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Proceedings of 2016 Aurora Scientific Day

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Proceedings of 2016 Aurora Scientific Day

The following abstracts were presented at the 42nd annual Aurora Scientific Day research symposium, held May 25, 2016, in Milwaukee, Wisconsin. Aurora Scientific Day provides a forum for original research conducted by faculty, fellows, residents, students and other allied health professionals affiliated with Aurora Health Care, a not-for-profit health system comprised of integrated hospitals and clinics across eastern Wisconsin and northeastern Illinois.

RIESELBACH DISTINGUISHED SESSION I **Benefit of Report Card Feedback After Point-of-Care Assessment of Communication Quality Indicators**

Michael H. Farrell, Clair R. Sprenger, Shelbie L. Sullivan, Bree A. Trisler, Jessica J.F. Kram, Erin K. Ruppel

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Background: Communication in health care is crucial for patient experience and biomedical outcomes, but problems with communication are often seen in health care. Training can improve communication, but skills must be reinforced after graduation to remain improved. Since educational methods are too resource intensive for sustained use throughout the Aurora Health Care system, it is necessary to develop affordable, quantitative methods. The first author has developed necessary techniques, including behavior-specific measures called communication quality indicators.

Purpose: To demonstrate secure audio recording in an outpatient visit and to use communication quality indicators with a heterogeneous set of patient-clinician conversations.

Methods: Thirty primary care physicians were audio-recorded with one or more patients via a secure Internet application running on exam-room computers. Transcripts were abstracted quantitatively using explicit-criteria definitions for two groups of communication quality indicators: assessments of understanding (AU) and jargon explanations (JE). There are four separate behaviors within the AU group: open-ended, close-ended, the highly effective “request for teachback,” and the least effective “OK?” question. Quality indicator data were returned using a previously described report card. After feedback, one or more follow-up recordings were done for comparison.

Results: Baseline transcripts included a mean of 15.5 unique jargon words, but words were often used more than once so the mean total jargon count was 25.1. JEs were rare at baseline, with a median of 1 per transcript. The JE ratio (fraction of jargon words that follow a JE for that word) averaged 0.26 out of a best-possible 1.0. AUs were found in 61.1% of transcripts, but most were “OK?” (median 2.13/transcript) or close-ended questions (median 0.52/transcript). After the report card, the median number of JEs improved to 4 per transcript ($P < 0.01$ by Wilcoxon), and the JE ratio improved to 0.36 ($P < 0.01$ by matched t-test). AUs improved to 81.3% of transcripts ($P < 0.04$ by chi-squared). Most of the increase was found in close-ended

AUs (median 0.97/transcript by, $P < 0.04$ by Wilcoxon).

Conclusion: This project demonstrated that it is feasible to record at the point of care, abstract transcripts at a central office and improve communication quality via a report card. The small sample size was acceptable for a demonstration project, but a larger, multifaceted program could improve patient experience and biomedical outcomes across Aurora.

RIESELBACH DISTINGUISHED SESSION II **Predictors of Mortality in Patients With Transient Severe Left Ventricular Systolic Dysfunction**

Kanwar Y. Singh, Firas Zahwe, Bilal Omery, Crystal Platz, Wassim Ballany, Robyn Shearer, Tadele Mengesha, M. Eymen Mortada, Jasbir Sra, Indrajit Choudhuri

Aurora Cardiovascular Services, Aurora Health Care; Aurora Research Institute

Background: About 20% of patients who develop left ventricular (LV) systolic dysfunction will have improvement in ejection fraction (LVEF) over time. This patient cohort is generally excluded from large sudden death trials and, hence, understudied.

Purpose: To evaluate the predictors of mortality in patients with severe LV systolic dysfunction who have improvement in LVEF during follow-up.

Methods: Patients who had transient LV systolic dysfunction from 2010 to 2014 within the Aurora Health Care system and who had LVEF improve to $\geq 40\%$, irrespective of implantable cardioverter-defibrillator (ICD) implant, were studied. Predictors of mortality were identified using Cox proportional hazards model. Patients were then divided into groups based on LVEF $> 50\%$ or $< 50\%$ to assess for benefit of ICD using Kaplan-Meier estimates.

Results: A total of 1,364 patients met inclusion criteria; 58.4% were male, and mean BMI was 29 ± 7 . Mean age post-LVEF improvement was 66 ± 14 years, and with each added year the hazard rate increased by 5% (hazard ratio [HR]: 1.05, $P < 0.0001$). Several clinical characteristics emerged as predictors of mortality, including smoking (HR: 1.8, $P = 0.0002$), chronic renal disease (HR: 2.3, $P < 0.0001$), atrial fibrillation (HR: 1.4, $P = 0.013$) and no-ICD (HR: 2.1, $P = 0.012$). With each percentage increase in LVEF, hazard rate decreased by 2% (HR: 0.97, $P = 0.007$). However, presence of ICD did not significantly improve mortality in the group with LVEF $> 50\%$

($P=0.2$), whereas it continued to show benefit in the group with LVEF of 40%–49% ($P=0.001$).

Conclusion: Clinical predictors of mortality in patients with transient LV systolic dysfunction may help further risk-stratify this cohort of patients. It appears that patients with LVEF of 40%–49% continue to derive benefit from ICD therapy.

FIRST PLACE ORAL PRESENTATION

See page 245 for citation.

SECOND PLACE ORAL PRESENTATION

Path to Resistance: Risk Factors Associated With Carbapenem-Resistant *Pseudomonas aeruginosa*

Kushal Patel, Jessica J.F. Kram, Dennis J. Baumgardner

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Background: An estimated 51,000 health care-associated *Pseudomonas aeruginosa* infections occur in the United States annually. More than 13% are secondary to non-carbapenem multidrug-resistant strains, which result in 400 yearly deaths. Traditional risk factors for resistance include ICU stay, mechanical ventilation, previous hospitalization and major comorbidities. As microbes evolve, risk factors also may evolve.

Purpose: To determine if traditional and/or new risk factors for *P. aeruginosa* resistance are valid and predictive of infection with carbapenem-resistant *P. aeruginosa*.

Methods: We retrospectively studied inpatients and outpatients ≥ 18 years old who presented to an Aurora Health Care facility with a positive *P. aeruginosa* culture during 2014. Cultures were obtained from the ACL Laboratories database, and patient medical records were reviewed in Epic. Chi-squared test with Yates correction and two-sample t-tests were performed on categorical and continuous variables, respectively. Binary regression was used for multivariable modeling. Significance was associated with $P<0.05$.

Results: Study population ($N=1,763$) characteristics were: mean age 68.0, body mass index 30.4 kg/m², 51.2% female sex, and 89.3% white race. Resistance to imipenem or meropenem (14.0%) on univariable analysis was associated with younger age (66.0 vs 68.3 years, $P=0.027$), hospitalized patients (19.7% vs 8.6%, $P<0.0001$), male sex (16.0% vs 12.0%, $P=0.017$), nonwhite race (23.5% vs 12.3%, $P<0.0001$), respiratory culture (30.9% vs 12.1%, $P<0.0001$), history of pulmonary disease (19.4% vs 12.9%, $P=0.005$), history of congestive heart failure (18.6% vs 13.0%, $P=0.016$), history of multidrug resistance (33.3% vs 13.6%, $P=0.003$) and recent surgery (17.8% vs 12.2%, $P=0.002$), as well as transfer from institution, Foley catheter, vasopressor treatment, central/PIC lines, mechanical ventilation, ICU admission, and bedridden status (all $P<0.0001$). In multivariable modeling, nonwhite race, respiratory culture, recent transfer, vasopressor use and central/PIC lines were significant. Only 0.57% of strains were

resistant to the six traditional non-carbapenem drugs and both carbapenems.

Conclusion: Demographic and traditional risk factors, as well as respiratory cultures, were predictive of carbapenem resistance. Such information may guide initial antibiotic treatment of *P. aeruginosa*. Fortunately, less than 1% of strains were resistant to all drugs tested. Further studies looking at change in outcome while incorporating these risk factors in determination of empiric coverage for patients should be performed.

THIRD PLACE ORAL PRESENTATION

See page 245 for citation.

FIRST PLACE POSTER

See page 245 for citation.

SECOND PLACE POSTER (tie)

The Association Between Doppler Measures of Cardiac Function and Outcomes in Patients With Left Ventricular Ejection Fraction $\leq 40\%$ Undergoing Noncardiovascular Surgeries

Yang Shi, Rachel Pedersen, Matthew Rappelt, Robyn Shearer, Nasir Z. Sulemanjee, Dianne L. Zwicke, T. Edward Hastings, Omar M. Cheema, Vinay Thohan

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Background: Preoperative risk assessments of individuals who undergo major noncardiac surgery have focused on ischemic heart disease. Information on how to assess the noncardiac surgical risks for patients with depressed cardiac function, as seen in heart failure, is sparse. Echocardiography is routinely performed in patients with depressed cardiac function and is an accepted standard cardiac assessment. Transthoracic echocardiography (TTE) provides strong independent prognostic implications in a wide range of cardiovascular conditions.

Purpose: To identify the echocardiographic parameters associated with outcomes among patients undergoing major noncardiac surgery.

Methods: A retrospective single-institution investigation identified 1,770 patients who underwent one or more major noncardiac procedures from Jan. 1, 2011, to June 30, 2014, and had at least one TTE performed within 90 days before surgery. Patients were stratified by presurgery left ventricular ejection fraction (LVEF) into LVEF $\leq 40\%$ and LVEF $> 40\%$ groups. The cohort was followed through June 12, 2015, with the outcome focused on all-cause mortality. Continuous and categorical variables were compared by Student's t-test and chi-squared test, respectively. Kaplan-Meier method was used to calculate mortality estimates postsurgery. Cox proportional hazards model was used for univariate and multivariable models.

Results: In patients with LVEF > 40%, the 1-, 6- and 12-month mortality rates were 3.8%, 9.0% and 12.1%, respectively. In patients with LVEF ≤ 40%, 1-, 6- and 12-month mortality was 9.5%, 18.4% and 25.2%, significantly greater than patients with LVEF > 40% at all time points (P<0.01). Univariate analysis of patients with LVEF ≤ 40% found the following echocardiographic parameters to be significant predictors of 6-month mortality: right atrial pressure, pulmonary artery systolic pressure, LVEF < 25%, mitral A-wave velocity, mitral E-wave deceleration time, and left ventricular posterior wall diastolic thickness. Multivariate analysis identified mitral A-point velocity (hazard ratio [HR]: 0.98, P=0.02), LVEF < 25% (HR: 3.48, P<0.01), glomerular filtration rate (HR: 0.71 at 10-unit increments, P<0.01) and colectomy (HR=5.47, P<0.01) as significant predictors of 6-month mortality.

Conclusion: Preoperative LVEF < 25%, lower mitral A velocity, colectomy, and lower glomerular filtration rate are associated with 6-month mortality postsurgery. Close preoperative cardiac assessment of patients with decreased LVEF prior to noncardiac surgery may prove beneficial in improving long-term outcomes.

SECOND PLACE POSTER (tie)

See page 245 for citation.

THIRD PLACE POSTER

See page 245 for citation.

SELECT ABSTRACTS

Association Between Pregnancy Intention and Maternal Characteristics, Outcomes, and Cost of Care: A Pilot Study

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Background: An estimated 51% of pregnancies in the United States are unintended. In Wisconsin, unplanned pregnancies account for 40% of all pregnancies and cost \$148 million in public funds. Unintended pregnancy, which creates increased hardship for mothers and threatened well-being of infants, has been recognized as an important health, social and economic problem.

Purpose: To determine the pregnancy intentions of postpartum women and the maternal characteristics, outcomes and costs of care associated with unintended pregnancies at a large urban hospital in Milwaukee, Wisconsin.

Methods: Postpartum women were surveyed prior to discharge. The 20-item survey included whether or not the woman had been trying to get pregnant and how she felt about the timing of her pregnancy. Electronic medical records were reviewed to determine maternal and neonatal outcomes, including antenatal,

perinatal, postpartum comorbidities and complications. To determine the most important factors influencing the binary and multicategory responses of pregnancy intention, logistic and multinomial regression models were developed using stepwise variable selection procedures.

Results: A total of 338 women were asked to participate, resulting in 243 completed surveys (95 exclusions: 8 declines, 29 language barriers, 46 lost to follow-up, 12 other). Overall, 63% (142/227) of pregnancies occurred when “not trying.” Logistic and multinomial regression revealed anemia (P=0.004–0.007), anxiety (P=0.048) and income level (P=0.002–0.045) as the most significant predictors of unintended pregnancy. The odds of unintended pregnancy for women at the lowest two income levels were 12.05 (odds ratio: 2.82–51.39) and 3.83 (odds ratio: 1.314–11.142) times greater than those for women at the highest income level. Significant univariate associations existed between unintended pregnancy and age (P<0.001), race (P=0.025) and insurance (P=0.003).

Conclusion: The unintended pregnancy rate of our study population was greater than state and national levels. Maternal characteristics of income, anemia and anxiety were the most significant predictors of pregnancy intention, but unintended pregnancy also was highly associated with younger age, African-American race and Medicaid insurance. Unintended pregnancy effects included: fewer prenatal care visits, increased prevalence of intrauterine growth restriction and decreased likelihood of breastfeeding. While the relative use of contraception was significantly greater, the absolute use among women who had an unintended pregnancy is of great clinical concern.

Models for Predicting Incident Delirium in Hospitalized Older Adults: A Systematic Review

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Background: Delirium is common in hospitalized older adults, and 40% of cases may be preventable. Hospital Elder Life Program is an evidence-based program to reduce incidence of delirium. It has been successfully implemented in one hospital and will be implemented in four other hospitals. Identification of patients at highest risk of developing delirium using the electronic health record (EHR) may be an effective targeted strategy to reduce the incidence of delirium.

Purpose: To systematically review and summarize the medical literature regarding risk prediction models for delirium in older inpatients.

Methods: A medical librarian customized and conducted the search strategy for all published medical articles on delirium prediction models. Electronic databases sourced included Ovid MEDLINE, CINAHL, Cochrane Database of Systematic Reviews, EMBASE and PsycINFO. Controlled vocabulary terms specific to database as well as relevant keywords were

used, including variants of delirium, altered mental status, acute confusional state, acute brain syndrome, acute brain failure, metabolic encephalopathy, predict, predictive, prediction, models, modeling, scores, scoring, tests, testing, rules, index and indices. The bibliographies of included studies were examined, and no additional articles were referenced.

Results: To appropriately extract data from the 12 studies meeting inclusion criteria, the following parameters were used: study description, study population, delirium assessment method, incidence of delirium, and risk factors for delirium. Quality for cohort studies was assessed using “Newcastle-Ottawa Quality Assessment Scale” ranging from 1 to 9 (1 = poor quality, 9 = high quality). Overall incidence of delirium in the studies ranged from 4% to 26%. Most common risk factors for delirium were dementia, decreased functional status, blood urea nitrogen to creatinine ratio, infection and severe illness. Other variables less common were alcohol, malignancy, history of delirium, older age, medications, physical restraints, malnutrition, admitted from other than home and an iatrogenic event. The quality of studies ranged from 4 to 8.

Conclusion: This systematic review summarizes the medical literature on risk prediction models for delirium in hospitalized older patients. We will use this information to develop an EHR-generated delirium risk prediction model to be used by the “Hospital Elder Life Program” to reduce delirium incidence.

Mind and Body Training to Improve Functioning and Coping With Chronic Pain: A Pilot Study

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Background: Patients with chronic pain are often crippled by psychological distress, depression and fear. These patients also can develop altered pain perception, with enhanced brain activity in pain-responsive regions and those associated with anxiety/depression. Exercise and meditation can impact pain-reducing brain areas and positively influence pain characteristics.

Purpose: To alter pain center activity by reducing the activation of the higher brain and deactivation of the lower brain with somatocognitive and meditative practices, with secondary aim of reducing anxiety/depression and improve overall quality of life.

Methods: We conducted a pilot study on mentally competent adult women with stable chronic pain who were resistant to conventional therapies. Our intervention consisted of an initial 8-hour session at which baseline assessments were completed with introduction to mind/body tools (i.e. deep meditation, breath work, etc.). Baseline assessments also included self-assessment using pain rating surveys, the Zung self-rating anxiety and depression scales, the World Health Organization

Quality of Life-BREF instrument, and the Conner-Davidson Resilience Scale. Following the initial session, 1.5-hour-long meetings were held weekly for 8 weeks, followed by biweekly meetings for 8 weeks, then monthly. Mind/body tools were systematically taught and reinforced during meetings. Patients kept a journal detailing their practice. Pain rating surveys were filled out monthly. All other measures were filled out at 3 and 6 months.

Results: Participating women (N=5) had mean age of 43.2 years and mean body mass index of 35.8 kg/m². Mean long-acting narcotic (LAN) was 260, 221.6 and 248.2 mg/day at baseline, 3- and 6-month assessments, respectively. Patients did not significantly decrease use of LAN. Additionally, no statistical difference was identified in a patient’s time in pain or pain right now, resilience, anxiety and depression. However, overall quality of life improved significantly at 6-month follow-up (50.0 vs 25.0, P=0.016). Following 6-month assessment, patients were highly satisfied with their experience. All (100%) strongly agreed that the instructors responded well to questions and established good relationships with participants.

Conclusion: Intervention resulted in statistically nonsignificant decreased LAN use and reduced anxiety and depression scales, as well as statistically significant improvement in overall quality of life. Data from these patients will continue to be collected at 6-month intervals to see if there are lasting effects or further improvements.

Quality Improvement of Procedural Services in Family Medicine Residency Clinics

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Background: Performing common procedures in our family medicine residency clinics is often a difficult and inefficient process. A 2008 Society of Teachers of Family Medicine consensus statement on procedural training found higher job satisfaction and better financial compensation for family practitioners who performed procedures. Patient satisfaction is likely increased when minor procedures are able to be performed by their primary clinician. This would suggest a disconnect between the known benefits of providing procedural services and the ability of our residency clinics to provide those services in an efficient manner.

Purpose: To assess clinician and staff comfort with performance of common family medicine procedures and implement an intervention to improve the efficiency of procedure performance in the clinic setting.

Methods: Phase 1: Preintervention survey was distributed to physicians, residents and staff at Aurora Health Care’s family medicine residency clinics. Survey evaluated comfort level of providers in performing common procedures and identifying proper equipment needed to perform procedures. Data was compiled in Microsoft Excel; statistical analysis was performed using ordinal logistic and binary regression. Phase

2: Instructional procedures manual was created for 15 common procedures and provided to clinics. Phase 3: Postintervention survey was distributed after providers had access to procedures manual.

Results: Presurvey data revealed the majority of respondents felt neutral about their ability to perform procedures. However, residents felt more comfortable performing procedures than faculty. Postsurvey data revealed that a minority of respondents were aware of or used the procedures manual.

Conclusion: Our study demonstrated that a targeted intervention to improve the efficiency of procedure performance in the clinic setting was not well utilized. Therefore, a definitive conclusion about the ability of the intervention to improve the efficiency of procedure performance was not able to be made. Future areas of focus include better promotion of and ease of access to any selected intervention to improve efficiency of procedure performance.

Prevalence of Prescription Opioid Abuse in Patients With Pain

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Background: Studies showed that 20% to 30% of opioid analgesic drugs prescribed for chronic pain in the United States are misused, while the rate of opioid addiction is approximately 10%. The study describes methods to identify high-risk behavior and forward recommendations to decrease opioid abuse.

Purpose: To assess prevalence and correlate multiple variables with opioid abuse and to forward appropriate recommendation to decrease the prevalence of opioid abuse in the primary care setting.

Methods: A prospective study was conducted at a primary health care clinic, Aurora Sinai Medical Center (Milwaukee, WI). Over 6 months, a total of 49 consecutive patients who take opioids were included in the study. Screener and Opioid Assessment for Patients with Pain-Revised (SOAPP-R), with a cutoff score of 18 (out of 24), is used to screen abuse/aberrant drug use. Additional variables were obtained by patient chart review. Data analysis was done using Minitab analysis software.

Results: A total of 49 patients (23 males, 26 females) were included in the study. Mean age of patients was 45.7 ± 7 years; 22 (44.9%) patients were on hydrocodone, 16 (32.7%) on oxycodone, 7 (14.3%) on tramadol, 3 (6.1%) on fentanyl patch and 1 (2%) on morphine and methadone. This means 33 (66.3%) patients were on an opioid other than oxycodone. Of the 16 on oxycodone, 12 were male (52% of gender population) compared to 4 female (15.4% of gender population), $P=0.013$. Five (10.2%) patients had high SOAPP-R scores; 3 (13%) of the males had a high SOAPP-R score compared to 2 (7.7%) females. Regarding males on oxycodone, 3/12 (25%) had high SOAPP-R scores; 1/4 (25%) females on oxycodone had a high SOAPP-R score. As age increased, the number of male patients

using oxycodone trended upward. Older males on oxycodone had a higher SOAPP-R score compared to younger patients. No patient had prescriptions by more than one prescriber; 45 (91.9%) patients had no pain contract. Urine drug screen was done in 11 (22.5%) patients.

Conclusion: Prescription opioid drug abuse is not uncommon in primary care clinics. Use of the SOAPP-R, along with other appropriate patient evaluations, can help primary care providers identify high-risk behavior and decrease opioid abuse.

An Interdisciplinary Process Change: Conversion of PICC Line Capping Solution From Heparin to Normal Saline

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Background: Heparin-induced thrombocytopenia (HIT) and HIT with thrombosis syndrome (HITTS) are serious conditions. Patients are at increased risk for developing HIT/HITTS with any exposure to heparin, even intravenous line flushes. Patients may be exposed to heparin multiple times each day when they have a peripherally inserted central catheter (PICC) that is flushed and capped with heparin. At Aurora Health Care, heparin is the standard capping solution for PICCs, but with a recent switch to positive pressurized caps, normal saline may be a capping option that reduces patient exposure to heparin.

Purpose: To reduce heparin exposure at a single hospital by replacing heparin with normal saline (0.9% sodium chloride) as the standard PICC capping solution.

Methods: We implemented an interdisciplinary pilot process change and evaluated whether normal saline was noninferior to heparin for maintaining PICC patency. Primary outcome measurements of patency include alteplase use due to occlusion. Secondary objectives were any change in invasive line infection rates and cost comparisons. The baseline patency rate for the hospital was derived from data extracted through a retrospective chart review from October 2013 through October 2014.

Results: Our baseline patency rate was 65.42% ($N=3,095$); 33% of all PICC lines placed during the 12-month period were treated with alteplase. Patency rates during our pilot period were based on retrospective chart reviews of patients with PICC lines placed from February to May 2015. During this period, a total of 979 PICC lines were evaluated. Of these, 30.4% were treated with alteplase. This resulted in a pilot patency rate of 69.5%, which is 4.1% greater than our baseline patency rate. Given the prespecified noninferiority margin of 5%, our pilot demonstrates that normal saline is noninferior to heparin for maintaining PICC line patency when used with positive pressurized caps ($\alpha<0.05$). Although number of infections increased 16%, only 9% with line infections were part of our pilot. The estimated yearly cost of both capping solutions is equal, at approximately \$3,960 per our baseline

usage data. By potentially avoiding a diagnosis of HIT/HITT in these patients, the hospital would realize an annualized savings of over \$86,000.

Conclusion: Normal saline has demonstrated historical noninferiority to heparin for maintaining PICC patency when used as the capping solution with positive pressurized caps. Similar results were found during our pilot.

Cost-Effectiveness of Genomic-Based Warfarin Therapy

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Background: With over 40 years of demonstrated clinical efficacy, warfarin remains the world's most used pharmaceutical to prevent ischemic stroke in patients with atrial fibrillation (AF). However, warfarin has many challenges. Thus, despite known effectiveness, warfarin is a leading cause to drug-induced morbidity and mortality. Over 50 different warfarin therapy protocols, including a number of pharmacogenomic-based (PG) protocols, with as many as 14 independent variables, have been developed to improve safety and efficacy, thereby reducing ischemic strokes and intracranial hemorrhages (ICH).

Purpose: To conduct a preliminary cost-effectiveness study to determine the price point at which using warfarin PG dosing to prevent ischemic stroke and ICH would provide a neutral cost difference for the AF patient population at Aurora Health Care.

Methods: Using a 15-year retrospective electronic medical record, we generated a large enough simulated AF population using Bayesian Network modeling to conduct a series of simulated warfarin therapies. We used five different PG and non-PG warfarin therapy protocols. The protocols with various levels of personalization used different PG and non-PG dosing algorithms for initial, adjustment and maintenance warfarin dosing. The simulation platform was able to predict daily international normalized ratio values and the rate of ischemic stroke and ICH in each simulated patient over 90 days for each of the five warfarin therapy protocols. Using nationwide estimates derived through literature review, we estimated the total cost of administering warfarin using the five different protocols and subsequent acute and 5-year care costs (adjusted according to annual Medical Care Component of the Consumer Price Index).

Results: In 2000–2015, a total of 48,006 patients, or ~3,000 patients annually, initiated warfarin therapy with a primary diagnosis of AF at Aurora. We found that Aurora's current best practice warfarin therapy protocol had the highest predicted costs for ICH, resulting in \$163,462.55 for acute care costs (averaged over 1,000 patients) and \$171,279.60 for 5-year ongoing care related to ICH. The current Aurora protocol also had the highest associated costs for ischemic stroke at \$51,333.45 for acute care and \$58,507.21 for 5-year ongoing care. In contrast, PG-protocol 3, which incorporated patient's genotype into the warfarin dosing protocol, had the lowest predicted acute care and ongoing costs associated with ICH at \$119,823.78 for acute care and \$125,462.75 for ongoing care.

For 1,000 AF patients initiating warfarin therapy in Aurora, switching to a PG protocol would save \$55,299.94 in acute care costs and \$59,198.50 in 5-year ongoing care.

Conclusion: At a cost of \$59.20 per patient, warfarin PG dosing is cost neutral. With substantial decreases in genotyping cost in recent years, it is likely this price is currently achievable. Therefore, although there is only incremental clinical benefit from warfarin PG dosing, it is likely cost-effective.

Identifying Disparities in Colorectal Cancer Screening Rates in Milwaukee-Based Academic and Nonacademic Clinics

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Background: The Institute for Healthcare Improvement's Triple Aim focuses on improving the patient's experience of care, improving population health and reducing the per capita cost of health care. Health care systems and providers continuously seek to improve quality of care through understanding what percentage of their patients are achieving quality-of-care standards for various indicators, including immunizations, tobacco cessation, asthma and cancer screening. As health care moves toward reimbursing for value-based care, deepening our understanding of patient population characteristics within each of these conditions is vital to continuous quality improvement.

Purpose: To determine if there are race/ethnicity/age/preferred language (REAL) disparities in care to patients 50 years old or older who are eligible for colorectal cancer (CRC) screening in family medicine residency clinics.

Methods: A retrospective analysis of all patients eligible for CRC screening at two Milwaukee-based family medicine residency teaching clinics (referred to as FM1 and FM2) and nonacademic clinics in greater Milwaukee (NAC-MKE) during a 12-month period (December 2014 – November 2015) was undertaken in collaboration with health care system quality improvement specialists. Percentage of patients achieving CRC screening metric was reported by REAL and gender. As the ultimate goal was to identify subpopulations to target for improvement, categories with $N < 25$ were omitted and criterion for disparity within a category was defined as $> 10\%$.

Results: The largest CRC screening disparity was associated with age, with gaps ranging from 13% to 15% between populations > 65 years old versus 50–54 years old: NAC-MKE (79% vs 66%), FM1 (81% vs 68%), and FM2 (80% vs 65%). CRC screening disparities varied by black/African-American race per location, 54% at NAC-MKE and 67% at FM2 ($N \leq 25$ at FM1). Other race, ethnicity and gender were $< 10\%$.

Conclusion: Per the Centers for Disease Control and Prevention, the African-American/black race has the highest

CRC death, making early CRC screening an imperative. While the Wisconsin Collaborative for Healthcare Quality ranks Aurora Health Care as eighth out of 20 systems in Wisconsin (77.6% from 2014 Q3 to 2015 Q2), local data analysis identified age as the largest disparity gap. Analyzing local population REAL/gender data provides key insights to support initiatives to reduce health disparity gaps and further progress toward achieving the Triple Aim for health care.

WISE-Family Medicine: A Statewide Faculty Development Collaborative

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Background: In many states, family medicine residencies and medical schools compete clinically for patients, educationally for trainees and, more recently, for community preceptors (CPs). As Wisconsin's medical schools and health care systems have expanded their geographic footprints, our CPs now teach trainees from competing institutions. Yet residency and medical student accrediting bodies require faculty *and* preceptor development.

Purpose: To evaluate the impact of a statewide collaborative of family medicine educators on meeting faculty development needs of our CPs and collaborative members.

Methods: Faculty development leaders representing the three largest family medicine residency training sponsors in the state created the Wisconsin Institute of Scholars & Educators in Family Medicine (WISE-FM). This statewide collaborative of family medicine educators is comprised of 3 to 4 representatives per sponsor — both junior and senior educators to further support their development as faculty — committed to developing common preceptor clinical teaching tools. Through online discussions and half-day WISE-FM meetings, WISE-FM participants identified preceptor development needs and designed highly regarded clinical teacher infographics for these priority topics. These tools are available for use statewide, providing CPs with a consistent teaching approach. To determine infographic value, a brief (< 5 items) parallel form survey was distributed to and voluntarily completed by: 1) CPs who received the infographics, and 2) WISE-FM participants. Item results on a 5-point Likert scale (5 = strongly agree, 1 = strongly disagree) were analyzed using descriptive statistics.

Results: Forty-two CP infographics recipients and the 11 WISE-FM participants completed the evaluations. Results revealed that faculty development infographics were a time-efficient (CP: 4.1, WISE-FM: 4.2) and effective way (CP: 4.0, WISE-FM: 4.2) to enrich skills as clinical teachers. Both groups intend to or have incorporated the infographics into their own teaching (CP: 4.2, WISE-FM: 4.2). WISE-FM respondents strongly

agreed (4.6) that the overall “returns” from participating were worth their investments (time, effort).

Conclusion: The WISE-FM provides a statewide faculty development model that can be adopted by others to meet accreditation requirements for CP teaching skill development through shared authoring of CP development resources while concurrently advancing the development of WISE-FM participants.

Evaluation of Preoperative Anemia and Transfusion Requirements in Adult Liver Transplant Recipients

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Background: Liver transplantation is often associated with massive blood loss due to surgical complexity and the hemostatic abnormalities of end-stage liver disease. Blood transfusions have been associated with increased risk of infection, multiorgan dysfunction, graft loss and mortality.

Purpose: To determine for liver transplantation whether correlation exists between preoperative anemia and transfusion requirements, length of stay or incidence of postoperative infection.

Methods: A retrospective review of liver transplantations from Jan. 1, 2012, to June 30, 2015, was conducted. Packed red blood cell (PRBC), fresh frozen plasma (FFP), platelet and cryoprecipitate units were collected preoperatively, intraoperatively and within the first 48 hours postoperatively. Cox proportional hazards model was used to model the outcome of infection. Linear regression was used to model the outcomes of postoperative length of stay and blood use.

Results: Of the 112 patients, mean age was 56 years, mean Model for End-Stage Liver Disease score was 27 and mean preoperative hemoglobin was 10.5 g/dL. Lower preoperative hemoglobin was significantly associated with increased preoperative PRBC, platelet and cryoprecipitate use ($P<0.04$) as well as increased intraoperative PRBC, FFP, platelet and cryoprecipitate use ($P<0.0001$). Preoperative PRBC, FFP, and platelets as well as intraoperative PRBCs were associated with longer length of stay ($P<0.045$). Each g/dL decrease in preoperative hemoglobin was associated with a 26% increased risk of infection in univariate models (hazard ratio [HR]: 1.26, $P=0.01$). Longer length of stay and higher preoperative cryoprecipitate, intraoperative FFP and postoperative FFP also were associated with increased risk of infection. More units of preoperative cryoprecipitate (HR: 1.07, $P<0.01$), fewer units of postoperative cryoprecipitate (HR: 0.19, $P<0.01$) and more units of postoperative FFP (HR: 1.75, $P<0.01$) were associated with infection in multivariable stepwise selection.

Conclusion: Lower preoperative hemoglobin was associated with increased preoperative and intraoperative transfusion

requirements as well as increased postoperative infection. More preoperative cryoprecipitate units, fewer postoperative cryoprecipitate units and more fresh frozen plasma units were independent predictors of infection.

Effect of Code Status Handout on Resident Physician Comfort During the Admission Process

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Background: Discussing code status can be a difficult part of the admission process, especially for residents. There have been various research studies looking at interventions to improve end-of-life discussions. However, these studies have focused on well-acquainted physicians and patients. With increasing use of hospitalists for inpatient care, there is increased need for improving code status discussions at admission.

Purpose: To determine if an easy-to-use handout would improve resident comfort with the code status discussion.

Methods: Following a literature search on how to discuss advance directives and end-of-life care, a code status handout was developed. The handout, written at fifth-grade reading level, was edited by attending physicians who oversaw the Adult Medicine Teaching Service (AMTS) at Aurora St. Luke's Medical Center, and used for patient admissions to AMTS by PGY1–3 residents from July 2015 to December 2015. A pre- and postintervention survey was emailed to residents before and after the start of their inpatient rotation, respectively. A predetermined script — read to residents on the first day of their rotation — discussed the handout, goals of the study and surveys. Paired t-tests were used to compare pre- and postintervention survey responses.

Results: Across respondents (N=39), the majority were PGY1 (63.2%) with prior personal experience explaining code status to patients (73.7%). Pre- and postintervention surveys did not identify a difference in physician comfort level when explaining code status, even when compared to year in residency. On the postintervention survey, residents identified that the code status handout better informed patients (73.0%), was easy to use (75.0%) and that they would continue to use the handout to explain code status (78.4%). Regarding “What would you change?” residents identified that the handout should be shorter (34.2%).

Conclusion: Use of the handout did not show significant improvements to resident comfort in this small pilot. While residents identified that they would use the handout again, several remarked that the handout was too long for them or patients to read. Given that the handout was one page and in patient-friendly language, it is concerning that residents have such limited time for code status discussions. Future quality improvement studies should be conducted to standardize the code status discussion. Doing so will ensure that every patient is being properly educated on this important topic.

Evaluation of Patient Opinions and Experiences With Electronic Cigarettes at a Family Medicine Residency Clinic

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Background: Since 2003, electronic cigarettes (e-cigs) have grown in popularity. E-cigs are often marketed as a safer, healthier alternative to smoking traditional cigarettes or as an aid for smoking cessation. However, the risks and benefits of e-cig use, as well as the beliefs that influence use or avoidance, are poorly understood.

Purpose: To assess our patient population's perception or beliefs as they relate to e-cig use.

Methods: A 13-question survey regarding nicotine and e-cig use was distributed to English-speaking adult patients at Aurora St. Luke's Family Practice Clinic from August 2015 to January 2016. Questions assessed patient demographics and smoking history as well as knowledge and opinions of e-cigs. Descriptive statistics were used to describe patient characteristics. Associations between patient characteristics and beliefs were analyzed using chi-squared tests and Fisher's exact test, as appropriate. Significance was associated with $P < 0.05$.

Results: Across respondents (N=100), patients were more likely to be female (60%) and of age 45–54 years. Patients either had heard about e-cigs through advertisements (48.9%) or by word of mouth (36.9%). Many believed that e-cigs could help others quit smoking (47.6%) and were a healthier smoking option over regular tobacco (47.5%). Only 21.7% of patients had ever tried e-cigs. Age, sex and race/ethnicity were not associated with trying e-cigs. Those who identified as ever-smokers were more likely to have tried e-cigs than never-smokers ($P=0.044$). Additionally, current smokers were even more likely to have tried e-cigs than former or never smokers ($P=0.017$). Smoking status was not associated with education and race/ethnicity. Views regarding cost and whether e-cigs were a good choice for cessation also were not associated with smoking status.

Conclusion: Smoking status significantly affects whether a patient has tried e-cigs, with current smokers being most likely to have tried them. Demographic characteristics were not associated with use or opinions of e-cigs. Future studies should be done to assess use and attitudes in other clinic settings as well as use within our adolescent patient populations.

The Crux of the Heart — the Closest Approach of the Right Atrium to the Left Ventricle

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Background: Accessory pathways, the source of atrioventricular reentry tachycardia, occasionally connect the left ventricle to the right atrium. This is possible because, in some patients, a portion of the right atrium abuts the left ventricle on the posterior wall of the heart, near the mid-coronary sinus. This anatomic region is known as the “crux” of the heart. These accessory pathways can be difficult to ablate because of the unusual and unexpected substrate. While the presence of these accessory pathways is described in the literature, the prevalence of the underlying anatomic substrate is not currently known.

Purpose: To measure the closest approach of the left ventricle to the right atrium by reviewing a consecutive series of standard-of-care computed tomography (CT) scans of the heart taken in patients undergoing interventional cardiac procedures such as catheter ablation of the left atrium.

Methods: Contrast-enhanced cardiac CT exams acquired with electrocardiography-gated retrospective image reconstruction and that had good image quality (i.e. appropriate contrast enhancement of the cardiac structures of interest and low motion artifacts of the acquired images) were reviewed. After scanning the axial images of the relevant anatomy, single or double oblique cuts were made of the three-dimensional data set, and the closest approach of the left ventricle to the right atrium was measured and tabulated.

Results: A total of 47 consecutive CT scans acquired between March 2014 and April 2015 from patients (36 male, 11 female) undergoing catheter ablation for atrial fibrillation were reviewed for this study. The mean distance between the right atrium and left ventricle was 3.6 ± 1.0 mm. The maximum value was 6.8 mm. For the remaining 46 patients, the right atrium was less than 5.3 mm from the left ventricle at the point of closest approach. The images showed a single muscular wall between the two chambers at this point, indicating that the right atrium was in contact with the left ventricle.

Conclusion: The right atrium came into direct contact with the left ventricle in all studied patients except one. This has important implications for catheter ablation of certain accessory pathways.

Bias in the Eyes of Resident Physicians

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Background: The utilization of patient characteristics can allow health care providers to arrive at diagnosis or decide

on treatment options; however, the subjective nature of patient characterization can negatively affect patient care. A 2003 Institute of Medicine report, called Unequal Treatment, recognized that bias or stereotyping may affect provider-patient communication or the care offered.

Purpose: To investigate residents’ recognition of bias in an inpatient care setting.

Methods: In order to explore the topic of bias among providers, we elected to indirectly assess its recognition among providers by asking their opinion in an anonymous manner about their fellow residents. This, we thought, would remove the issue of self-judgment and make it easier for responders to reflect on their observations. We asked residents the following two-step question: “Have you observed a colleague of yours SAY, PORTRAY, or ACT in a biased manner toward a patient while providing inpatient service?” If the answer was yes, we subsequently asked them to elaborate on the bias.

Results: The survey was sent to 39 postgraduate internal medicine residents in their first to third year of training. Half of the responders (20/39) were female. The response rate was 100%, and 46% (18/39) reported observing their colleague(s) being biased toward patients. Of those who reported bias, 77.8% (14/18) reported one or more examples about the content of the perceived bias. The largest category of these, at 42.8% (9/21), regarded bias toward patients with past or current “drug/substance abuse” or “narcotic seeking” behavior; 14.3% (3/21) involved patients with repeated admissions or so-called “frequent fliers”; 9.5% (2/21) related to race/ethnicity; 14.3% (3/21) indicated providers not wanting to care for patients who were perceived to be “difficult.” Interestingly, another 9.5% (2/21) reported witnessing preferential service for “affluent/VIP” patients. Other examples included bias against obese patients, female patients and general stereotyping with no specifics given.

Conclusion: The majority of resident physicians did recognize bias in their colleagues’ approach to patient care. Given the evidence that implicit bias can be recognized and improved upon, this study reinforces the need for implicit bias training/discussion to be included in residency programs.

Zero-Fluoroscopy Cavotricuspid Isthmus Ablation Using Carto Mapping System as Sole Guiding Method

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Background: Catheter ablation of the cavotricuspid isthmus (CTI) is traditionally performed using fluoroscopy and electroanatomical mapping systems. Zero-fluoroscopy approaches have recently been studied, mostly using the EnSite® mapping system (St. Jude Medical Inc., St. Paul, MN). We studied the feasibility and efficacy of zero-fluoroscopic mapping and ablation of the CTI using the Carto® 3 system (Biosense Webster Inc., South Diamond Bar, CA).

Purpose: To evaluate the efficacy and safety of a zero-fluoroscopic approach to CTI ablation.

Methods: We included 9 patients with typical atrial flutter for whom mapping and ablation of the CTI was done using Carto mapping as the sole guiding modality. Zero fluoroscopy was achieved in all of them. Another group of 9 matched patients whose ablations were done using the traditional method (i.e. fluoroscopy and Carto guidance) were included as a control.

Results: Both groups had similar baseline characteristics. The total fluoroscopy time and radiation dose in the control group were 12.8 ± 4.8 minutes, 230.2 ± 131.9 mGy, respectively. The zero-fluoroscopy group were done while wearing no lead aprons. The average total procedure time was 114.8 ± 16.9 minutes in the zero-fluoroscopy group, significantly less than that of the control group (138.6 ± 24.3 minutes; $P=0.0286$). The total radiofrequency time was similar in both groups (15.2 ± 7.4 minutes in zero-fluoroscopy group vs 16 ± 2.9 minutes in control group; $P=0.9294$). Bidirectional block was achieved in all patients of both groups. No complications were encountered in either group.

Conclusion: To our knowledge, this is the first study of a zero-fluoroscopic approach using the Carto mapping system for ablation of the cavotricuspid isthmus in the United States. The approach is feasible and effective in achieving bidirectional block with less average total procedure time.

Determining the Incidence and Factors of Cardiotoxicity in Breast Cancer Patients Treated With Anthracycline and/or Trastuzumab-Containing Regimen at Aurora Health Care

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Background: Anthracycline and trastuzumab are common breast cancer treatments. While improving survival, they elevate risk of congestive heart failure. The incidence of cardiotoxicity (CTx) with these therapies varies in the literature from 10% to 59%, higher than those reported in clinical trials (4%–10%) that excluded patients with preexisting cardiovascular comorbidities. Studies have failed to establish consensus on the risk factors for CTx associated with these therapies.

Purpose: We aim to determine the incidence and risk factors of CTx in breast cancer patients treated with anthracycline and/or trastuzumab at Aurora Health Care.

Methods: A retrospective review of patients with breast cancer who received anthracycline and/or trastuzumab from 2002 to 2011 yielded a total of 2,383 patients. Patients with a left ventricular ejection fraction (LVEF) recorded prior to treatment and at least one follow-up LVEF were included in analysis ($n=319$, 13.4% of total cohort). Database queries

and electronic medical records review (assisted by an in-house natural language processing tool) retrieved data on demographics, comorbidities, congestive heart failure symptoms, oncological treatments and LVEF. The study outcome was CTx, defined as a $\geq 10\%$ decrease in LVEF to a level of $< 55\%$. Chi-squared and Fisher's exact tests were used for categorical variables to test differences in patient characteristics by CTx status (yes/no). Multivariate logistic regression analyses examined the association between risk factors and CTx.

Results: Average age of the patients was 54.9 ± 12.1 years; the cohort was comprised of 50.5% with obesity, 44.2% with smoking history and 47.3% with hypertension. A total of 79 patients developed CTx, an incidence of 24.8%. Multivariable analysis identified divorced/widowed marital status (odds ratio [OR]: 2.70, 95% confidence interval [CI]: 1.26–5.77), history of structural/electrophysiological (EP) cardiac disease (OR: 2.66, 95% CI: 1.24–5.70) and combined anthracycline-trastuzumab therapy (OR: 2.92, 95% CI: 1.48–5.77) as significant risk factors for CTx.

Conclusion: The incidence of CTx was greater in a community setting for which cardiac history and comorbidities are more diverse than in clinical trials. Consistent with prior literature, our study identified combined treatment with anthracycline and trastuzumab as a risk factor for CTx. Our study also suggests divorced/widowed marital status and prior structural/EP cardiac disease as additional risk factors for CTx. Further prospective studies are warranted for verification. We advocate for pre- and posttreatment cardiac monitoring of patients receiving these two therapies.

Are There Advantages to Hiring In-House Training Program Graduates?

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Background: Several studies have compared international graduates on measures of performance, quality and satisfaction. No studies have compared internally versus externally hired graduates in relation to these measures.

Purpose: To identify if there is a difference in hiring patterns and care management (CM)/patient satisfaction (PS) scores between internal and external graduate hires.

Methods: We conducted a quality improvement study on graduates hired by Aurora Health Care from Jan. 1, 2006, to Dec. 14, 2015. CM scores were determined based on hire date. PS scores were calculated based on the calendar year, regardless of exact hire date. PS scales for scoring changed in mid-2010. Hired graduates with no CM and PS scores, as well as those with less than one year of employment, were excluded. Means were compared using two-sample t-tests and regression analysis. Categorical variables were analyzed using chi-squared and Fisher's exact test, as appropriate.

Results: Study population ($N=108$) characteristics included: mean age 38.0 years, 62.0% female gender and 56.5%

white race. The majority of those hired (mean starting FTE 0.99) were external graduates (70.4%) and family medicine physicians (50.9%). Of those hired since 2006, 71.3% are still employed (mean longevity 3.5 years). There was no difference in age, sex, race or employment status between internally and externally hired graduates. Family medicine hires were significantly more likely to be internal graduates compared to internal medicine (40.0% vs 13.6%, $P=0.03$) and all other physician specialties combined (40.0% vs 18.9%, $P=0.03$). First-year CM scores did not differ by age, sex, race, year offer accepted, or external versus internal residency. Family medicine hires had significantly lower initial CM scores (2.76 vs 3.14, $P=0.009$) when compared to other physician specialties. However, second-year CM scores showed no difference between family medicine and other physicians. First-year PS (scale one) scores were significantly higher with younger age ($P=0.03$), female sex ($P=0.04$) and internal graduates ($P=0.04$). Younger age and female sex remained predictors of higher PS for second-year scores. No statistical difference was noted with use of scale two for PS scoring.

Conclusion: Care management scores do not differ between internally and externally hired graduates; patient satisfaction scores differed based on scale used. Further study is needed to determine internal hiring disparities between specialties and if CM scores are lower in those hires with more items to be scored.

Additional Presentations

The following citations reflect the remaining 2016 Aurora Scientific Day presentations, some of which have been published as abstracts or articles in scientific journals.

First Place Oral Presentation: Tjoe J, Dalmar A, Greer D. The role of surgical primary tumor extirpation in de novo stage IV breast cancer in the era of targeted treatment. In: The American Society of Breast Surgeons 2016 Annual Meeting Official Proceedings, Volume XVII. *Ann Surg Oncol*. 2016;23(3 Suppl):21-23.

Third Place Oral Presentation: Krum D, Erickson L, Hare J, Choudhuri I, Rowe D, Sra J. Three-dimensional cardiac mapping using only single-plane fluoroscopy. Orally presented at Aurora Scientific Day, Milwaukee, WI, May 25, 2016.

First Place Poster: Rizvi F, Siddiqui R, DeFranco A, Holmuhamedov A, Xu H, Emelyanova L, Ross G, Shi Y, Holmuhamedov E, Tajik AJ, Jahangir A. Simvastatin prevents TGF- β 1-induced SMAD2/3 phosphorylation involved in ventricular fibrosis: role of protein phosphatases. Subsequently presented at the Basic Cardiovascular Sciences 2016 Scientific Sessions, July 18–21, 2016, Phoenix, AZ.

Second Place Poster (tie): Petrovic M, Godic Z, Holmuhamedov A, Kraft K, Negmadjanov U, Emelyanova L, Rizvi F, Ross G, Kress DC, Holmuhamedov E, Tajik AJ, Jahangir A. Functional and structural differences in fibroblasts from atria of patients with and without atrial fibrillation. *J Am Coll Cardiol*. 2016;67(13_S):744.

Third Place Poster (tie): Ahmad MN, Ahmad MM, Hussaini SF, Khandheria BK, Jain R, Tajik AJ, Ammar KA. Aortopathy in hypertrophic cardiomyopathy; the association with sinus of Valsalva versus mid ascending aorta: an epidemiological study. *J Am Coll Cardiol*. 2016;67(13_S):1613.

Third Place Poster (tie): Naeem U, Nangia V, Koeberl R, Mortada ME. Medtronic Carelink Express device usage in midsize emergency department. *Heart Rhythm*. 2016;13(5):S523.

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Flores K, McDearmon S, Phelps B, Kram JJ, Baumgardner DJ, Kotovicz F. FP059: Understanding providers' emotions and thoughts regarding opioid use for the management of chronic non-cancer pain in a family medicine residency program. Presented at Society of

Teachers of Family Medicine Annual Spring Conference, Minneapolis, MN, May 2, 2016. Available at: <http://www.stfm.org/Conferences/AnnualSpringConference/PastConferences/2016AnnualSpringConference?m=6&s=17304>.

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