI)</td>
<td>1.3</td>
<td>1.5</td>
<td>1.8</td>
<td>1.7</td>
</tr>
</tbody>
</table>

Compared to its peers, MSH pharmacy is out-performing in cost measures. Actual dollars saved per admission and patient day against all percentile benchmarks is shown below.

### MSH Pharmacy Drug Cost Comparisons to Current Inpatient Benchmarks

<table>
<thead>
<tr>
<th></th>
<th>25&lt;sup&gt;th&lt;/sup&gt;</th>
<th>50&lt;sup&gt;th&lt;/sup&gt;</th>
<th>75&lt;sup&gt;th&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-teaching/Community</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drug cost per admission</td>
<td>Opportunity to save $1,008,940</td>
<td>($1,604,380)</td>
<td>($3,837,280)</td>
</tr>
<tr>
<td>Drug cost per patient day</td>
<td>Below 25&lt;sup&gt;th&lt;/sup&gt; percentile</td>
<td>($2,330,775)</td>
<td>($4,575,225)</td>
</tr>
<tr>
<td><strong>Teaching Hospitals (academic &amp;</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drug cost per admission</td>
<td>($8,501,560)</td>
<td>($11,875,720)</td>
<td>($14,125,160)</td>
</tr>
<tr>
<td>Drug cost per patient day</td>
<td>($7,682,925)</td>
<td>($8,891,475)</td>
<td>($10,359,000)</td>
</tr>
</tbody>
</table>
Personnel costs account for 21% of MSH pharmacy budget and are a major contributor to decreased drug costs. This decrease in drug expenses from services provided by pharmacy personnel more than compensates for the current personnel costs (see examples below on next page).
Pharmacy staffing is required to maintain drug expense reduction strategies. Please see examples below.

Cost Saving Strategies

The prepack technician packages bulk items (heavy workload) into unit dose forms, resulting in annual savings of $130,000 in drug costs net of labor expenses.

The swing shift technician draws up all daily patient specific insulin doses (vs sending whole vials) resulting in a ROI of $350,000 per year net of labor expenses.
The IV room technician compounds medications in batches with an annual cost savings of $260,000 net of labor expenses.
Mission Statement

The Pharmacy Department’s mission is to provide evidence-based, cost-effective and safe drug therapy, with the purpose of attaining optimal patient care outcomes. To achieve this, maximization of technology and the emphasis on education, training, and development of pharmacy staff are prioritized.

The Pharmacy Department at Mount Sinai Hospital has been working towards the objectives of our Mission Statement over the past 8 years. Evidence based interventions are formulated and presented to healthcare team and to create hospial wide order sets and guidelines. Cost effective and safe drug therapy is implemented in medication replacement, reduction, dosing, monitoring, ambulatory care services, and transitions of care – with the goal of attaining optimal patient care outcomes.

By staying up to date with current technological advances and providing education to pharmacists and technicians we are able to offer safe, efficient, and complete care for our patients.