MSHP Pharmascript

Volume 43, Issue No.3,
Supplement 1
Third Quarter

Supplement: 2019 Pharmacy Resident Research Abstracts

Pharmascript

Volume 43, Issue No.3,
Supplement 1
Third Quarter

Analysis of medication-related triggers to determine preventable adverse drug events

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Objective: Voluntary event reporting systems continue to be the most common method used to identify adverse events in most US hospitals; however, this method fails to capture more than 90% of adverse drug events (ADEs). Integration of trigger tools within an electronic health record has the potential to improve adverse event detection and allow healthcare providers to mitigate potential harm. The purpose of this project is to examine which medication-related triggers have the highest positive predictive values (PPV) for detecting preventable adverse drug events at a large academic medical center.

Methods: A one-year, single center, retrospective quality improvement study was conducted to assess the PPV of four medication-related triggers: flumazenil, naloxone, glucose < 70 mg/dL, or dextrose 50%. Patients admitted for more than 24 hours were included in the analysis if at least one medication-related trigger was present. Patients were excluded if the medication-related trigger occurred in the emergency department or an outpatient clinic. Patients were identified utilizing available chart data from the electronic health record (Epic v.2018). Retrospective chart review was conducted on a random sample of eligible patients to establish if an adverse drug event occurred and determine its preventability. Consensus voting among the medication safety officers confirmed adverse drug event determination and preventability classification. Assessed triggers were also compared against the hospital's voluntary event reporting system to determine whether the events were previously reported.

Results: A total of 161 triggers were reviewed with 107 ADEs detected. PPV values for detection of ADEs were 0.55, 0.58, 0.76, and 0.68 for flumazenil, naloxone, glucose < 70 mg/dL, and dextrose 50%, respectively. PPV values for detection of preventable ADEs were 0.09, 0.16, 0.32, and 0.34 for flumazenil, naloxone, glucose < 70 mg/dL, and dextrose 50%, respectively. Of the 107 ADEs identified, three events were reported through the hospital's voluntary event reporting system (2.8%).

Conclusions: Trigger tools successfully detected both preventable and non-preventable adverse drug events. Our study revealed that events detected using trigger tools are unlikely to be reported through voluntary event reporting systems; therefore, trigger tools can serve as a useful adjunct for adverse event detection. Further research aimed at reviewing preventable ADEs already identified by these trigger tools, including determination of root causes and implementation of systems changes, is ongoing.

Assessing the impact of clinical pharmacy in the management of pre-exposure prophylaxis (PrEP) within adult medicine

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Purpose: Statistics reported from District of Columbia in 2016 showed an alarming rate of new Human Immunodeficiency Virus (HIV) diagnoses, reflecting the need to target at-risk populations to curtail the spread of HIV. Pre-exposure prophylaxis (PrEP) with tenofovir disoproxil fumarate and emtricitabine (Truvada), in conjunction with safe sex practices, is recommended in persons at high risk of HIV acquisition. At Kaiser Permanente Mid-Atlantic States (KPMAS), candidates for PrEP are managed primarily by adult medicine providers. Clinical pharmacists are well-positioned to play an integral role in providing education, managing PrEP and identifying and

addressing barriers to medication adherence. This study seeks to evaluate the impact of clinical pharmacy at KPMAS on patients managed on PrEP through assessment of data pre- and post-telephonic intervention.

Methods: Participants at least 18 years of age actively managed on PrEP by an adult medicine provider were included in this study. Telephonic intervention consisted of the clinical pharmacist providing medication adherence counseling to ensure adherence with follow-up monitoring on a scheduled basis. Laboratory data including HIV RNA and antibody testing, renal function, hepatitis serologies and sexually transmitted infection (STI) screenings, were assessed pre and post telephonic intervention via chart review. Demographic variables, medication fill history and medication refill adherence rates (MRAR) were also assessed. The primary outcomes assessed include evaluation of changes in medication refills, lab monitoring and adherence strategies pre and post-pharmacist intervention.

Results: Of the 44 patients included in the study, a total of 39 patients (87%) filled Truvada after clinical pharmacist intervention, compared to 34 patients (77%) pre-intervention which demonstrated a 10% increase (n=5) in the number of Truvada prescriptions filled. A total of 35 patients (79.5%) completed labs post-intervention compared to 24 patients (54.5%) pre-intervention. This demonstrated a 25% increase in number of patients who were compliant to lab monitoring for PrEP (n=11). There were no significant changes in adherence strategies reported by the participants pre- and post-intervention.

Conclusions: Results suggest that clinical pharmacists add value to PrEP management through provision of medication counseling, outreaching for medication adherence and lab monitoring and drug information consults. Provider-pharmacist collaboration increased with the interventions made by the clinical pharmacist which demonstrated the value of a pharmacist in patient care, especially in the PrEP management. The increased demand for PrEP in adult medicine requires a collaborative approach and clinical pharmacists are well-positioned to play an integral role in PrEP management.

Assessment of the impact of pharmacist-led transition of care services in a primary health care center

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Objective: The impact of pharmacist-led transition of care services with collaborative drug therapy management has shown to improve patients' outcomes and decrease health costs. One in five patients experience adverse drug events and complications weeks after discharge.
This reinforces pharmacists' contributions in delivering a safe and effective continuum of care between health systems. Compelling statistics show higher readmission rates for under-insured patients compared to insured patients at primary health care clinics. The integration of pharmacists in primary care teams can improve patients' health, experience, and safety. Moreover, providing innovative patient care is one of the strategic health goals targeted in this study.

Methods: This is a single center, prospective, cohort study designed to examine team-based collaborative drug therapy management (CDTM) and its effect on therapeutic outcomes of under-insured patients with target chronic health diseases managed in a primary health center. The study was approved by the local Institutional Review Board. Targeted chronic disease states included dyslipidemia, diabetes, hypertension, anticoagulation disorders, chronic obstructive pulmonary disease (COPD), and heart failure. Inclusion criteria for this study specified that

participants must be at least 18 years of age with a minimum of one targeted chronic disease state, took at least five medications, or had emergency department visits secondary to uncontrolled disease. Patients were excluded from the study if they were unable to follow-up or discharged to hospice or a skilled nursing facility. The primary outcome measures included percentage of time in therapeutic international normalized ratio (INR) and percentage of patients at targeted goals of blood pressure, lipids, and hemoglobin A1c (HbA1c). Secondary outcomes included reduced emergency department visits, number of patient encounters, hospital readmissions within 30 days of discharge, and disease exacerbation rates. Primary and secondary outcomes were analyzed using an unpaired t-test.

Results: Patients were at INR goal 58% of the time compared to 52% at baseline (P=0.66). There was a 9% improvement in mean HbA1c in the intervention group when compared to baseline (9.6% vs. 10.9%, P=0.03). With pharmacist intervention, 73.8% of the patients had their blood pressure at goal compared to 50% at baseline. A limited number of patients were readmitted for different reasons, including uncontrolled disease states.

Conclusion: The pharmacist-physician collaborative drug therapy management led to improved blood pressure control, average HbA1c and time in therapeutic INR range. A decrease in healthcare utilization was also identified.

Characterization of Post-Operative Infection and Outcomes Following Delayed Sternal Closure

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Objectives: To compare the incidence of post-operative infections, morbidity, and mortality in patients managed with delayed sternal closure (DSC) versus primary sternal closure (PSC). To evaluate the appropriateness and effectiveness of the surgical prophylaxis utilized.

Design: Retrospective chart review

Setting: Large academic medical center

Participants: Cardiothoracic surgery patients in the Society of Thoracic Surgeons (STS) database managed with DSC between August 2015 and November 2018 matched 1:1 to patients managed with PSC.

Interventions: Not applicable as this was a retrospective chart review

Measurements and Main Results: A total of 114 patients were included in this study, 57 patients in each of the DSC and PSC groups. The most common indication (56.1%) for DSC was for coagulopathy. All patients received surgical prophylaxis for at least 48 hours post-operatively. The DSC group had a higher rate of any postoperative infection [18 (31.6%) vs. 2 (3.5%), P < 0.005], as well as pneumonia [11 (19.3%) vs. 1 (1.8%), P < 0.005]. Ninety-five percent of the organisms speciated were Gram-negative.

Conclusion: The incidence of postoperative infection is higher in cardiothoracic surgery patients managed with DSC when compared to PSC despite appropriate duration of surgical prophylaxis.

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Development and implementation of a personalized dashboard to determine clinical appropriateness of pharmacist order verification

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Objective: Advancements in technology have provided methods for health care professionals to improve medication appropriateness. Despite these efforts, medication errors persist and can result in significant patient harm. Strategies such as individual performance feedback and clinical dashboards have separately shown benefit in mitigating medication errors. The purpose of this study was to develop a personalized dashboard and assess verification accuracy for select renally dose-adjusted medications based on institutional guidelines.

Methods: Orders for adult patients who received acyclovir, amoxicillin/clavulanate, ampicillin/sulbactam, and ertapenem between July 2016 and October 2018 at The Johns Hopkins Hospital were included. Orders for patients without a serum creatinine, weight, or height documented at time of medication verification were excluded. Data collection included medication dose and frequency, pharmacy location, pharmacist name, patient's age, serum creatinine, weight, and height at time of order verification. Orders were assessed for compliance with institutional guidelines based on patients' calculated creatinine clearance using the Cockcroft-Gault equation. The primary objective was to develop a personalized pharmacist dashboard. The secondary objective was to assess adherence to institutional guidelines for select renally dose-adjusted medications.

Results: A total of 11,445 orders were verified between July 2016 and October 2018. Of these orders, 9,506 met inclusion criteria. Among the medications included in the study, ampicillin/sulbactam had the highest order verification accuracy of 96.5% (2,853/2,956). Verification accuracy for ertapenem was 95.7% (3,259/3,407), amoxicillin/clavulanate was 94.2% (2,239/2,378), and acyclovir IV was 85% (650/765).

Conclusion: The development of a personalized pharmacist dashboard is a useful tool to investigate verification accuracy trends for select renally dose-adjusted medications.

Development and implementation of an extended infusion beta-lactam protocol in the medical intensive care unit at an academic medical center

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Objective: FDA labeling for beta-lactam administration includes a short infusion (30 minutes), which can cause suboptimal times of free drug concentration above the MIC in patients with preserved renal function. This is particularly concerning in critically ill patients with sepsis who may have an increased volume of distribution and augmented renal clearance. Several studies compared intermittent-infusion to prolonged-infusion beta-lactams in the critically ill and found that prolonged administration optimized drug concentrations and improved mortality. Unfortunately, this approach poses operational challenges. Institutions that have implemented extended infusion beta-lactams for all patients found the following challenges: prescriber resistance, ordering errors, lack of IV access, and missed doses. At our institution, extended infusion beta-lactams are used on a patient-specific basis. The purpose of this quality improvement project is to develop and implement an extended infusion beta-lactam multidisciplinary protocol in the medical intensive care unit (MICU) and ultimately all intensive care units in this institution.

Methods: Beta-lactams included in the protocol were piperacillin/tazobactam, cefepime, ceftazidime, and meropenem. A multidisciplinary team including unit-based midlevel practitioners, pharmacists, and nurses collaborated to write the protocol. The protocol addressed the following: ordering and appropriate dosing, pharmacist verification, IV compatibility, tips for patients with IV access challenges, and de-escalation of therapy. Directed education was provided to providers, pharmacists, and nurses to facilitate the transition from intermittent to extended infusion beta-lactams. After implementation, MICU patients with an order for a targeted beta-lactam were prospectively followed to assess adherence to the protocol and identify logistical problems that prevented protocol execution.

Results: Operational challenges that prevented initiation of the protocol included inadequate IV access and clinicians forgetting to implement the protocol in eligible patients. Four missed doses were observed in patients receiving extended infusion beta-lactams, though only two of them were due to issues specific to extended infusion. Additionally, there were nurses who incorrectly re-timed the first extended infusion dose to be given several hours after the initial bolus. These findings support the need for frequent education, consistent leadership, and close monitoring in order to successfully implement an extended infusion beta-lactam protocol. Future directions include creating an extended infusion beta-lactam order set within the computerized physician order entry system and implement the protocol in all adult intensive care units at our institution.

Conclusion: Overall, implementing an extended infusion beta-lactam protocol is possible, though it requires a significant amount of time and attention. Necessary components of successful implementation include multidisciplinary involvement, continuous solicitation of feedback, close evaluation for operational challenges to propose solutions, and frequent education.

Evaluation of Ketamine for Excited Delirium Syndrome in the Adult Emergency Department

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Introduction: Excited delirium syndrome (ExDS) is characterized by delirium, agitation, and hyperadrenergic autonomic dysfunction. A guideline for ExDS management, which recommends the use of ketamine as a second-line agent, was implemented in our hospital's adult emergency department (ED).

Objectives: The primary objective is to determine if ketamine, 1 mg/kg IV or 2 mg/kg IM, is being used according to the ExDS guideline. Secondary objectives include evaluating the specific agents, routes, and dosages used to manage ExDS and the safety and efficacy of ketamine.

Methods: Single-center, retrospective chart review of subjects who received ketamine for the management of ExDS in the ED. Efficacy was measured by documented Richmond Agitation Sedation Scale (RASS) scores. Safety was assessed through evaluation of vital signs and adverse effects.

Results: Thirty-one subjects met inclusion criteria. Eight (25.8%) of them received ketamine for ExDS in adherence with all aspects of the guideline. Administration of ketamine led to a statistically significant decrease in RASS score: 4 (3 to 4) vs. 0 (2 to -1) (P=0.001) (median, IQR). There were no statistically significant differences in vital signs or

RASS scores in our subgroup analyses of patients treated according to protocol and of those treated with ketamine, 2 mg/kg IM.

Conclusion: We found discordance between current practice and our institution's ExDS guideline for subjects managed with ketamine. Low-dose, 1 mg/kg IV or 2 mg/kg IM, ketamine appears to be safe and efficacious as second-line therapy for ExDS.

Evaluation of Therapeutic Drug Monitoring in the Neurocritical Care Unit

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Background: Fosphenytoin is commonly used in neurologically injured patients for the treatment of seizures or as prophylaxis in neurosurgical procedures. Critically ill patients often have altered pharmacokinetic parameters, requiring frequent dose adjustments based on therapeutic drug monitoring. Pharmacokinetic equations exist to help guide additional fosphenytoin dose recommendations, although the validity of such equations remains uncertain. The aim of this study was to determine if the current method of calculating a fosphenytoin reloading dose results in a therapeutic free phenytoin level on subsequent days.

Methods: Medical records of patients receiving fosphenytoin in the Neurocritical Care Unit (NCCU) between July 2017 and June 2018 were screened. Included patients were those who had received at least 3 doses of fosphenytoin and required re-loading doses based on concentrations obtained through therapeutic drug monitoring. Free phenytoin levels were categorized based on the pre-specified patient specific target range, generally between 1.5-2.5 mcg/mL.

Result: Of fosphenytoin reloading doses administered, 48% (72/152) resulted in a therapeutic free phenytoin concentration on the subsequent day, with the remaining 52% resulting in non-therapeutic levels (39% subtherapeutic, 13% supratherapeutic). When evaluating reloading dose calculation strategies, patients were two times as likely to obtain a therapeutic level with the use of a modified pharmacokinetic equation omitting the use of volume of distribution or salt formulation (58%, n=39), as compared to doses calculated using the current pharmacokinetic model (41%, n=20) or doses based on provider preference (39%, n=14).

Conclusion: The current method of calculating a fosphenytoin re-loading dose in the critically ill population does not consistently result in therapeutic concentrations. With multiple factors affecting the pharmacokinetics of critically ill patients, the creation of a new pharmacokinetic model with less emphasis on volume of distribution may result in therapeutic concentrations more consistently.

Impact of an opioid stewardship program in reducing unnecessary opioid use in a community, teaching health system

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Objective: The national opioid epidemic is currently declared a public health crisis. From 1999- 2017, the Center for Disease Control and Prevention reported about 400,000 deaths from opioid overdose. Approximately half of these overdoses are due to prescription opioids. The Joint Commission requires hospitals to collect and analyze data on

pain management and establish protocols for increase safety and quality. An opioid stewardship program was implemented in two community teaching hospitals, in an effort to reduce unnecessary use of intravenous (IV) hydromorphone and morphine. The objective of this study is to assess the impact of this program on the utilization of IV hydromorphone and IV morphine in a community teaching health-system.

Methods: This Institutional Review Board approved study was a single-centered, prospective, interventional analysis comparing outcomes pre and post exposure to the intervention. The intervention included a policy in which pharmacists place a next–day-at-noon stoppage of all IV hydromorphone and morphine orders upon verification. This allowed pharmacists to review and assess the orders for appropriateness and make recommendations for alternative or adjunctive non-opioid pain medications when appropriate. This policy was implemented in January 2018. Pharmacists also utilized an opioid stewardship tool to assess current therapy, recommend alternative therapy and document any interventions. Patient-controlled analgesia, patient-controlled epidural analgesia and hospice patients were excluded. The primary outcome is the average IV morphine milligram equivalents (MME) per total patient days. The average IV MME/total patient days for each month was calculated using total number of charges upon dispensing of the opioid product. Secondary outcomes include average pain score and incidence of naloxone use. For the primary and secondary outcome, a 2-tailed, unpaired t test, with p-value of < 0.05 was utilized.

Results: The mean (SD) of IV MME/total patient days for hydromorphone was reduced by 63% (9.49 [2.75] vs 3.47 [2.19], $p < 0.0001$). The mean (SD) of IV MME/total patient days for morphine was reduced by 18% (0.86 [0.11] vs 0.70 [0.13], $p < 0.0001$). The mean (SD) of naloxone use, based on number of patients treated per total patients' receiving opioids, increased by 0.1% compared to the control period (0.07% [0.035] vs 0.2% [0.091], $p=0.075$) but was not statistically significant.

Conclusions: Preliminary results show a statistically significant decline in use of IV hydromorphone and morphine since the implementation of the opioid stewardship program. The difference in the rate of naloxone use was not statistically significant. Moving forward, pharmacist documentation of interventions can be used to determine amount of alternative non-opioid therapies used pre and post intervention. Future directions include continuation of data collection and analysis, continued engagement with physicians through educational sessions and grand rounds discussions.

Impact of targeted interventions on antibiotic utilization and outcome measures using a 48-hour time-out in a community teaching hospital

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Objective: National organizations advocate prudent antimicrobial use through a recommended review of antibiotics at 48-hours post initiation. Our hospital strives to implement strategies that help patients in the community by improving their quality of life and advancing stewardship; however, there was no standard systematic approach that was utilized at our institution to address this issue. The objective of this study was to determine the impact of a 48-hour time-out on targeted empiric intravenous antibiotics through a systematic approach evaluating the appropriateness of antibiotic usage.

Methods: This single-centered, prospective, interventional study was approved by the Institutional Review Board. Customized daily alerts, generated by an electronic data mining tool, were utilized to identify patients who were of age 18 years or greater on intravenous vancomycin, piperacillin/tazobactam, daptomycin, ertapenem, and meropenem for greater than 24 hours. Patients were excluded if they were on antibiotics for surgical prophylaxis, were pregnant, or had febrile neutropenia. Pharmacist interventions included implementation of a clinician-based prospective audit feedback system consisting of the following targeted interventions: intravenous to oral conversion, dose optimization/adjustment, de-escalation, and serum procalcitonin tests. Antibiotic streamlining tools that utilize nationally standardized guidelines were provided to assist in interventions. Primary endpoints included days-of-therapy per 1000 days (DOT/1000), days-of-therapy per 1000 days at risk (DAR/1000 DAR), and de-escalation rate. Secondary endpoint measured was antibiotic susceptibility rate.

Results: In the intervention group (INT), there was a mean reduction in DOT/1000 for targeted antibiotics when compared to the control group (CTL), which was reported as follows: vancomycin (INT-20.18, CTL-122.29, p-value<0.0001); piperacillin/tazobactam (INT-6.26, CTL-140.8, p-value<0.0001); meropenem (INT-9.43, CTL-40.19, p-value=0.0018). There was also a mean reduction in DOT/1000 DAR for targeted antibiotics for the INT, which was reported as follows: vancomycin (INT-15.68, CTL-90.46, p-value<0.0001); piperacillin/tazobactam (INT-4.81, CTL-109.99, p-value<0.0001); meropenem (INT-7.80, CTL-43.91, p-value=0.0117). A mean increase in de-escalation rate for INT was reported as follows: vancomycin (INT-67%, CTL: 39%, p-value: <0.0001); piperacillin/tazobactam (INT-70%, CTL-45%, p-value<0.0001). A mean decrease in de-escalation rate was noted in the INT for meropenem (INT-60%, CTL-77%, p-value<0.001). The impact of this study's interventions on the susceptibilities of the targeted antibiotics will be reflected in the following year's hospital antibiogram.

Conclusion: Implementation of a 48-hour time-out of targeted empiric antibiotics resulted in a significant reduction in the use of intravenous vancomycin, piperacillin/tazobactam, and meropenem. These results revealed an important need of a pharmacist-led 48-hour surveillance and assessment of antibiotic utilization. From this study, pharmacists have been acknowledged as key drivers in the prevention of antibiotic resistance and champions of optimal antibiotic stewardship.

Implementation of a deprescribing clinic for medication management with a patient-centered approach

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Objective: Deprescribing is the process of discontinuing unnecessary medications from a patient's drug regimen under the guidance of a healthcare professional with the goal to reduce polypharmacy and improve patient outcomes. Polypharmacy has been shown to increase the risk of falls, delirium, emergency room visits, hospitalizations, hospital readmissions, morbidity, mortality, and costs while reducing quality of life. The purpose of this project was to implement a pilot program within primary care at the VA Maryland Health Care System that uses a deprescribing tool with a patient-centered approach.

Methods: Under the supervision of clinical pharmacy specialists with advanced scopes of practice that include prescriptive authority, a medication deprescribing clinic was implemented. The clinical service is an expansion of the current pharmacist-run primary care clinical service at the VA Maryland Health Care System. This pilot program consists of three appointments per patient and includes an initial medication reconciliation, an assessment of

patients' quality of life related to their medication usage, and utilization of the VA deprescribing tool, VIONE. This deprescribing tool is a mnemonic tool that assesses which medications in a patient's regimen are vital, important to quality of life, optional, or not indicated, in order to ensure each medication has a specific indication. Assessing a patient's quality of life related to medication administration is essential to deprescribing in a patient-centered manner. A medication-related quality of life (MRQoL) assessment is utilized in the clinic, focusing on the patient's overall well-being and the impact of polypharmacy. Patients eligible for the clinic include those enrolled in primary care who take at least 20 medications. A patient survey is administered to evaluate the clinical service, assess for changes in MRQoL, and implement necessary improvements.

Results: Sixteen patients were enrolled in the deprescribing clinic pilot program, and twelve patients completed all three sessions, resulting in a 75% clinic show rate. Prior to enrollment, patients were prescribed an average of 27 medications. The average age was 69 years old, 92% of whom were African American, and 92% of whom were male. On average, per patient, six medications were deprescribed and two medications were dose-reduced. The types of medications most frequently deprescribed were supplements, topicals, pain medications, proton pump inhibitors, and ocular solutions. The types of medications that were most frequently adjusted to decrease medication exposure were inhaled beta-agonists, antihistamines, laxatives, alpha-1 blockers, topicals, and pain medications. Medication-related quality of life improved upon deprescribing for every component of the assessment, including reduced impact of polypharmacy on activities of daily living, recreational activities, and social activities; the psychological impact of polypharmacy decreased as well. Patients were satisfied with the utility of each clinic appointment, as well as the amount of time spent with the pharmacist, and would recommend the clinic to other veterans.

Conclusion: Medication deprescribing through this clinical service decreased polypharmacy and medication exposure, while also improved patients' quality of life. Based on the patient satisfaction questionnaires, patients were satisfied with the clinic, including the utility of each session. Recruitment for this clinical service is ongoing and this service has been expanded to include all providers in Primary Care at the VA Maryland Health Care System.

Novel Techniques for Therapeutic Drug Monitoring for Clozapine Levels

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Purpose: Clozapine is the most effective antipsychotic for treatment-resistant schizophrenia. Serum levels could guide therapy decisions; however, they are underutilized because they require venous draws and several-day determination time using off-site high performance liquid chromatography-tandem mass spectrometry (LC/MS-MS). This project evaluates if clozapine measured with an immunoassay technology, which could be developed into a point-of-care device, correlates with LC/MS-MS and assesses the impact of demographic and clinical variables on assay results.

Methods: 117 serum samples (N=48 with schizophrenia on clozapine, N=24 with schizophrenia not on clozapine and N=45 healthy controls) were included. One aliquot was sent to a national reference laboratory (NRL) for determination by LC/MS-MS. Another aliquot was sent to Saladax for immunoassay (MyCare® Psychiatry Clozapine

Assay Kit) and measured 3 times. Later, an additional matching frozen aliquot was sent to the NRL. Participants' age, sex, race-ethnicity, smoking status, co-medications and complete metabolic panel were collected. Concordance Correlation Coefficients (CCC) were calculated to measure the agreement between the 2 LC/MS-MS samples and 3 immunoassay samples. Linear regression and mixed effects modeling were used to examine the correlation of the LC/MS-MS results to the immunoassay samples.

Results: NRL had 18 false positive clozapine levels (mean 42.39±32.06, range 21-159 ng/ml) in schizophrenia participants not on clozapine (N=3) and healthy controls (N=15). The immunoassay had no false positives. A mixed effects model yielded a strong Pearson correlation ($r=0.843$, $p<0.0001$). In patients on clozapine, the mean clozapine level was 414.98 ± 186.29 ng/ml on the LC/MS-MS and 482.08 ± 270.88 ng/ml on the immunoassay. Although immunoassay was significantly higher than the LC/MS-MS measurement ($p=0.013$), the agreement level was high (CCC=0.76; 95% CI 0.64, 0.84). No association was found between age, sex, smoking status, albumin, and globulin on clozapine levels higher by immunoassay. Additionally, for each unit increase in total protein an increase of 145.6 units (SE: 70.81) was predicted for LC/MS-MS and a 225.5-unit (SE: 104.60) increase for the immunoassay. Within the LC/MS-MS samples, the CCC for the NRL was 0.869; 95% CI 0.690-0.970. Within the immunoassay samples the CCC for the immunoassay was 0.99; (95% CI 0.979-0.997)

Conclusions: Immunoassay results were in good agreement with LC/MS-MS results in clozapine-containing samples, indicating good assay performance. The lack of false positives in the immunoassay results may indicate higher specificity than LC/MS-MS methods. Total protein values may lead to changes in clozapine values. More work is needed to account for total protein values when decision-making with clozapine results. The agreement between samples is significantly great with the immnoassay than the NRL.

Funding: This was funded in part by NIMH R56 (MH105571-02) and NIMH R01 (MH102215). Saladax provided funding for the immunoassay (MyCare® Psychiatry Clozapine Assay Kit*) results.*CE/RUO in US

Pharmacist-Initiated Discharge Counseling in High-Risk Patients

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Objective: Ensuring patients understand the importance of their medications has been shown to improve the patient care experience and decrease readmission rates. The purpose of this study was to ensure patients grasped the importance of their medication regimen while improving patient adherence and decreasing readmission rates.

Methods: This was a multi-phase, single-site, comparative, interventional study. Patients were selected from a discharge list provided by discharge order reports and assessed based on high risk for readmission. Patients were offered counseling once discharge orders were written. Patients were then counseled on drug-related therapy management utilizing teach back methodology. The primary endpoint was 30-day readmission rate. Secondary endpoint was patient medication knowledge assessment scores.

Results: 473 and 108 patients were included in control group and intervention group respectively. Sixty-five total patients in control group for all five phases were readmitted within thirty days of hospital discharge. Seven patients in the intervention group (out of 108) for all phases had been readmitted within thirty days of discharge. Thirty day readmission percentage for control group was 13.7%. Mean thirty day readmission percentage for intervention

phases I through V was 6.48% (P=0.0506). Thus, a 7.5% reduction was observed between control and intervention groups. Heart failure in both control and intervention groups had the highest rate of readmissions. Patient knowledge assessment showed majority of correct responses regarding how to take medications and purpose of medications (81% and 75%). Knowledge on medication side effects had the lowest score at nineteen percent.

Conclusion: There was a reduction seen in readmission rates for the intervention group in all disease states compared to control group. Patients with heart failure had the highest rates of readmission in both control and intervention group for all phases. Majority of patients understood the purpose of their medications and how they should be taken. Most patients struggled with naming all medications and their side effects. Barriers identified were possibly the amount of medications per one patient and increased age. Future long term studies with larger sample sizes are needed to further investigate and determine significance.

Retrospective review on outcomes of proton-pump inhibitor deprescribing in medication therapy management patient population

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Objective: The purpose of this study was to determine the proportion of patients taking long-term proton-pump inhibitors (PPI) therapy who were able to successfully discontinue, reduce dose or use intermittent PPI therapy as a result of medication therapy management (MTM) pharmacist intervention during a comprehensive medication review (CMR). Patients with heartburn, mild to moderate gastroesophageal reflux disease (GERD) or esophagitis may benefit from short-term use of PPIs, however, many patients continue taking these medications on a long-term basis. Long-term use of PPI therapy has been linked to negative consequences including osteoporosis, increased risk of infections such as *Clostridium difficile* and community-acquired pneumonia, and Vitamin B12 deficiency. Given the health risks and high cost associated with overutilization of PPIs, patients may benefit from optimal medication management to reduce pill burden, medication cost and continued control of acid reflux symptoms.

Methods: Electronic medical records were reviewed of patients who underwent PPI deprescribing intervention made by a MTM pharmacist during CMR and at 4 and 12-week follow-ups between September 2018 and February 2019. Patient records were evaluated for acid reflux symptom control pre- and post-intervention to assess the impact of pharmacists led PPI deprescribing. Study population included Medicare Part D members who are eligible for MTM services and actively on PPI therapy for longer than 28 days with an indication for mild to moderate GERD or esophagitis.

Results: A total of 118 patients were included in the study. At least 25% of the patients who underwent a deprescribing intervention were able to successfully discontinue off of PPI therapy (57 pre-intervention vs 22 post-intervention; p = 0.0178). Compared to PPI discontinuation and intermittent use approaches, PPI dose reduction was the most effective deprescribing method. There was a 51.2% success rate with dose reduction intervention group. In terms of economical impact of PPI deprescribing, there was an estimated total of $4690.27 cost-savings per month. The rate of intervention acceptance was also evaluated. Of the total 118 eligible patients, there was a 73.7% acceptance rate from the patients and 77.9% from the prescribers.

Conclusion: This study suggests that pharmacist-led PPI deprescribing can help reduce inappropriate use of proton-pump inhibitors in those without a strong indication and further support proper management of acid reflux

symptoms. An established, evidence-based deprescribing protocol will aid MTM pharmacists to effectively deprescribe PPI.

Use of Antibiotic Therapy for Urinary Tract Infections in a Primary Care Setting

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Introduction: Antibiotic resistance in the outpatient setting is an emerging public health concern. According to the Centers for Disease Control and Prevention (CDC), at least 30% of antibiotics prescribed in the outpatient setting are unnecessary. It was previously found that urinary tract infections (UTI's) were the most common indication, accounting for approximately one in six antibiotics prescribed by our practice in one year.

Research Question/Hypothesis: Does antibiotic prescribing align with clinical practice guidelines for management of UTI's in a primary care setting?

Study Design: A retrospective, single-site chart review of patients diagnosed with a UTI and were managed at one University Family Medicine Practice (UFP).

Methods: A chart review of patients who were diagnosed with a UTI and managed at UFP between dates January 1, 2017 and January 1, 2018, was completed. Patients were excluded if they were pregnant or if urologic abnormalities were present. The primary outcome was the proportion of patients who were prescribed guideline directed therapy. Primary and secondary outcomes were analyzed with descriptive statistics using proportions, means, and standard deviations as deemed appropriate. A logistic regression was performed to evaluate associations between the proportion of patients receiving guideline directed therapy and identified baseline characteristics.

Results: One-hundred and ninety-one patients were identified with a diagnosis of a UTI within the specified study period. Fifty-four patients were excluded from the statistical analysis. Ninety-seven (70.8%) patients were prescribed a guideline directed antibiotic. Of these 97 patients, 44 patients were prescribed guideline directed dose and duration of therapy (45.3%). The three most common antibiotics prescribed were nitrofurantoin (39.4%), sulfamethoxazole/trimethoprim (31.4%), or a fluoroquinolone (19.0%).

Conclusion: A large proportion of patients diagnosed with UTI's in this primary care setting were prescribed antibiotics that generally followed guideline recommendations. Opportunities exist to improve guideline directed dosing and duration of therapy within the practice.