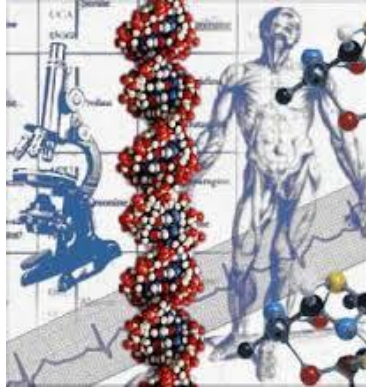


# Brody School of Medicine Summer Scholars Research Program



## Medical Student Research Day

August 7<sup>th</sup>, 2017  
Brody Commons  
Brody Medical Sciences Building

**East Carolina University**

*The Brody School of Medicine Summer Scholars Program would like to express its sincere gratitude to the following individuals and participating faculty of the following departments for their support of the 2017 Program. Those listed provided financial support for student stipends, research resources, administrative support and/or funds for the 2017 Medical Student Research Day. These generous contributions make it possible for BSOM students to learn and make their own contributions to the field of medicine through scholarly pursuits.*

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## **Pre-charging defibrillation devices during a shockable cardiac arrest decreases CPR hands off time, but may not correlate with patient neurological outcomes**

Matthew W. Coco <sup>BSOM</sup>, Dr. Jennifer Stahl <sup>ED</sup>

### **Background:**

Even with improved EMS response times and defibrillation technology, probability of surviving a cardiac arrest (CA) is extremely low. The AHA stated that “survival to hospital discharge after nontraumatic EMS-treated CA... was (only) 10.6% for patients of any age” (Mozaffarian). Recent work has been done to try and improve CPR protocol and patient survivability following CA. In general, it has been shown if CPR compression time can be maximized patient outcomes significantly improve (Kern; Cheskes). Thus, showing an inverse relationship between preshock and perishock pause time with patient survivability (Cheskes; Walcott; Brouwer).

### **Objective/Hypothesis:**

Pre-charging defibrillators during a CA will decrease peri-shock pause and CPR hands off time, thus improving patients’ neurological outcome and survivability.

### **Methods:**

A preliminary retrospective chart review was used to analyze a potential correlation between patient neurological outcomes following an out-of-hospital CA and the precharging of defibrillators. The review enrolled patients spanning 2015-2017 presenting to EMS with a shockable rhythm and received at least one shock during their care. Of the 70 patients meeting this criterion, 57 had complete data and were enrolled. EMS encounter files were used to obtain compression data, treatment summaries, and shock pause times. The survivors’ neurological outcomes were then graded using a modified RANKIN scale. Upon completion of data acquisition, statistical analysis of a 95% confidence was used to determine if any significant correlations were present.

### **Results:**

Analysis included 57 cases, with 16 surviving to hospital discharge and pre-charging of devices occurring 48% of the time. Of these survivors six had RAKIN scores of 0, five scores of 1, four scores of 3, and one a score of 4. Precharging was shown to decrease time from rhythm analysis to shock delivery by  $12.7 \pm 3.5$  seconds ( $p=.0004$ ). No statistical significance was seen with time to ROSC ( $p=.4518$ ), number of shocks given ( $p=.925$ ), or neurological outcome ( $Rsquare=0.025$ )

### **Conclusion:**

From the preliminary analysis, there is no statistical correlation between precharging the defibrillator and improved patient neurological outcomes. This may be due to a lack of surviving patients within our study, and requires an increased sample size. However, there is a significant reduction in CPR hands off time by precharging the device.

## **Elevated Blood Pressure Among Emergency Dental Patients: A Descriptive Study**

Tashana Detwiler, DMD Candidate 2021

Mentors: Kimberley Gise, DDS, Director, Emergency Care Clinic

**Background:** Hypertension, also known as the “silent killer,” affects 1 in 3 adults over the age of 20. It is the 13th leading cause of death in the U.S. and accounts for 26% of deaths in North Carolina each year. As the disease progresses, those affected are at an increased risk for heart attack, heart failure, stroke, kidney failure, and other major health problems. A targeted effort must be made to develop best practices for risk assessment, early diagnosis, and early intervention.

**Objective:** To examine and evaluate the prevalence of elevated blood pressure among emergency dental patients in the Advanced Care Emergency Clinic at the ECU School of Dental Medicine.

**Methods:** This study was conducted by accessing records of de-identified adult patients over the age of 18 who visited ECU SoDM Emergency Dental Clinic between June 2015 and June 2017. Patients presented to the clinic with elevated Systolic blood pressure above 120 mmHg or Diastolic blood pressure above 80 mmHg. American Heart Association blood pressure guidelines were used to define hypertension. Patient medical history is self-reported including comorbidity conditions and medications. Data from these patients were examined for trends across gender, age, and race.

**Results:** 5,353 records were reviewed. 1,925 patients, or 36%, visiting ECU SoDM Emergency Dental Clinic presented with elevated blood pressure. 1,100 patients, or 57%, reported no hypertensive medications. While 76% of hypertensive patients not taking medication are Stage 1, there were 46 patients, or 4%, with blood pressure measurements at crisis levels.

**Conclusion:** The prevalence of elevated blood pressure in ECU SoDM emergency patients is slightly higher than the national average and NC average. The readings in this study were taken in an emergency dental clinic. Factors affecting elevated blood pressure include pain, white coat syndrome, and medications. Going forward, there needs to be more coordination between health professionals to raise awareness in patients, and develop early diagnosis and intervention to improve health outcomes and decrease healthcare costs.

## **Herbal and Dietary Supplement Fatalities in the Annual Reports of The American Association of Poison Control Centers 2006-2015**

Keia V. Faison<sup>1</sup>, Gabrielle Kattan<sup>1</sup>, Peter W. Greenwald<sup>2</sup>, Brenna M. Farmer<sup>2\*</sup>

1- The Brody School of Medicine at East Carolina University; 2 - Weill Cornell Medical Center, Division of Emergency Medicine, New York, NY, USA

**Background:** Herbal and Dietary supplement (HDS) use dates back to the beginning of civilization and is still the leading class of medical ailment in most parts of the world. However, HDS use in the United States is relatively new but has become increasingly common in recent years. Unlike prescription drugs, the Dietary Supplement Health and Education Act of 1994 (DSHEA) virtually exempts these supplements from federal supervision. Since the 1994 act, there has been an estimated increase in HDS products with the American Association of Poison Control Centers (AAPCC) reporting growth from 4,000 to more than 55,000 in 2012. Although relatively harmless when used correctly, unnecessary or reckless use of these products can lead to adverse events.

**Objective:** We seek to evaluate trend and epidemiology of HDS use contributed to fatal poisonings between 2006-2015 reported to US Poison Control Centers in the Annual Reports of the American Association of Poison Control Centers.

**Methods:** Fatality tables in the Annual Reports of the AAPCC, from 2006 to 2015, were reviewed. Substances were determined to be HDS or non-HDS by a board certified medical toxicologist (Farmer B). Inclusion criteria: all substances in the fatality reports. Exclusion: substances determined not to be HDS by the medical toxicologist, elemental supplements (calcium, magnesium, potassium, etc. supplements) commonly prescribed by healthcare providers. The number of deaths from HDS was then determined. Analysis was performed using statistical software (Stata,v12.0).

**Results:** Fatality rates were calculated by using the data from “summary of fatal exposures” table as the denominator and the number of fatalities involving herbal and dietary substances as the numerator. There were a total of 1598 known substances with 104 HDS identified. Of the 15,759 total fatalities from 2006-2015, 84 were due to herbal and dietary substances (0.53%). A trend was not revealed.

**Conclusions:** Our data demonstrated no clear temporal association of fatalities due to HDS use. Additionally, death reported to the Poison Control Center is uncommon but should continue to be monitored for public health surveillance.

## **Development of liquid chromatography/mass spectroscopy methodology for detecting drugs of abuse via the umbilical cord matrix**

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**INTRODUCTION:** Neonatal abstinence syndrome (NAS) is an array of signs and symptoms experienced by the newborn that occur after birth due to abrupt discontinuation of intrauterine exposure to substances, primarily opioids, taken by the mother. Incidence of NAS in the United States has tripled over the last decade. Current standard of care for drug testing involves radioimmunoassay of urine and meconium samples collected from babies after birth. Positive screens are confirmed using mass spectrometry. It takes an average of 4-5 days for results and an additional 4-6 days for confirmation. Umbilical cords tissue has emerged as a convenient, rapid alternative with lower levels of detection that reflects in utero drug exposure.

**OBJECTIVE:** To develop liquid chromatography/mass spectrometry (LC/MS) methodology to detect illicit drugs (cocaine, tetrahydrocannabinol, heroin, and opioids) and nicotine exposure during pregnancy via the umbilical cord matrix. By characterizing drug type and concentration, we anticipate using this data to develop a reliable alternative testing method to urine/meconium immunoassay screens.

**METHODS:** Twenty umbilical cords were collected after informed consent within one hour post-delivery. Umbilical arterial cord blood was also collected. The cord was washed with normal saline to remove blood, dried, cut into four equal pieces, and stored in sterile containers at four temperatures: 23°C, 4°C, -20°C, or -80°C. Cord samples were then homogenized, and internal standards at twice the cutoff concentration were added. Drug-free cord tissue was prepared as positive and negative controls, fortified at the cutoff concentration established for each analyte. Solid phase extraction and methanol extraction were compared for optimization of sample extraction for both umbilical cord and cord blood. Method validation was evaluated based on bias, accuracy/repeatability, precision, carryover, interference, ionization suppression/enhancement, limit of detection, limit of quantitation, and processed sample stability. Sample stability was assessed among storage environments.

**RESULTS and CONCLUSION:** Currently in process.

## **Dopamine receptor D3 agonist reduces morphine-induced tolerance and preserves cardiac function in mice during morphine exposure and withdrawal**

Gabriel Gaweda, BS; Iyer Rugmani, PhD; Patti Shaver, BS; Gabriel Grilo, PhD; Mai-Lynne Dinkins, BS; Hamilton Stoffel; Whitney Green, BA; Stefan Clemens, PhD; Lisandra de Castro Brás, PhD

Department of Physiology, Brody School of Medicine, East Carolina University

**Background:** Prolonged morphine exposure leads to desensitization of pain receptors, such as the G-coupled mu-opioid receptor (m-OR). Additionally, extended morphine exposure is related to cardiac dysfunction. This is problematic for patients undergoing withdrawal from extended morphine pain management, especially those with pre-existing heart conditions. Current literature suggests a synergism between m-OR and dopamine receptor 3 (DRD3).

**Objective:** The purpose of this study is two-fold. It aims to show that using a DRD3 agonist (DRD3ag) as an adjunct therapy to morphine improves pain tolerance by preventing the desensitization of pain receptors. Additionally, it aims to show that DRD3ag preserves cardiac function in mice withdrawing from morphine, compared to those withdrawing from morphine alone.

**Methods:** 30 mice were randomly divided into 5 groups (G1-G5) and given morphine (5 mg/kg) for 7 days (D7). Two groups were euthanized after morphine tolerance was established at D7 (G1, morphine only; G2 morphine + DRD3ag). The other 3 groups (D14) underwent a 7-day period of morphine withdrawal (G3, withdrawal no treatment; G4, morphine+DRD3ag until D7 followed by withdrawal; G5, D7 morphine and withdrawal + DRD3ag). Echocardiography was performed on each animal at D0 to establish a baseline for cardiac function, D7, and again on D14. Histology and immunoblotting were conducted on the left ventricle (LV) to measure tissue fibrosis, collagen 1 deposition, myocyte hypertrophy, and DRD1 and DRD3 expression.

**Results:** Pain tolerance testing indicates decreased sensitivity to pain in animals receiving DRD3ag adjunctive therapy, compared to animals receiving only morphine. Echocardiography shows improved cardiac function in animals treated with DRD3ag. Picrosirius red staining did not show a significant difference in cardiac collagen deposition among groups. Decreased cardiomyocyte hypertrophy was noted in all groups receiving DRD3ag after morphine withdrawal. Immunoblotting shows increased collagen 1 expression in morphine only groups. DRD1 and DRD3 expression was markedly decreased in groups treated with DRD3ag compared to their morphine-only counterparts.

**Conclusion:** Our data suggests that using DRD3ag as an adjunctive therapy with morphine improves pain management and decreases morphine-induced cardiac dysfunction. Additionally, using DRD3ag during morphine withdrawal shows cardioprotective potential that should be further studied for its therapeutic advantages over morphine administration alone.

## **Differences in the tensor veli palatini muscle between adults with and without cleft palate using high resolution three-dimensional magnetic resonance imaging**

Thomas George<sup>1</sup>, Jamie Perry, PhD<sup>2</sup>

1-Brody School of Medicine 2-Communication Sciences and Disorders

**Background:** Approximately 90% of patients with cleft lip and/or palate develop Otitis Media with Effusion (OME). Although many studies have sought to determine the etiology of increased OME in the cleft population, a lack of congruency persists within the literature.

**Hypothesis:** We hypothesized that the increase in OME may in part be caused by tensor veli palatini (TVP) muscle (the TVP muscle is the primary muscle implicated in Eustachian tube (ET) functioning) hypoplasia present within the cleft population.

**Methods:** Analysis and comparison of the TVP muscle and surrounding structures using 3D MRI data from 8 non-cleft and 6 cleft individuals was conducted using Amira 5.5 Visualization Modeling software. Several different parameters were used for comparison between subject groups based upon previous research methods that measured the TVP muscle.

**Results:** A non-parametric Mann-Whitney U test was utilized in the statistical analysis of the data because of an unequal sample size. After statistical analysis, the data showed a significant increase in the TVP muscle volume in the non-cleft ( $Mdn = 895.19$  mm) versus cleft group ( $Mdn = 536.22$  mm). Additionally, the length of the TVPM was also shown to be significantly greater in the non-cleft ( $Mdn = 21.18$  mm) versus cleft group ( $Mdn = 18.04$  mm). No other significant differences were noted in any of the other measured parameters following statistical analysis.

**Discussion:** Data from the present study demonstrate an increased TVP muscle volume and length in the non-cleft subjects when compared with the cleft subjects, thereby giving a potential explanation for the increased incidence of OME seen in the cleft population following reparative surgeries. It is our hope that this study, along with support from similar studies, will assist in the formation of treatment plans for cleft patients with recurrent OME by giving physicians a better understanding of where to focus reparative aims.



## **Role of the adenosine system in modulating spinal cord sensitivity and hyperexcitability in animal model of Restless Leg Syndrome (RLS)**

W. Green, M. Kassai, PhD, S. Clemens, PhD

**Introduction:** Restless Leg Syndrome (RLS) is a neurological condition characterized by a compelling urge to move during inactivity. Treatment with dopamine improves RLS symptoms, but is associated with adverse side effects. Existing Adenosine/dopamine heterodimer receptors offer a potential alternate target to mitigate RLS symptoms.

**Objectives:** The purpose of this study was to inject Adenosine Receptor modulators, Caffeine and CPA, to wild type (WT) and Dopamine 3-Receptor knock out (D3KO) mice. We used their response to thermal pain stimuli as a measure of A1 and D3 receptor-induced neural activity

**Methods:** Male dopamine D3 receptor knockout mice (D3KO; strain B6.129S4-*Drd3<sup>tm1dac</sup>/J*) and their appropriate associated wild-type (WT) controls (C57BL/6) underwent morning injections of saline (sham) and afternoon injections of caffeine or CPA with each injection followed by a period of acclimation and finally testing on a Hargreaves Apparatus. During testing each mouse was subjected to heat stimuli of 50 °C on their right hind paw until a withdrawal reflex was induced. Five trials were performed in each morning and afternoon session.

**Results:** Western analysis of untreated mice show an increased production of A1R and D1R in D3KO mice compared to WT mice. There was no significant increase in production of A2R in D3KO. Treatment with CPA binding the A1 receptor resulted in a significant response to thermal stimuli in WT mice with intact A1 and D3 receptors. No response to CPA was detected in D3KO mice. Treatment with caffeine did not induce a significant response to heat stimuli in WT or D3KO mice potentially due to equalizing agonist and antagonist activity from D3 and A1 receptors, similar to dopamine. However, comparison of treatment effects of Caffeine vs CPA indicated a significant effect in WT mice.

**Conclusions:** In the present study we confirm that D3R expression and activity are linked to the A1 receptor. The increased withdrawal time using Adenosine modulators in WT compared to D3KO indicates that D3R is essential for proper function of the A1R and the potential exist for use of Adenosine receptor modulators to treat RLS.

## **Short-term high fat diet induces obesity with minimal impact on bladder or mitochondrial physiology**

Trevor C. Hunt<sup>1</sup>; Michael D. Tarpey<sup>1,2</sup>; Michael R. Odom<sup>1</sup>; Elena S. Pak<sup>1</sup>; Espen E. Spangenburg<sup>1,2</sup>; Johanna L. Hannan<sup>1</sup>

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**Background:** Bladder dysfunction affects nearly 80% of type 2 diabetes patients. High fat diet (HFD) is associated with obesity and insulin intolerance and can lead to mitochondrial dysfunction. The contribution of mitochondria to bladder dysfunction has not yet been examined.

**Objective:** We hypothesized that a short-term HFD will cause increased voiding, detrusor overactivity, and increased mitochondrial respiration and oxidative stress.

**Methods:** Male C57Blk6NJ mice (10wks) were fed control (10% fat) or HFD (45% fat) for 6 weeks. Body weight, MRIs to assess body composition, and glucose and insulin tolerance tests were performed. Bladder physiology was assessed via void spot assays every other week. Mitochondrial function was measured via high-resolution respirometry of the individual electron transport chain complexes in the detrusor or urothelium.

**Results:** HFD for 6 weeks increased body weight, percent body fat, and decreased lean body mass ( $p < 0.001$ ). Fasted blood glucose increased with HFD ( $p < 0.01$ ) and remained elevated 90 minutes following glucose administration ( $p < 0.01$ ). There was no evidence of insulin resistance. Voiding frequency, volume, and bladder weights were unchanged with 6 weeks HFD. Mitochondrial respiratory capacity was trending towards lower levels in detrusor and urothelium from HFD mice although this was not significant.

**Conclusions:** Preliminary data show minimal impact of HFD on bladder and mitochondrial physiology after 6 weeks. Ongoing studies will assess bladder contractility and determine if mitochondrial derived hydrogen peroxide emission is elevated.

## **PROTEASE-ACTIVATED RECEPTOR 2 SENSITIZES PROTEASE-ACTIVATED RECEPTOR 4 IN VASCULAR SMOOTH MUSCLE CELL**

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Protease-Activated Receptors (PARs) are members of a family of G protein coupled receptors (GPCRs) that are cleaved and activated by extracellular serine proteases. PAR activation has been suggested to, at least in part, regulate vascular smooth muscle cell (VSMC) proliferation, migration, and hypertrophy; however, their discrete mechanisms have yet to be elucidated. PAR4, a low sensitivity receptor for thrombin, has been documented to rely on other PARs including PAR1 and 3 as cofactors. Recent evidence suggests that PAR2 and PAR4 form a stable heterodimer during normal trafficking to the plasma membrane. We hypothesized that PAR2 serves as a biological cofactor for PAR4 resulting in increased PAR4 sensitivity to its ligand. We investigated whether activation of PAR2 enhances PAR4 activity by pretreating primary rat VSMCs with either PAR2 agonist or antagonist and measuring PAR4 activation via Erk phosphorylation using Western blot analysis. In summary, treatment of cells with the PAR2 agonist showed decreased PAR4 activity compared to baseline control levels yet interestingly exhibited increased PAR4 activity compared to the PAR2 antagonist groups. These early data suggest that exogenous modulation of PAR2 causes PAR4 to be less susceptible to activation by an agonist. These findings could also suggest that PAR2 activation and antagonization cause a decrease in the expression and/or activity of PAR4 in VSMCs. We hypothesize that this may be due to the co-endocytosis of PAR2 and PAR4 after manipulation of the PAR2 receptor. We are furthering our work to unravel this cooperative mechanism between PAR2 and PAR4 as it could potentially identify therapeutic pharmacologic targets that could help prevent abnormal cell proliferation foundational to cardiovascular disease (CVD).

## Postnatal Nutritional and Neurodevelopmental Outcomes in Ex-Extremely Low Birth Weight (ELBW) Infants at School Age and Beyond

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Premature infants have a higher risk for death and disability with extremely low birth weight (ELBW) infants, birthweight < 1000 grams, having an approximate morbidity risk of 20-50%.<sup>1</sup> The long-term challenges facing ELBW infants include hearing/visual impairment, cognitive/motor disabilities, developmental delay, and cerebral palsy.<sup>2</sup> Long-term studies involving ELBW infants are necessary as younger and smaller infants are resuscitated, and providers seek information to guide parental expectations. Outcome data is essential for primary care providers and educational systems as these preterm children become school aged. Identification of problems affecting former ELBW infants will help providers coordinate early intervention and better utilize resources to improve long-term health. This study was a retrospective review of former ELBW infants who delivered at Duke University Hospital (DUH) between January 1, 2001 and May 31, 2012 who remained in the DUH health system at school age. Demographic data and early neonatal morbidities were collected from the medical record. Early motor outcome, along with subspecialist visits, were collected through chart review at outpatient follow-up visits. Associations were evaluated between ELBW infants ICN admission and their growth, educational deficits, hospitalization frequency, and pulmonary, cardiovascular, renal, and neurodevelopmental outcomes. Retrospective data included growth, feeding, medications, hospital admissions, medical devices, specified diagnoses, and morbidity/mortality. This project is ongoing and final analysis and results are pending. A total of 137 ELBW infants were included in this initial subset with 5.5 years of subject data. Demographic means for the initial subset were as follows: 65 (47.4%) males, 72 (52.6%) females, birthweight 773 grams, gestational age 25.8 weeks/2.1 days, and ICN stay of 117.6 days. The following trends in diagnoses were noted at school age: 43.1% language delay, 36.5% visual impairment, 34.3% asthma; 17.5% cerebral palsy, 11.7% ADHD, and 7.3% autism. Unexpected incidental findings included an increase in severe constipation requiring medical management, precocious puberty, ongoing feeding difficulties, toe-walking, hyperactivity without formal diagnosis, nasal columella injury requiring surgery, and hepatoblastoma. Assessment of ELBW postnatal development will allow investigators to develop and test hypotheses for mechanisms between ICN management and longer-term outcomes. Incidental trends noted in the study will provide direction for future studies.

1. Glass HC, Costarino AT, Stayer SA, Brett C, Cladis F, Davis PJ. Outcomes for Extremely Premature Infants. *Anesthesia and analgesia*. 2015;120(6):1337-1351. doi:10.1213/ANE.0000000000000705.

2. Patel RM. Short and Long-Term Outcomes for Extremely Preterm Infants. *American journal of perinatology*. 2016;33(3):318-328. doi:10.1055/s-0035-1571202.

## **Relationship between age and growth of nasopharyngeal structures from childhood to adolescence**

Mary Jordan, BS, and Dr. Jamie Perry, PhD

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**Background:** During the first decade of life, involution of the adenoid mass coincides with growth of the pharyngeal soft tissue structures. Growth of the velum, known as velar stretch, throughout development allows for maintenance of the velopharyngeal mechanism during this time.

**Objective:** The purpose of this study is to evaluate the effect of age on growth of nasopharyngeal structures.

**Methods:** MRI data on 44 subjects between 4-16 years of age were evaluated using Amira 5.4.0 Visualization and Volume Modeling software. Using the midsagittal plane, the following linear measures were performed: velar length (VL), effective velar length (EVL), pharyngeal depth (PD), adenoid thickness (AT), and adenoid width (AW). Adenoid volume (AV) and pharyngeal volume (PV) were obtained using volumetric segmentation of multiple slices within the sagittal plane. The adenoid lateral width (ALW) was measured using the AV three-dimensional segmentation. A general linear regression model was used to examine the effect of age across the variables.

**Results:** Mean PD ( $p = 0.010$ ), PV ( $p = 0.000$ ), and VL ( $p = 0.000$ ) each show a progressive and significant increase across the age groups. Mean AW ( $p = 0.010$ ) shows a gradual and significant decrease with increasing age. Mean AT ( $p = 0.529$ ) shows a modest, but insignificant, decrease in association with age. Mean AV and EVL decrease from ages 4-13 years with an increase among ages 14-16 years. Mean ALW shows a decrease after ages 4-6 years but remains stable through ages 7-16 years. Age had no significant influence on EVL ( $p = 0.849$ ), AV ( $p = 0.068$ ), or ALW ( $p = 0.461$ ).

**Conclusions:** Velar growth was not proportionate to changes in PV and adenoid size. Although VL was significantly impacted by age, the EVL was not. This suggests the anatomic changes alone cannot explain the adaptations needed for velopharyngeal closure with increasing age. Rather, it is likely the functional aspects of velar stretch are most important in ensuring proper velopharyngeal function throughout development. Lastly, it is likely the levator muscle maintains its position in the velar body (EVL) despite rapid growth of the velum.

## **Hypernatremic, Intubated Patients Recovering from Shock: A Negative Net Fluid Balance May be Safe**

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**Background:** Dysnatremias have traditionally been understood as occurring due to changes in free water balance controlled by the kidney with neuro-hormonal influences. Current treatment guidelines therefore assume that hypernatremia intrinsically represents a “free water deficit.” However, little supporting evidence exists for this assumption in the acutely ill patients and a large fraction of hypernatremic patients are now acknowledged to be hypervolemic. Emerging literature suggests sodium balance is predominantly driven by innate immune responses. This model may help refine understanding and treatment of hypernatremia in critically ill patients.

**Objective/Hypothesis:** We sought to estimate correlation between clinical fluid balance, intubation duration and hospital mortality in a prospective, observational study of resuscitated, intubated patients recovering from septic or cardiogenic shock with ICU-acquired hypernatremia.

**Methods:** 398 intubated Vidant ICU patients were screened and 9 were enrolled. Details of fluid balance, laboratory values, medication administration and intubation status were obtained daily for the hospital stay until extubation or death. Formal statistical significance testing not performed given the limited current sample size.

**Results:** Of nine enrollees, three died during hospitalization and five survived to discharge though one remained on ventilator support. The surviving group had a median cumulative net fluid balance of -2,038 mL (-10,217 – +2,544\*) versus +12,284 mL (+6,023 – +13,508\*) for non-survivors. During the first three days post-hypernatremia, the surviving group had a median net fluid balance of -2,634 mL (-3,250 – +2,025\*) versus +2,543 mL (-1,037 – +6,086\*) for non-survivors. The surviving group had a median 15 days on ventilation (6 – 22\*) versus 21 days (18 – 39\*) for non-survivors. (\* = inter-quartile range).

**Conclusion:** Initial results suggest that among hypernatremic, intubated patients recovering from shock, higher cumulative net fluid balance is associated with increased mortality and increased ventilation duration. Our initial results lend credence to the emerging immune-driven model of sodium balance in acutely ill and suggest that maintaining a negative fluid balance in such patients is safe and may be associated with decreased ventilation duration and reduced in-hospital mortality.

## **“APPLES” Mnemonic Useful for Teaching Ultrasound Guided Procedures to Residents**

Natalie Karr; Vivek Sindhi, MD; Michael McIver, MD; John Norbury, MD; Kimberly Rathbun, MD; Stephen Charles, PhD, Kelly Harrell, PhD, MPT; Eric Morrison, MD

**Background:** Ultrasound-guided interventions are becoming increasingly popular in the medical field because they have the potential to reduce error and improve accuracy compared to blind interventions. However, success with the procedure relies on proper set-up of the administrator and patient.

**Objective/Hypothesis:** We sought to determine if the “**APPLES**” mnemonic (Angle, Position, Perpendicular, Line UP, Entry, Sweep) is useful for remembering steps in ultrasound-guided interventions. A secondary objective was to determine if the “Line of sight Approach” (LOSA) was better than the “standard approach” (SA) for performing injections.

**Methods:** The design of the study was a double-blind randomized crossover trial, where seven residents were randomized into Group A and performed the LOSA first followed by the SA. The other seven residents were randomized into Group B which performed the SA followed by the LOSA approach. A GE Logic E ultrasound with a 12 MHz transducer was used to guide a 21g echogenic needle to the subdeltoid bursa on an embalmed cadaver.

**Results:** Of the participants, 87% found the APPLES mnemonic helpful for learning ultrasound injections. For the **LOSA** group, the average time to reach the target was 9.833s +/- 4.30s, and the paired t-test analysis revealed:  $t(5)=2.77$ ,  $p=0.039$ . For the **SA** group, the average time to reach the target was 17.500s +/- 8.73s, and the paired t-test analysis revealed:  $t(5)=2.26$ ,  $p=0.073$ . Two participants' data was omitted from analysis because they did not reach the target structure in either attempt.

**Conclusions:** Our results show that most resident physicians find the APPLES mnemonic helpful. Our data also suggest that LOSA may be superior to the SA. Future research is needed to determine the utility of the APPLES mnemonic and superiority of LOSA on a larger scale.

## **Line of Sight is a Superior Technique for Learning and Teaching Ultrasound-Guided Interventions**

Natalie Karr, Vivek Sindhi, MD; Michael McIver, MD; Kimberly Rathbun, MD, PhD; Stephen Charles, PhD; Kelly Harrell, PhD, MPT; Eric Morrison, MD; John Norbury, MD

**Background:** Ultrasound is currently used by clinical practitioners to identify target structures and guide needle interventions in an inexpensive and noninvasive manner. Despite its growing popularity, there is no systematized approach to teaching ultrasound-guided interventions. To our knowledge, this is the first study that evaluates the position of the injection administrator as a technique to improve accuracy and reduce time of ultrasound-guided procedures.

**Hypothesis:** We propose that the “Line of Sight” method is superior to the standard method for ultrasound guided injections.

**Methods:** This study utilized a randomized controlled crossover trial to compare two techniques. Participants were randomized into either Group A or Group B (“experimental”). They watched the video for their corresponding method and performed the injection. Afterwards, they watched the video for the second method (“control”) and performed that injection. A total of 96 participants had data obtained in the study.

**Results/Discussion:** When comparing the two approaches to each other, the average times for an individual participant were significantly different: perform Method A (Line of Sight Approach - **LOSA**) and then cross into Method B (Standard Approach - **SA**) ( $p = 0.033$ ) compared to Method B and cross into Method A ( $p=0.046$ ). There is evidence to suggest that gender plays a role in ability to hit Method A vs Method B; females hit the target with Method A more often than they hit Method B ( $p = <0.0005$ ). This was also reflected in their Method preference: females preferred Method A over Method B more than males ( $p=0.033$ ). The participants with no prior experience are more likely to hit the target with Method A than with Method B ( $p = 0.036$ ). Furthermore, 74% of all participants preferred Method A over Method B.

**Conclusion:** The “Line of Sight” Approach (LOSA) is a novel and superior technique for learning and teaching ultrasound-guided interventions compared to the Standard Approach (SA), as demonstrated in the decreased time to hit target and individual preferences.



## **Utility of Neuromuscular Ultrasound in Surgical Planning for a Patient with Elbow Arthritis and Ambiguous Electrodiagnostic Results**

Natalie Karr; John Norbury, MD; Eric Morrison, MD

**Background / Case Description:** A 66-year-old male with a history of an elbow deformity and elbow arthritis secondary to a childhood fracture presented with numbness and weakness in the left hand and swelling at the elbow. The numbness included the 4<sup>th</sup> and 5<sup>th</sup> fingers, extending into the medial forearm and the elbow, four months after a fall. On physical examination, he had a flexion contracture of the 5th digit of the left hand, a posterior elbow effusion, numbness in the 4<sup>th</sup> and 5<sup>th</sup> digits that extended up the medial aspect of the forearm. He had 3/5 strength in finger abduction and 5<sup>th</sup> finger flexion.

**Setting:** Outpatient Clinic

**Results / Clinical Course:** Electrodiagnostic (EDX) evaluation demonstrated a velocity of 114 m/s across the left elbow, with fibrillations in the first dorsal interosseous (FDI), and normal flexor carpi ulnaris (FCU). Neuromuscular ultrasound (NMUS) showed scar tissue surrounding the nerve with increased cross sectional area (10.91mm<sup>2</sup>), hypo-echogenicity and at the medial epicondyle, and an unusual tortuous nerve course. He underwent surgery for decompression of the ulnar nerve and aspiration of an elbow effusion. Within surgery, these sonographic findings were verified.

**Discussion:** Ulnar neuropathy at the elbow can be a challenging diagnosis when anatomical variations or fascicular sparing result in alterations in nerve conduction parameters and abnormalities on needle EMG.

**Purpose / Conclusion:** NMUS can be a valuable pre-surgical planning tool to evaluate scar tissue, anatomical variations, and clarify ambiguous electrodiagnostic results to improve surgical outcomes.

## **Trends in poison control center reported fatalities involving anticoagulants: data from fatality reports in the annual reports of the American Association of Poison Control Centers 2006-2015**

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**Introduction:** Anticoagulation therapy has become increasingly prevalent in the United States, with over \$8 billion spent in 2014.<sup>1</sup> Anticoagulants are ranked 14<sup>th</sup> on the top 20 most commonly prescribed classes of medication.<sup>1</sup>

**Objective:** To evaluate changes in anticoagulant fatal poisoning over time as the primary cause of death, using annual reports published by the American Association of Poison Control Centers (AAPCC).

**Methodology:** AAPCC annual reports were reviewed from 2006 to 2015. Substances were reviewed and coded as anticoagulant or non-anticoagulant. The percentage of anticoagulant were trended over time. Subset analysis of specific anticoagulants listed as cause of death was performed to determine if a specific anticoagulant had more deaths associated with it. Reason of toxicity was determined for each cause of death.

**Results:** There were 23,371,480 calls and 15,759 fatalities reported to poison control centers from 2006 to 2015. Anticoagulants were the primary cause of death in 394 cases. There was a consistent decline in an anticoagulant substance as the primary cause of death in the years 2011 to 2015. The most common anticoagulant associated with fatality was Salicylate while the least common were Argatroban, Fondaparinux, and Abciximab. Intentional-suicide was the main reason for poisoning in 295 cases of the anticoagulant deaths.

**Limitations:** The data is limited by the reports received to regional poison control centers, and fatalities are not reflective of all deaths due to anticoagulants. Providers caring for patients assisting an adverse event complicated by an anticoagulant may not call the poison center to report a toxicity or adverse drug event. Furthermore, prescribers may be more comfortable with the anticoagulants and subsequently management of adverse events without the need to call the poison control centers for advice.

**Discussion and Conclusion:** Anticoagulant fatalities reported to the AAPCC occur each year. There has decline of anticoagulant deaths reported in the past 5 years.

### Works Cited:

1. Aitken M, Kleinrock M, Lyle J, Nass D, Caskey L. Medicines Use and Spending Shifts: A Review of the Use of Medicines in the U.S. in 2014. April 2015

## **Distinct Localization of Aurora A Kinase in Mature Sperm and Spermatids Suggests a Role in Motility**

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**Introduction:** Aurora A Kinase (AurA) is a serine/threonine kinase that is associated with the basal body of primary cilia and is responsible for disassembly of cilia when somatic cells enter the cell cycle from the quiescent state. Although cilia and flagella are analogous structures with an internal core of microtubules, little is known of AurA's role in flagella and no current studies of the localization or function of AurA in male germ cells exist. Increased understanding of AurA in spermatids and sperm will expand our understanding of its role in spermatogenesis and the development of flagellar motility.

**Purpose:** The purpose of this study is to determine whether AurA has a role in flagellar biogenesis by first investigating its localization within mature sperm and testes.

**Methods:** This study utilized immunoprecipitation (IP), immunohistochemistry (IHC), and indirect immunofluorescence (IF) as methods for localization. We also used ELISA to quantify the endogenous expression of Aurora A as well as the presence of the activated form.

**Results:** IP demonstrated AurA expression increased during testes development reaching a peak at 35 days. Additionally, immunohistochemistry and immunofluorescence confirmed detectable amounts of AurA in adult mice testes including the cytoplasm of dividing germ cells and sperm flagella. An ELISA demonstrated the presence of AurA within the epididymis with a peak of expression in the corpus. Further immunofluorescent studies on adult epididymal sperm of the caput, corpus, and cauda specifically pinpoint the localization of AurA to the principal piece.

**Conclusion:** The increased expression demonstrated by IP suggests AurA is found in spermatids as this cell type becomes more abundant in the seminiferous tubules during development. The principal piece of the sperm flagella is involved in motility and AurA's association with this structure suggests a role in this process. Taken together, our data suggest that AurA is present in pre- and post-mitotic germ cells of male mice, specifically cells and structures associated with sperm motility. Further studies will determine how AurA functions in these locations. This information will allow for novel approaches to solving infertility resulting from sperm malformation and immobility. Additionally, in depth understanding of spermatogenesis has the potential to lead to the development of non-hormonal male based contraception methods.

## **Geofencing: Mobile technology as a health promotion tool to raise awareness of a dental clinic in rural North Carolina**

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**Background:** Improving access to care relies on the ability of patients to find sites that provide affordable health services<sup>1</sup>. This can be difficult in areas where there are cultural differences concerning health care and low literacy rates. Geofencing, a technology that uses global positioning systems (GPS) to create a virtual barrier around a specific area, can be an innovative way to reach the masses to provide access to care<sup>2</sup>. The purpose of this study is to analyze the survey results on awareness, further analyses is being conducted on the geofencing data.

**Objective:** To use geofencing technology to raise awareness of the East Carolina University School of Dental Medicine Lumberton Community Service Learning Center (CSLC).

**Methods:** Questionnaires on awareness of the Lumberton CSLC were voluntarily completed by adults in Robeson County twice, pre- and post- a sixty-day intervention of geofencing technology.

**Results:** The survey conducted pre- intervention found that 65.5% of respondents were aware of the CSLC, this percentage increases to 71.45% post- intervention. The respondents or the family of the respondents who have had an appointment at the CSLC increased from 6.5% to 15.0%.

**Conclusion:** Geofencing has the potential to increase the awareness of health care services and ultimately increase the number of patients receiving care.

## **The effectiveness of opioids for analgesia in emergency department patients is dependent on the pathophysiology of the pain condition**

Ethan Lubanski BS; Austin Colquitt BS; Kori Brewer PhD, Department of Emergency Medicine, The Brody School of Medicine at East Carolina University, Greenville, NC

**Background:** Current research suggests that opioids are less effective at providing analgesia for neuropathic than for nociceptive pain. The distinction between nociceptive and neuropathic pain in the emergency department (ED), as well as analgesic management of both types of pain, has critical importance for proper patient care and the current opioid addiction crisis.

**Objective:** This objective of this study was to comparatively assess the effectiveness of opioids for analgesia of nociceptive and neuropathic pain inpatients presenting to the ED with a specific pain complaint.

**Methods:** Patients presenting to the ED with a chief complaint of non-traumatic pain were categorized as having neuropathic or nociceptive pain using established NIH PROMIS scales. The type and amount of analgesics used, as well as pain reduction achieved on a 10-point scale were recorded. Significant pain reduction was defined as a decrease  $\geq 4$  points. Chi-square analysis was used to determine associations between pain type and change in pain score during ED visit.

**Results:** 106 patients were enrolled with 33 categorized as having some type of neuropathic pain and 54 having nociceptive pain. Participants categorized as having neuropathic pain who received opioids in the ED were less likely to experience significant pain relief versus those with nociceptive pain ( $p=0.008$ ). There were no differences between the 2 groups in the dose of opioids given in the ED ( $p=0.08$ ). In neuropathic pain patients, there was no difference in pain relief achieved with opioids compared to non-opioid analgesics ( $p=0.81$ ).

**Conclusion:** Effective and accurate distinction of pain type between nociceptive and neuropathic pain is important in the ED, as pain type may impact on the effectiveness of commonly used analgesics, specifically opioids. Similar pain relief was achieved in neuropathic pain patients using non-opioid alternatives, suggesting that this is a population in which opioids can be avoided.

## **Management of glaucoma in patients with intellectual disability**

Mitchell Nash; David Fleischman, MD

**Purpose:** To investigate the indications, methods, and outcomes of medical and surgical glaucoma management in patients with intellectual disability (ID).

**Procedures:** A retrospective interventional case-series of all patients with intellectual disability with any diagnosis of glaucoma suspect, glaucoma or ocular hypertension seen at the UNC Kittner Eye Center from 2004 to 2017. The charts are reviewed for patients' functional characteristics, extent of glaucoma, interventions performed, and outcomes.

**Results:** Preliminary analysis yielded 99 patients matching the required parameters of the study. Of those patients, 52 (52.5%) were on topical glaucoma drops at the time of the last patient exam. Ten patients (10.1%) had glaucoma tubes placed, 1 (1.0%) had trabectome, 4 (4.0%) underwent cyclophotocoagulation, one (1.0%) underwent trabeculectomy with shunt, 1 had a history of goniotomy, and one (1.0%) patient selective laser trabeculoplasty. Five (5.1%) patients underwent lensectomies and 4 (4.0%) were enucleated. At minimum, 3 patients had worsened vision in at least one eye to the point of no light perception (NLP). All 3 of those patients' treatment plans only included drops.

**Conclusions:** Current results show that a majority (52.5%) of the patients with intellectual disability and a history of glaucoma, glaucoma suspect status, or ocular hypertension are currently being treated by topical glaucoma medications. Some patients required more invasive procedures to control their glaucoma, with tube surgery being the most common. Further analysis will compare the patients' functional characteristics to their treatment plan and treatment success, yielding valuable data regarding appropriate treatment options for this patient population. Success will be based off maintaining the patient's vision, intraocular pressure, and cup/disc ratio from before intervention to the patient's most recent exam.

## **Immunostimulatory pathways in melanoma: evaluation of DAMP induction by cannabinoids and prostaglandins**

Nina Neill, Rene Escobedo, Ariel Pinkham, Daniel Laden, Ahmed Elhassanny, Hussam Albassam, and Rukiyah Van Dross

**Background:** Melanoma is the most lethal form of skin cancer in the US. Cytotoxic chemotherapeutics have limited efficacy against melanoma. However, drugs that activate host immune responses (e.g. checkpoint inhibitors) increase melanoma survival rates. A recently discovered approach to initiate immunity against cancer is to activate the damage-associated molecular patterns (DAMPs) pathway. DAMPs that are typically increased in response to certain cancer chemotherapeutic agents include cell surface calreticulin expression (ecto-CRT), as well as the release of ATP and HMGB1. The interactions of these DAMP molecules with dendritic cell (DC) receptors causes DC maturation, tumor cell engulfment and cytotoxic T cell activation which leads to protective immunity. Only a few agents have the capacity to increase DAMP signaling. Therefore, the goal of this study is to identify new agents that are potent inducers of DAMP expression.

**Objectives:** The chemotherapeutic activity of bioactive lipids including the cannabinoids and prostaglandins is being investigated by numerous research groups. In this study, we examined the cytotoxicity of different cannabinoids and prostaglandins and determined whether ecto-CRT was increased in melanoma.

**Methods:** B16F10 melanoma cells were treated for 24 hours with different concentrations of cannabinoids [arachidonoyl ethanolamide (AEA), met-AEA, Win55,212-2, arvanil and CBD], prostaglandins (PGE<sub>2</sub>, PGJ<sub>2</sub> and PGA<sub>2</sub>), commercially utilized chemotherapeutics (doxorubicin, mitoxantrone, oxaliplatin and cisplatin) or drug vehicle. Cell viability was then determined by conducting MTS assays. To determine if the bioactive lipids increased the expression of ecto-CRT, cells were treated with each agent for different periods of time and CRT expression was detected by conducting flow cytometric analysis.

**Results:** Of the agents tested, only CBD (IC<sub>50</sub>= 9.74 μM), arvanil (IC<sub>50</sub>= 14.4 μM) and doxorubicin (IC<sub>50</sub> = 3 μM) were potent inducers of melanoma cell death. In addition, CBD and doxorubicin (positive control for DAMP induction) significantly increased ecto-CRT expression. In contrast, none of the prostaglandins increased ecto-CRT expression.

**Conclusions:** CBD is both cytotoxic and increases ecto-CRT suggesting that it may have utility as an immunotherapeutic for melanoma. Further investigation into CBD-mediated expression of other DAMP molecules and DAMP-mediated immune cell activation in cancerous tissue is needed.

## The Role of Statins in Pulmonary Fibrosis via the Inhibition of YAP Signaling

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Idiopathic Pulmonary Fibrosis (IPF) is an increasingly diagnosed and often fatal lung disease in which lung transplantation is the only curative treatment. Although its pathogenesis remains to be incompletely understood, it is thought that the principal effector cells are activated fibroblasts, also called “myofibroblast.” Studies have shown that transcriptional co-activators, YAP and TAZ, play an important role in the activation of fibroblast. High-Throughput screens from our lab and others have identified statins as inhibitors of YAP and TAZ. We therefore hypothesized that statin treatment could decrease YAP nuclear translocation and subsequent pro-fibrotic gene expression in cultured human fibroblasts and a mouse model of pulmonary fibrosis. We measured the expression of pro-fibrotic genes (COL-1,  $\alpha$ -SMA, CTGF, and Cyr61) by qPCR in fibroblasts treated with TGF- $\beta$  and Simvastatin. Additionally, YAP expression and phosphorylation status were measured by western blot. *In vivo* YAP expression in lung fibroblasts was then evaluated by a combination of immunohistochemistry (IHC) and microscopy. Our experiments found decreased levels of YAP protein expression in fibroblasts treated with statins compared to control fibroblast. Co-treatment with Simvastatin and TGF- $\beta$  was able to reduce COL-1 and  $\alpha$ -SMA expression. *In vivo*, fibrotic mice displayed YAP nuclear translocation and subsequent fibroblast activation. With a decrease in the expression of YAP and pro-fibrotic markers, our data indicates statins inhibit fibroblast activation by inhibition of YAP translocation to the nucleus. We are hopeful that further investigation into the YAP signaling pathway and its role in pulmonary fibrosis may eventually yield therapeutic options for patients suffering from IPF.



## **Healthier MATCH school environments are associated with better baseline measures, improved cardiovascular status for adolescents in obesity intervention**

Chloe E. Opper, BA, Suzanne Lazorick, MD, MPH, B. Kelsey Ross, MPH, Xiangming Fang, PhD, George T. Hardison, MS

Childhood obesity is a public health epidemic that requires prevention and intervention. The Motivating Adolescents with Technology to CHOOSE Health™ (MATCH) program in North Carolina middle schools is a school-level obesity intervention which promotes nutrition, fitness, and behavioral change. Studies show that social determinants and environmental factors are closely associated with obesity. School and community environment and its effects on weight and cardiovascular health have not been studied in MATCH. An environmental scan was developed as an objective measure to assess if the school environment affects baseline differences amongst participants and program outcomes for the 2016-17 school year. Determinants were selected through an inclusive literature review and expert consultation. Once selected, a 5-point scale was created and applied to rate determinants from very low (1) to very high (5) and then totaled for a final score (max. 50 points, higher score indicating healthier environment). The environmental scan score was assessed for association with baseline measures, change in BMI z-score and percent change in PACER laps completed from pre to post measure, and program fidelity. The environmental scan score was significantly associated with both baseline PACER and change in PACER, although the strength of the association was relatively weak. A higher environmental scan score was associated with higher baseline PACER ( $r = 0.25$ ) and lower PACER change ( $r = -0.14$ ). The association between environmental scan score and PACER change was different between gender groups ( $p=0.02$ ) and race groups ( $p<0.001$ ), with a flatter downward regression for females (vs. male) and black participants (vs. white). Unexpectedly, the environmental scan score was not significantly associated with BMI measures. Possible explanation for the lack of association may be key factors missing from the score or other factors that affect weight-related behaviors, including genetics, individual motivation, and family and peer influences. Additionally, the environmental scan score was not associated with fidelity, which suggests that implementation of MATCH is not limited by poor school environments. This study shows that adolescents, even in high-risk settings, can show improvement in cardiovascular status through the MATCH program. Developing a more comprehensive scale, including more school-level variables, is needed for further research.

## Antifungal Effect of Capric Acid Against *Candida Albicans* *in vitro*

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**Background:** Natural compounds are currently being studied as antimicrobial therapeutic agent. Medium-chain saturated fatty acids have been found to have a broad spectrum of microbicidal activity against enveloped viruses and various bacteria *in vitro*. They have shown a strong inhibitory effect against *C. albicans* yeast growth as well. Capric acid is a medium-chain fatty acid found in saturated fats. Small amounts are present in cow's milk and goat's milk, but it is abundant in tropical oils such as coconut oil and palm kernel oil. Capric acid, together with other medium-chain triglycerides, is responsible for the health benefits attributed to coconut oil. Capric acid should be effective as an antifungal agent. The objective of this study was to test the susceptibility of *C. albicans* to various concentrations of capric acid.

**Methods:** *C. albicans* strains (321182, 90028, MYA 274, and MYA 2876) were seeded onto Sabouraud Dextrose Agar for 24h. The minimum inhibitory concentration (MIC) was determined using an inoculum of  $1 \times 10^3$  to  $5 \times 10^3$  CFU/mL *C. albicans* grown in RPMI-1640. Serial dilutions of capric acid (1mM-100mM) with *C. albicans* strains were placed in 96-well plates and incubated for 24h. The minimum fungicidal concentration (MFC) was determined by subculturing 10 $\mu$ l of each well that had concentrations at or above MIC on Sabouraud Dextrose Agar for 24h. The MIC and MFC of capric acid was compared to the serial dilutions of fluconazole (10 $\mu$ M-1000 $\mu$ M) and vehicle control (1% ethanol).

**Results:** Susceptibility of capric acid against *C. albicans* showed antifungal activity. The MIC and MFC for each strain were as follows: **321128** (MIC:10-25mM, MFC:10mM); **90028** (MIC:50-100mM, MFC:100mM); **MYA 274** (MIC:25-100mM, MFC:25mM); **MYA 2876** (MIC:50-100mM, MFC:50mM).

**Conclusion:** This data suggests that capric acid may be a potential antifungal agent against *C. albicans*. Future testing of capric acid against *C. albicans* will include a time-kill assay, biofilm assay, cytotoxicity test with fibroblast, and a co-culture model test.

## **Self-Reported Relative Water Intake Increase as a Result of MATCH Obesity Intervention in Middle School Students**

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Obesity in childhood is associated with many chronic health problems. Water intake, specifically, replacing sugar-sweetened beverages with water, has the potential to reduce overall caloric intake, thus helping to decrease obesity. A number of methods have been employed in an attempt to increase water intake in children, and thus decrease the risk of being overweight, including implementing school curricular programs such as the MATCH (Motivating Adolescents with Technology to CHOOSE Health™) program in middle schools. The MATCH program provides water bottles to students and teaches lessons related to beverage and water consumption; however, the effect of this program on water consumption has not previously been studied. This study analyzes whether self-reported water intake changed significantly in the seventh grade students who participated in the MATCH program during the 2016-2017 school year. Water intake changes are also evaluated in relation to BMI z-score change, school, and the provision of drink-related lessons or activities as part of the program. 46 North Carolina middle schools participated in MATCH in the 2016-2017 school year, and 2,835 seventh grade students completed pre and post BMI and survey measures as part of the program. Change in reported water intake was assessed among these students using a validated questionnaire (Neuhouser, Beverage and Snack Questionnaire) to compare relative water intake pre and post program. Relative water intake was measured as annual water intake frequency compared to annual total beverage intake frequency. T-test and Wilcoxon rank sum test were used to assess for significant change. Results showed a significant overall increase in relative water intake among participants, by 2.2%, and significant increases in 5 individual schools (by 4.8% to 8.0%). Using standard estimated beverage servings, these increases amount to replacing approximately 3 to 18 sugar-sweetened beverages per week, or 475 to 2,720 calories, with water. Overall, this data suggests that school-based obesity interventions such as the MATCH program can contribute to healthy behavior changes such as increased water intake, thus decreasing the risk for obesity. Further research will investigate school-specific implementation techniques in order to better understand school variation and adapt program strategies to improve effects in subsequent years.

## **An Educational Program to Address Maternal Health Disparities and High Infant Mortality in Pitt County, NC**

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Infant mortality, defined as a baby's death before his or her first birthday, remains a significant area of concern in the United States. North Carolina infant mortality rates surpass national averages, while Pitt County exceeds the state average. Various factors have been shown to impact infant mortality, including prenatal care, breastfeeding, education, socioeconomic status, single motherhood, smoking, and race. Prenatal support and education can have an advantageous effect, particularly for vulnerable populations. This project seeks to demonstrate positive effects of prenatal support and education on anxiety, confidence, and lifestyle for mothers and partners in Pitt County, as analyzed through longitudinal prenatal education. A curriculum was developed to cover topics including pregnancy health, breastfeeding, infant care, and safety. Participants completed pre- and post-class surveys, including the Spielberger State-Trait Anxiety Inventory (STAI-6), Lifestyle Indicator Questionnaire (LIQ, Godwin), and skill confidence assessments. These items were scored according to published guidelines and statistical analyses (paired t-test, Wilcoxon signed-rank test) were performed. The data indicated an overall decrease in mean anxiety from pre- to post-class (pre-class score: 34.2 vs. post-class score: 28.1;  $p < 0.001$ ). The data also showed increased mean confidence scores in multiple areas: breastfeeding from 1.9 to 3.0, infant CPR from 1.8 to 3.6, and infant choking rescue from 1.9 to 3.7 ( $p < 0.001$ ). Corresponding infant CPR and rescue written assessment scores increased from a mean of 43.2 % to 100.0% ( $p < 0.001$ ). In qualitative data analysis, 9 individuals reported specific healthy lifestyle changes throughout the course series. This data suggests that prenatal support and education can affect mothers and partners by decreasing anxiety, increasing confidence, and contributing to beneficial lifestyle changes, which can greatly assist in decreasing infant mortality. Future research will further investigate longitudinal data with a larger sample size, to compare anxiety and lifestyle indicator scores in participants who attended one class with those who attended multiple classes. This will help to better understand program benefits and adapt strategies to improve effects on maternal and infant outcomes.

## **Prostate brachytherapy (BT) combined with external beam radiation therapy (EBRT) as a dose-escalation technique for intermediate- and high-risk prostate cancer is associated with an increased incidence of genitourinary toxicity $\geq$ 24 months post-treatment**

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**Background:** The use of prostate brachytherapy (BT) as a dose-escalation technique in conjunction with external beam radiation therapy (EBRT) is associated with improved biochemical progression-free survival (b-PFS). This technique is also associated with increased genitourinary (GU) and gastrointestinal (GI) toxicity.

**Objective:** This study compared b-PFS and post-treatment toxicity in patients receiving either EBRT-BT or EBRT alone. We hypothesized that patients in the EBRT-BT cohort would demonstrate improved b-PFS and an increased incidence of GU and GI toxicity.

**Methods:** The start date of radiation was taken as t-0 to determine acute (<6 months) and late (>6 months) events. Incidence of acute and late GU and GI toxicity was obtained along with the prevalence of late toxicity 12-23 months after treatment and  $\geq$  24 months after treatment. Mann-Whitney *U* tests were used to compare cohort differences.

**Results:** 55 patients met inclusion criteria for the EBRT-BT cohort with median follow-up of 7.5 months. 27 patients met inclusion for the EBRT cohort with median follow-up of 11.6 months. Log-rank comparison of the b-PFS rates between the EBRT cohort (n=22, 95.5%) and the EBRT-BT cohort (n=29, 93.5%) was not significant ( $p = .721$ ). Patients in the EBRT-BT cohort demonstrated a higher incidence of moderate (CTCAE v4 grade 2 or higher) GU toxicity at follow-up  $\geq$ 24 months after treatment compared to the EBRT group (40.0% vs 0%,  $p = .085$ ). In contrast, acute moderate GU toxicity was similar in both EBRT-BT and EBRT cohorts (57.7% vs 61.1%,  $p = .506$ ).

**Conclusion:** Comparison of toxicity incidence in our study approached significance in patients seen for follow-up  $\geq$ 24 months post-treatment. In contrast, the ASCENDE-RT trial reported significantly higher acute moderate GU toxicity in the EBRT-BT treatment group (Rodda Int J Radiation Oncol Biol Phys 2017). Furthermore, our study reports no significant difference in b-PFS between the two treatment cohorts. While other studies have shown improved b-PFS in patients receiving EBRT-BT, these distinctions were noted more than 4 years (Morris Int J Radiation Oncol Biol Phys 2017) and 5 years (Sathya J Clin Oncol 2005) after the end of treatment. Thus, longer follow-up is warranted for more reliable comparison.

## **Race and socioeconomic status impact quality of life after head and neck cancer radiotherapy**

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**Background:** Head and neck cancer (HNC) accounts for approximately 3% of all cancers diagnosed in the US and has been shown to disproportionately affect those who use tobacco, drink alcohol or are infected with the HPV virus. Race and socioeconomic factors have also been shown to impact incidence, and treatment outcomes in HNC patients.

**Hypothesis:** Radiation toxicities disproportionately impact HNC patients both in incidence and severity based on race and socioeconomic status as determined by insurance coverage.

**Methods:** Records of 138 patients receiving radiation therapy for HNC at Vidant Medical center from 2013 to 2017 were reviewed and data collected on patient demographics, HNC diagnosis and staging, treatment characteristics, and clinical outcomes. Study subjects were grouped by race (Caucasian vs. non-Caucasian) and insurance status (Medicaid and uninsured vs. all other insurers). Radiation toxicities were graded using the Common Terminology Criteria for Adverse Events (CTCAE) v.4.0. Chi square and Mann-Whitney U tests were used to identify differences in toxicities between populations. The impact of patient and treatment characteristics on overall survival was analyzed using log-rank test and multiple regression analysis.

**Results:** 91 patients from the initial cohort were eligible for analysis. The median follow-up time for these patients was 8 months and the median overall survival for this cohort has not been reached. Factors that significantly decreased overall survival included disability status at the time of treatment ( $p=0.014$ ) and pre-treatment dysphagia ( $p=0.006$ ). No significant difference was noted in overall survival based on race or insurance status. Of the radiation toxicities graded in treatment follow-up, neck fibrosis was shown to be more common in both non-Caucasian patients ( $p=0.028$ ) and patients that were uninsured or insured by Medicaid ( $p=0.014$ ). For patients diagnosed with radiation related fibrosis or dermatitis, a trend of increased severity of symptoms approached significance for those who were uninsured or insured by Medicaid ( $p=0.08$  for neck fibrosis and  $p=0.07$  for dermatitis). Based on univariate analysis neck fibrosis was more likely in subjects who smoked ( $p=0.0005$ ) or drank alcohol during treatment ( $p=0.026$ ). An increased likelihood to develop fibrosis was noted in subjects with higher stage at diagnosis ( $p=0.035$ ), treatment of recurrent cancer ( $p=0.042$ ) and treatment during middle age (45-65 years old) or younger ( $p=0.006$ ). A multiple regression was fit to predict development of neck fibrosis using variables deemed significant on univariate analysis. Variables that retained significance on multivariate analysis included tobacco use during treatment ( $p=0.0162$ ), alcohol use during treatment ( $p=0.0334$ ) and age ( $p=0.001$ ).

**Conclusions:** Race and socioeconomic status have an impact on the incidence and severity of certain toxicities for patients treated for HNC with radiotherapy including dermatitis and neck fibrosis. However, these factors do not appear to have an effect on overall survival. Care should be taken to identify patients at risk for increased severity of radiation related toxicities in order to increase patient quality of life.

## **Ground Level Falls in Patients Aged 65 and Older Treated in a Rural Level I Trauma Center: Implications For Targeting High-risk Individuals in a Falls Prevention Strategy**

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**Background:** Falls are the leading cause of doctor and ED visits, hospital and nursing home admissions, and accidental death in people 65 years and older. Previous studies have shown the efficacy of a structured interdisciplinary approach, including occupational therapy assessment, to reduce the occurrence of falls in the geriatric population.

**Objective:** This study aims to describe the current geriatric population seen for ground level falls and to identify potential targets for a future falls prevention strategy.

**Methods:** This retrospective chart review analyzed the demographic and clinical characteristics of 774 patients aged 65 and older that were seen and treated for ground level falls during 2015.

**Results:** Most of the patients in this study fell in their own homes (59.5%) and lived in Pitt county (32%) with the next most common counties being Beaufort and Lenoir (6.9% each). Most patients had previous comorbidities and on average were taking 6.5 medications prior to their fall. Patients were predominantly white (84.7%) and more frequently female (63.5%). 24.8% of patients seen had a history of previous falls within the previous 12 months. The most common risk factors for falls that were observed in this study were patients taking  $\geq 4$  medications (82.7%), patients with history of arthritis (36.5%), patients with history of stroke/CVA (23.7%), and patients with impaired cognition (14.1%). Of the medications shown to have the strongest links to an increased risk of falling, the most prevalent medications being taken prior to falling were selective serotonin-reuptake inhibitors (28.7%), benzodiazepines (28.2%), anticonvulsants (21.5%), antidepressants (19.5%), and neuroleptic agents (12.4%). Statistical significance of the results will be noted upon completion of analysis.

**Conclusions:** Current results show that a majority of the geriatric patients being treated for ground level falls are falling in their own homes. These results also suggest that a significant portion of these patients have predisposing factors known to increase risk of subsequent falls, including the use of 4 or more prescription medications. Further analysis will use these observed characteristics to implement a targeted fall prevention strategy. Success will be based on the reduction in overall occurrence of ground level falls and associated morbidity and mortality.

## Experiences of Rural Practices in Receiving Practice Facilitation to Improve Hypertension Control Rates

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**Background:** The Southeastern Collaboration to Improve Blood Pressure in the Black Belt: Addressing the Triple Threat uses practice facilitation to catalyze change for improving hypertension control rates among African Americans living in rural areas. The Black Belt is a rural and agricultural region that stretches from eastern Texas to Maryland, characterized by a higher proportion of individuals with rural residence, minority ethnicity, and low SES—a proverbial “triple threat”.

**Objective:** We hypothesize that greater intensity of implementation of activities in the 4 Key Driver domains will be associated with improved hypertension control rates. This secondary analysis of the Triple Threat study will examine the relationship between key quality improvement activities adopted by practices receiving the practice facilitation (PF) intervention and hypertension control rate.

**Methods:** The Triple Threat Study is a cluster-randomized, controlled, pragmatic implementation trial that will compare enhanced usual care with 3 distinct interventions—practice facilitation, peer support, and practice facilitation + peer support— to achieve BP control. It will use process data, such as intervention dose and the degree of intervention implementation (as measured through the Key Driver Implementation Scale) to assess practice facilitation intervention fidelity.

**Results:** The Triple Threat study is in the beginning stage of recruitment and intervention implementation. Currently 48 primary care practices are enrolled into the study. Seventy-five percent of practices in the sample identified as Family Medicine specialty, 45.7% (the largest group) identified as a community health center and the mean percent (SD±) of Medicaid patients in is 27.2 % (±15.3). Seventy-five percent of practices reported have implemented quality improvement efforts for chronic diseases in the past, with 29.8% of enrolled practices having already gained Patient Centered Medical Home status.

**Conclusions/Significance:** This study can provide insight on some of the facilitators and challenges that rural practices face when implementing quality improvement projects to improve HTN – related outcomes for vulnerable populations. Results of this study can help communities and practices decide which approach is right for them, informed by how much effort is required for each intervention, and how much benefit they can expect to derive from implementing practice facilitation and quality improvement activities.



## **ICU Decision Making: Experience, Belief in God's Influence on Health Matter**

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**Background:** It has been demonstrated that terminally ill patients and their families are often unprepared to make medical decisions. Often, intensive care unit (ICU) patients facing the end of their life must decide between continuing aggressive medical interventions or transitioning to palliative care. Although many factors play into this decision, religion and spirituality have been described as important in end-of-life decision making.

**Objective Hypothesis:** Our study attempted to discern whether specific aspects of religion, especially an increased belief in the God's control of health outcomes or the miraculous, correlate with decisions for end-of-life care.

**Methods:** Questionnaires were prepared in coordination with East Carolina University's Sociology Department based on literature verified surveys. Eligible ICU patients were identified by their treating teams and surveys provided to medical decision makers. Our control group consisted of medical decision makers in palliative care.

**Results:** Five surveys were returned: four surrogates and one patient. No difference in understanding of prognosis and treatment team goals was reported between groups choosing aggressive or palliative care. Surrogates choosing palliative care report previous experience making ICU decisions whereas aggressive care surrogates deny any prior experience. The aggressive group agreed with statements regarding God's control of patients' health outcome whereas the palliative group expressed uncertainty or disagreement with these statements. Palliative group patients report a lower church attendance rate versus the aggressive group. No difference noted between strength of the belief in the miraculous among the groups.

**Conclusion:** Our sample size limits the ability to make inferences from the data, however, trends among the groups were apparent. Individuals with previous experience making ICU medical decisions seem enabled to choose palliative care. Increasing church attendance and increasing belief in God's control over medical outcomes correlated with aggressive treatment choices perhaps indicating that a greater religious belief system correlates with choosing aggressive care. Interestingly, both groups reported a complete understanding of their prognosis which suggests these decisions may be more dependent on religious influence than the treating teams' input. Hopefully, further increases in the sample size clear up discrepancies in the data and allow for greater understanding of the end-of-life care decision-making process.

## **Examination of the Volume-Outcome Relationship and Regionalization of Cholecystectomy Patients in Eastern North Carolina**

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### **Background**

Many studies have shown superior post-operative outcomes at hospitals that experience greater patient volumes for a specific procedure. In an effort to foster improved patient outcomes, the volume-outcome model has been implemented as evidence in support of regionalization of patients requiring specific procedures to high-volume medical centers.

### **Objective**

The aim of our study is to examine the outcomes of patients undergoing cholecystectomy within the Vidant Health system of Eastern North Carolina in relation to hospital volumes, and to determine whether regionalization of patients to the higher-volume flagship hospital (VMC) is merited based on outcomes.

### **Methods**

Retrospective analysis of 728 cholecystectomy patients admitted to Vidant Medical System hospital between 01/01/2013 and 10/05/2016 was performed. Quality of outcomes was quantified by obtaining mean length of stay (LOS), discharge status, and charges observed. Examination of medical complexity was evaluated based on admit severity of illness and expected mortality.

### **Results**

VMC performed 61.7% of cholecystectomies for the cohort of patients evaluated. Patient populations originating at VMC had no significant difference in LOS, charges or the proportion that were discharged to home self-care when compared patients treated at Vidant satellite hospitals. However, the data trended towards worse outcomes for VMC-origin patients. Transfers to VMC, when compared to satellite hospitals, had significantly higher LOS and charges observed ( $p < 0.05$ ), and were discharged to home self-care less frequently ( $p > 0.05$ ). Patients admitted to VMC were more often classified as 'major' severity of illness than those at satellite hospitals, and had a greater expected mortality ( $p < 0.05$ ). Patients transferred to VMC were also more often classified as 'major' severity of illness than those at satellite hospitals, and had a greater expected mortality ( $p < 0.05$ ).

### **Conclusions**

Outcomes at VMC, in both the originating and transfer populations, were less favorable than those at Vidant satellite hospitals. This does not corroborate the volume-outcome relationship. However, the medical complexity of both groups of VMC patients was greater than that of patients at satellite hospitals. These data suggest that patients who are more acutely ill, or who present more complex cases are frequently transferred, and directly referred to VMC for treatment.

# Heat Index is the Main Factor Influencing Rates of Patient Presentation at ECU Football Games

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## Background

Mass gathering events are large gatherings of greater than 1000 people where access to patients is difficult and response by emergency medical services (EMS) may be delayed. Current literature suggests that multiple factors can influence patient presentation rates during these events. Local emergency physicians and EMS provide medical care at ECU football games with a stadium capacity of 51,082. ECU football games are typically staffed by six EMS units placed around the field's perimeter, one field-dedicated EMS unit and 2 Medical Treatment Areas staffed with four MD's. Cooling tents are used based on weather forecasts for the game.

## Objective/Hypothesis

This study aimed to quantify patient presentation rates and factors influencing patient presentation during ECU football games between 2008 and 2016.

## Methods

A retrospective review of EMS field records and 911 incident numbers originating from the stadium on the dates and times of home football games from 2008-2016 was conducted. JMP Version 13 (Cary, NC) was used to conduct a bivariate correlation analysis on the cumulative data set to determine relationships between external factors and patient presentation as well as ED transport rates per 10,000 attendees. Heat index, attendance, and kickoff times were the main factors evaluated.

## Results

Data from 47 home football games with attendance ranging from 33,048 to 51,082 were included. The heat index during the games ranged from 37.8 to 89.6 °F. Kickoff times ranged from 1200 to 2000 hours. Bivariate correlation analysis of heat index and patient presentation was calculated as 0.432 ( $p < .05$ ). This result suggests a positive correlation between heat index and patient presentation rates. The correlation between heat index and rates of ED transport was moderately positive at 0.316 ( $p < .05$ ). The bivariate analysis of attendance and kickoff times with patient presentation and ED transport rates showed little to no correlation with no statistical significance.

## Conclusion

Heat index values were shown to have a moderately strong correlation with rates of patient presentation at ECU football games. There was no correlation between attendance at the football games, kickoff times, and patient presentation rates.

## **Allograft Bone-Patellar Tendon-Bone (BPTB) Anterior Cruciate Ligament Reconstruction in Patients $\leq 30$ Years: Part I**

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**Background:** The controversy of allograft versus autograft bone-patellar tendon-bone anterior cruciate ligament (ACL) reconstruction is highly debated in the literature. While allografts offer decreased morbidity, shorter surgical times, and faster recovery, others suggest allograft failure rates are 3-4 time greater than autograft and result in worse functional outcomes, particularly in younger patients.

**Objective:** This study investigates differences in failure rates and functional outcomes between BPTB autograft and allograft ACL reconstruction in patients <30 years of age.

**Methods:** All 17 to 30 year-old patients who underwent a BPTB allograft or autograft ACLR by a single surgeon (KDP) were included. Exclusion criteria were follow-up <2 years, osteochondral drilling, revision ACLR and multi-ligamentous injuries. Allograft source was always five years younger than patient age and not terminally irradiated. All patients completed a conservative rehabilitation program with bracing and return to pivoting sports at no less than 6 months. An independent physical exam involving knee range of motion (ROM) and stability testing, including KT-1000, Lachman, and pivot shift, was performed. Patients completed Lysholm, International Knee Documentation Committee (IKDC), and Tegner questionnaires to assess clinical outcomes. Recurrent subjective knee instability or positive Lachman and/or pivot shift test characterized a failure. Significance for independent samples t-tests was set at  $p < 0.05$ .

**Results:** Thirty-five patients with BPTB autograft (27 males, 8 females;  $22.0 \pm 4.4$  years) and 13 patients with BPTB allograft (5 male, 8 female;  $23.8 \pm 3.9$  years) ACLR were included. Average follow-up was  $8.7 \pm 5.2$  years in autograft patients and  $6.7 \pm 3.7$  years in allograft patients ( $p = 0.155$ ). There were no significant differences between BPTB autograft and allograft in functional outcomes (IKDC:  $81.1 \pm 15.9$  vs.  $86.5 \pm 14.7$ ,  $p = 0.324$ ; Lysholm:  $88.6 \pm 13.2$  vs.  $92.3 \pm 9.0$ ,  $p = 0.380$ ) or KT-1000 at manual maximum ( $p = 0.740$ ). All patients returned to preoperative sport at Tegner score of  $\geq 5$ . There were no failures in the allograft group and 1 in the autograft group (2.9%).

**Conclusion:** Allograft BPTB ACLR is an excellent option to return young patients  $\leq 30$  years of age to pre-operative sports with no evidence of increased failure rates. We believe that graft selection with allograft source following the guidelines listed and a conservative rehabilitation program are keys to a successful outcome.

## **Antimicrobial Activity of Honokiol Against the Periodontal Pathogen *Aggregatibacter Actinomycetemcomitans*: An *In Vitro* Study**

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**Background:** *Aggregatibacter actinomycetemcomitans* is a putative periodontal pathogen associated with aggressive periodontitis (AP). Although scaling and root planing are the foundations of periodontal therapy, adjunctive antimicrobial chemotherapy can improve treatment outcomes in individuals with AP. Honokiol (HNK), a biphenol from *Magnolia officinalis*, has previously shown antibacterial properties to treat patients with various infections; therefore, it may represent a novel, adjunctive therapy for AP.

**Objective:** The purpose of this study is to evaluate whether HNK has antimicrobial effects against *A. actinomycetemcomitans* and any cytotoxicity effects on host cells. This study is based on the hypothesis that HNK has antibacterial activity against *A. actinomycetemcomitans* as demonstrated by a minimal inhibitory concentration (MIC) and low host cell toxicity as demonstrated by fibroblast cell integrity.

**Materials and Methods:** Human gingival fibroblast cells (HGF-1) and *A. actinomycetemcomitans* (D7S-1) were used for this *in vitro* investigation. The MIC of HNK was determined by plating  $1 \times 10^6$  cfu/mL of *A. actinomycetemcomitans* in 96-well plates and cultured with 0 (negative control), 100, 500 and 1000  $\mu\text{g/mL}$  of HNK for 24 and 48 hours. A spectrophotometer at 625 nm evaluated bacterial culture growth. HNK toxicity on fibroblast cells was tested by plating  $5 \times 10^5$  cfu/mL cells on a 96-well plate and adding HNK concentrations of 0, 10, 25, 50 and 100  $\mu\text{g/mL}$ . At 24 and 48 hours, fibroblasts were enumerated using Cell Titer Blue Viability Assay according to manufacturer instructions. Three experiments were performed in triplicate ( $n=9$ ), and the data was analyzed using ANOVA and pairwise t-tests. The significance level was set at  $p \leq 0.05$ .

**Results:** The significant antibacterial activity of HNK against *A. actinomycetemcomitans* was detected at the highest concentration (1000  $\mu\text{g/mL}$ ,  $p < 0.05$ ) as compared to the negative control, but not for any of the lower concentrations (100 or 500  $\mu\text{g/mL}$ ). The cytotoxicity results indicated that cell viability of HGF-1 cell line was preserved between 10 to 25  $\mu\text{g/mL}$  of HNK; however, higher HNK concentrations (50 and 100  $\mu\text{g/mL}$ ) resulted in cell death.

**Conclusion:** HNK demonstrated *in vitro* antibacterial activity against *A. actinomycetemcomitans* at a MIC of 1000  $\mu\text{g/mL}$ , a concentration not compatible with host fibroblast survival.