Mount Sinai Hospital
Department of Pharmacy

Introduction

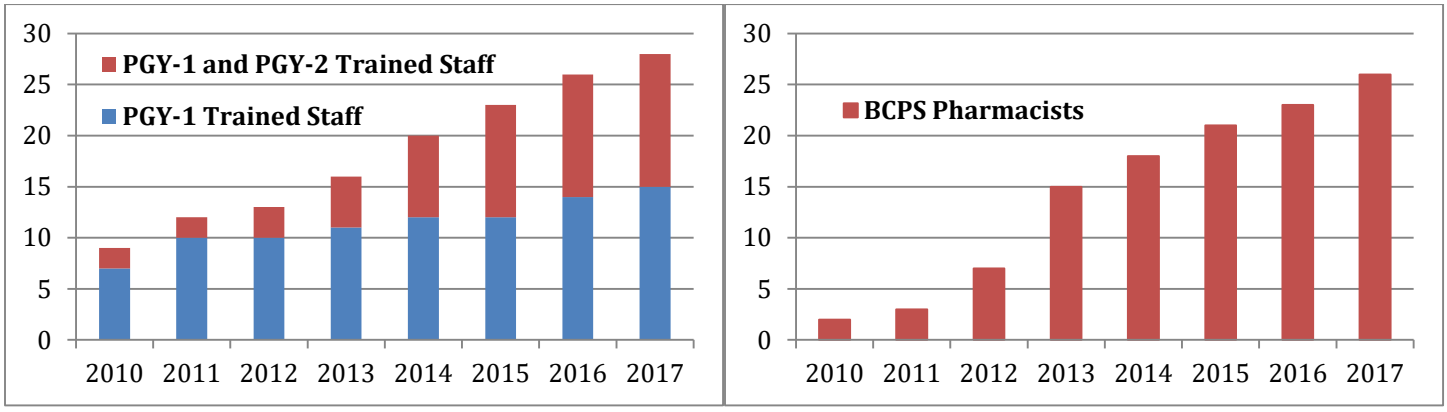
Mission

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. In 2009, there were no board certified pharmacists on staff and now, in 2020, 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, over 40% of our 30 graduates (through 2020) 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

Introduction to Health-System Quality Initiatives
Generated by PGY1 Pharmacy Residency Program

Graduating Classes from 2012 - Present

Year	Project name	Resident	Preceptor	Brief Project Description	Impact or Practice Δ
2019-20	β-lactam Allergies (BLA): Optimizing Antibiotic Selection and Documentation Quality	Stephany Fournier	Jason Alegro Karen Trenkler Ann Wehmeyer	Optimization of BLA documentation and Improving Antibiotic Selection in those patients (by measuring impact on aztreonam use) • Large baseline MUE (aztreonam and levofloxacind) & identified OFI, then developed proposal approaches ACTION • Implementation of aztreonam prescribing criteria ▪ Prescribers must enter allergy history, evaluate previo\us administration of β-lactams, and have appropriate indication for aztreonam ▪ Criteria reviewed by pharm prior to verification ▪ Clinical Intervention documentation required for each aztreonam order • Prescriber education ▪ Presentations for internal medicine, surgery, and family medicine services ▪ Circulation of educational PowerPoint via shared drive for future reference • Pharmacist education ▪ Development of pharmacist module ▪ Education on doc of clinical intervention ▪ Circulation of educational PowerPoint via email/shared drive for future reference	- Looking at the baseline aztreonam MUE, pharmacists documented an allergy intervention in only 10% of patients POST-implementation: Subsequent to the resident actions (March through May), 67 % of aztreonam patients had allergy interventions documented - 95.7% (100% in the last two months) of aztreonam orders were appropriate per the hard-wired aztreonam criteria in EMR - 12.5% ↓ in aztreonam used Mar/Apr 2019 vs 2020
2019-20	Optimization of Diltiazem IV Use in ED	Spencer Kruggel	Karen Trenkler Jaxson Burkins	Appropriate use of diltiazem IV in treatment of atrial fibrillation in ED. • Conducted large baseline MUE & identified OFI, then developed proposal approaches ACTION • Collaboratively developed a guideline with ED physicians, • Developed EMR administration criteria for diltiazem IV AND • Provided brief educational sessions FOLLOW-UP: Thereafter, he conducted a follow-up MUE: although a	Preliminary Improvement - Results - Adequacy of IVP dosing increased by 34% from 60 to 81% - reliance on diltiazem continuous infusions trended downward ?

				relatively short study period,	
2019-20	Discharge Prescribing Patterns in Patients Admitted with Heart Failure with Reduced Ejection Fraction or Acute Myocardial Infarction	Gina Chernia wski	Maureen Barnes-Israel Amulya Murthy Karen Trenkler	Review of MSH discharge prescription trend for key cardiac admission (HF and AMI), large study of 297 patients. Results, HF discharges – in comparison to CHAMP. Missed opportunities for medication optimization - ACEI/ARB/ARNI : 21 vs 27 % - Beta-blocker: 8 vs 33% - MRA: 71 vs 67%	- MSH patients compare favorably with the landmark CHAMP-HF study (likely due to strong collaborative efforts between our TOC pharmacist and the med residents/prescribers). - TOC pharmacist interventions were associated with a reduction in readmission rates for patients treated for heart failure exacerbations
	<u>TOC Services in ED / Observations</u>	" "	Maureen Barnes-Israel Amulya Murthy Karen Trenkler	Evaluation of impact of TOC services in the ED by providing services for almost 2 months	Gina demonstrated significant impact of ED TOC services; however, she was unable to implement actions due to COVID crisis.
2019-20	**<u>Darbepoetin Use Optimization in HemoDialysis CLinic</u>**	Michael Bolnaos	Thomas Yu Karen Trenkler	Optimization of Darbepoetin use in the HD Clinic. A large, comprehensive MUE was conducted and the data analyzed. OFI identified, with conclusions • Dose escalation and time of titration were suboptimal (per KDOQI) • Iron supplementation was suboptimal • Variable regimens for both ESAs and iron sup may have lead to suboptimal response – Study population net hemoglobin + 0.16 g/dL • Further pharmacist involvement may optimize overall ESA outcomes	Unfortunately, due to timing and COVID crisis, he was not able to implement any of the improvements that had been identified by the analysis in baseline darbepoetin usage evaluation
2018-19	*Effect of Vasopressor Discontinuation on Hemodynamic Stability in Septic Shock*	Kendall Galarza	Basi Sanuth	- Baseline Evaluation of vasopressor use - Action - ICU Order Set & Guidelines - Comprehensive clinical staff education o MD, RNs, Pharmacists	The results of the study demonstrated that discontinuation of vasopressin prior to norepinephrine led to several suboptimal outcomes: - ↑'d incidence hypotension - ↑'d ICU LOS - Higher mortality

					rate - No cost benefit Study results affected a practice change, with update in the Sepsis guidelines
2018-19	Regadenoson (Lexiscan®) Optimization in Stress Testing	Kasia Plis-Cyran	Tejal Patel, Zahra Khudeira	- Baseline Evaluation: only 62.5% of regadenoson was appropriately used in the inpatient setting ACTION - Due to large non-reimbursable drug cost in this setting, initiatives were implemented to ↓use of lexiscan in patients who were able to tolerate exercise and who did not have contraindications o Order set development, o Updates to guidelines, and physician education. Follow-up Evaluation	- Relative 21.6% improvement in appropriateness of regadenoson use was demonstrated - Improvement approximates an annual savings of $40,000 for MSH. - Further benefit anticipated: expansion of order set to Holy Cross Hospital is planned, yielding additional cost savings
2018-19	*VANCOMYCIN STEWARDSHIP*	Vanessa Hutzley	Jason Allegro, Karen Trenkler	- Baseline Evaluation of vancomycin use ACTION: resident-provided vancomycin stewardship - For a two week period, the resident actively evaluated ALL vancomycin orders for appropriateness, excluding surgical prophylaxis Comparison of Vancomycin Utilization: Baseline vs Resident-provided Stewardship Results - 18 of 47 orders were D/C'd by resident: D/C or discontinuance ensures NO more doses administered - Savings occurred NOT only in ↓'d drug Acquisition Cost, but ALSO o INDIRECT Savings, including ▪ Laboratory reagent ▪ Staff Time •Pharmacists •Lab staff •Prescribers •Nurses	On a broader level AND going beyond the vancomycin project, resident focused on MSH efforts on two key antibiotic areas 1. Development of an Antibiotic Time Out (ATO) Policy & Procedure (at 72 hrs) *and* 2. Implementation of a Required Indication Field in Meditech for all ordered parenteral antibiotics
2018-19	*OPIOID STEWARDSHIP of Post-Op Analgesic Discharge Prescriptions in a Community Teaching Safety-Net Hospital*	Anne Reda	Dallas Schepers / Zahra Khudeira	- Baseline Evaluation of discharge opioid prescribing - ACTION : Specific interventions designed and executed by a pharmacy resident: 1) elimination of range orders (inpatient and outpatient CPOE system) by	Result - Statistically significant ↓(p=0.039) in patient specific day supply, from 9.3 to 6.5 days, with % of prescriptions exceeding CDC recommendation of 3 day limit trending downwards, from 79% to

				removing 1 – 2 tablet strings; 2) addition of a CPOE prescriber alert at discharge when an opioid is prescribed, with reminder to review patient opioid requirement for the 24h period prior to discharge; and 3) prescriber education on optimization of opioid use Verification: follow-up MUE	60% (p=0.163). - Correspondingly, the mean tablet quantity / Rx prescription ↓'d significantly, from 35 to 22 (p<0.001) - Total oral morphine equivalents (OME) / Rx was ↓'d from 193.2 to 127.0 (p<0.001). - Further, multimodal pain management at discharge ↑'d from 18 to 38% (p=0.011)
2017-18	*Implementation of Reduced Dose Alteplase for Central Venous Catheter Clearance*	Esther Chung	Tejal Patel, Zahra Khudeira	- Baseline: comprehensive literature review, baseline MUE - Action: o Pharmacy education (including technicians) o Automation modification: CPOE change and change alteplase display o Physician education & Practice change and o Nursing efforts (Enhancement of EMar documentation, Development of mandatory Nursing Net Learning Module, Issuance of a Nursing Practice Alert). - Follow-up MUE	Result: Based on resident's small post-implementation study (which, importantly, demonstrated no difference in rate of catheter clearance), a minimum cost-savings of $13 K annually is anticipated for MSH alone - Now, as first detailed in the plan, all catheter clearance doses are prepared in the Pharmacy Clean Room.
2017-18	Second-Line Vasopressors in Septic Shock Patients	Krista Policchio	Basi Sanuth	- Baseline: retrospective analysis comparing use of epinephrine vs. vasopressin as second-line vasopressor in septic shock patients. Both epinephrine and vasopressin achieved similar shock outcomes– however, epinephrine resulted in increased incidence of arrhythmias, with a significantly lower cost than vasopressin. - ACTION - Based on the baseline MUE , physician/resident education was provided and Sepsis Order Set & Guideline (in late 2017) were optimized by delineating second-line vasopressor selection : epinephrine in patients without tachyarrhythmias and vasopressin those with tachyarrhythmias. Follow-up evaluation	Result Follow-up evaluation demonstrated ↓'d use of epinephrine in patients with tachyarrhythmias; however, vasopressin use increased overall – even in those patients without tachyarrhythmias. - Further education, reinforcing the data, was then provided. - Sidebar – use of third-line agent, phenylephrine ↓'d --- a drug with virtually no evidence-basis for use and thus quality of care was positively impacted by subsequently ↓ing use

2017-18	Impact of Incorporating a Pharmacy Resident into a Rapid Diagnosis Protocol for Bloodstream Infections	Daniel Carlsen	Jason Alegro, Karen Trenkler	- Baseline usage evaluation on appropriateness of hospital use of the Rapid Diagnostic Test. - ACTION - for a three month period, resident acted on RDT results, in the capacity of an Antimicrobial Stewardship pharmacist Comparison Baseline response to Resident-provided RDT Stewardship	- Results demonstrated that incorporating an antimicrobial stewardship pharmacist into RDT protocols for blood cultures : time to optimal therapy ↓'d (trending to significance) as did LOS - Trends were demonstrated, but statistical significance was not achieved because of prolonged 'down times' of evenings & weekends
2017-18	*Chronic Care Management Pays Off*	Lisa Do	Brooke Griffin, Julio Rebolledo	*Chronic Care Management (CCM)* is a topic at the 'cutting edge' of Ambulatory Care. CCM is defined as non-face-to-face services provided to Medicare beneficiaries (≥ 65 years) who have multiple (≥2) chronic conditions. Medicare may pay for a healthcare professional's help to manage those conditions in *non-face-to-face* interactions. Centers for Medicare and Medicaid Services (CMS) estimates 2/3 of Medicare beneficiaries, ≈ 35 million individuals, are eligible for CCM services . -CCM is overall cost sparing: in 2016 CMS paid out $52 million in CCM fees, but, realized a net savings $36 million. CCM is substantially underutilized in the entire Midwest Baseline: resident studied the patient population at two Sinai clinics, evaluating patient profiles for CCM opportunities - Estimates for the range of reimbursement potential were provided – possible revenues ranged from $530,000/year for 980 standard care patients to $556,000 for 472 complex care (e.g., Type 2 DM) patients.	Based on resident assessments, the resident estimated that it would be a reasonable workload for an ambulatory care pharmacist to conduct 10 x 20 minute phone calls per day, working 260 days per year for a total 0f 2600 standard interventions. - At the time of project completion, there was a continued ongoing study at Sinai Clinics. - Subsequently, pharmacists dedicate set hours to this function weekly.
" "	Evaluation of ibuprofen and indomethacin use in neonates with patent ductus arteriosus	Lisa Do	Kelli Covington, Karen Trenkler	• Baseline Evaluation: resident studied the two agents used in MSH NICU for closure of patent ductus arteriosus (PDA) – ibuprofen IV and indomethacin IV. In line with literature, Lisa found that IV ibuprofen and IV indomethacin are comparable in terms of rate of ductal closure. (Although not shown in Lisa's study (due to sample size), ibuprofen has with a more favorable intestinal and renal safety profile, per literature); further it is less costly. Acetaminophen was	*Improvement were targeted, based on lit review* 1) Using ibuprofen, when appropriate, to the extent possible – based on improved safety AND lower cost 2) Using ibuprofen orally in appropriate patients 3) Using acetaminophen

				demonstrated effective in 2011 and has since been incorporated into multiple major US NICUs treatment algorithms. Acetaminophen is associated with improved safety and lower cost that the historic standards, indomethacin &ibuprofen *Actions* - *Guidelines* - *Administration Criteria*	in appropriate patients
2016-17	Efficacy and safety of inhaled nitric oxide compared to inhaled epoprostenol in patients with acute respiratory distress syndrome	MinHa Kim	Basi Sanuth	- Baseline Evaluation ACTION - P&T Formulary review - ICU Order Set & Guidelines - Comprehensive clinical staff education o MD, RNs, Respiratory Therapists, Pharmacists, Pharmacy Techs - Enactment of major critical care practice change, then ensuring integration into actual practice Follow-up assessment	Critical Care Practice Change: resident affected a 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 Action - Resident conducted both arms of the evaluation - Outcomes o A1c and BP in HIV patients with DM and/or Hypertension o Comparison with and without pharmacist presence in HIV clinic	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 Schepers	Baseline evaluation of Medication administration through enteral feeding tubes ACTION - P&P and Guideline development - Meditech (EMR) enhancement - Comprehensive clinical staff education o Nurses, pharmacists	Development of updated P&P, Guideline on Medication Administration through Feeding Tubes. Meditech messages and alerts.
2016-17	Gentamicin Utilization as Infection Prophylaxis in Open Fractures	Tanya Abi-Mansour	Kuntal Patel, Marc McDowell	- Baseline evaluation of Open Fracture Anti-infective Prophylaxis ACTION - Development of MSH Guideline on Prophylaxis in Open Fracture Anti-infective	Study of 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	Basi Sanuth	- Baseline Evaluation, with follow-up ACTION - Comprehensive clinical staff education - MD, RNs, Resp Therapist,	Critical Care Practice Change: Change in pain assessment from FLACC to BPS, with demonstration of

				Pharmacists, Pharm Techs - Enactment of major crit care practice change, then ensuring integration into actual practice - Meditech Enhancement Follow-up, ongoing assessment	improved criteria and outcomes
2015 - 16	Evaluation of transition from patient controlled analgesia to oral analgesia in post surgical patients	Alok Salgia	Dallas Schepers, Tejal Patel	- Baseline MUE : Study of opportunities for improvement in the "post-PCA" period post-op ACTION - Development / Implementation of Order Set to facilitate the transition off PCA to oral analgesia - Comprehensive Clinical Education - Surgeons, Nurses, Pharmacists Follow-up MUE	- Demonstration of improved process
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 ACTION - Optimization of patient education materials - Development of enhanced educational material for pharmacy students: "train the trainer" method Follow-up MUE	- Demonstration of improvement in patient knowledge and skill - -
2014-15	Evaluation of opportunities for pharmacist integration into the discharge process	Diane Cluxton	Karen Trenkler	- Baseline Medication Reconciliation MUE- demonstrating suboptimal results ACTION - Project: resident functioned as TOC pharmacist for a period of 2 months o Adm & Dischg 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)	Demonstration of an expanded role for pharmacists at discharge – based on resident effort. Highlighted significance of accurate ADM Med History. Ultimately, 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 on DM outcomes (A1c) in the Ambulatory Care setting - Resulted in doubling of FTE allocation to Ambulatory Care, from 0.5 to 1.0
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	Jacqui Aroworade	Adrienne Perotti, Jillian	- Baseline MUE ACTION - Revision of AWS Order Set	Optimization of AWS Order Set

	hospital		Szseziul	Follow-up MUE	
2013-14	A retrospective analysis of vancomycin dosing and monitoring in patients on hemodialysis	Tyler A Bickel	Karen Trenkler, Basi Sanuth	- Baseline MUE demonstrating opportunities for improvement Action - 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	- Baseline assessment of medication surveillance Action - Customization of MedMined (surveillance software) for MSH - Implementation of MedMined - Comprehensive Pharmacist Educatioon	Implementation of surveillance software system (Medmined)
2013-14	Management of sickle cell crisis in an urban teaching hospital	Uzoma Okeagu	Karen Trenkler	- Baseline MUE Action - Education of Pharmacists - Meditech enhancement	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 ACTION - Development and Implementation of MSH's initial inpatient HIV medication guidelines - Education – pharmacists and physicians - Meditech EMR automated alerts enhancements Follow-up MUE	- Demonstrated improvement in pharmacotherapy of hospitalized HIV patients - Represented the initial action of MSH HIV Stewardship Program
2012-13	Evaluation of the potential use of Hydroxyethyl starch 130/0.4	Andrew Volk	Karen Trenkler	Pharmacoeconomic Analysis Action Formulary evaluation & analysis for P&T - Medication Usage Evaluation	Cost – Efficacy review of Plasma Volume Expanders
2011-12	Optimization of Empiric Treatment of Obstetrics and Gynecologic (Ob-Gyn) Infections	Jonathan Murray	Karen Trenkler	- Baseline MUE Action - Development/Implementation of OB-Gyne Anti-infective Guidelines (new) - Comprehensive clinical staff education o Physicians, pharmacists	Implementation of Empiric Antibiotic Treatment Guidelines for Obstetrics and Gynecologic (Ob-Gyn) Infections
2011-12	Adherence of Patient-Controlled Analgesia Order Form on an Oncology Unit	Tejal Patel	Zahra Khudeira	- Baseline MUE Action - Development/Implementation of PCA Orderset - EMR (Meditech) Enhancements - Comprehensive clinical staff education o Physicians, pharmacists	- PCA Order Set, PCA Dosing Card, Automated Nursing Assessments - EMR (Meditech) Enhancements

Table of Contents

Clinical Services

Value – Added Services

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)

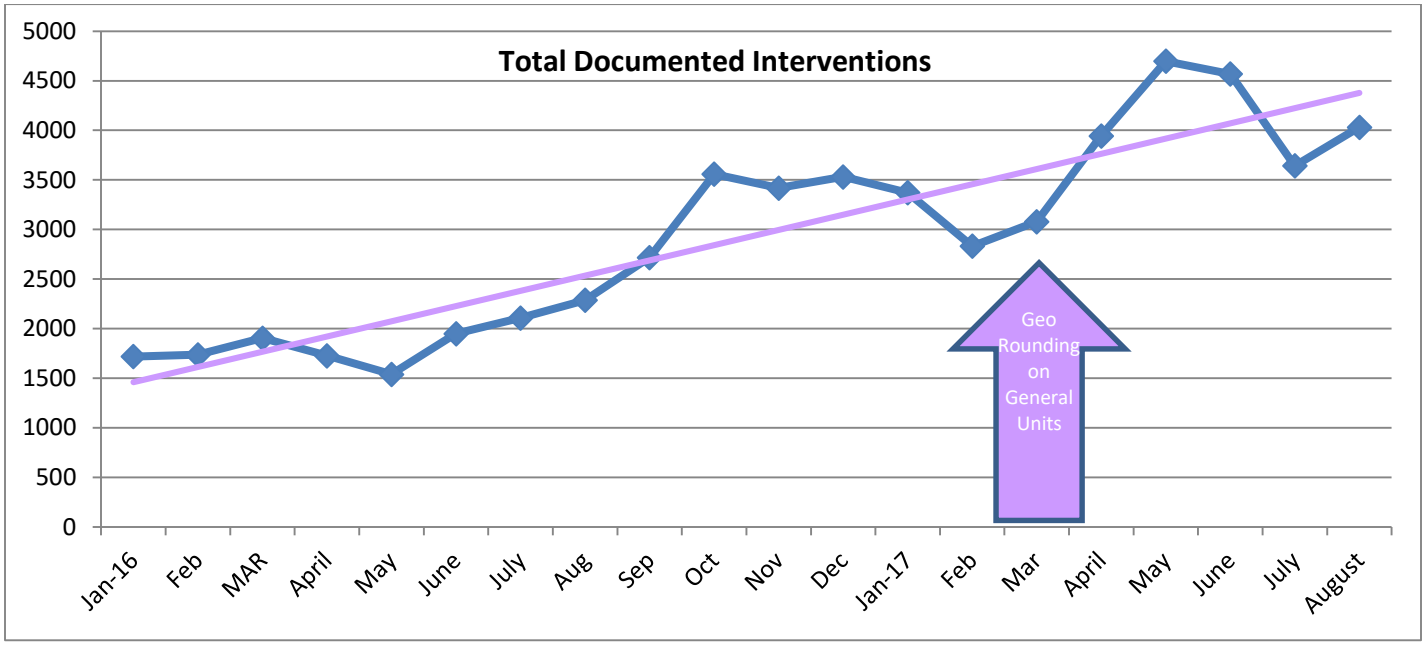
MSH pharmacists have expanded from traditional pharmacy practice to comprehensive pharmacotherapy individualization & optimization. Most recently, to direct interactive patient care (i.e., medication histories/reconciliation, HCAHPS improvement initiatives including disease state counseling, participation 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.

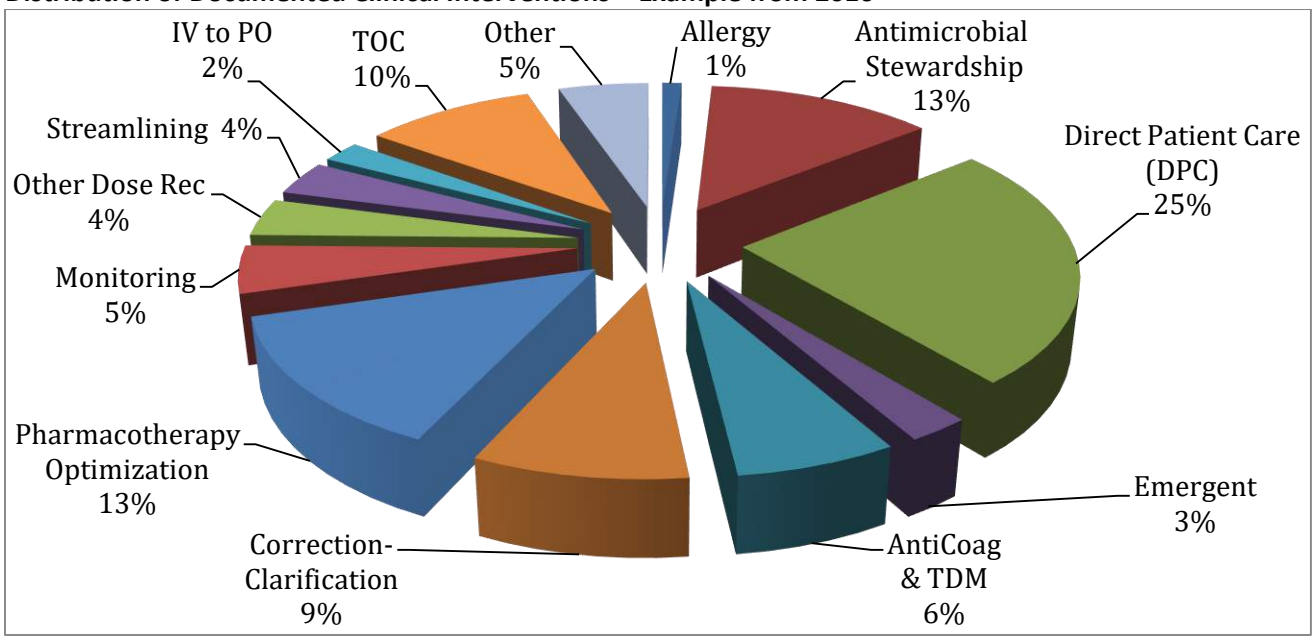


Background

• 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

Distribution of Documented Clinical Interventions – Example from 2016



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 with 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

2018

Order Sets

- Alcohol Withdrawal (General Medicine Unit)
- L&D Intrapartum Insulin Management in Diabetes
- Critical care infusion parameters
- Dexmedetomidine guidelines
- Chest pain – Code Heart (STEMI)
- 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

- NICU RSV Seasonal Palivizumab Guidelines
- 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)
- Tranexamic 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 Erythromycin ointment

Hospital-Wide Order Set and Guideline Development
2019

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

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)

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®

Hospital-Wide Order Set and Guideline Development 2020

Order sets

1. Adult – general
   - Hyperkalemia
   - Alcohol Withdrawal
   - Apheresis & Plasma Exchange
   - Cosyntropin Order Set
   - Clozapine
   - Outpatient Pre/Post Procedure Evaluation / Order Set
   - Covid
     - Remdesevir
2. Cardiac Cath
   - Post Cath Diagnostic Order – for Cath Lab Use
   - Post Cardiac Cath Intervention Order Set
3. Emergency Department
   - STROKE
4. NICU
   - NICU Admission Order Set
   - Neonatal Abstinence Syndrome (NAS)
   - Persistent Pulmonary Hypertension
   - TPN
5. Critical Care
   - Diabetic Ketoacidosis Order Set
   - HyperOsmolar HyperGlycemic Sate (HHS)
   - Adult MICU / Medical Stepdown Insulin Infusion Protocol – rev
   - MICU Admission Standing Orders – rev
   - Hypoglycemia Management in ICU
6. L&D
   - Morphine PF (Duramorph) – Anesthesiologist
   - L&D Order Set

Formulary - Restriction Criteria

- Omegavan
- Aztreonam
- Dornase/alteplase
- Penicillin G Intramuscular
- Pneumovax

Therapeutic Interchange

- Rosuvastatin to Atorvastatin
- Brimonidine 0.15% to 0.2%

Guidelines

- Hyperkalemia, corresponding to OS
- Dornase/alteplase Intrapleural Instillation Guidelines
- Concentrated IV Electrolyte Administration Guidelines
- CINV Prevention
- Clinical Recommendations for AntiDiabetic Med Use
- Naloxone Dosing & Administration Guidelines
- Antiooagulation
  - Enoxaparin Dosing & Monitoring - revision
  - Direct-acting Oral Anticoagulant Agents (DOACs)–new
  - Anticoagulant Transitions – new
  - Unfractionated Heparin Reversal Guidelines – rev
  - Enoxaparin Reversal Guidelines – rev
- Anti-infectives
  - Update of Antibiotic Reference Card
  - Update of Renal Adjustment Tables
  - Optimization of Beta-Lactam Allergy Documentation and Use of Aztreonam
  - Aminoglycoside Guidelines - rev
  - Empiric Antibiotic Guidelines – comprehensive, detailed update
- Covid
  - Covid Comprehensive Guideline, corresponding to OS
  - Covid Thromboprophylaxis Gdlns
  - STEMI in COVID
  - COVID Therapeutic AntiCoagulation – focus enoxparin

Critical Care

- Reference Book – update and alignment with IV P&P, Smart-pumps
- Hypoglycemia Mgnt in ICU

Emergency Department

- ED A-Fib Rate Control
-

Cost – Initiatives

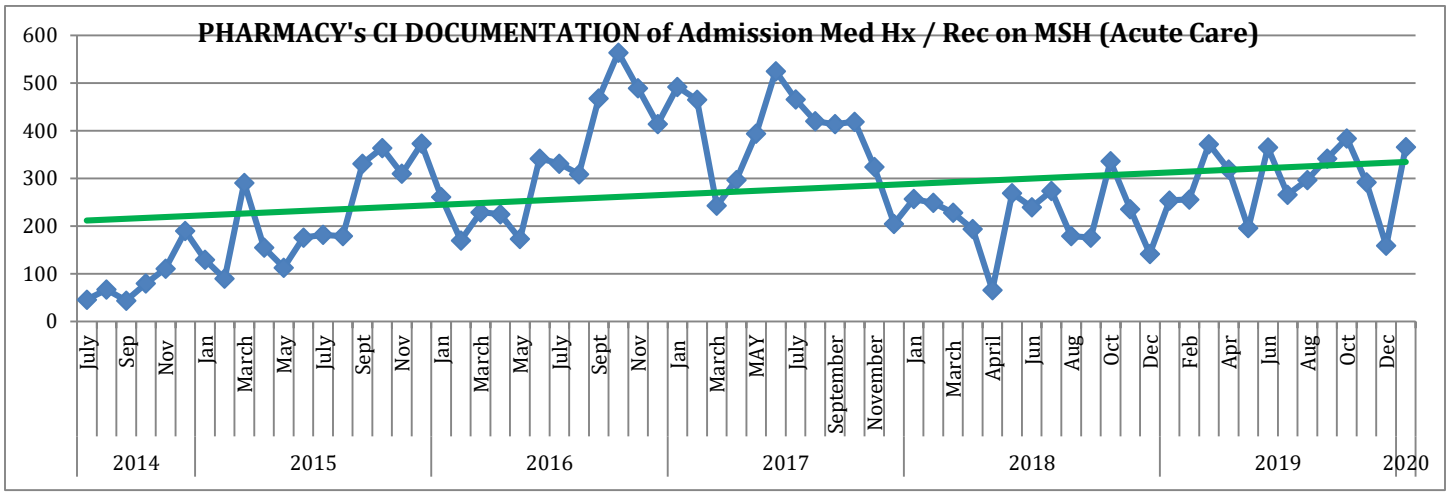
- Residency Projects
- Levetiracetam & Lacosamide IVP Initiative

MUEs (non-Residency projects)

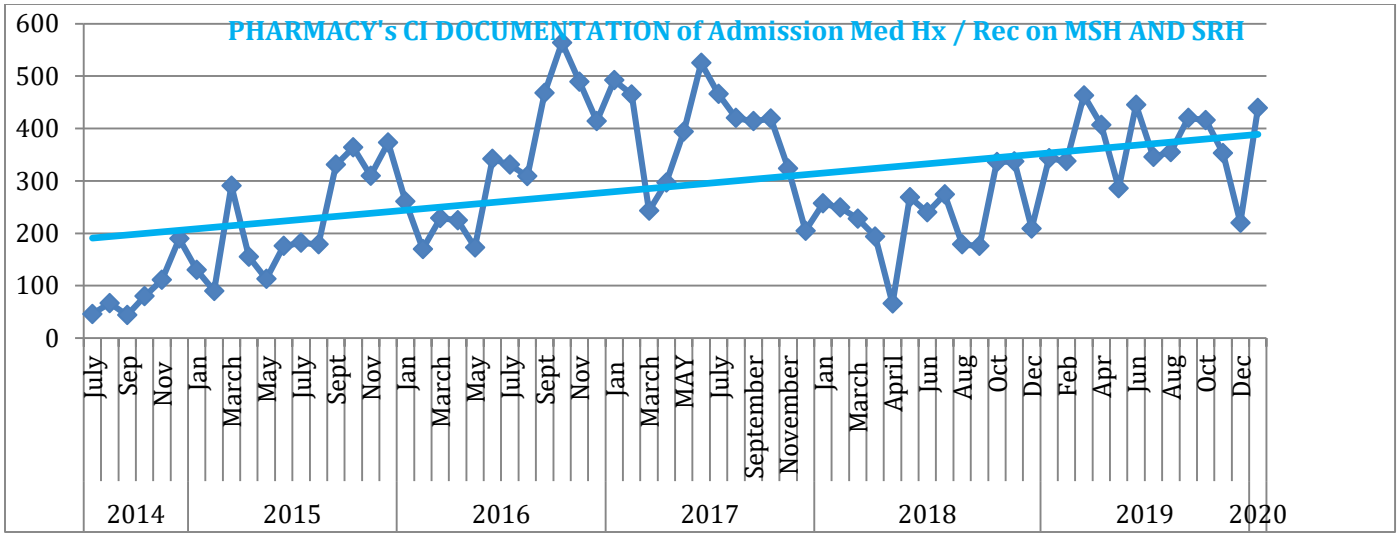
- Vasopressor Use in the MICU

Medication Histories Completed by Pharmacy

ACUTE CARE:



ACUTE CARE & SRH:



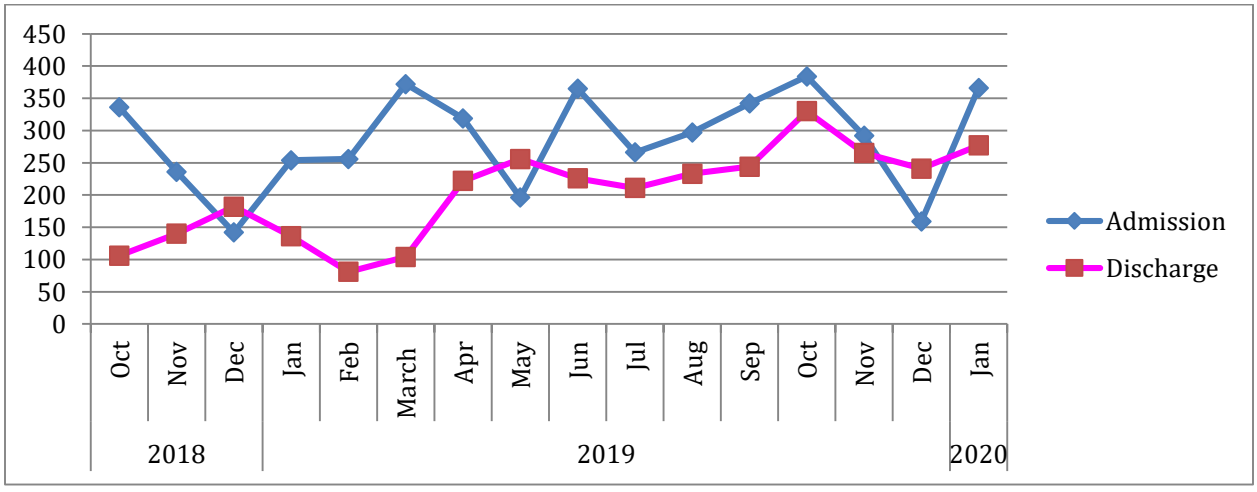
Trend line demonstrates steady growth

- 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.

MEDICATION RECONCILIATION

The graph, below, summarizes the reconciliation efforts by pharmacists on Admission (blue- conducted by general medicine pharmacists/students) and on Discharge (red – conducted by TOC pharmacists/students). The target is completion of reconciliation for patients with multiple medications, comorbidities or those at high risk for readmission.



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

	Average Cost per Dose	
	Pre-Switch	**Post Switch**
Magnesium 2 G IVPB	$6.65	$10.38
Magnesium 4 G IVPB	$5.87	$6.46

Figure 1.

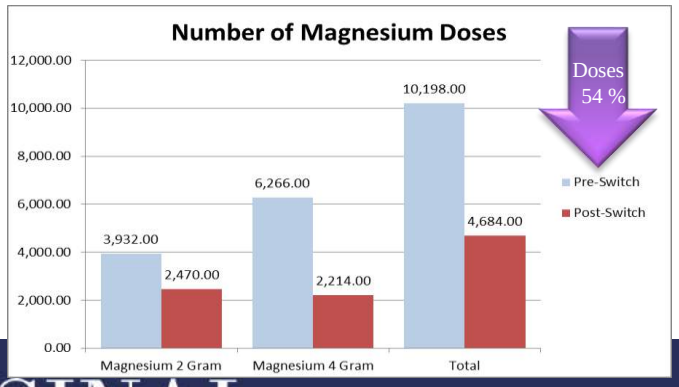
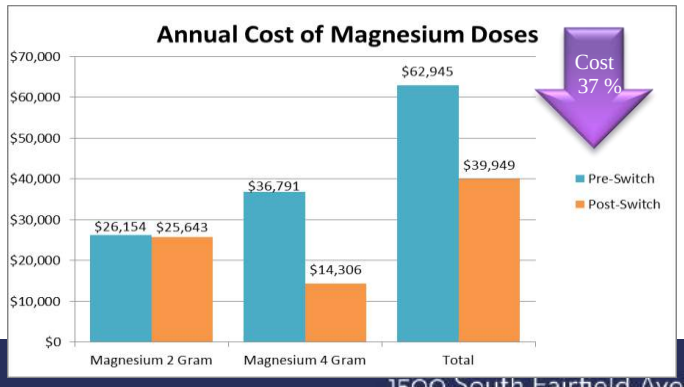


Figure 2.



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 H_2-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

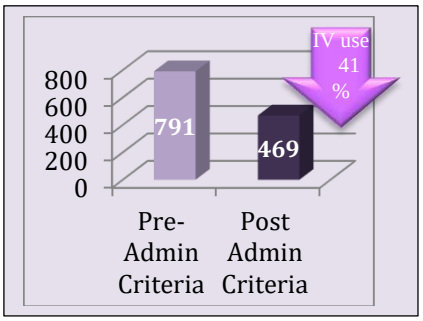
Administration criteria for PPI CPOE were developed by pharmacists, approved by P&T, and then implemented.

IMPACT

Oral and IV 30-day Administrations for Pantoprazole

	Pre- Admin Criteria 11/29/15 – 12/28/16	**Post Admin Criteria** 3/31/16 – 4/29/16	**Difference** (%)
Pantoprazole – IVP	791	469	- 292 (41.2)
Pantoprazole – infusion	105	86	- 19 (18.1)
Pantoprazole – PO	1389	950	- 439 (31.7)

Pantoprazole Use over 1 month – IVP

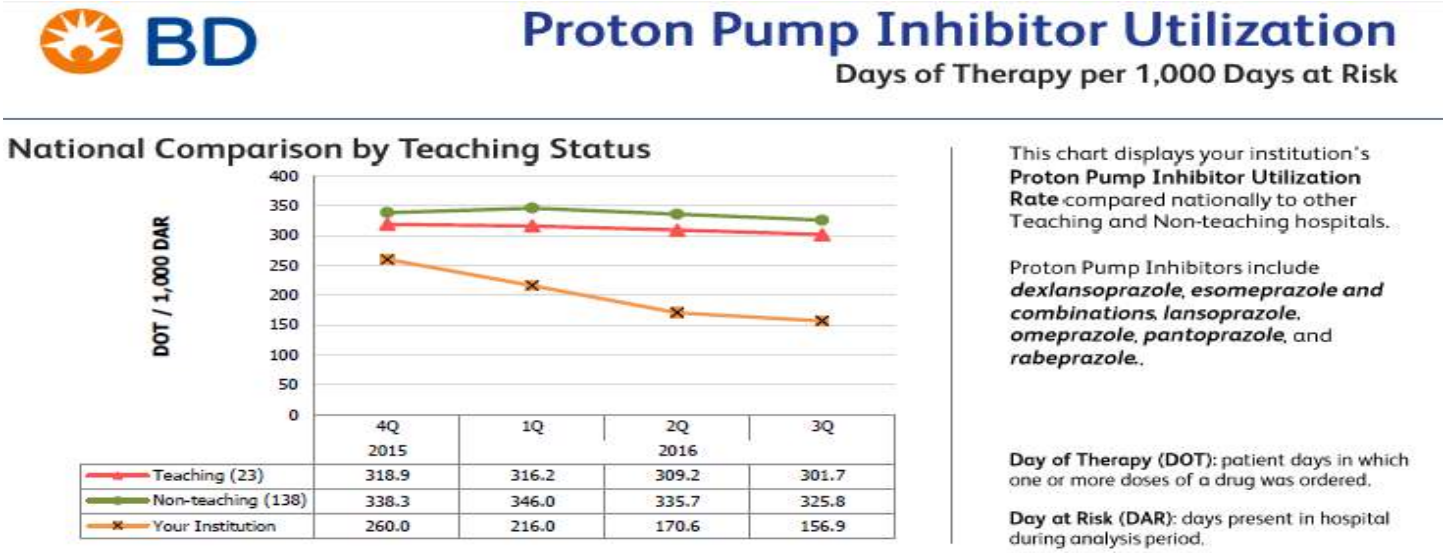


Projected Annual Pantoprazole Cost

	Pre-Admin Criteria 11/29/15 – 12/28/16	Post-Admin Criteria 3/31/16 – 4/29/16	Difference
Vials Administered (40 mg/vial)	1,001	641	- 360
Projected Vials – Annually	12,178	7,798	- 4,380
Projected Vial Cost – Annually	$38,604.26	$24,722.30	- $13,881.96
Oral doses administered	1,389	950	- 439
Projected oral doses – Annually	16,899	11,463	- 5,436
Projected oral dose cost – Annually	$2,365.86	$1,604.82	- $761.04

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%).

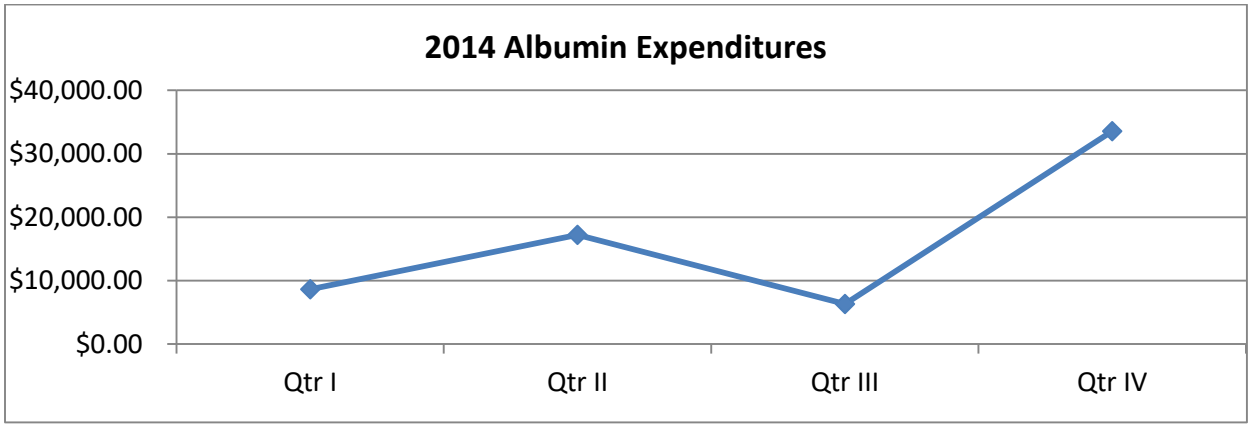


Cost-Effective Quality Improvement Effort

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

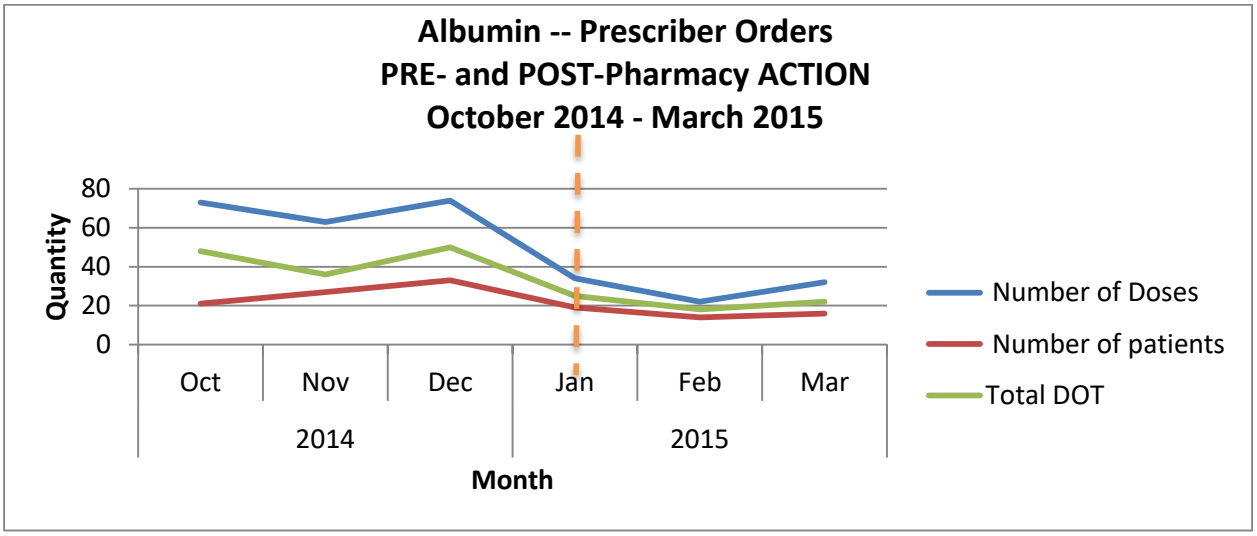


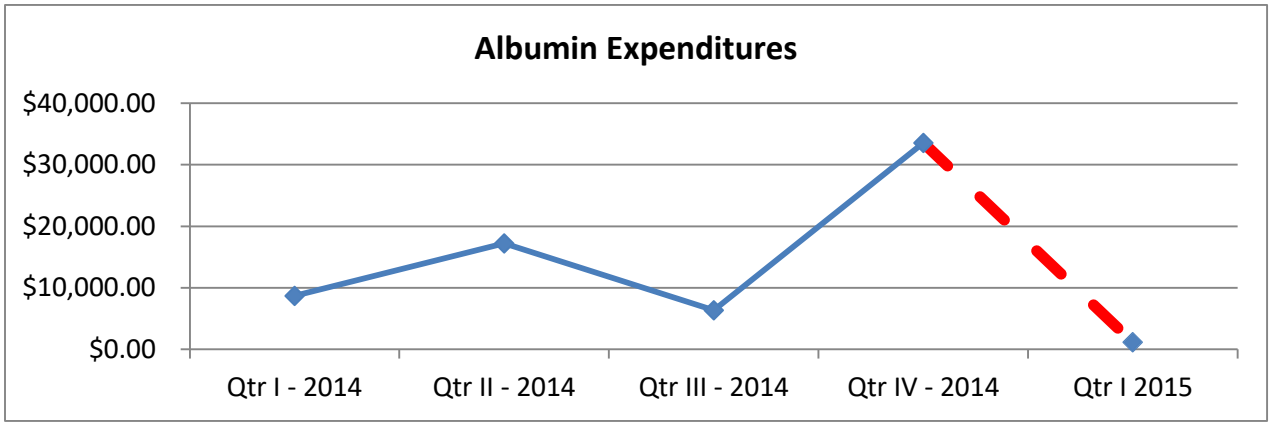
Action

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).

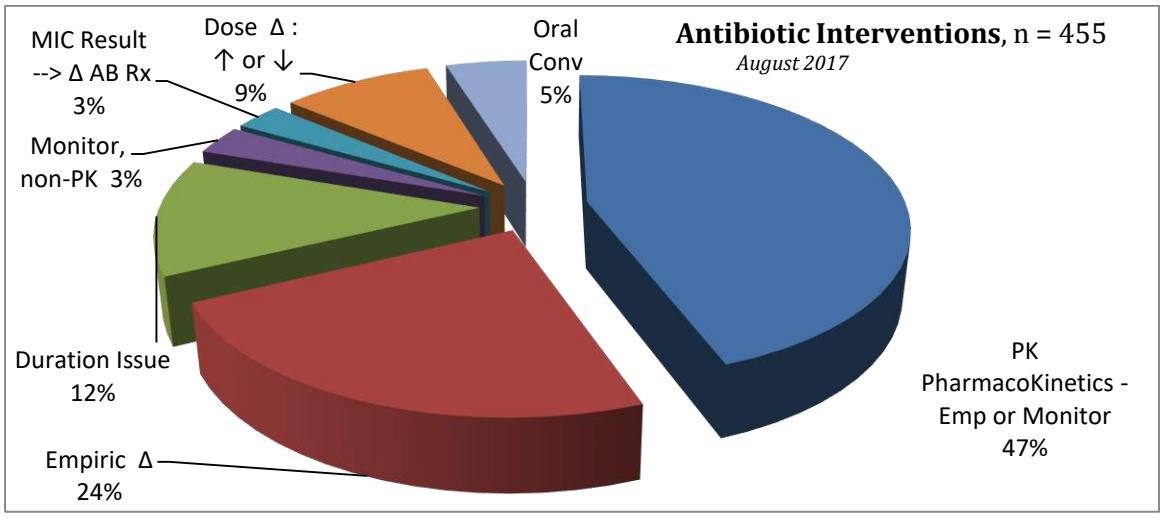
Antibiotic Stewardship: Established Routine of Clinical Staff Pharmacists

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 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.

Illinois Council of Health-System Pharmacists – 2016 Best Practice Award

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 1 Patient Characteristics

	Pre-BR (n=42)*	BR (n=25)*	*P*-value
Gestational Age (weeks)	29 (27.65-31)	30.0 (28-31.5)	0.3689
Birth weight (kg)	1 (0.8-1.44)	1.20 (1.03-1.45)	0.3057
Male (%)	16 (38.1)	10 (40)	-
Calcium (mg/dL)	9.4 (9.11-9.72)	9.44 (9.28-9.44)	0.5418
Phos (mg/dL)	5.15 (4.44-5.9)	5.29 (4.56-5.25)	0.9897
Vitamin D (ng/mL)**	49 (47-80)	37.25 (24-36.5)	n/a
Furosemide (mg/kg/day)	1.22 ± 0.47	1.13 ± 0.24	0.9575
Furosemide duration (days)	18 (1-48)	18 (1.5-14)	0.8246
Hydrocortisone (mg/kg/day)	2.08 ± 0.51	2 ± 0.12	1.0
Hydrocortisone duration (days)	6.5 (3-10.75)	11.5 (7-16)	0.2371
Dexamethasone (mg/kg/day)	0.16 ± 0.05	0.29 ± 0.17	0.1172
Dexamethasone duration (days)	4 (1.5-96.5)	6 (4.5-5.5)	0.7378
TPN Duration (days)	29.5 (23-47.75)	21 (15-21)	0.0799

* 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 2			
	Pre-BR (n=42)*	**BR (n=25)***	***P*-value**
ALP (units/L)	318 (242.5-399.5)	246 (186.75-243.5)	0.0431
Peak ALP (units/L)	486 ± 243	386 ± 167	0.0382
Tbili (mg/dL)	4.14 (3.2-6.21)	4.4 (3.45-4.33)	0.907
AST (units/L)	32.5 (26-41.25)	28 (20.5-27.5)	0.1341
Elemental Calcium IV to PO (mg/kg/day)	46.68 ± 17.29	66.96 ± 21.85	0.0012
Elemental Phos IV to PO (mg/kg/day)	45.8 ± 14.97	42.39 ± 17.68	0.5974

* 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.

Table 3			
	Pre-BR (n=42)*	**BR (n=25)***	***P*-value**
Osteopenia Lab Diagnosis, n (%)*	3 (7.1)	0	-
Time to Lab Diagnosis, day**	75 (62-91)	-	-

*Lab diagnosis of osteopenia was defined at ALP > 600 units/L + Phos < 4.0 mg/dl or ALP > 600 units/L + Ca < 8.0 mg/dl
**Values are reported as median (interquartile range)

Table 4			
	Pre-BR (n=25)*	**BR (n=12)***	***P*-value**
Osteopenia on Radiograph, n (%)	8 (32)	2 (16.7)	0.445
Time from birth (days)**	47 (27-59.5)	44.5 (33-80.5)	-
Break or Fracture on Radiograph, n (%)	2 (8)	0	-
Time from birth (days)**	118.5 (104-133)	-	-

*25 and 12 radiographs from patients in the Pre-BR and BR groups, respectively, were available for analysis
**Values are reported as median (interquartile range)

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 t 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.

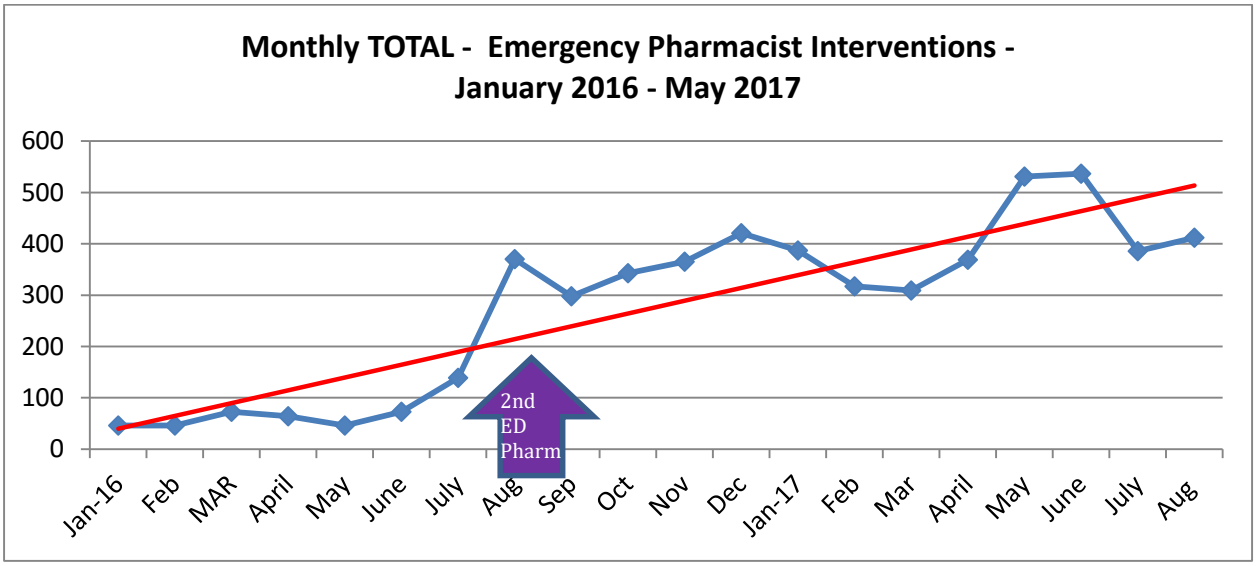
Emergency Department Pharmacy Services

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.

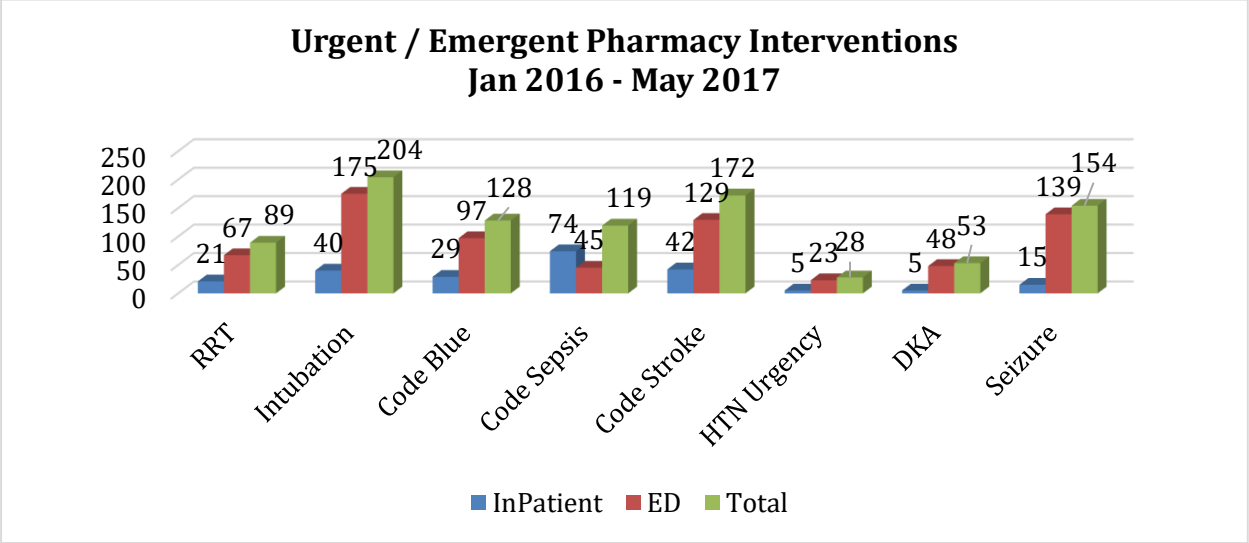
ED Pharmacist Interventions

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.

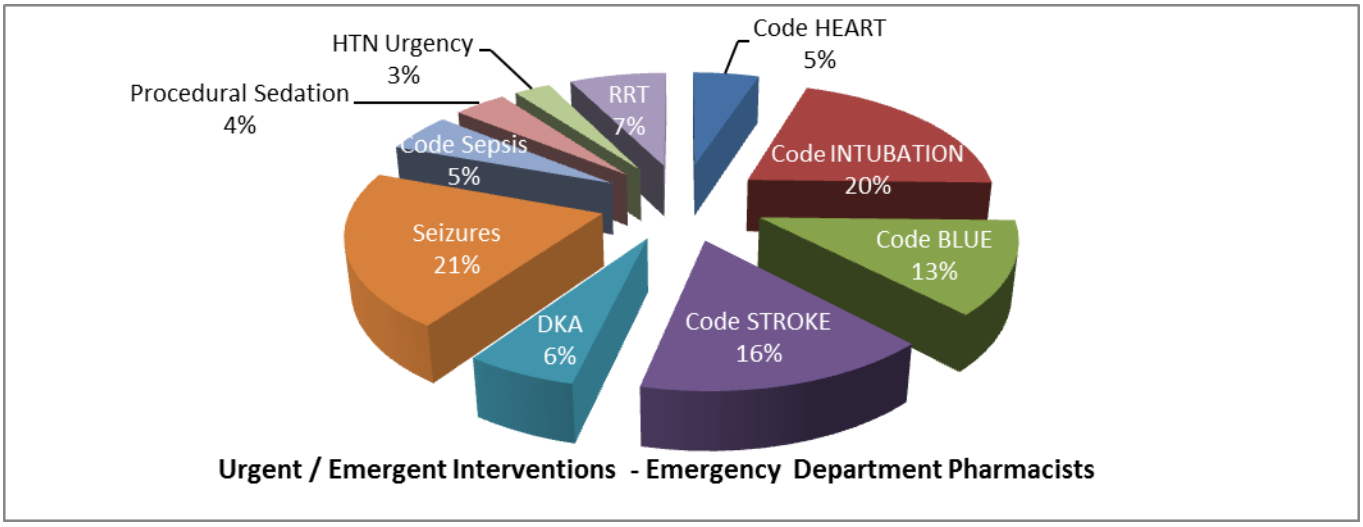


Analysis of ED Urgent/Emergent Interventions

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.

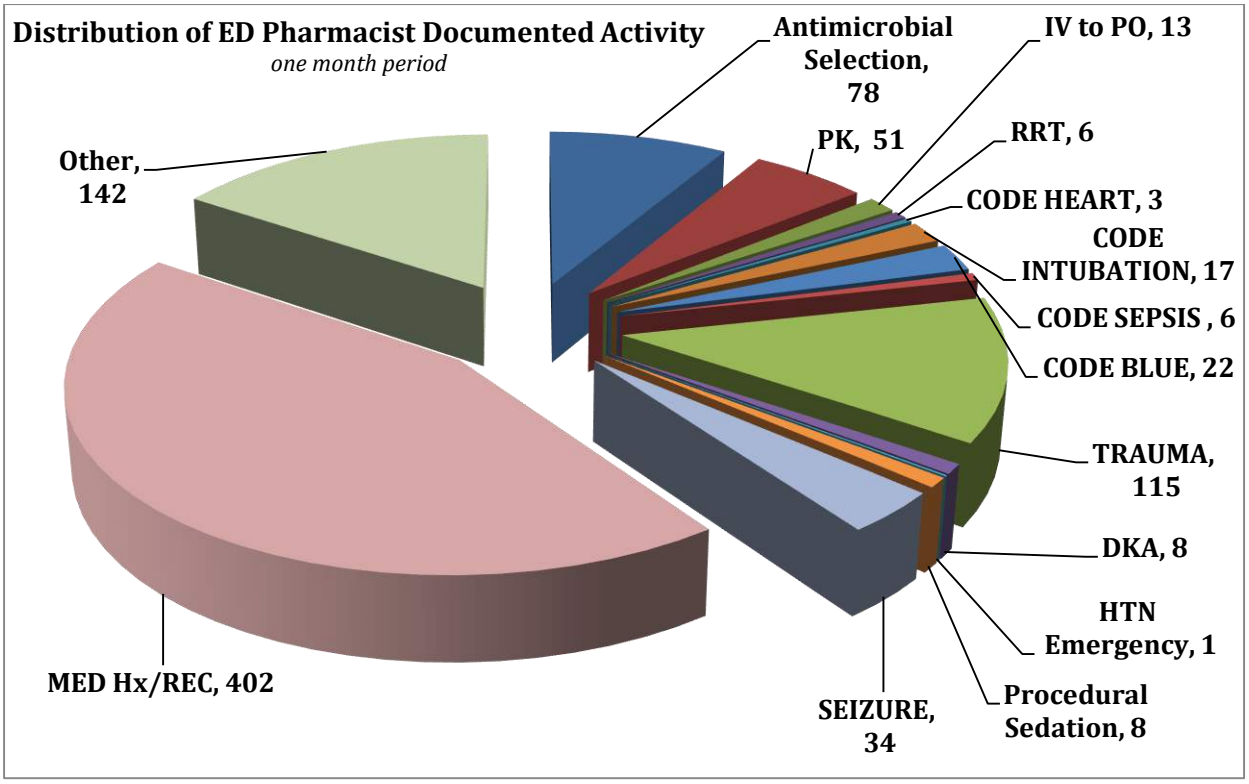


Examining ED pharmacists participation in urgencies/emergencies since Jan 2016 – excluding Code Trauma – the workload distribution (in percentage of such interventions) is depicted below:



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.

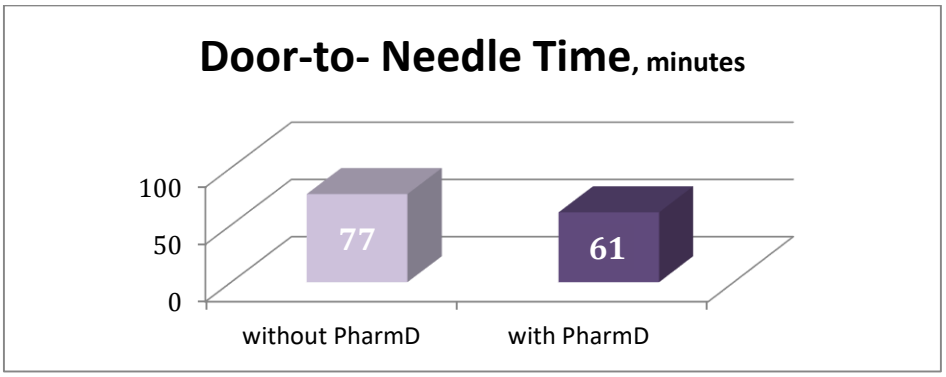


The hospital was recently JC Stroke Center certified in November 2016. Pharmacy efforts at process improvements were instrumental in ensuring the outstanding clinical results.

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.

Pharmacy Alteplase Data January 2015 through August 2017

	Door-To-Needle Time (DNT) in minutes *	Number of Patients Analyzed
Overall	65 (54 – 84)	82
Without PharmD Present	77 (58 – 113)	30
With PharmD Present	61 (51 – 73)	52



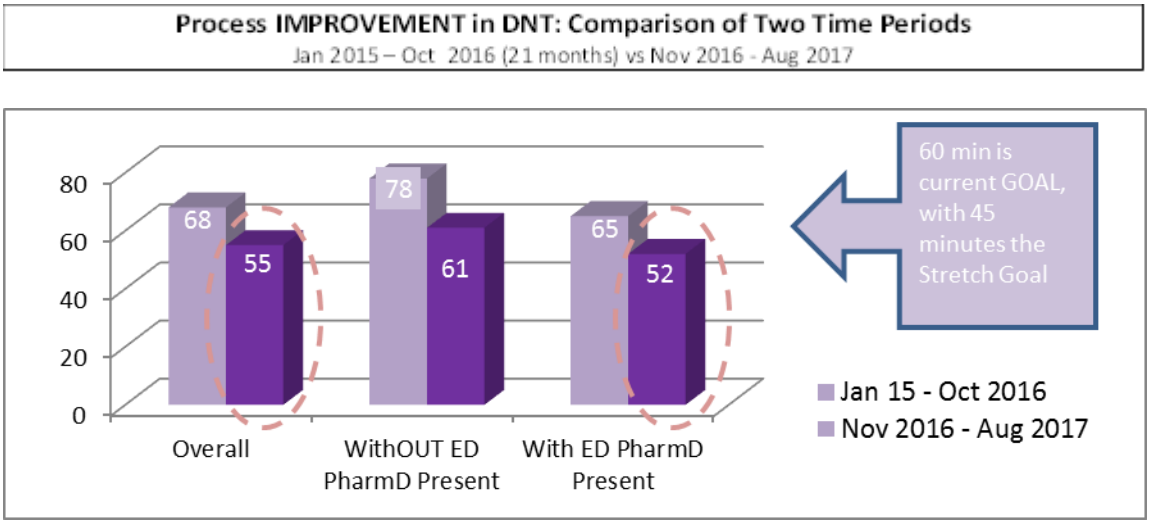
** All values are expressed as median and interquartile range*

Process Improvement Over Time

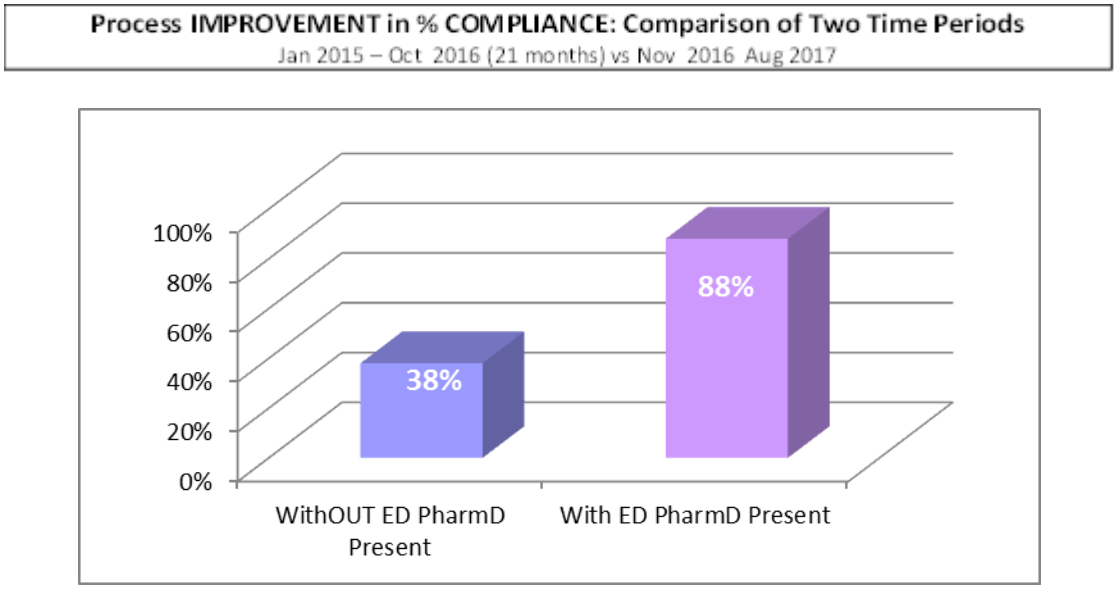
Comparing two time increments, pre and post-Stroke Accreditation, a decrease in overall DNT is demonstrated during the post-survey period, in addition to a decrease in variability. Clearly, improvements have been demonstrated in the process; notably presence of the pharmacist in the ED during the latter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

	Jan 2015 - Oct 2016	Nov 2016 - Aug 2017
	Door-To-Needle Time (DNT) in min	**Door-To-Needle Time (DNT)** in min
Overall	**68** (57 - 93)	**55** (43 – 61)
WithOUT ED PharmD Present	**78** (60 - 115)	**61** (56 – 78)
With ED PharmD Present	**65** (55 – 84)	**52** (39 -56)

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.

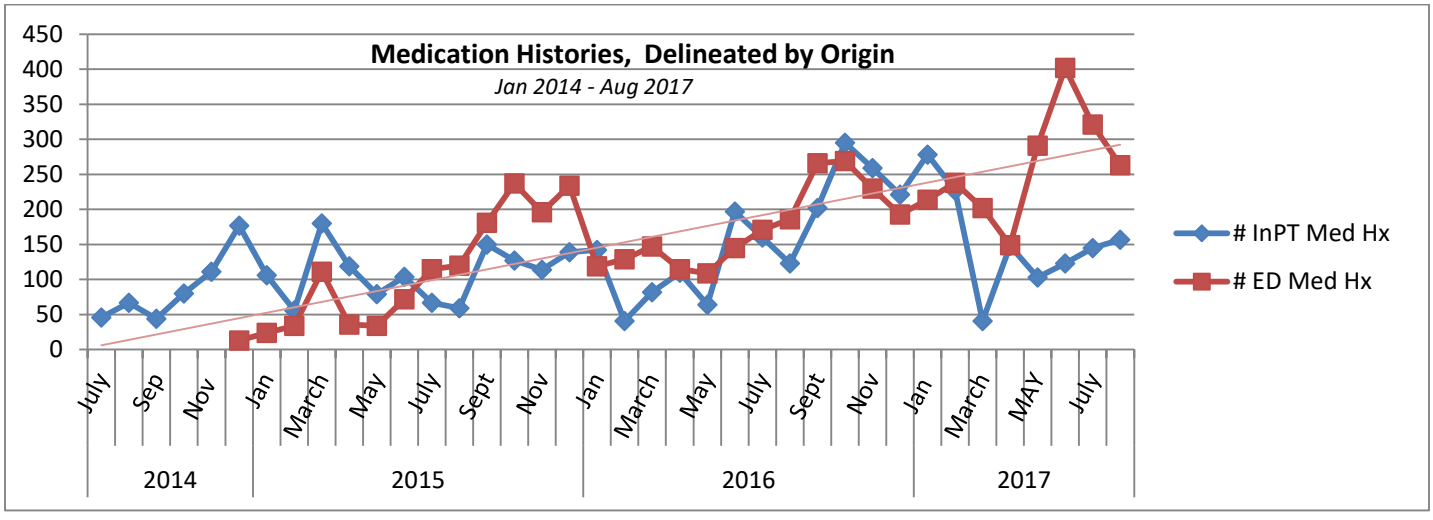


The last graph illustrates the impact of the ED pharmacist , over the two time periods, on % compliance with the Stroke Core Measure AND the improvement in the DNT process, over time. With a pharmacist in the ED, the % compliance with the JC Core Measure approaches 90%.



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).

> Kcentra (prothrombin complex concentrate [human]) and FEIBA (factor eight inhibitor bypassing activity) are the two 4-factor PCCs currently available in the U.S.

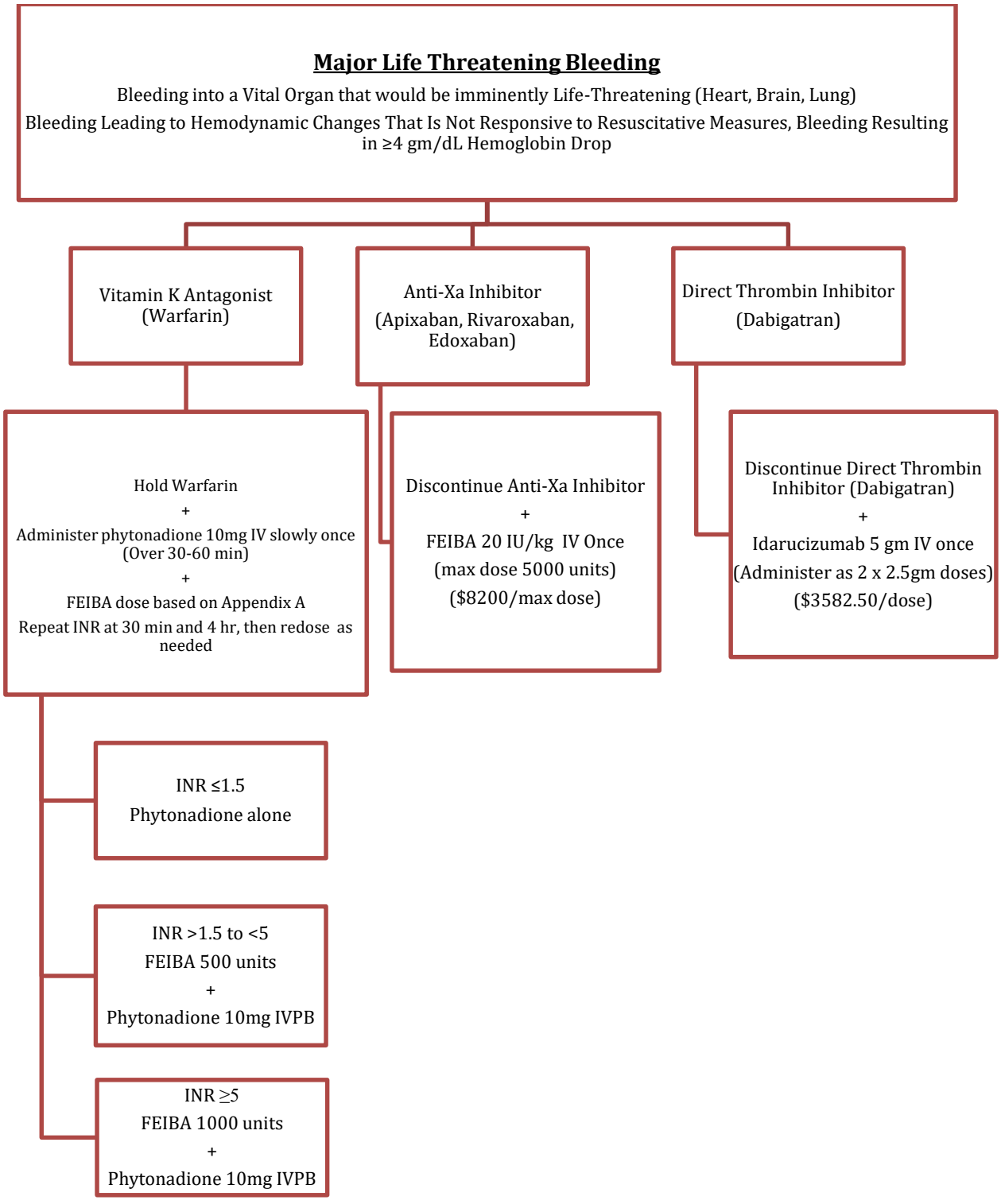
The study at MSH use showed that KCentra was utilized as an antidote for warfarin, the FDA-approved indication, only 27% of the time. The other uses (for the majority of the time) managed bleeding related to Direct-acting Oral AntiCoagulants (DOACs).

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.

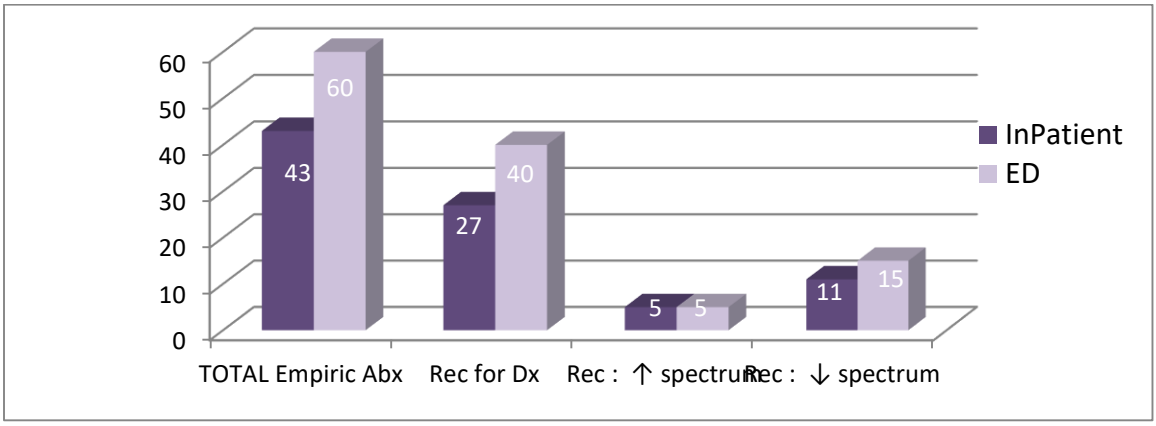
An algorithm was devised to guide appropriate use of blood factors in reversal in major life-threatening bleeding.



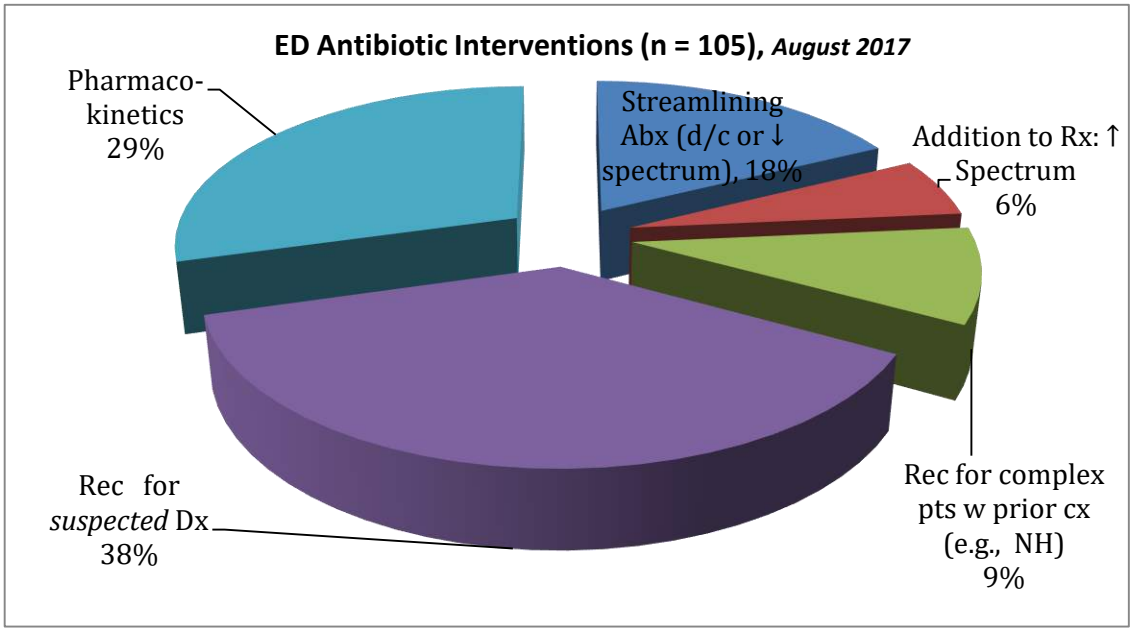
Antimicrobial Stewardship: ED Pharmacists Essential as Initial Gatekeepers

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

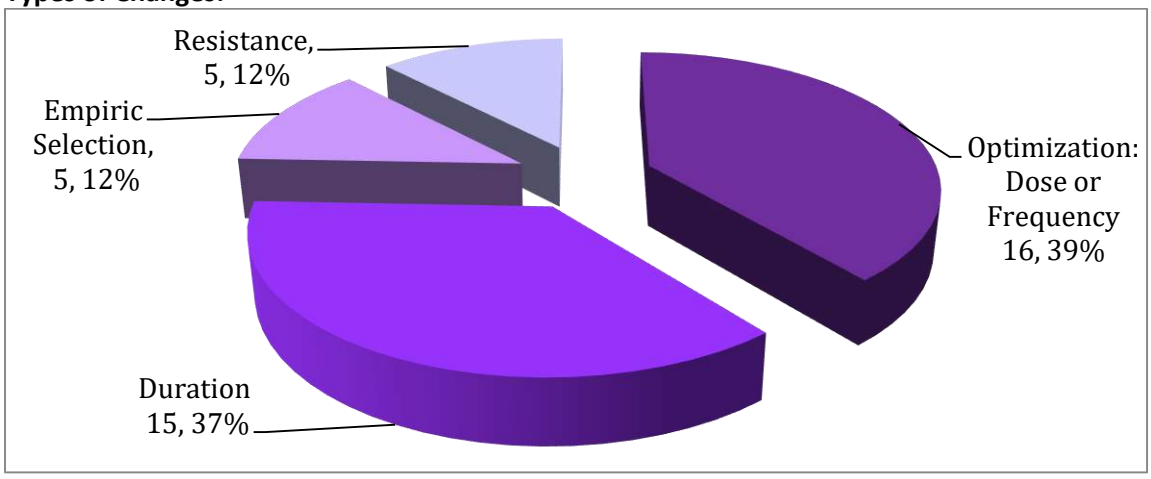
In this era of growing antibiotic resistance and continued reports of antibiotic over-use, the ED pharmacists identified the need to act on UTI culture results that are reported by the lab (typically 2 – 3 days after a patient is 'discharged-to-home' from ED). The ED pharmacists acted pro-actively to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



Selection: Antibiotic selection issues – whether empiric OR culture-based demonstrating resistance – represented almost one-quarter of stewardship interventions.

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.

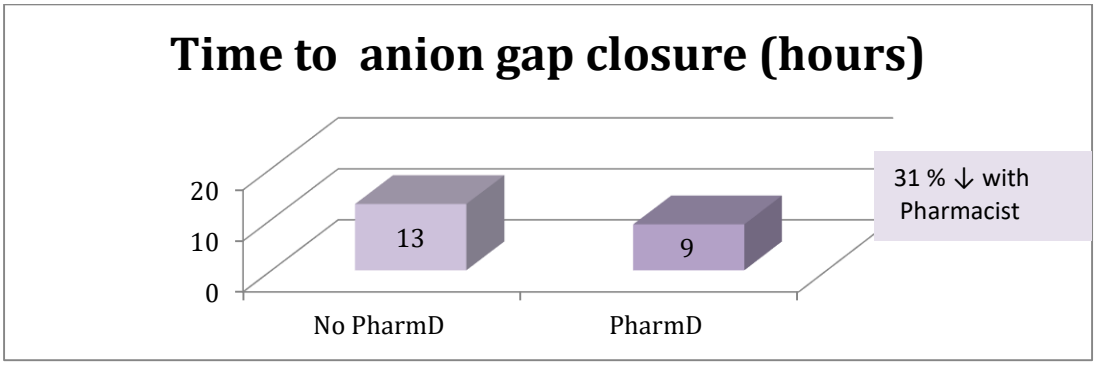
Quality Initiative: DKA Analysis

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.

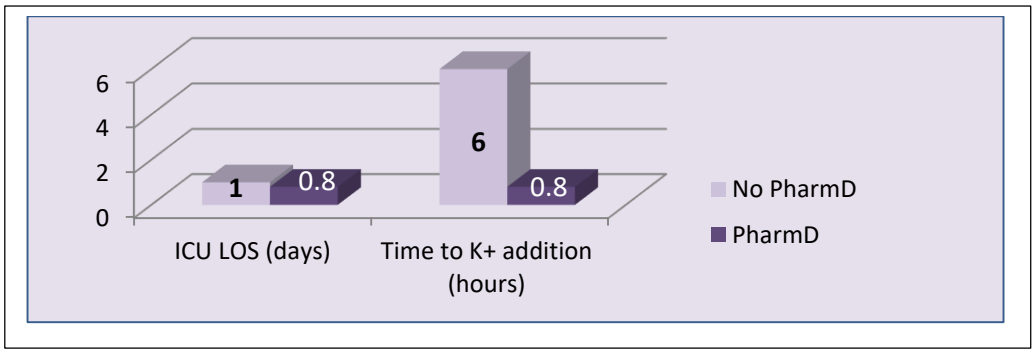
- Retrospective analysis of 34 patients (44 patients were excluded)
  - Period: 5/1/15 – 5/1/17
- Objective: To compare ED DKA management with and without pharmacist in the ED
  - Primary endpoint: Time to anion gap closure
  - Secondary endpoints: Appropriate addition of potassium; appropriate addition 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_{50}), 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

PRIMARY Outcome	No PharmD	PharmD	% Difference with PharmD
Time to anion gap closure (hr)	13	9	**31 % ↓**

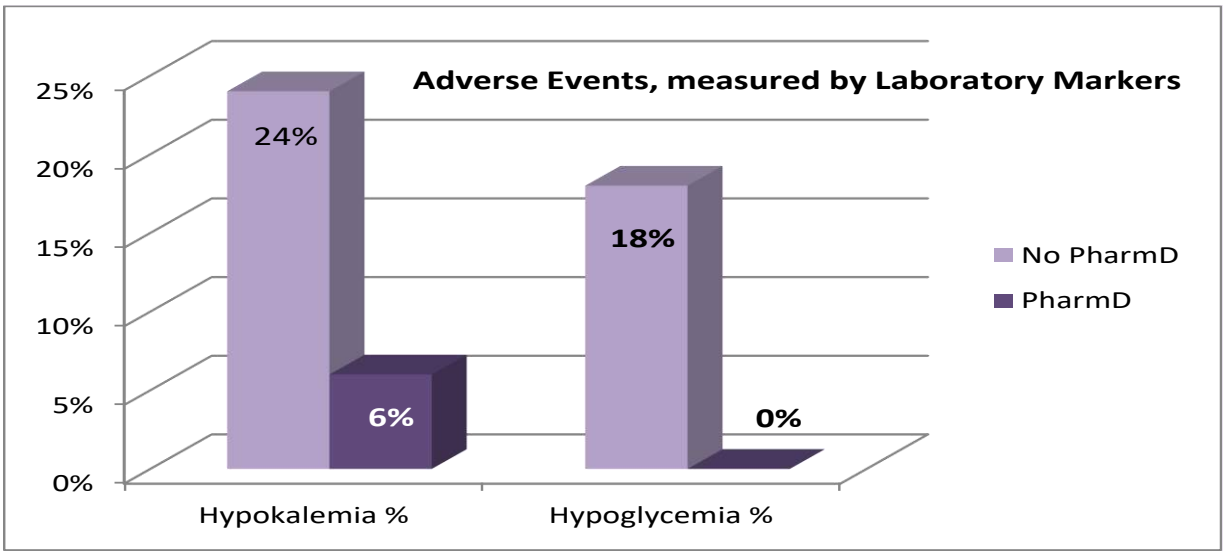


Other Outcomes	No PharmD	PharmD	% Diff w PharmD
ICU LOS (days)	1	0.8	**20% ↓**
Time to K+ addition (hours)	6	0.8	**80% ↓**



Adverse Events, measured by Lab Markers	No PharmD	PharmD
Hypokalemia %	24%	6%
Hypoglycemia %	18%	0%

- 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.

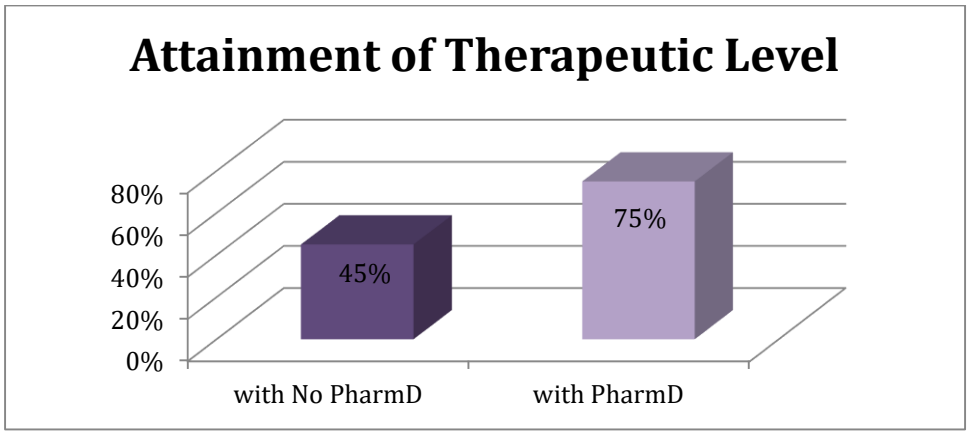
The recommended phenytoin dose for adult patients in status epilepticus is 15–20 mg/kg; similarly, for maintenance doses, adults may be loaded at 15–20 mg/kg. In non-urgent scenarios, the oral route is optimal; however, in urgencies, the goal is attainment of therapeutic level as soon as can be safely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

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

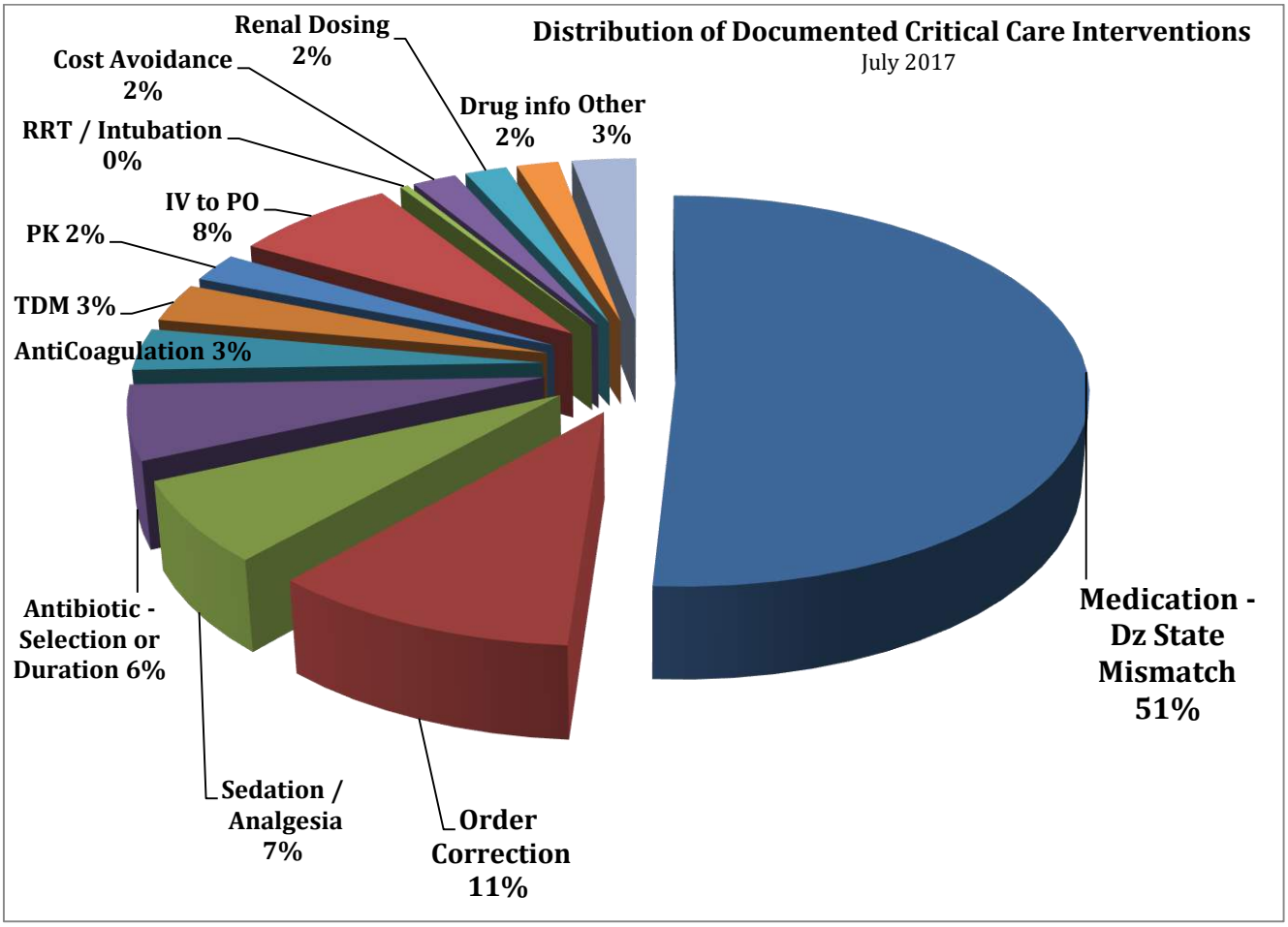


ICU Pharmacy Services

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.



MICU Pharmacist/Resident Project (2016-2017): Focus on Cost-Efficacy

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 (PaO_2), PaO_2 over fraction of inspired oxygen (PaO_2/FiO_2) 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, PaO_2/FiO_2 ratio, sequential organ failure assessment (SOFA) score.

Primary Outcome	iNO	iEPO
Ventilator-free days, mean (range)	2.6 (0-24)	9.1 (0-21)

Secondary Outcomes	iNO	iEPO
PaO_2 change (mmHg)	22 (0 – 47.4)	38 (6.1 – 54.4)
PaO_2/FiO_2 ratio change (mmHg)	22 (0 - 61)	72.7 (5.9 – 106.1)
Dose of medications	15 (10 – 20)[b]	0.05[c]
Duration of therapy (hours)	51.3 (21.5 – 94.5)	20 (18 – 65)
Tracheostomy, n (%)	4 (14)	1 (14)
Mortality, n (%)	17 (60.7)	2 (42.8)
Cost ($/person)	7,695 (3,225 – 14,175)	370 (259 – 1,221)

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

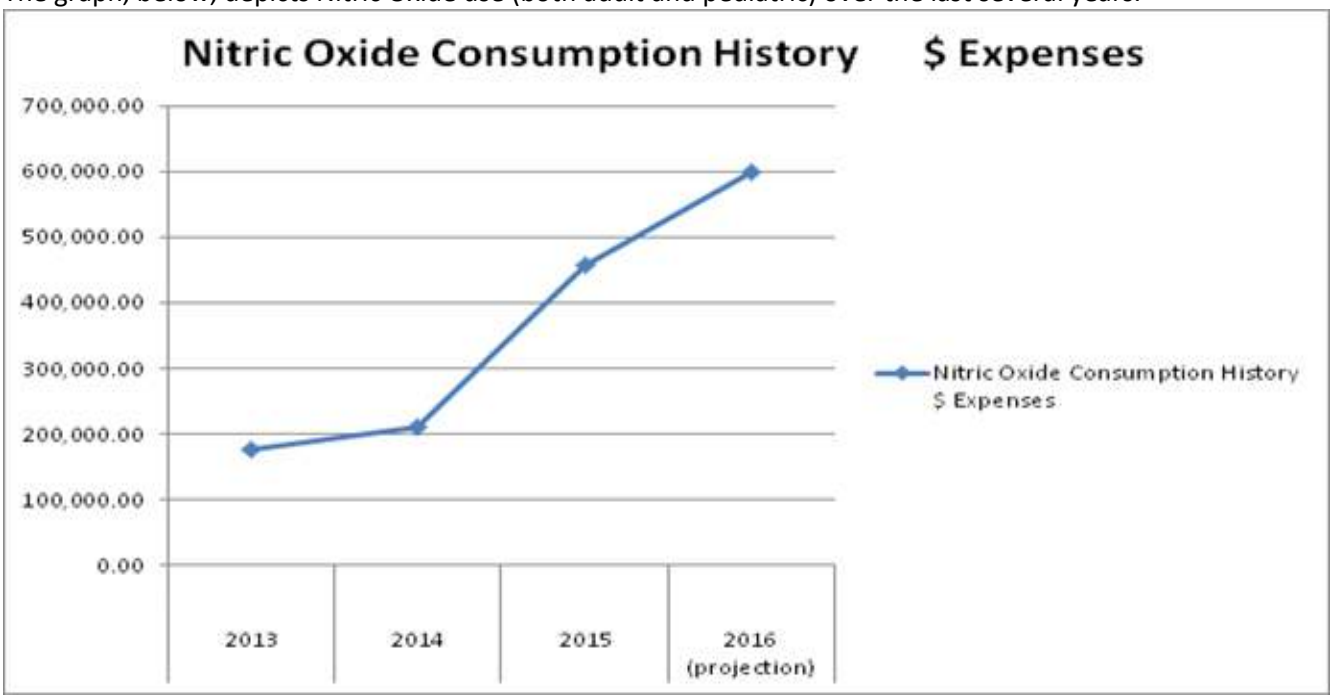
Discussion

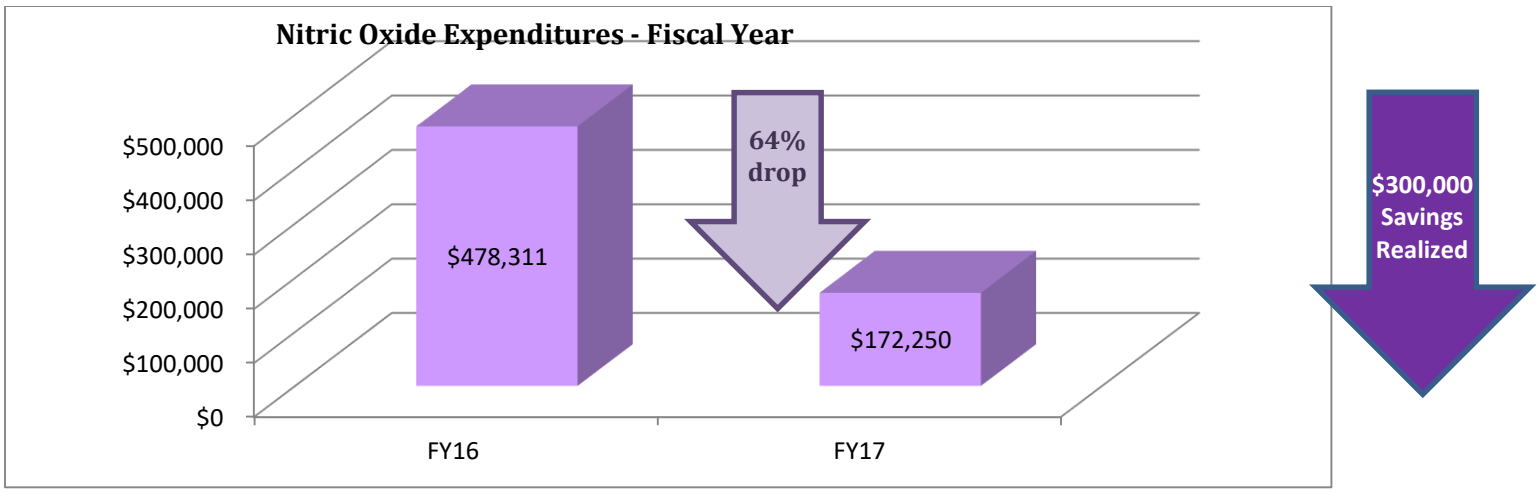
In this study, iEPO group had a higher ventilator-free day (9.1 compared to 2.6). For the secondary outcomes, both groups demonstrated significant increase in PaO_2/FiO_2 ratio. The doses of the medications were 15 ppm in the iNO group and 0.05 mcg/kg/min in iEPO group. Duration of therapy was 51.3 hours 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 methomoglobin 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.





MICU Pharmacist/Resident Project (2015-2016): Focus on Quality

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 $\geq$ 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:

Primary Outcome	**Pre-BPS (n=63)***	**Post-BPS (n=69)***	***p*-value**
Average Opioid Analgesic Requirement Per Day, mcg of Fentanyl Equivalent	1235 [72-3850]	1726 [563-4570]	0.01

Secondary Outcomes - Pain	Pre-BPS (n=63)*	Post-BPS (n=69)*	*p*-value
FLACC Scale	0.55 [0-5.53]	--	N/A
BPS	--	3.52 [3-7.4]	N/A
% of Time Within Target BPS, (BPS ≤ 5)	--	94 [0-100]	N/A

Secondary Outcomes - Sedation	Pre-BPS (n=63)*	Post-BPS (n=69)*	*p*-value
Average Sedative Requirement Per Day, mg of Midazolam Equivalent	138.3 [0-452]	106.3 [0-468]	0.36
Average RASS#	-2.7 [-5–1.25]	-2.82 [-5-0.71]	0.62
% of Time Within Target RASS, (RASS 0 to -2)	27.8 [0-93]	36.2 [0-100]	0.14

Secondary Outcomes - Delirium	Pre-BPS (n=63)*	Post-BPS (n=69)*	*p*-value
CAM-ICU Positive, n (%)	5 (8)	7 (10)	0.66
Initiation of Atypical Antipsychotic, n (%)	20 (40.8)	4 (6)	0.0001

Secondary Outcomes – Miscellaneous	Pre-BPS (n=63)*	Post-BPS (n=69)*	*p*-value
Mechanical Ventilation, days	9.3 [2-29]	8.3 [2-44]	0.42
ICU Stay, days	9.6 [2-31]	8.2 [2-53]	0.26
Hospital Stay, days	15.2 [2-46]	16 [2-66]	0.71
Mortality, n (%)	15 (24)	37 (54)	0.0005

Conclusion:

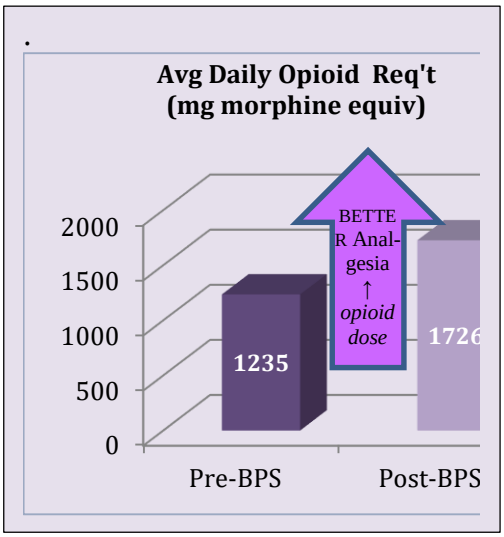
The pre- and post-BPS implementation groups were similar except for the SOFA score (mortality predictor). The post-BPS implementation group seemed to have a sicker population. In conclusion, there was more analgesia used, less sedative use, less atypical antipsychotic use, decreased duration of mechanical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

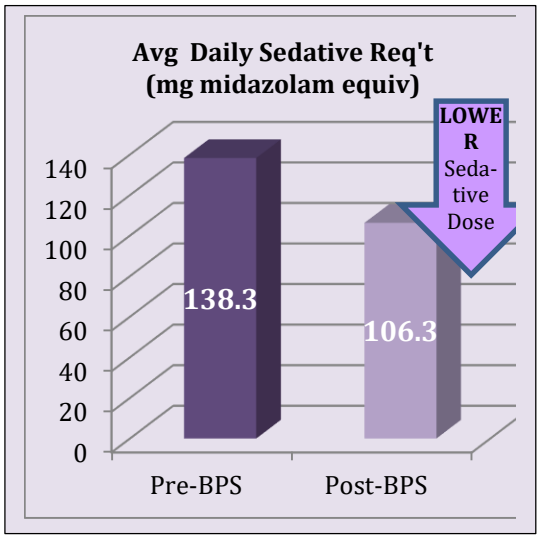
With these results, it may appear that the implementation of the BPS promoted analgosedation (analgesia first before sedation), which led to more analgesia use and less sedative use. Although there was a higher mortality rate, this may have been attributable to the higher SOFA scores at baseline.

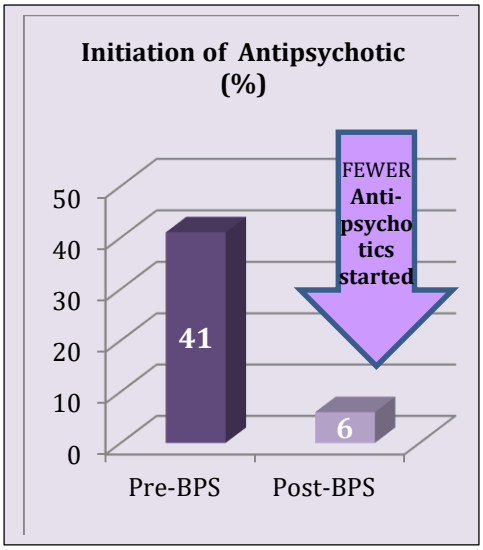
There were some limitations to this study: it was a retrospective chart review with a small sample size. Also, adjustments for pain and sedation scores outside of the specified target range were not taken into account. In addition, bolus doses of analgesia or sedative may not have been documented due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







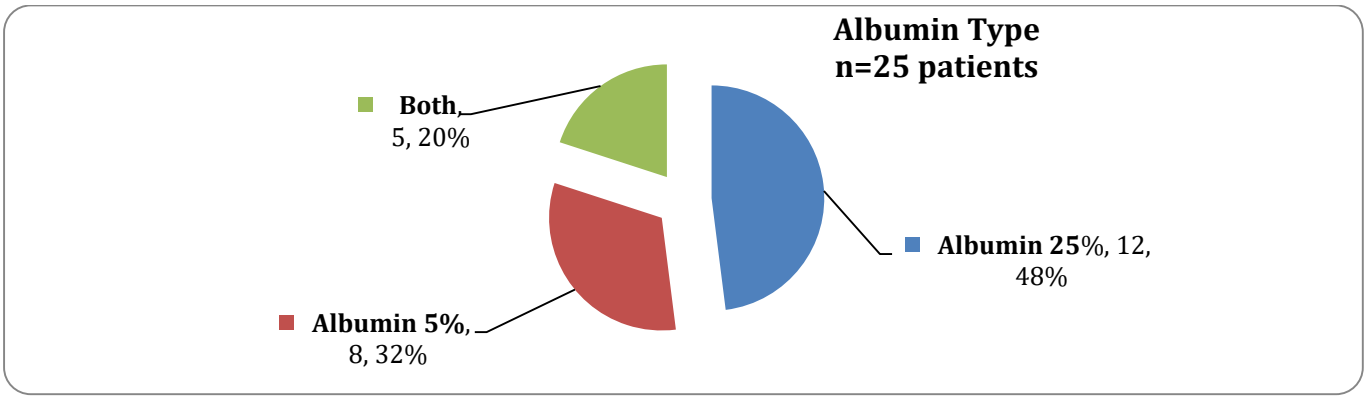
Cost Efficacious Use of a Limited Resource: Albumin

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:

Type of ACS	Number of Patients (%)
STEMI	27 (69.2%)
NSTEMI	8 (20.5%)
Unstable angina	2 (5.1%)
Atrial flutter	1 (2.6%)
Unspecified	1 (2.6%)

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%), $\geq$ 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 eptifibitide 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 eptifibitide were identified. The interventional cardiology group was approached based on the data generated by this analysis; they agreed to round down dosing if $\leq$ 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.

Purchase/Cost

	Number of vials or bottles	Cost per vial or bottle ($)	Total Expenditure– 6 mos($)
Bolus (20 mg/10 mL vial)	**37**	**127.95**	**4734.15**
Infusion (75 mg/100 mL bottle)	**114**	**400.42**	**45,647.88**
Total Cost			**50,382.03**

Savings of > $13,000

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

Pharmacist Oversight: DOSE & DURATION

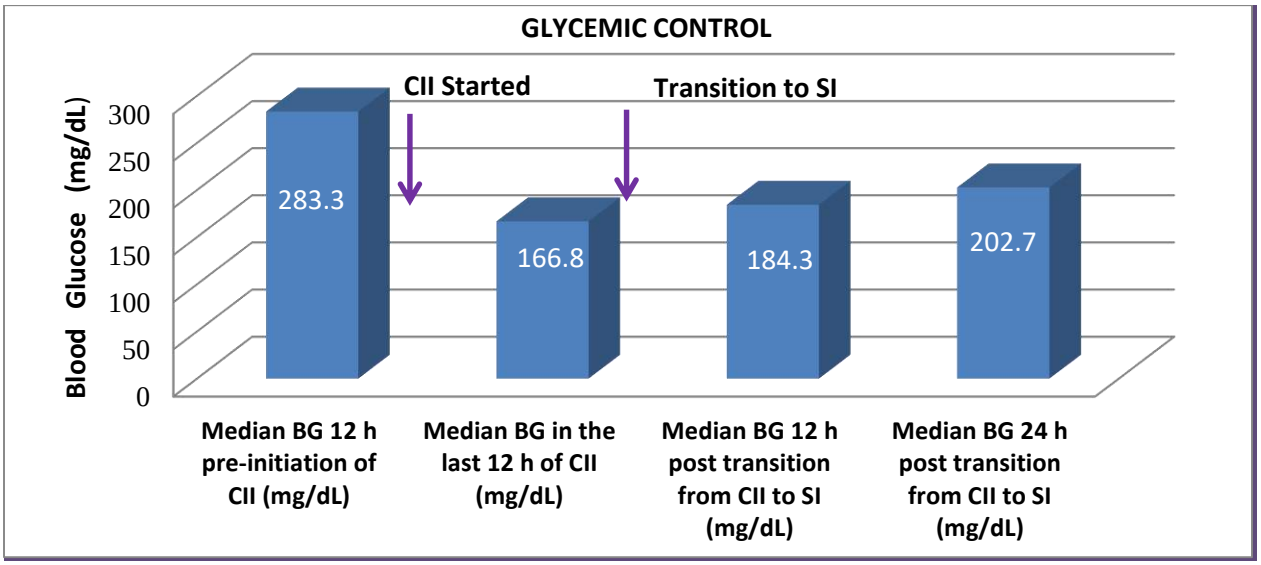
Focus on Quality Improvement: Evaulation of the Efficacy of Transitioning from Continuous Insulin Infusion to Subcutaneous Insulin in the MICU

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: Evaulation 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: Evaulation of MICU Anti-Delirium Medication Use on Discharge

Background

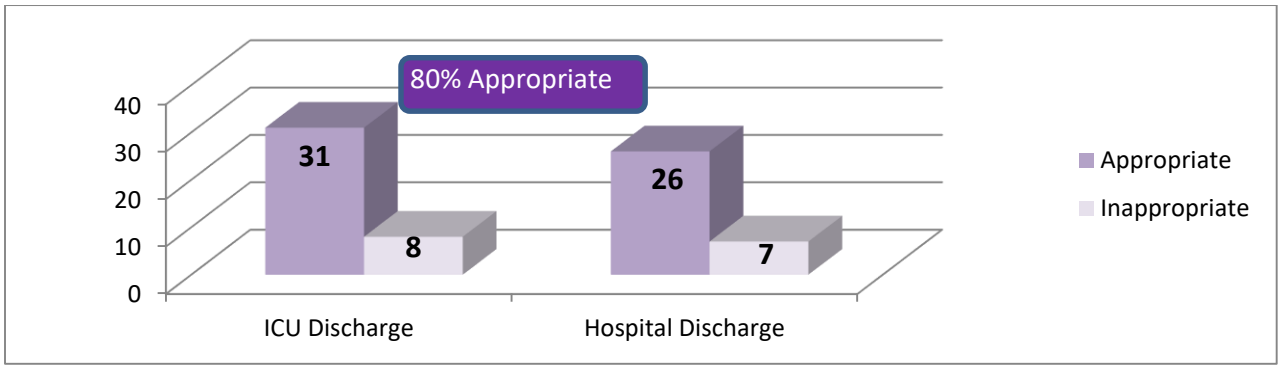
- Intensive care unit (ICU) delirium is a recognized complication of critical illness.
- The prevalence of delirium has been reported as high as 60% - 80% in mechanically ventilated ICU patients and 20% - 50% in non-ventilated ICU patients.
- ICU delirium is a predictor of higher cost of care, a 3-fold higher mortality over 6 months and significant ongoing cognitive impairment among survivors.
- It is a 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



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: Evaulation 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
    - 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
    - TH for 12-24 hours in unconscious patients
    - Sedation and analgesia for shivering
    - NMBs for refractory shivering
        - Bolus NMB is generally adequate though continuous infusion may be necessary
- 2015 ILCOR Recommendations
    - 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:
    - Patients treated with TH were compared to those who did not receive TH
    - 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
    - Shivering prevention and treatment strategies
        - Magnesium 4 g IV x 1
        - Sedation and analgesia
        - NMB continuous infusion
    - 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

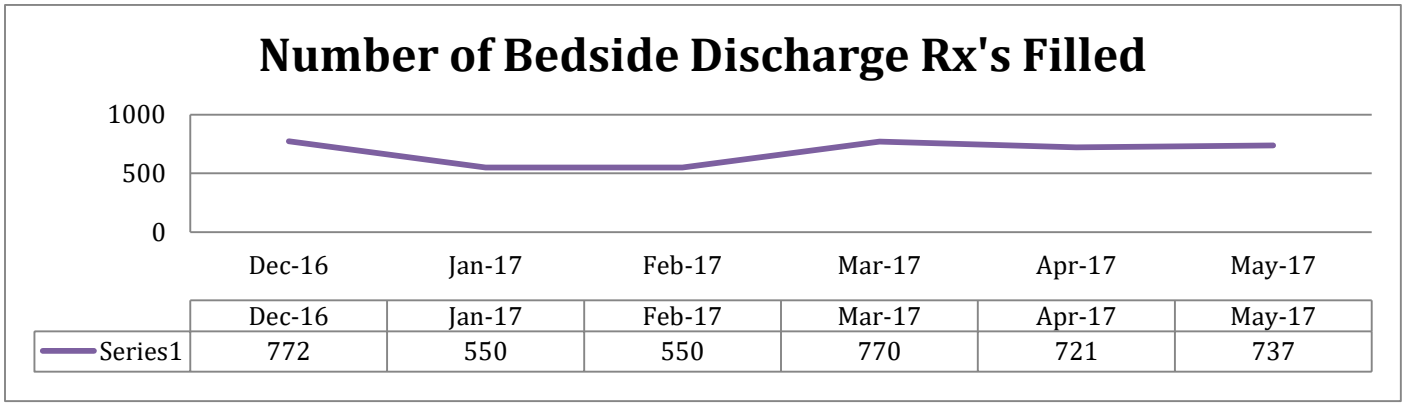
- Medication therapy must be continued as soon as possible after discharge
- Interruptions in medication therapy during transitions of care can negatively impact patient outcomes and increase hospital readmissions
    - Failure or delays in filling prescriptions at the time of hospital discharge
    - 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



	Dec-16	Jan-17	Feb-17	Mar-17	Apr-17	May-17
Series1	772	550	550	770	721	737

Considerations

• Patients have positively responded to bedside discharge concierge service
    o Majority of patients consulted choose to partake in discharge program
• On average, 50 patients monthly utilize service
    o 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

Medication Reconciliation
2014-2015 Resident Project – The Basis for Addition of 2 Transitions of Care Pharmacists

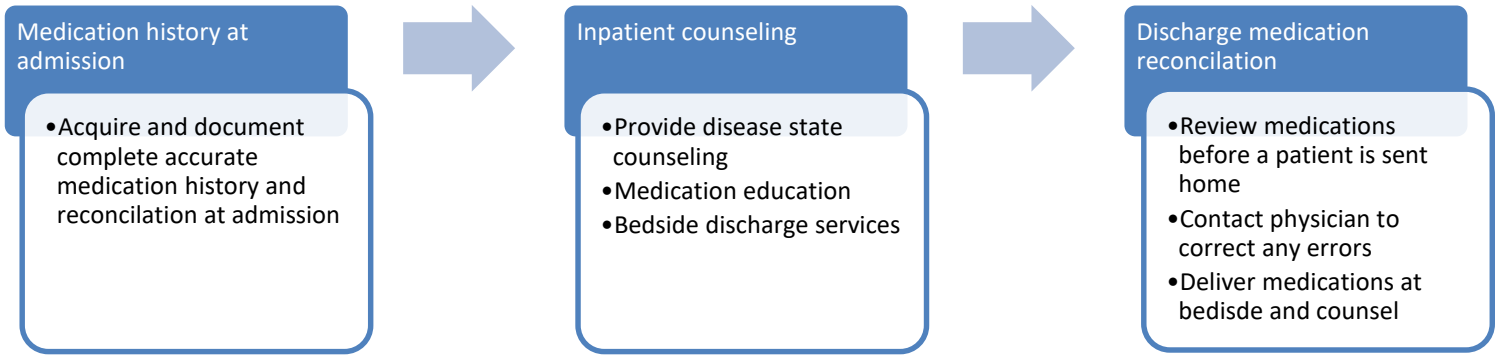
Background

- 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

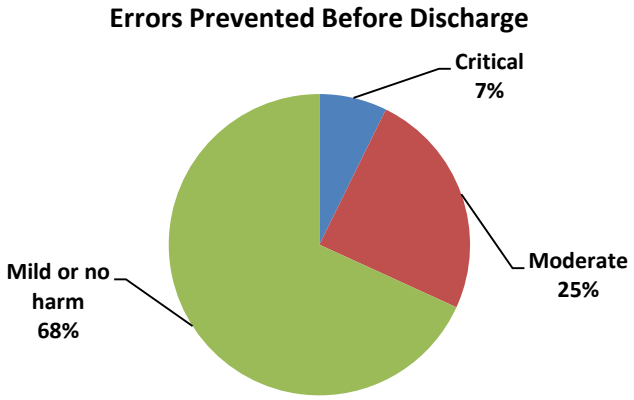
Intervention Process



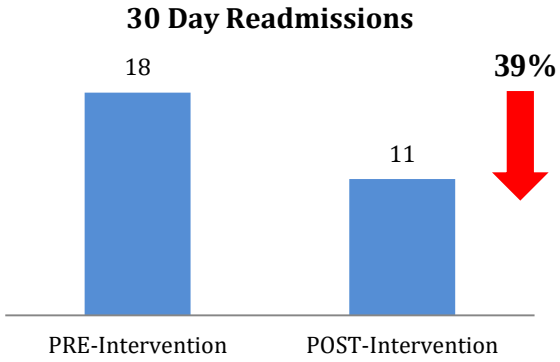
Results

- 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)

Type	Percent (%)	Example
Omission	57	Beta blocker for CHF Rescue inhaler for COPD
Wrong Dose	21	Insulin for DM
Duplication	11	2 statins for CAD
No Indication	8	PPI
Drug/Disease	3	Ibuprofen in CHF



- 35 prevented errors could have caused moderate to critical patient harm
- Prevention of approximately 1 potential adverse drug event per patient



- 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

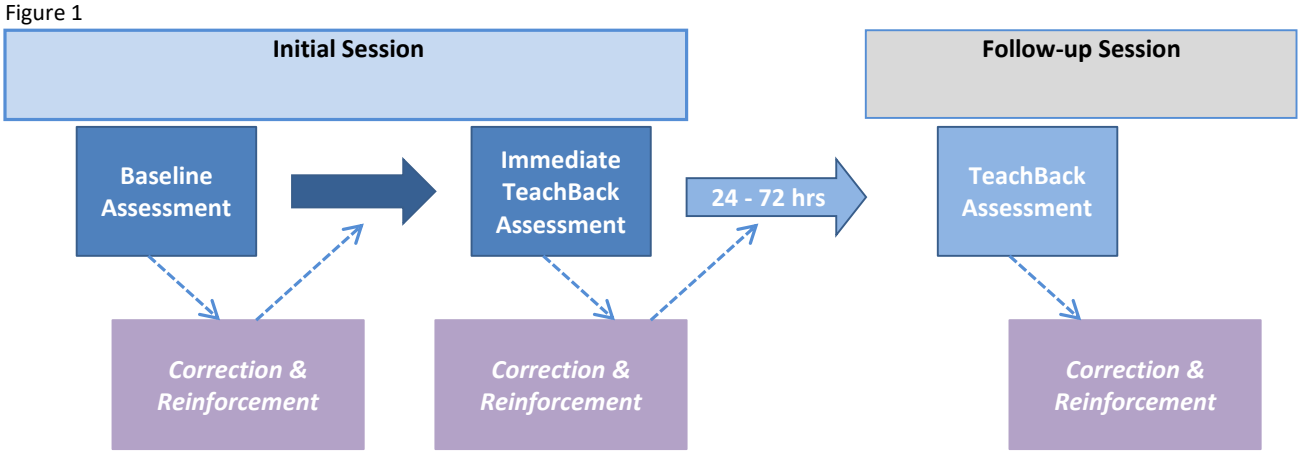
Background

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

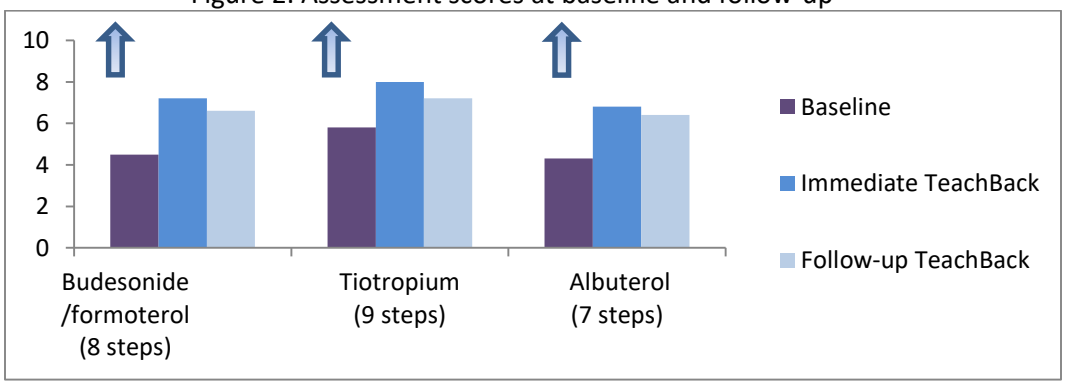
Figure 1



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.

Patient numbers - increasing https://www.cdc.gov/cancer/dcpc/research/articles/cancer_2020.htm (accessed 8-18-17)

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.

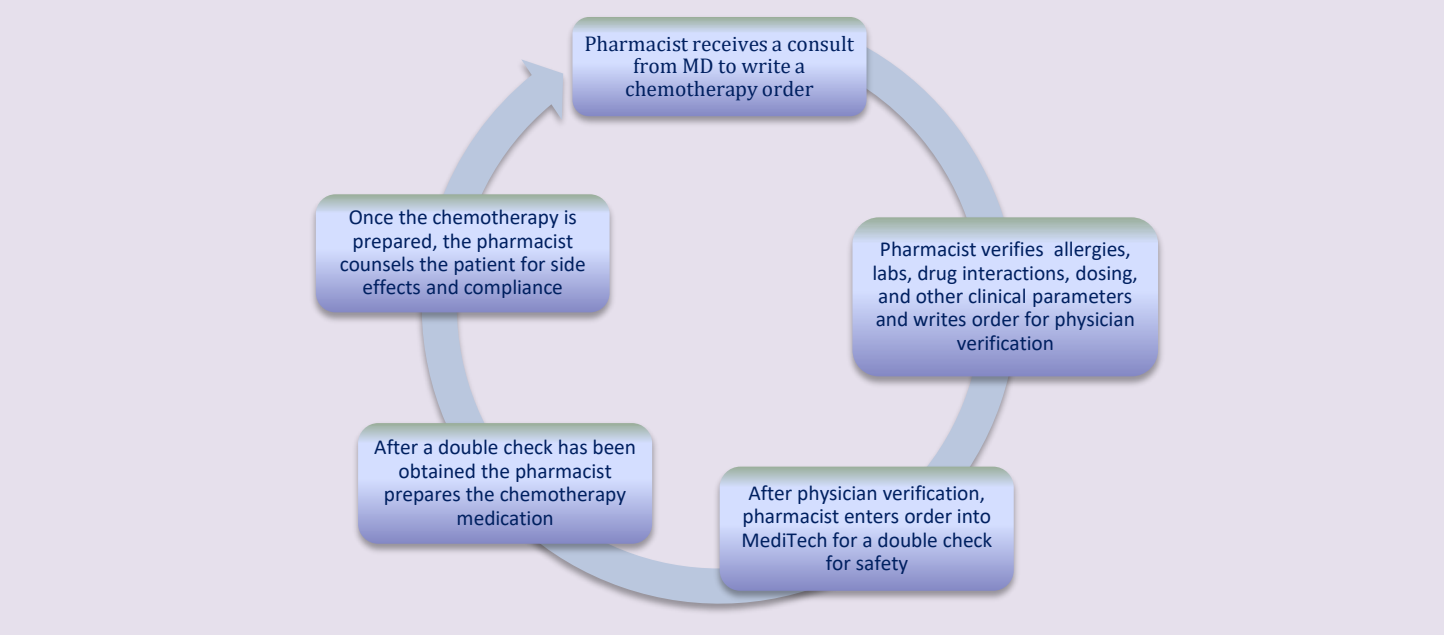
Assuming a pro-active stance, MSH oncology pharmacists have acted strategically to avert some of the aforementioned issues – working with Oncologists to develop guidelines, protocols and order sets.

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



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.

January 2016 – January 2017	
Patients Reviewed	11
Total Calcitonin Doses Administered	46
Inappropriate/Extra Doses Administered	31
Cost Associated with Extra Doses ($2164/vial)	$41,108

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

$30,000 Annual Savings

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.

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

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

Criteria	Total Number (%)
Patients Reviewed	26
Total Pegfilgrastim Doses Administered	168
Patients with Inappropriate Initiation of GCSF per	18 (69%)
Resulting Pegfilgrastim Doses administered	83 (49%)

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 a added once they demonstrate need. An annual $360 K of cost-avoidance was anticipated.

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.

Results Timeframe: August 2016 – February 2017	
Patients Reviewed	31 (17 breast; 7 lung; 6 prostate; 1 gastric)
Total Xgeva Doses Administered	145
Total Xgeva Drug Spend ($2400/unit dose)	$348,000
Patients Eligible for Conversion	25
Patients Not Eligible for Conversion to	6 (CrCl < 30 ml/min, n=1) (CrCl 30-40 ml/min; n=5)
Projected Xgeva Drug Spend After Conversion	$160,000 (55% reduction)

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

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.

Ambulatory Care Pharmacy Services

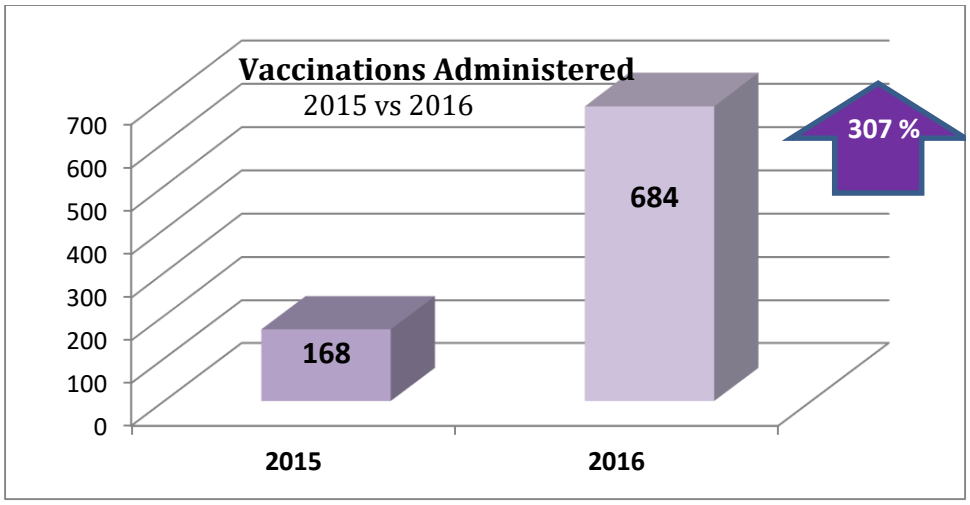
Introduction

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

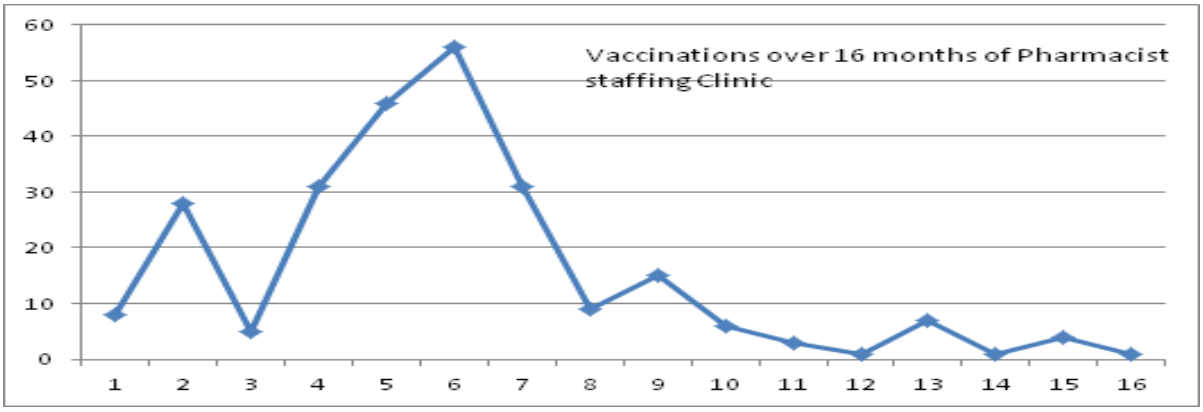
Currently, we staff Ambulatory Care primary care with a pharmacist a full five days weekly – the two pharmacists cover three clinics, Lawndale Plaza, Antillas, and South State. Further, we also staff an HIV/Hepatitis C Clinic with an Infectious Diseases pharmacist four days weekly

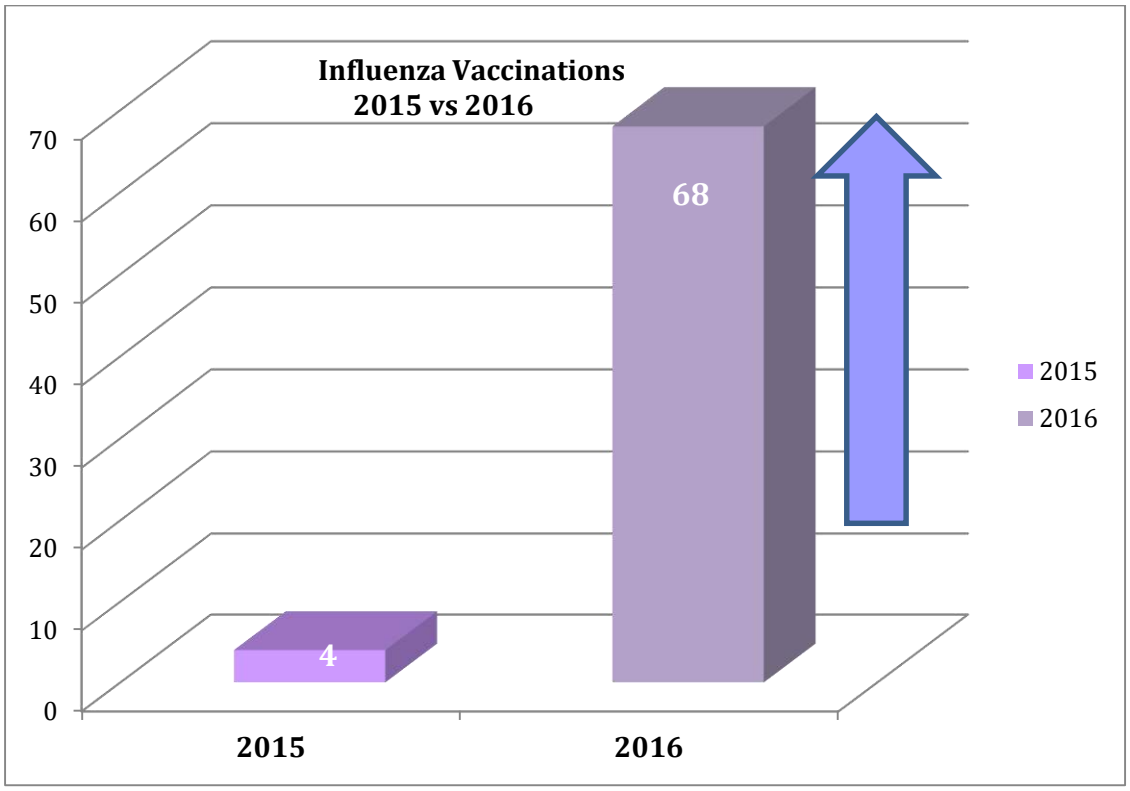
Vaccionations

Ensuring immunoprotection is an essential function of ambulatory care pharmacists. A pharmacist was integrated at LawndalePlaza 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.

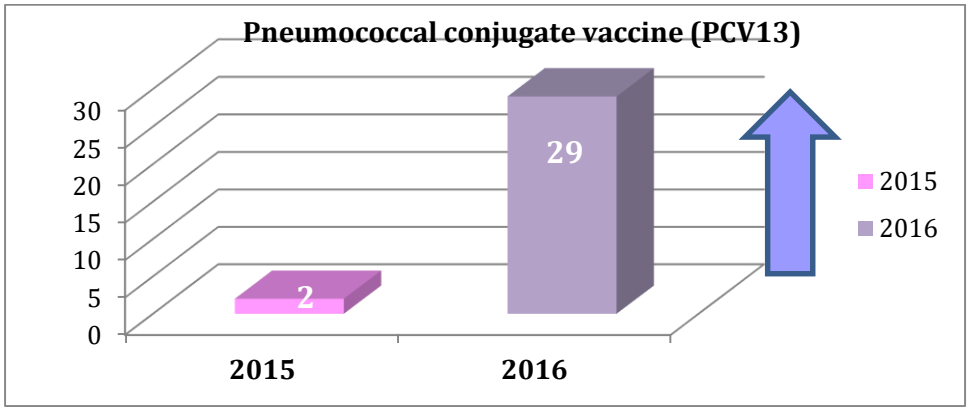


Efforts to immunize a population, are front-loaded ... the initial work is the most challenging ... Of course, there are exceptions, such as annual influenza and milestone events, such as a 65th birthday. The graph, below, depicts:

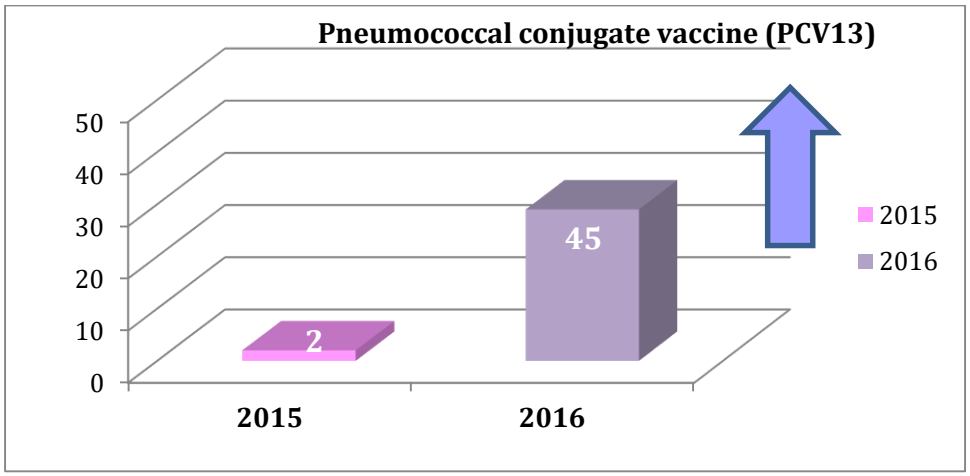




Another key vaccine with dramatic increased vaccination rates: the pneumococcal conjugate vaccine (PCV 13)



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

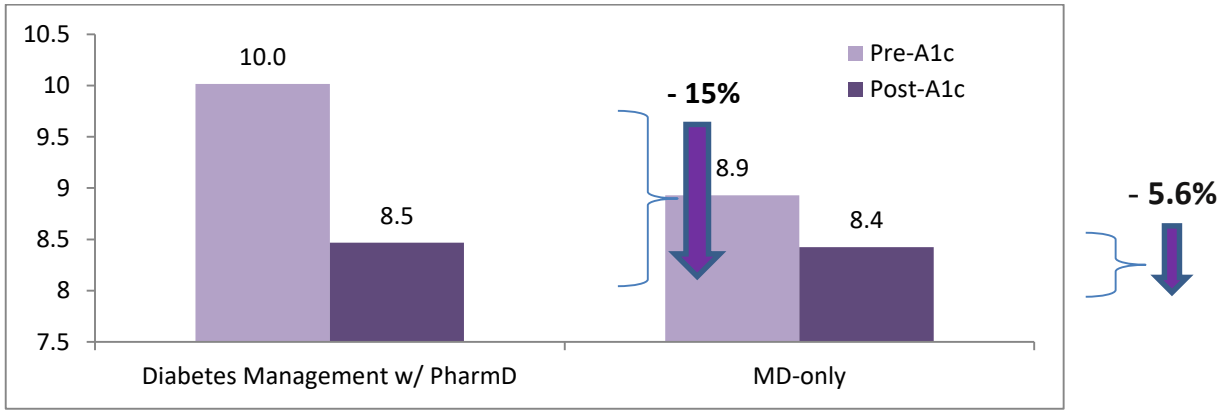
Background

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

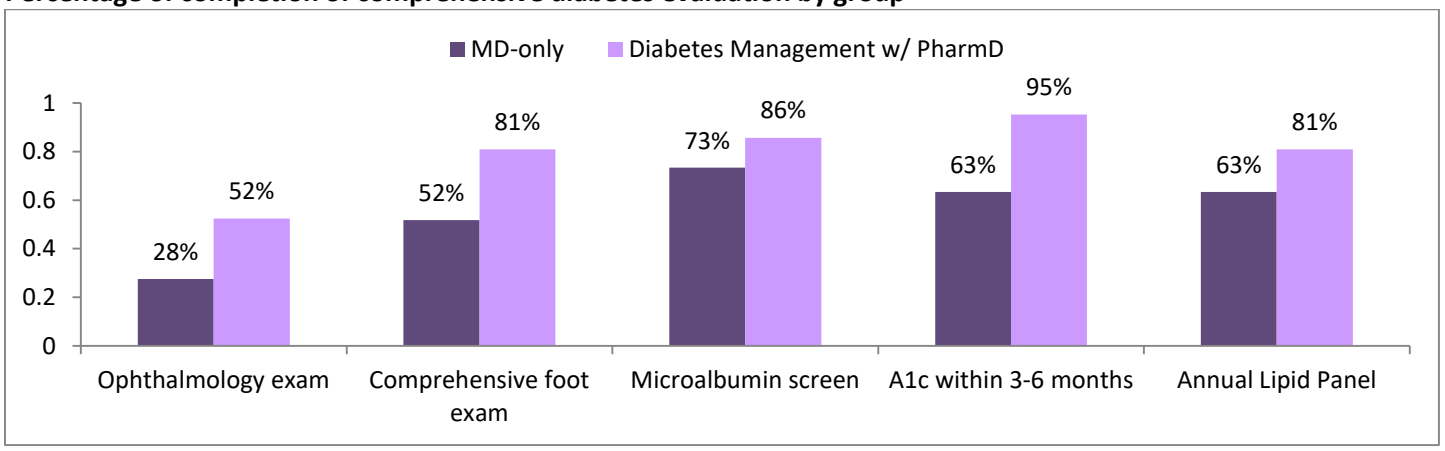
Services Provided

- 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)

Percentage of completion of comprehensive diabetes evaluation by group



- 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

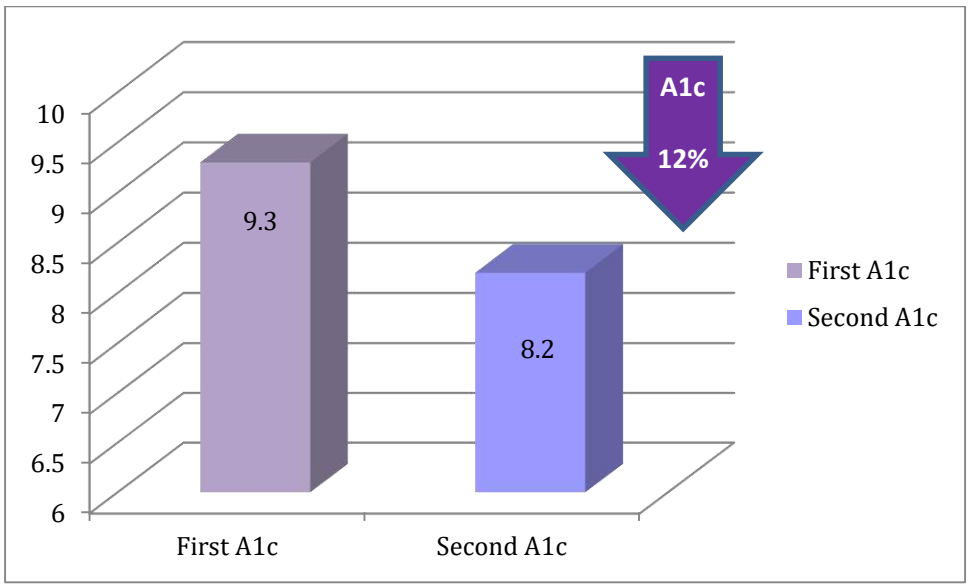
Considerations

- 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.



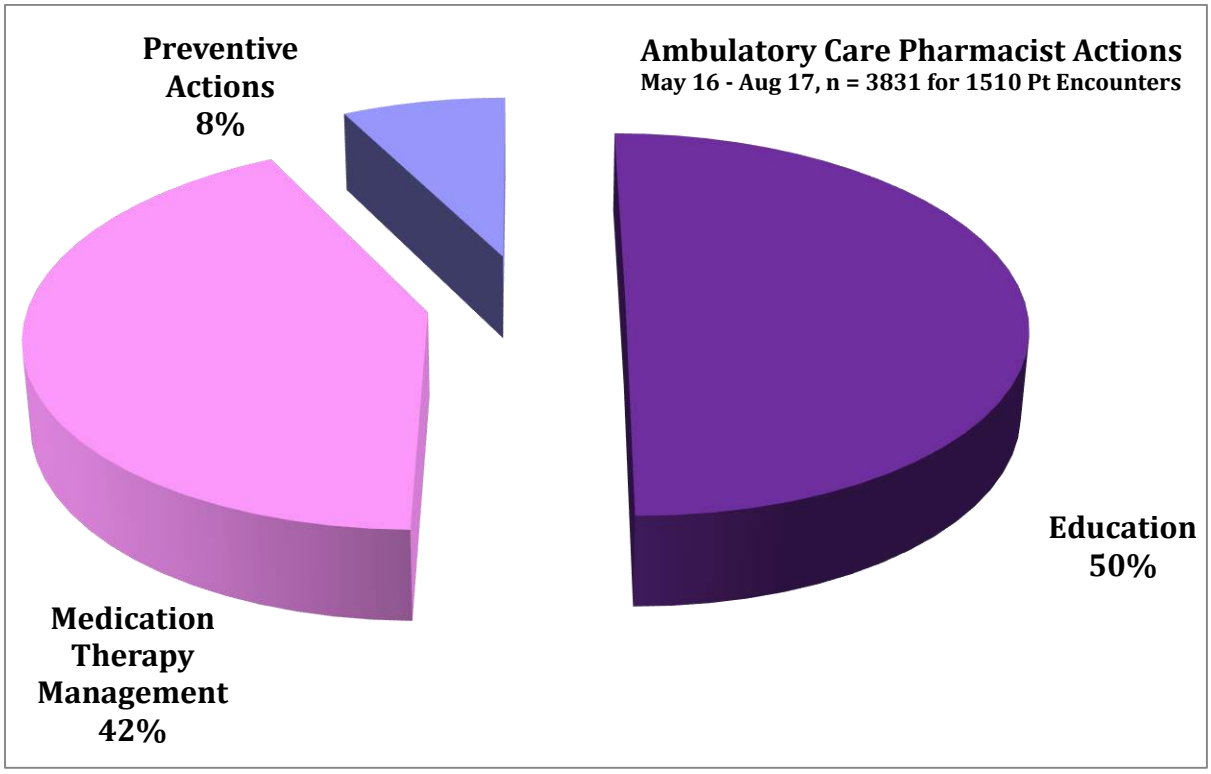
Current State: Care Distribution of Ambulatory Care Pharmacists

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.

	Educatior	M T M	Preventative Actions
TOTAL Actions per 3831 Clinic Encounters	**1921**	**1619**	**291**
Action per Patient Clinic Encounter Ratio	**1.3**	**1.1**	**0.2**
Action per Individual Clinic Patient Ratio	**1.9**	**1.7**	**0.3**

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.



The span of some of the services are detailed, below:

- 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: 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 of 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.

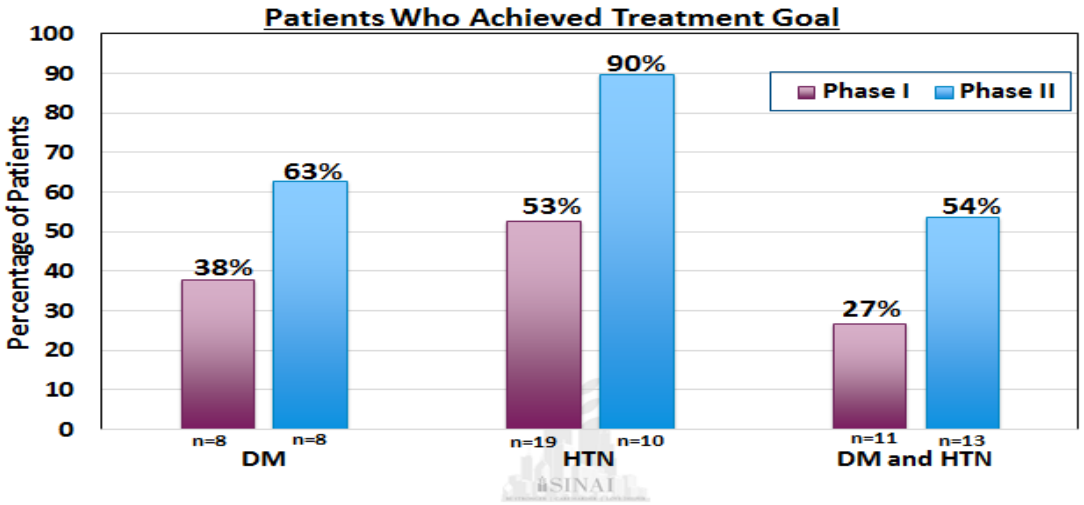
There have been multiple studies evaluating the impact on DM or HTN outcomes in patients receiving pharmacist management or usual care. Studies have shown statistical significance with pharmacist management on the decrease in A1c and the percentage of patients meeting DM treatment goals. Similarly, studies 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

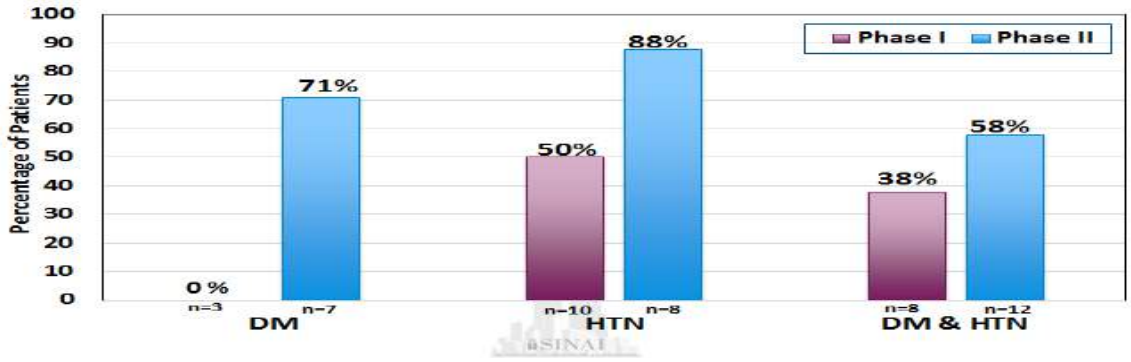
The primary objective was to retrospectively evaluate clinical outcomes in HIV positive patients with diabetes, hypertension or both before and after the implementation of ID ambulatory care pharmacy services. The secondary objectives were to correlate virologic suppression with controlled DM, HTN or 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:

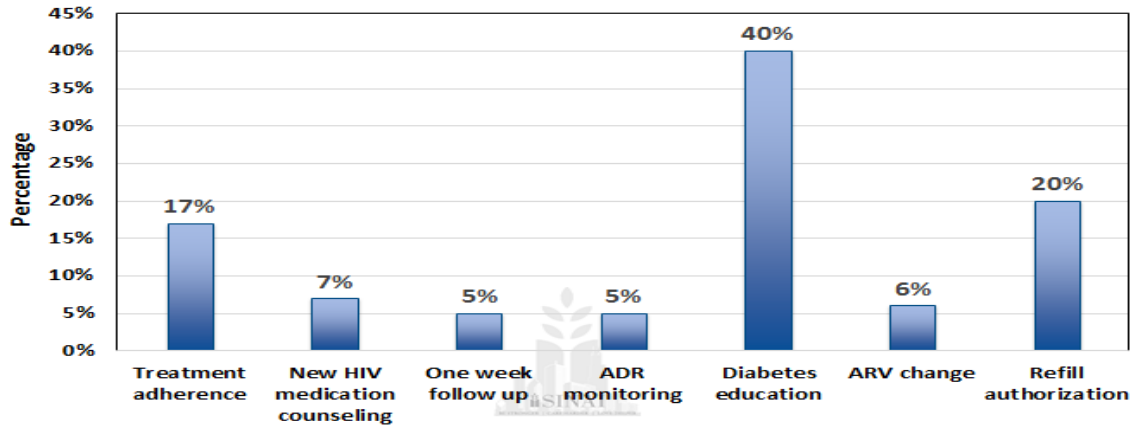


Secondary Outcomes:

Virologically Suppressed Patients Who Met Treatment Goal



Pharmacist Interventions

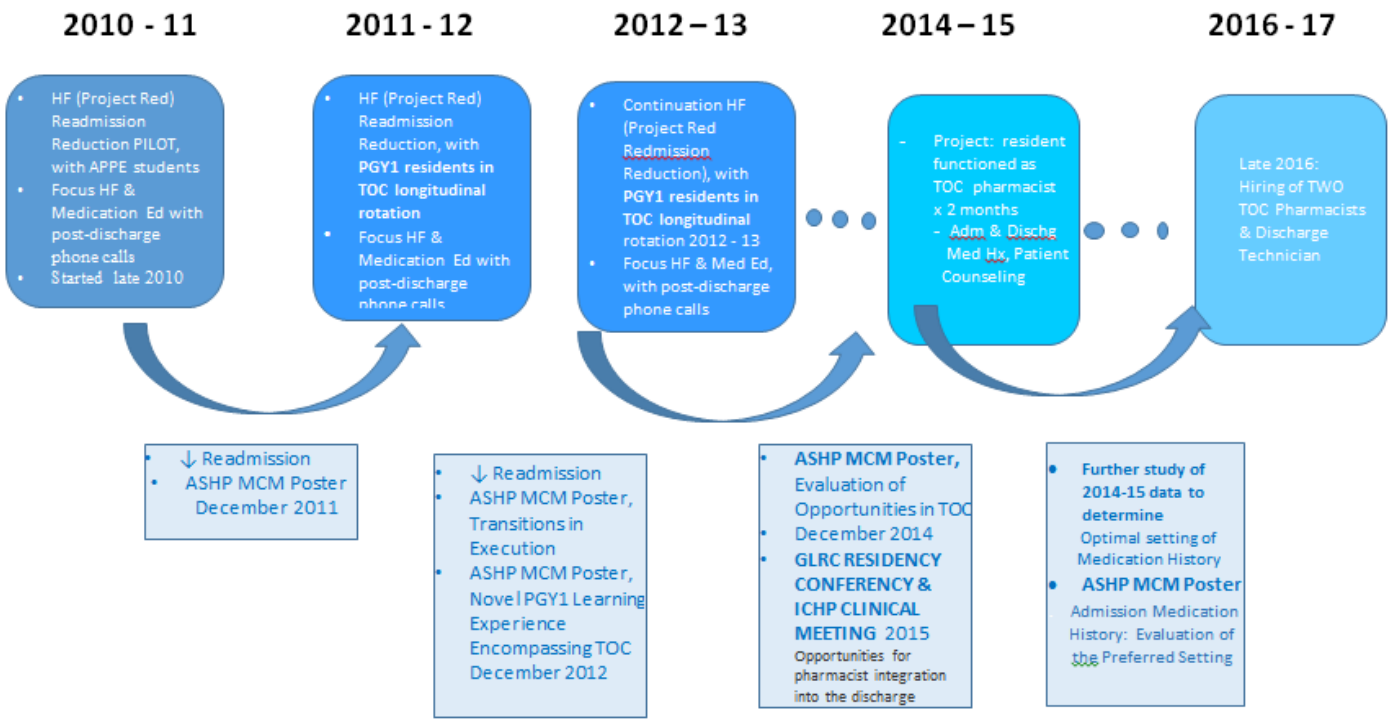


Conclusions

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



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

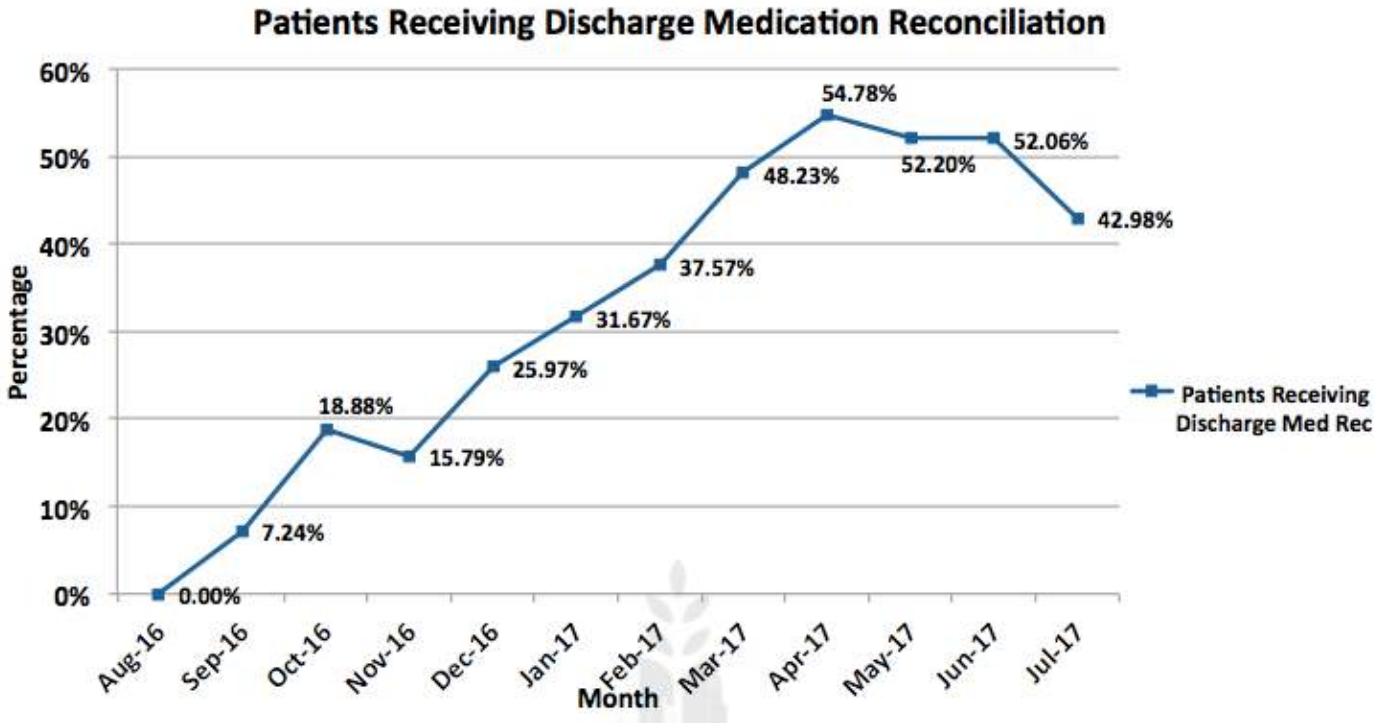
Planned Points of TOC Contact

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

Pharmacy Discharge Prescription Program Alone: RESULTS	
DURATION	**Oct 2015 – Dec 2015**
Overall 30-day readmission rate	22%
Participation in discharge program + readmission rate	17%
Total # of discharges during study period	3904
Prescriptions collected over study period	264 (30.3% of all general medicine prescriptions)

Current TOC Service - Phone Calls: RESULTS		
	3 Day Phone Call N = 145 (%)	**14 Day Phone Call N = 145 (%)**
Completed	74 (51)	65 (44.8)
Readmitted	11 (14.9)	10 (15.4)
Attempted (left voicemail)	49 (33.8)	39 (26.9)
Readmitted	9 (18.4)	6 (15.4)
Missed	15 (10.3)	29 (20)
Readmitted	4 (26.7)	8 (27.6)
Readmitted	7 (4.8)	12 (8.3)

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


Patients Receiving Discharge Medication Reconciliation
60%
50%
40%
30%
20%
10%
0%
Percentage
0.00%
7.24%
18.88%
15.79%
25.97%
31.67%
37.57%
48.23%
54.78%
52.20%
52.06%
42.98%
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
Jan-17
Feb-17
Mar-17
Apr-17
May-17
Jun-17
Jul-17
Month
Patients Receiving Discharge Med Rec

Value-Added Services

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

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

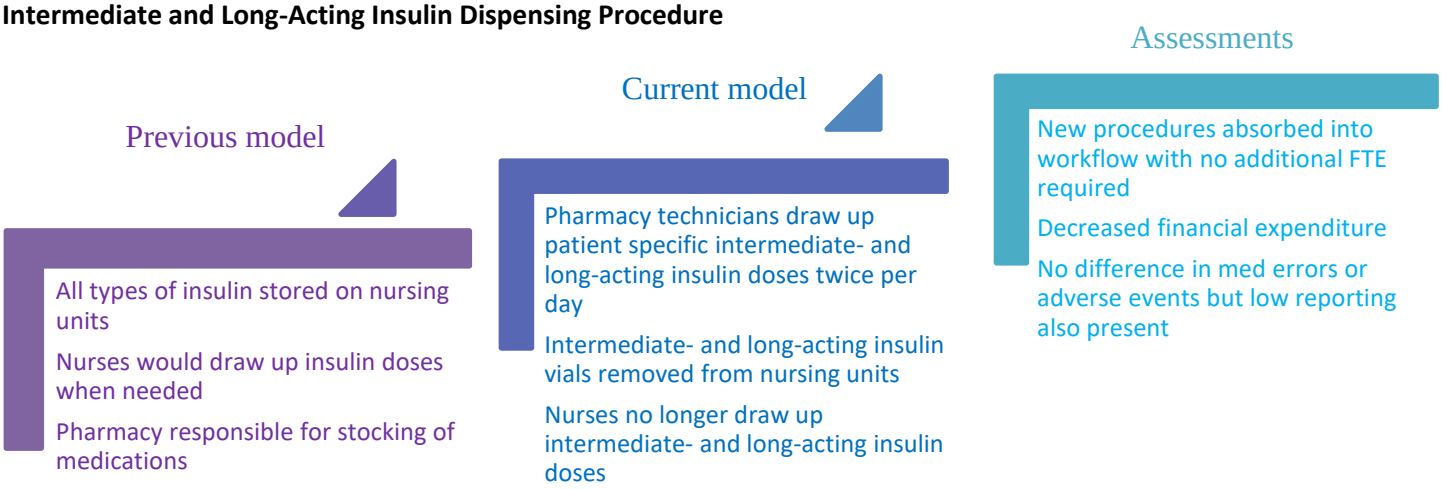
Insulin is one of the top five high-alert medications. The consequences of an error with a high risk medication are more devastating to patients.

- 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

	2011-12			2012-13 Pre-Intervention		2013-14 Post-Intervention		2014-15	
Vial Size	**Vial Cost**	**# of Vials**	**Cost**	**# of Vials**	**Cost**	**# of Vials**	**Cost**	**# of Vials**	**Cost**
50 mg	**$1,242.70**	**18**	**$22,368.60**	**7**	**$8,698.90**	**14**	**$17,397.80**	**5**	**$6,213.50**
100	**$2,348.46**	**28**	**$65,756.88**	**27**	**$63,408.42**	**13**	**$30,529.98**	**3**	**$7,045.38**
	Subtotal		**$88,125.48**		**$72,107.32**		**$47,927.78**		**$13,258.88**
			Pre OS Spending		**$160,232.80**		**Post OS Spending**		**$61,186.66**
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
Pharmacy Expense Indicators	Quartile	Opportunity to Next Quartile	Notes
Anti-infective $ per AAD	1	$0	Daily pharmacist involvement
Anti-infective $ per AAPD	1	$0	Daily pharmacist involvement
Antihemorrhagic $ per AAD	1	$0	Rarely used medications - pharmacist act as gatekeepers
Antihemorrhagic $ per AAPD	1	$0	Rarely used medications - pharmacist act as gatekeepers
Blood Deriv & IVIG $ per AAD	1	$0	Rarely used medications - pharmacist act as gatekeepers
Blood Deriv & IVIG $ per AAPD	1	$0	Rarely used medications - pharmacist act as gatekeepers
Antifungal $ per AAD	2	$1,142	Daily pharmacist involvement
Antifungal $ per AAPD	2	$1,467	Daily pharmacist involvement
Antineoplastic $ per AAD	3	$213,343	Includes outpatient purchases - not reflective of inpatient practice
Intra-op CNS drug $ per AAD	3	$5,652	Anesthesia medications - physician operated
Intra-op CNS drug $ per AAPD	3	$7,578	Anesthesia medications - physician operated
Antineoplastic $ per AAPD	4	$17,318	Includes outpatient purchases - not reflective of inpatient practice
Blood Coag & Thromb $ per AAD	4	$14,481	Data needs to examined further - potential area of improvement
Blood Coag & Thromb $ per AAPD	4	$14,357	Data needs to examined further - potential area of improvement
Hematopoietic $ per AAD	4	$35,352	Includes outpatient purchases - not reflective of inpatient practice
Hematopoietic $ per AAPD	4	$51,810	Includes outpatient purchases - not reflective of inpatient practice
Toxoid & Vaccine $ per AAD	4	$88,486	Nursing driven protocol - area of improvement
Toxoid & Vaccines $ per AAPD	4	$106,973	Nursing driven protocol - area of improvement
Intra-op CNS drug $ per OR Case	-	-	Anesthesia medications - physician operated

MSH Pharmacy Benchmarking and Performance Executive Summary

Executive Summary

- *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 favorably ranked in top 70th percentile for community hospital and 90th 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.

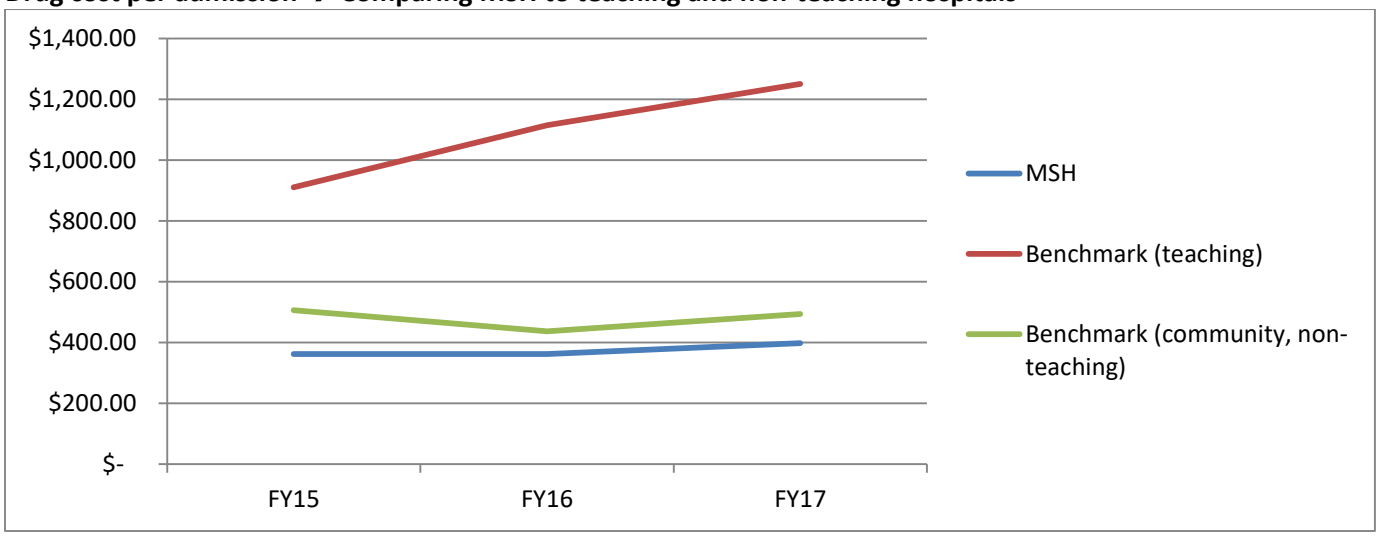
This data represents budget reductions already made for FY18

LAZARUS REPORT	Non-Teaching/Community Group			MSH Community Results	Teaching Group			MSH Teaching Results
	25th %ile	50th %ile	75th %ile		25th %ile	50th %ile	75th %ile	
% of Beds ICU	7%	10%	12%	10%	14%	17%	22%	10%
Cost Measures								
Drug cost per admission	$336	$494	$629	$397 30th %ile	$911	$1,115	$1,251	$397 Less than 25th %ile
Drug cost per patient day	$81	$103	$129	$76 Less than 25th %ile	$165	$179	$196	$76 Less than 25th %ile
Pharmacy Cost as % of Hospital Cost	5.1%	6.0%	6.8%	4.0% Less than 25th %ile	6.0%	9.7%	12.1%	4.0% Less than 25th %ile
Case Mix Index (CMI)	1.3	1.5	1.8	1.7 MSH/SRH	1.9	2.0	2.2	1.7 Less than 25th %ile

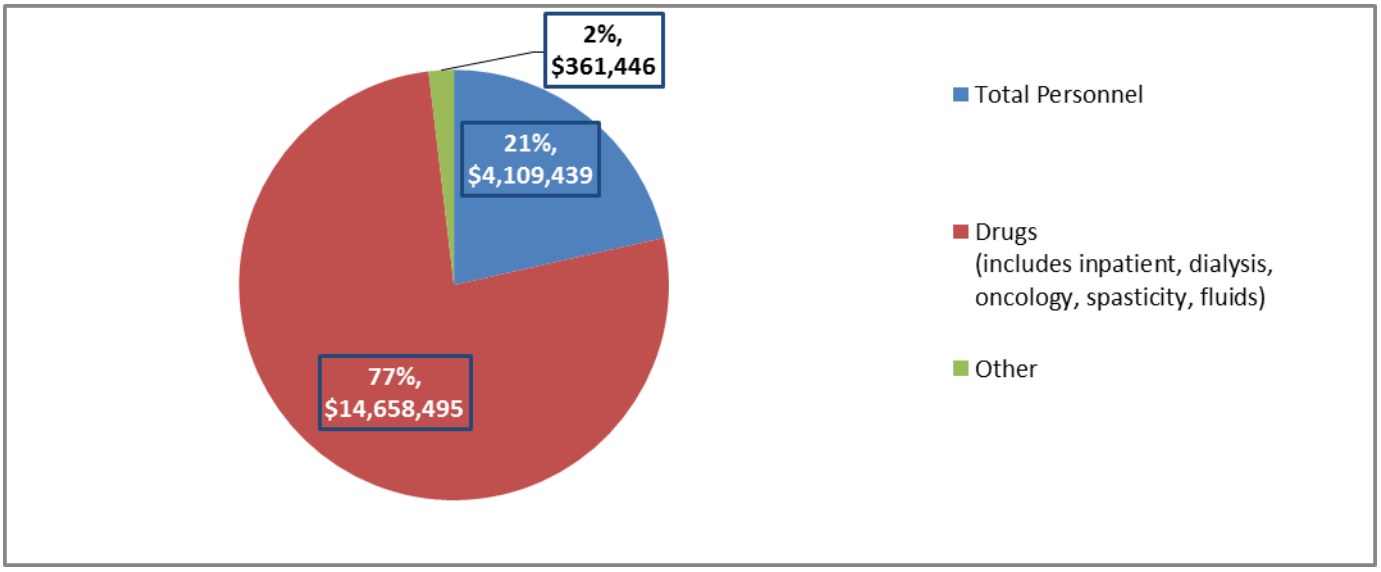
Compared to its peers, MSH pharmacy is out-performing in cost measures. Actual dollars saved per admission and patient day against all percentile benchmarks is shown below.

MSH Pharmacy Drug Cost Comparisons to Current Inpatient Benchmarks			
	25th	50th	75th
Non-teaching/Community			
Drug cost per admission	Opportunity to save $1,008,940	($1,604,380)	($3,837,280)
Drug cost per patient day	Below 25th percentile	($2,330,775)	($4,575,225)
Teaching Hospitals (academic &			
Drug cost per admission	($8,501,560)	($11,875,720)	($14,125,160)
Drug cost per patient day	($7,682,925)	($8,891,475)	($10,359,000)

Drug cost per admission → Comparing MSH to teaching and non-teaching hospitals



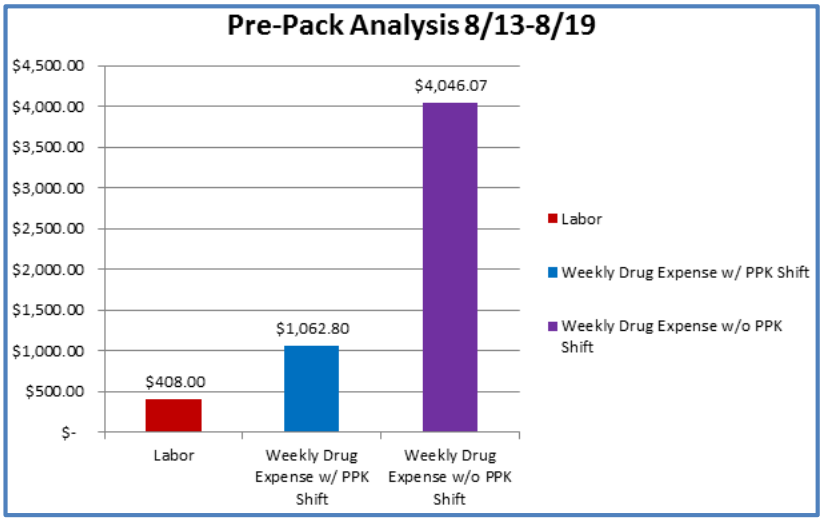
Personnel costs account for 21% of MSH pharmacy budget and are a major contributor to decreased drug costs. This decrease in drug expenses from services provided by pharmacy personnel more than compensates for the current personnel costs (see examples below on next page).



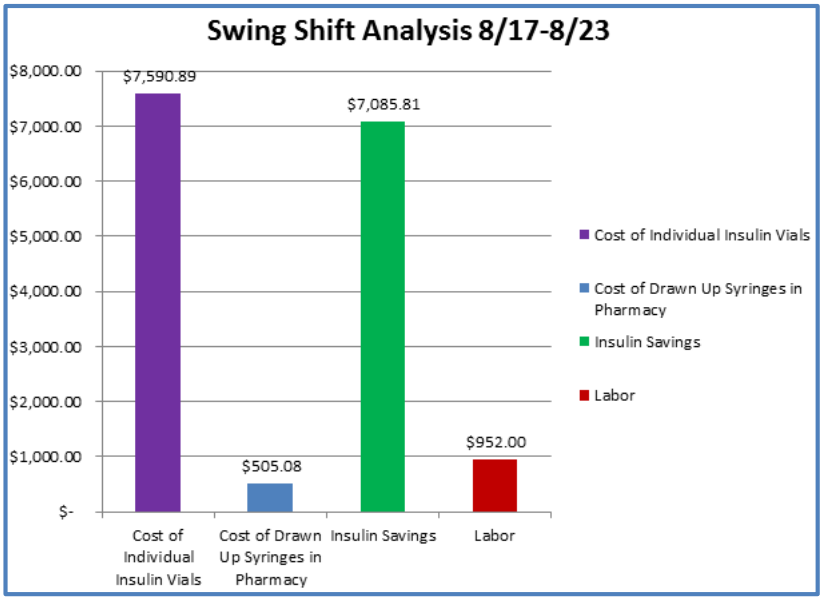
Pharmacy staffing is required to maintain drug expense reduction strategies. Please see examples below.

Cost Saving Strategies

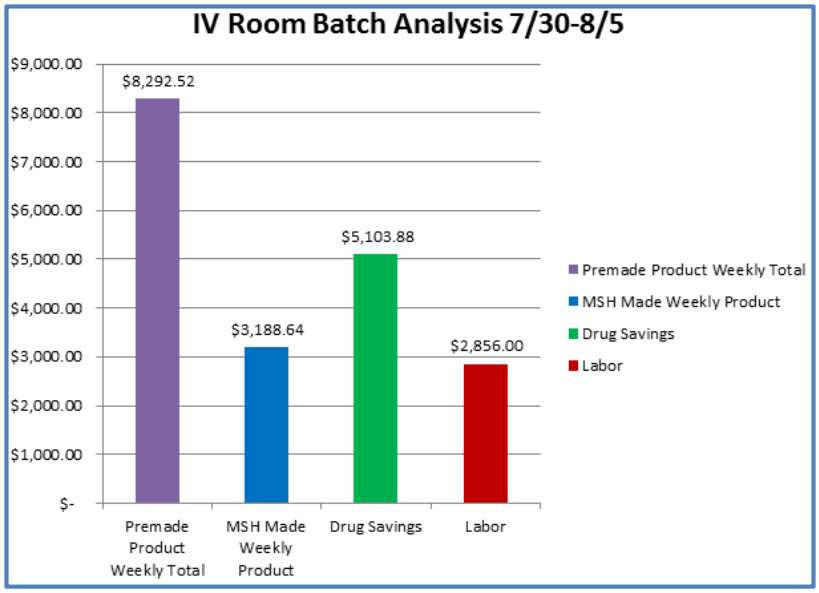
The prepack technician packages bulk items (heavy workload) into unit dose forms, resulting in annual savings of **$130,000 in drug costs net of labor expenses.**



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 hospital 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.