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Project title: **KIDS (Kinematics of Impact Data Set) Study**

Principal* and co-investigators: Joel D. Stitzel, PhD*, Biomedical Engineering, WFUHS
Joseph Maldjian, MD, Radiologic Sciences, WFUHS
Chris Whitlow, MD PhD, Radiologic Sciences, WFUHS
Alex Powers, MD, Neurosurgery, WFUHS
Daryl Rosenbaum, MD, Sports Medicine, WFUHS
Dwayne Godwin, PhD, Neurobiology & Anatomy, WFUHS
Dr. Stefan Duma, PhD, VT-WFU School of Biomedical Engineering and Sciences
Dr. Steve Rowson, PhD, VT-WFU School of Biomedical Engineering and Sciences

Project classification: PREVENTION, ACUTE CARE, REHABILITATION

Project status: in progress

Project summary: The objective of the study is to collect information about the number and type of helmeted impacts that youth and high school football players are exposed to over the course of a season of practice and games. Three age levels are included, including two youth and one adolescent age group team(s): Jr Pee Wee, Pee Wee, and High School. We are performing neuroimaging studies including magnetic resonance imaging and magnetoencephalography both at the beginning and end of season and in case of a concussion. We are performing computer modeling of the brain, modeling each impact over the course of a season using a model of the brain that deforms like a real brain. These deformations will be correlated with imaging findings and neurocognitive testing and injury (concussion) results to better understand impacts and injuries in youth football. This will inform prevention, mitigation, and treatment of injuries in the future.

Award period: 6/30/2012-7/1/2013; project extended through 7/1/2015.

Award amount: $200,000 (Project period 1); $150,000 (Project period 2).
Project title: **Violence Intervention Screening and Initial Treatment, ‘VISIT’**

**Principal investigators:** Laura Veach, PhD, Regina Moro, PhD Candidate, LPCA, Preston Miller, MD

**Project classification:** PREVENTION, ACUTE CARE, REHABILITATION

**Project status:** in progress

**Project summary:** Each day in the US, 16 young people are murdered, homicide ranks as the second leading cause of death for our youth, and nearly half of deaths from trauma among youth are attributed to violence. Further, violence-related injuries result in approximately 1,800 youths per day receiving medical care in our nation’s hospitals. Healthcare systems are challenged to address this public health crisis and the current research study serves an urgent community need to provide violence intervention services to young people ages 15 to 20 in our Wake Forest Baptist Medical Level I Trauma Center. Utilizing a model of specialized counseling intervention services that has shown effectiveness in lowering risky drinking and reducing subsequent alcohol-related injuries, we developed a screening and brief intervention model for violence intervention with hospitalized trauma patients aged 15-20. In addition, this research will assist our collaboration with Carolinas Medical Trauma Center in Charlotte, NC as we conduct multi-site violence intervention studies to optimize care of young, violently-injured trauma patients.

**Award period:** 9/1/2012-8/31/2013; project extended through 6/30/2014.

**Award amount:** $5,600
**Project title:** Improvement in Field Triage in Children through Refinements in Injury Scoring and Utilization of Advanced Automatic Crash Notifications

**Principal Investigator:** Andrea Doud, MD*

**Project classification:** ACUTE CARE, INFRASTRUCTURE BUILDING

**Project status:** in progress

**Project summary:** Unintentional injury in children is the leading cause pediatric mortality in the United States. Early treatment for severely injured children at a Level One or Two Trauma Center can drastically reduce mortality and improve outcomes while treatment of minor injuries at such large centers leads to higher costs and inappropriate use of resources. Currently, injury severity is most commonly calculated using the Abbreviated Injury Severity Score. Using this score in field triage, however, leads to significant rates of under-triage and over-triage. The VT-WFU Center for Injury Biomechanics has recently constructed a new list of injuries for adults that are severe enough to require immediate transport to a Level One or Level Two trauma center as well as a new algorithm to dictate this decision based on crash characteristics obtained from Event Data Recorders in the vehicles. However, children, given their variety of developmental stages are at risk for different injuries. My aim, along with the VT-WFU Center for Injury Biomechanics will be to better classify the different developmental stages in children that put them at risk for various injuries. Then, the most common injuries in each age group will be scored based on severity, time sensitivity and predictability. Using these factors, Target Injury Lists will be constructed for the varying developmental stages of children. These lists will include the injuries in different pediatric age groups that require immediate treatment at a Level One or Two Trauma Center. This work will eventually be used to construct algorithms based on crash criteria to alert EMS immediately as to whether or not a child will require transport to a Level One or Two Trauma Center. The ultimate aim of this work is to improve outcomes in pediatric trauma patients through better classification of injuries requiring care at designated trauma centers and improved methods to predict which children have sustained those injuries during field triage.

**Award period:** 9/1/2013-8/31/2015

**Award amount:** $16,000 per year for 2 years

*Childress Scholar
Project title: Development of the Pediatric Trauma Assessment and Management Database

Principal Investigator: Frederick P. Rivara, MD, MPH

Project classification: ACUTE CARE, INFRASTRUCTURE BUILDING

Project status: in progress

Project summary: The goal of this project is to contribute to the reduction in morbidity and mortality from pediatric trauma by the further development of a unique database, the Pediatric Trauma Assessment and Management (PTAM) database and to test its utility by examining a number of important questions in the care of critically injured children. This in turn, will lead to the development of appropriate quality of care indicators for pediatric trauma.

In this day of fiscal constraints, the ability to fund a replacement for the National Pediatric Trauma Registry is very limited. Instead, we have linked two existing databases from pediatric trauma centers – the data submitted to the National Trauma Data Bank and data from the Virtual Pediatric ICU system (VPS). This proposal will expand this linkage and collect additional data variables on pediatric trauma patients admitted to five pediatric trauma centers in calendar year 2013. This linked data will be verified and then analyzed by the coordinating center to examine important questions in the care of injured children.

The proposed work is necessary for the future expansion of the PTAM to ~20-30 of the pediatric trauma centers in the VPS system and will serve as the preliminary data for federal grant applications to fund the expansion and to address critical questions in pediatric trauma care.

Award period: 1/1/2014-12/31/2014

Award amount: $75,000
Project title: ATV Injury in Children and Youth: A Review of the Literature

Principal Investigator: Michael D. Smith, Psy.D

Project classification: PREVENTION, EDUCATION

Project status: in progress

Project summary: Approximately 30,000 children and teens enter emergency departments each year due to injuries suffered riding all-terrain vehicles (ATVs); one in ten young people riding an ATV will be injured as a result. Neurological trauma, fractures, and even death are all too frequent outcomes from ATV use among young people. Factors associated with high risk ridership have been identified. These include use of inappropriately sized/powered vehicles, lack of safe riding instruction, deficient supervision, and lack of protective gear. Parents often ignore guidelines about minimum age and size requirements for children. Alcohol use while riding ATVs seems to be a growing problem among teens.

Despite outlining the co-factors of youth ATV-related injuries, relatively little research has examined prevention efforts. Thus, the current proposal will set the stage for a significant intervention study designed to reduce ATV injury in children and teens by conducting a thorough review of the research literature in this area. Such a review will provide much needed context and will examine all existing studies evaluating prevention of ATV injuries in children and adolescents. With this analysis in hand, extramural funding could be secured and promising high impact intervention models (e.g. peer-to-peer safe ridership programs) identified so as to conduct meaningful prevention research. Our goal is to publish this review in a major public health journal and then apply for grant funding to conduct the intervention program within the next two years.

Award period: 3/1/2014-12/31/2014

Award amount: $15,000
COMPLETED PROJECTS

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Project title: Improved Understanding of Pediatric Injury Utilizing the CIREN Database

Principal investigator: Joel Stitzel, PhD

Project classification: PREVENTION

Project status: completed; Final Report attached as Appendix I

Project summary: The Crash Injury Research and Engineering Network (CIREN) database, sponsored by the National Highway Traffic Safety Administration (NHTSA) contains the most detailed information about pre-crash, crash, injury, treatment, and subsequent outcome for the same cases available in the world. It is very important to be able to compare real-life with laboratory crash conditions to understand injury, evaluate protection and to inform regulatory and/or consumer safety oversight organizations. However, the lack of standardized techniques to compare a real-world with test crash data makes this analysis difficult. To address this problem, the WFU CIREN center has developed an analysis method for comparing adult crash injuries and this project seeks to develop and refine the methodology to evaluate pediatric crash data and injury. The CIREN database will be queried for all pediatric cases (Age 17 or less) and those cases will be rank ordered based on similarity in each of these categories. Comparative analyses can provide insight into the specific strengths and weaknesses of regulatory and consumer group crash tests as well as current crash test dummy strengths and weaknesses.

The resulting deliverable will be a report, publication, and recommendation on the most important areas of research in pediatric trauma injury prevention and mitigation in motor vehicle crashes. The research will provide quantitative comparative pediatric injury data and inform future development in injury prevention.

Award period: 2009-2010.

Award amount: $30,000
Project title: Development and Testing of PED-ER™

Principal investigators: Andre A. Muelenaer, Jr., MD and Alfred Wicks, PhD

Project classification: ACUTE CARE

Project status: completed; Final Report attached as Appendix II

Project summary: For emergency personnel who must deal quickly, efficiently, and accurately with infants and children of various weights and lengths, this project will develop and test PED-ER™. Current pediatric resuscitation protocols are limited to paper and/or very restrictive electronic content displayed on hand-held devices, laptop computers, or desktop monitors. In contrast, PED-ER™ provides treatment algorithms, medication doses, and appropriate sizes of resuscitation equipment on a 46” LCD monitor that allows the entire treatment team complete access to information and automatically displays/logs treatment activities during resuscitation. This project supports the development of a prototype PED-ER™ to be tested at three Pediatric Medical Devices Institute (PMDI) Consortium hospital simulation laboratories. Validation of content, testing of systems, and study of human factors/ergonomics will be assessed and modifications will be made to the prototype system. Further guidance will be solicited from the Childress Institute for Pediatric Trauma (CIPT). We will seek FDA approval to test, produce and deploy the PED-ER™. The Department of Public Health Sciences at Wake Forest University School of Medicine and the Committee on Trauma of the American College of Surgeons will participate in an outcomes evaluation. Ownership of intellectual property arising out of the development of enhancements, if any, will be established in accordance with U.S. patent law and managed under an inter-institutional agreement to be executed upon such development.


Award amount: $63,000
Project title: **Promoting Positive Outcomes for Youth who Have Experienced Trauma**

Principal investigator: Elizabeth Arnold, PhD

Project classification: PREVENTION, REHABILITATION

Project status: completed; Final Report attached as *Appendix III*

Project summary: Each year many youth experience traumatic life events that can have a long-standing and a detrimental impact on their mental health. Few youth receive the necessary treatment that they need to process the trauma, recover from it, and move on with their lives. When such events occur within the family, the trauma can impact the youth and his/her family. Intervention is most effective when treatment is received close to the time of the traumatic event and research suggests that early screening and coordinated efforts to provide intervention to injured youth and their families may positively affect outcomes. However, many youth who experience family violence are discharged directly from the emergency department back to their home. Without identification and treatment, these youth fail to receive treatment and return home to families who may be the source of trauma and/or cannot provide the needed support.

Despite the seriousness of this problem, there are virtually no family-focused interventions for adolescent trauma. This project will adapt an intervention for adolescents and families developed at the UCLA Center for Community Health by Dr. Norweeta Milburn called STRIVE (Support To Reunite, Involve and Value Each Other). In consultation with Dr. Milburn, we will test the applicability and feasibility of the STRIVE intervention with youth exposed to trauma in this region. We hope to demonstrate that this intervention program will reduce youth trauma, improve familial relationships and provide long term mental recovery.

**Award period:** 6/30/2009-12/31/2010.

**Award amount:** $55,000
**Project title:** **HITS (Head Impact Telemetry System) in Wake Forest University Football Players**

**Principal investigators:** Joel Stitzel, PhD and Daryl Rosenbaum, MD

**Project classification:** PREVENTION, ACUTE CARE, REHABILITATION

**Project status:** complete; Final Report attached as Appendix IV

**Project summary:** Concussions are a difficult problem in sports today. Recent studies of impacts in football players have provided improved understanding of exposure-normalized risk in collegiate football players. However, there is a general lack of understanding of the relationship between mechanical insult (impact, measured through acceleration), biomechanics of brain deformation, clinical imaging of the brain, and subsequent clinical outcome.

Over the last several years, several universities including Virginia Tech, University of North Carolina, Oklahoma, Dartmouth, Brown, and two high schools have implemented the Head Impact Telemetry System (HITS) in their football players’ helmets. This proposal is to purchase, install, and support the HITS system in the Wake Forest University football program for the 2010 season. This equipment will provide WFU researchers and the CIPT with the acceleration information for football players in practices and in games. Using this seed equipment, a research program will be built up around pre- and post- injury baseline cognitive assessment, biomechanics, neuroimaging, and functional outcome. The study will be one of the first of its kind relating mechanical deformation through the use of mechanical models of the brain to imaging and outcomes studies. There is an NIH group of HITS researchers collecting data which is used for concussion research and WFU can join this group and participate in its meetings. The results will improve our understanding of the biomechanical basis of mild Traumatic Brain Injury, the assessment of low-grade brain injury through cognitive assessment and imaging modalities of MRI and MEG, and the relationship between functionally relevant parts of the brain, mechanical deformation, and findings in imaging studies.

Implementation of this system and associated preliminary studies will provide the knowledge, experience and infrastructure for placing HITS in Forsyth County high schools. High school players, parents, coaches, athletic directors, and high school administrative staff, as well as CIPT research network collaborators can observe HITS at WFU to facilitate an informed decision to begin a parallel research program at the high school level.

**Award period:** 2010-2011.

**Award amount:** $28,195
**Project title:** Correlating Changes over Time on MRI Scans with Neuropsychological Findings for Traumatic Brain Injury: A Functional Imaging Study

**Principal investigator:** Alexander K. Powers, MD

**Project classification:** ACUTE CARE

**Project status:** complete; Final Report attached as Appendix V

**Project summary:** The neurological mechanisms underlying response to treatment of traumatic brain injury (TBI) must be identified to provide the basis for theoretically motivated treatment programs. At present, these mechanisms are poorly understood. The scientific challenge is increased by the heterogeneity across TBI patients with respect to their cognitive-linguistic impairments and with respect to their profile of neurological injury. Injury and impairment is particularly difficult to predict in the adolescent population, where the incidence of TBI is high. The proposed project will entail (1) functional imaging (functional Magnetic Resonance Imaging, fMRI) and (2) structural imaging of selected TBI patients, with an emphasis on young adults (ages 12-25). In this study, 50 subjects with mild to moderate TBI and 50 normal healthy subjects will undergo MRI scanning and neuropsychological evaluation. This research will provide preliminary data to demonstrate the feasibility and promise of a large-scale project based on individual subject analyses to examine the anatomic and functional correlates of traumatic injury to the brain.

**Award period:** 2010-2012

**Award amount:** $45,653
Project title: **Pediatric Pre-hospital Trauma Care Educational Initiative: Phases 1 & 2**

Principal investigator: Roy L. Alson, MD, PhD

Project classification: ACUTE CARE

Project status: complete; Final Report attached as *Appendix VI*

Project summary: In response to a need identified by the EMSC (EMS for Children) Program, International Trauma Life Support (ITLS) developed a course to specifically train EMS personnel in the care of the injured child. The North Carolina Chapter of ITLS is one of the oldest and most active chapters in ITLS both in the main and pediatric courses. At the current time, ITLS is the only pediatric specific EMS focused trauma course available. There is little doubt that EMS personnel want this type of training and many have recognized the need. A limiting factor for the dissemination of the information has been the number of available instructors, coupled with drop in funding of EMS agencies. As a result, EMS services tend to choose more general types of training when confronted with budgetary restrictions.

The WFUBMC has long served as a training center for the pediatric EMS program and our staff serves as authors and editors for both courses. This project seeks to partner WFUBMC with the CIPT to take a lead role in providing EMS personnel with specific training to provide the best possible field care to the pediatric trauma patient. To achieve this objective we propose a multifaceted approach on the part of CIPT, to address this issue. Specific support is requested for phase I of this project to provide training materials for ITLS pediatric instructors and providers. We anticipate that we will be able to train 850 providers and 80 instructors across our state and put in place a sustainable training program that incorporates nationally accepted guidelines for the pre-hospital care of the pediatric trauma patient.

*Award period: 1/1/2011-12/31/2012*

*Award amount: $91,370*
**Project title:** Prevalence of Protein and Vitamin D Malnutrition in Pediatric Orthopaedic Trauma Patients

**Principal investigators:** Bettina Gyr, MD, Patrick Whitlock, MD, PhD, Peter Apel, MD, PhD

**Project classification:** ACUTE CARE, PREVENTION

**Project status:** completed, Final Report attached as *Appendix VII*

**Project summary:** Protein and vitamin malnutrition are well known to negatively affect fracture healing. Over the last 20 years, there has been a well-documented increase in childhood obesity and a decrease in physical activity levels. In adults undergoing orthopedic surgery for trauma, over 60% had insufficient or deficient vitamin D levels. The prevalence of protein malnutrition in adult and pediatric trauma patients is unknown. In our practice, we have observed an alarmingly high incidence of malnourished pediatric trauma patients with subsequent morbidity from delayed union and nonunion of long bone fractures.

This study seeks to establish the prevalence of protein and vitamin D deficiency in the pediatric trauma population. Malnutrition is a potentially modifiable risk factor for poor outcomes following trauma. Thus, establishing the incidence of malnutrition in the pediatric trauma population and instituting a protocol to screen and treat malnutrition is likely to improve outcomes in the pediatric trauma population.

**Award period:** 4/1/2011-3/31/2013.

**Award amount:** $9,747.88
Project title: **Using Impedance Cardiography to study Hemodynamic Changes in Pediatric Trauma Patients**

Principal investigators: Alison Gardner, MD*, John Petty, MD, Chadwick Miller, MD, MS, James Hoekstra, MD

Project classification: ACUTE CARE

Project status: completed, Final Report attached as *Appendix VIII*

Project summary: There exist a large percentage of pediatric trauma victims who are in shock, defined as a state of poor perfusion, with no identifiable source of significant blood loss. Hypotension, a marker of poor perfusion, in the pediatric trauma patient is traditionally treated using the adult based algorithm of aggressive volume resuscitation. However, in the majority of pediatric patients blood loss is not a source of their hypotension or shock. The need exists to determine the cause of poor perfusion in the non-hemorrhaging pediatric trauma patient. Impedance cardiography (IC) is a promising non-invasive method to study hemodynamic changes in the pediatric trauma patient. Using IC involves the applications of four sticky electrode pads to the skin of the patient’s chest and neck. It can provide information about cardiac output, vascular tone, and other cardiovascular parameters without being invasive, time consuming, or requiring specialized training to apply. With more information obtained via IC regarding the hemodynamic changes in pediatric trauma patients we can shift the paradigm of trauma treatment to become pediatric specific, with the future design of therapeutic interventions beyond fluid resuscitation.

Award period: 7/1/2012-6/30/2013.

Award amount: $21,000 per year for 2 years.

*Childress Scholar
SUPPLEMENTAL MATERIAL

APPENDIX I: Report on Pediatric Research with the Wake Forest University-Virginia Tech CIREN center

APPENDIX II: Final Report on Development and Testing of PED-ERTM

APPENDIX III: Summary Report: Promoting Positive Outcomes for Youth who Have Experienced Trauma

APPENDIX IV: Final Report on HITS in Wake Forest University Football Players

APPENDIX V: Final Report on Neuropsychological and Functional Imaging Studies in TBI

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APPENDIX I

Report on Pediatric Research with the Wake Forest University-Virginia Tech CIREN center
This report summarizes the pediatric research that has been completed by the Wake Forest University – Virginia Tech Crash Injury Research and Engineering Network (WFU-VT CIREN) during the bridge funding period. The WFU-VT CIREN center was successful in securing funding by the National Highway Traffic Safety Administration (NHTSA) in June 2010 for another 5 years. This successful proposal was greatly aided by the support of the Childress Institute funds during the bridge period for WFU-VT CIREN from October 2009 through May 2010. This funding also provided the WFU-VT CIREN center with the resources to study pediatric occupants and injuries in motor vehicle crashes. Multiple projects have been conducted with this funding, and a summary on each one is provided below. Final work on these projects is being completed, and then they will be submitted to conferences and journals for publication. A CIREN pediatric presentation has also been created, and this has been used in public outreach and for future project proposals within the CIREN system. This presentation is included in the Appendix.

**CIREN Overview**

CIREN is a group of 6 centers across the United States that investigate real-world crashes. The WFU-VT CIREN Center has been enrolling cases since January of 2006, and has now enrolled over 200 cases. For consideration as a CIREN case, the vehicle model year must be within six years of the current year and the occupant must have either an AIS 3 injury or two or more AIS 2 injuries in different body regions with clinical significance. No ejected occupants are enrolled in CIREN. There are injury severity, crash configuration, and model year exceptions for pediatric and pregnant occupant cases. Cases with greater than six quarter turns, significant rear impacts, or complicated crash scenarios are excluded from CIREN. These CIREN case inclusion criteria were designed to ensure clean crashes and a database with very detailed information about occupant injuries and outcome for the study of real-world crashes. This data is then uploaded to the national database to be used for studying vehicle safety and occupant injuries in detail.
CIREN Pediatric Injury Study
All CIREN cases were queried in the database to investigate pediatric injuries in motor vehicle crashes (data extracts June 2009). There were over 600 pediatric cases in the database (Figure 1), with most of those occurring in passenger vehicles (Figure 2).

The DeltaV ranges for these crashes showed that most crashes occurred between 10-30 mph (Figure 3).
Pediatric ISS scores calculated from AIS scores can be seen in Figure 4.

Each injury type was split to analyze the highest AIS severity for each body region per occupant. Results showed that the most frequently injured body region was the face, but the most seriously injured body region (AIS 2+) was the head, followed by the lower extremity and pelvis. A table of these values can be seen in Table 1.
Table 1. CIREN Pediatric Injury Counts and highest AIS for each occupant in each body region

<table>
<thead>
<tr>
<th>Injured Body Region</th>
<th>Total # Injuries</th>
<th>AIS 1</th>
<th>AIS 2</th>
<th>AIS 3</th>
<th>AIS 4</th>
<th>AIS 5</th>
<th>AIS 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>805</td>
<td>46</td>
<td>95</td>
<td>54</td>
<td>73</td>
<td>55</td>
<td>5</td>
</tr>
<tr>
<td>Face</td>
<td>824</td>
<td>280</td>
<td>61</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Neck</td>
<td>85</td>
<td>67</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Chest</td>
<td>378</td>
<td>73</td>
<td>6</td>
<td>71</td>
<td>60</td>
<td>13</td>
<td>2</td>
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<tr>
<td>Abdomen</td>
<td>558</td>
<td>96</td>
<td>64</td>
<td>57</td>
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<tr>
<td>Upp Ext</td>
<td>484</td>
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<td>37</td>
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<tr>
<td>Low Ext &amp; Pelv</td>
<td>718</td>
<td>118</td>
<td>56</td>
<td>117</td>
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</tbody>
</table>

Plots were also generated for comparing this data, as shown in Figure 5, where A shows the percent of injuries in each body region and B shows the percent of the highest AIS severity per body region for occupants.

**Figure 5.** CIREN pediatric occupant A) injured body regions B) AIS severities

By characterizing the most frequent injuries, it will be possible to investigate the cause of the most frequent injuries, which may lead to future vehicle safety advancements for pediatric occupants in the future.
**CIREN Pediatric Restraint Study**

In conjunction with the CIREN pediatric injury data, the WFU CIREN team felt it was important to investigate child safety seat and position recommendations from NHTSA. Two simple suggestions from NHTSA are:

1) Children under 13 years of age should not be seated in the front row of a vehicle.
2) Children under 4’9” tall should have some form of a child safety seat to ensure proper belt placement.

Results showed that 104 pediatric CIREN case occupants under the age of 13 were seated in the front row of the vehicle at the time of the crash. While there were 133 pediatric occupants under 4’9” tall seated in some form of a CSS, there were also 227 that were NOT seated in a CSS. A diagram of the CIREN pediatric occupant seating positions and average ages is shown in Figure 6.

![Figure 6. CIREN pediatric occupant seating positions](image)

This data showed that pediatric proper restraint is still a problem in the US. Future enhancements to child safety seats may improve their ease-of-use and increase use in the future. More educational programs and outreach for parents at hospitals and schools may also be beneficial to increasing proper seating position and restraint for pediatric occupants, which should reduce injuries and injury severity for these vulnerable occupants in motor vehicle crashes.
NASS Pediatric Injury Study
The National Automotive Sampling System – Crashworthiness Data System (NASS-CDS) contains motor vehicle crashes from across the United States, and each case is assigned a weight to result in a population sample. Using this data, it is possible to investigate the number of pediatric cases that occur in the United States broken down by occupant age and injury severity. This investigation used NASS-CDS from 2000-2008, which resulted in 13633921 weighted pediatric injuries and 8423645 that were uninjured. As shown in Figure 7, 62% of these occupants were 18 years old or younger.

When NASS pediatric occupant injuries were investigated by AIS severity, ~7% were AIS 2+ injuries. Using all NASS injuries, approximately 56% were AIS 1 severity, and this same trend was seen for pediatric injuries, with 55% being AIS 1 severity. Figure 8 shows each AIS injury severity and percentage for NASS-CDS injured pediatric occupants (<22 yr old).
This NASS-CDS pediatric data will be used in conjunction with the CIREN pediatric data to investigate injury trends for the US population. CIREN can then be investigated in more detail regarding specific injuries or occupant scenarios.
CIREN Pediatric Outcome Study
The WFU-VT CIREN center has been working with Dr. Michelle Bryan to gather crash, injury, and outcome data from the entire CIREN database. This data is being analyzed to investigate whether children with close family injured in the crash have lower scores on Pediatric Quality of Life (Peds QL) outcomes after a crash. One hypothesis is that children who are injured in crashes with their support family also injured may have lower outcome scores than children who are injured and do not have a family member involved in the crash. There is also a hypothesis that children who have been injured and have recoverable injuries have improved scores after the crash due to an increase in attention and help. This study is ongoing, and is one of the first to analyze Peds QL outcome data from the CIREN database.
APPENDIX II

Final Report on Development and Testing of PED-ER™
CIPT Summary Report- PED-ER Project

Project Overview- The original project goals and objectives were to:
1. Fabricate 3 PED-ER units and deploy to three simulation labs.
2. Enhance the simple electronic conversion from the Broselow Tape to large screen format to include features suggested by end users.
3. Evaluate PED-ER in the simulation environment, and prepare for clinical evaluation in rural emergency departments.

Major accomplishments during this project were:
1. Bar coding of medications to be administered and identification/verification through the FDA National Drug Code Directory that is imported and resident in the PED-ER computer.
2. Time stamping of medications administered.
3. Display of elapsed time since administration of each medication.
4. Alerts for time sensitive medications requiring repeat dosing at specific time intervals.
5. Video recording on same time stamp as medication administration.
6. Resuscitation algorithms and mapping of decision logic in real time.
7. Percent body surface area burned calculator and integrated fluid resuscitation and pain management calculator.
8. Interactive protocol/calculator for diabetic ketoacidosis.
9. Wireless, hand-held, touch screen module for control and data entry of graphics presented on the large-forma LCD display.

One project shortfall was inability to successfully complete an outcomes study in the simulation environment. Two factors influenced this. First, at the start of this project, Stacy Steans, MD, Carilion Clinic Children’s Hospital Critical Care, had agreed to spearhead this aspect of the project. Several months into the project, as the hardware/software configuration was ready for deployment, Dr. Steans announced that he was leaving. An alternate in department of surgery was identified at WFUBMC, but he failed to follow through on agreed upon action items. Second, in some ways we were victims of successful development of the device. As noted in “major accomplishments” above, enhancements continued to be made throughout the project, and modifications continue to occur. This has made creation of study protocols difficult. Current status is
that Dr Meredith has identified a PI at WFUBMC to take charge of outcomes testing in simulation environment.

Scientific Progress- Sharing of PED-ER with end users has generated enthusiasm as to its utility. We have had numerous requests regarding availability of the device for clinical use. At the request of Dr. James Broselow, PED-ER was demonstrated at the simulation center at Johns Hopkins University, and interest in a study utilizing a network of pediatric critical care simulation labs has been expressed. Conceptually, PED-ER should improve efficiency and reduce medication errors during acute resuscitation of pediatric trauma victims. Drs. Abramson and Meredith were briefed on progress, and Dr. Meredith has made arrangements for WFUBMC emergency department faculty to engage in the next phase of this project, outcomes studies in the simulation environment. This research will provide the foundation for deployment of additional TEAM-Broselow™ units as specified by Dr. Meredith and his contacts through the American College of Surgeons. PED-ER was shared with university collaborator, University of Michigan, Medical Innovation Center, in August as part of a technology review.

Future Directions- Co-PIs Muelenaer and Wicks have worked with Dr. Jim Broselow to integrate his electronic content through the software development company, Zolstice, while continuing to facilitate the hardware development at Wireless MedCARE. These two companies have executed agreements to co-develop this device. PMDI supported a project at the Roanoke College Innovations Challenge 2010, a summer internship experience for rising seniors from colleges and universities from throughout the US. A team of five students created the business plan for this joint venture, and it will serve as the basis of commercialization when the product is ready. (print version available upon request)

Marketing research suggested that PED-ER would be better branded through its association with Dr. Jim Broselow, the Broselow-Luten Tape, and its attribute of enhancing medical team communications, thus its new designation as TEAM-Broselow™.

One of the four TEAM-Broselow™ units was displayed in early August at National Instruments NI Week 2010 in Austin, Texas. (photo below with PMDI’s Andy Muelenaer, Jim Broselow, MD (center), and Virginia Tech graduate student, Carlos Guevara)
Publications and Presentations:

PED-ER has not been submitted to peer reviewed journals for publication. Poster presentations have been made:

Guevara CE³, Muelenaer AA¹², Wicks AL³. TEAM-Broselow: Pediatric Electronic Device for Emergency Resuscitation.¹ Virginia Tech Carilion School of Medicine, ² Carilion Clinic Children’s Hospital, ³ Virginia Tech Department of Mechanical Engineering National Instruments Week, Austin, Texas. August 2010

Guevara CE³, Muelenaer AA¹², Wicks AL³. TEAM-Broselow: Pediatric Electronic Device for Emergency Resuscitation.¹ Virginia Tech Carilion School of Medicine, ² Carilion Clinic Children’s Hospital, ³ Virginia Tech Department of Mechanical Engineering Virginia Biotechnology Association, Southwest Virginia Life Science Forum. 4 Oct 2010

Guevara CE³, Muelenaer AA¹², Wicks AL³. TEAM-Broselow: Pediatric Electronic Device for Emergency Resuscitation.¹ Virginia Tech Carilion School of Medicine, ² Carilion Clinic Children’s Hospital, ³ Virginia Tech Department of Mechanical Engineering Pediatric Medical Device Institute Consortium Conference. Winston-Salem, NC 18 Nov 2010

Media Coverage:

Roanoke Times: Tech team develops pediatric care tool. 5 December 2010

Virginia Tech News- Virginia Tech, Carilion team with physician to create digital version of ER pediatric response chart. 16 Dec 2010

Roanoke Times: Embracing the healthy potential: With affiliations to Virginia Tech, Carilion Clinic and others, health care startups are a growing force in the region. 19 December 2010

The Roanoke Star Sentinel- VA Tech, Carilion to Create Digital ER Pediatric Response Chart. December 31-January 6, 2011

Financial Expenditure Report- Hardware funds were expended as listed in the original budget. Funds for labor were applied as specified for graduate student support, and salary support for Drs. Wicks and Muelenaer. Labor costs for Dr. Broselow were as listed, including travel to Austin, Texas, in August to support inservice and installation of the unit at Dell Children’s medical Center. The balance of funds was utilized to cover travel and materials needed to complete the wireless touch-screen control module.

Submitted by Andre A Muelenaer, Jr., MS, MD
PMDI, Chief Medical Officer
Project Co-PI
APPENDIX III

Promoting Positive Outcomes for Youth who Have Experienced Trauma
Summary Report
Promoting Positive Outcomes for Youth Who Have Experienced Trauma
Liz Arnold, Ph.D., Principal Investigator

Project Overview
We are pleased to report that we have accomplished the proposed aims of this project. We were able to recruit 18 parent/youth dyads, which is only 2 short of our target of 20. After some initial recruitment challenges, we were able to find a method of recruitment that was productive. Our specific progress toward accomplishing the specific aims of this project is as follows:

Aim 1: To demonstrate the feasibility and acceptability of this model of intervention with youth exposed to trauma in this region

Through this study, we were able to demonstrate the feasibility and acceptability of this model of intervention with youth exposed to trauma in this region. We received positive feedback on the intervention itself from all of the participants indicating the intervention’s acceptability. We demonstrated that it is feasible to go to families’ homes in this region and provide the trauma-focused intervention in such a setting. Participants indicated that they liked the facilitator coming to their homes as opposed to an office setting.

We also examined the feasibility and acceptability of the study assessments. Some participants in both study groups expressed concerns about the length and content of the questions (e.g., that there were too many questions, the questions were “boring”, and that the wording of some questions was “confusing”). Thus, in the future we plan to address this issue by reducing the number of questions and possibly replacing some of the measures.

Aim 2: To obtain data on our ability to engage and retain youth and families in the intervention

The biggest overall challenge that we faced was recruiting youth and parents to be a part of the study. Of the various methods that we tried, we found that the most effective was outpatient clinic recruitment. Our study staff member would work with the clinicians in the clinic to remind them of the study criteria during clinic times. We also added a Co-Investigator, Dr. Matt Hough, to assist with recruitment of participants in his outpatient child psychiatry clinic. When any clinician identified a family who was interested in learning more about the study, a study staff member was there on site to schedule the study screening. This method seemed to work best, and clinicians were receptive to making referrals of appropriate youth to the study. Newspaper advertising seemed somewhat effective in certain counties but not in others. Thus, in our future work with this intervention, we will use primarily a clinic-based recruitment approach, which is not an approach that we had anticipated would be the most productive.

We did very well with retaining youth and parents once we engaged and recruited them into the study. Of the 10 youth/parent dyads randomized to the intervention group, 7 completed all of the study sessions and all of the study assessments. Those who did not
complete the intervention or dropped out (N=3) each completed the baseline study assessment only. For the 6 parent youth dyads who were randomized to the comparison group, all but 1 completed all of the study assessments Thus, 80% of all youth and parent assessments for the intervention group and 89% of all comparison group assessments were completed.

While we anticipated that youth and parents might not want to be in the comparison group, this was not typically the case. While a couple of families expressed disappointment in not being randomized to the intervention, others stated that they “enjoyed coming,” and one youth stated that he had actually not wanted to be in the intervention. This finding supports the acceptability of using a “standard care” group as an arm in our next study using this intervention.

In this study, we sought to determine the amount of compensation would that would allow us to recruit and retain participants without providing too much compensation that might be construed as coercive. In our exist interviews, we found that compensation provided to participants in both arms of the study appeared to be adequate. No participant indicated in that the compensation was inappropriate or should be more.

**Aim 3: To make any refinements needed to the intervention and study protocol**

In the first phase of this study, we made initial revisions to the existing STRIVE manual to make the intervention more focused on pediatric trauma. Our revisions included adding an initial session to the existing 5 session protocol that was focused specifically on the trauma itself. We then piloted the manual with the intervention group. Based on feedback from the sessions and the exit interviews, we are working on making a few more minor revisions to the manual. One of the recommendations that we received from youth and parents in the intervention was that they would like to have had either more sessions added to the weekly ones or had booster sessions a couple of months after the initial sessions. We have discussed these recommendations with our consultant, Dr. Norweeta Milburn, at UCLA (who developed the original intervention), and she supports the decision to add a couple more sessions (likely 2 sessions) to the protocol. We will also be making modifications to the assessment battery given the concerns noted above about length and content.

**Aim 4: To collect preliminary data on the efficacy of this model in terms of improving family functioning and relationships as well as reducing trauma and depressive symptoms**

At present, we are working on completing the data analysis. As we were finishing the last two follow-up interviews, the staff member in charge of data entry left her position here. (She replaced the project manager and Co-I who left in July 2010 to attend graduate school.) As a result of this staff departure, we were left short-handed. At present, we are going through and cleaning the data and completing the small amount of data (2 follow-ups) that still need to be entered. We made a decision not to use the DAU statistical services as we had this unanticipated delay and it was likely going to cost significantly more than we had budgeted. As such, we are returning the unspent funds. The PI will conduct the data analysis and will consult with a biostatistician if needed.
Scientific Progress
Through this pilot study, we have demonstrated that it is feasible to adapt an existing intervention to focus specifically on the needs of youth who have experienced a traumatic event. The modifications that we made to the study manual and protocol prior to starting the trial proved to be appropriate and acceptable to study participants. One of the underlying questions that we hoped to answer through this study was whether youth who have experienced a traumatic event want to discuss the actual event itself. We asked about this issue directly in exit interviews with intervention group youth and parents. We found that there was not a consensus. Participants were fairly equally divided with half wanting more emphasis on the trauma itself and about half not wanting any additional focus on the event. This is something that we need to explore further in our future work with this population.

Future Directions
After the final modifications are made to the protocol, we plan to work with Dr. Milburn to submit an R01 proposal to either NIMH or NICD. We have discussed some of the details of the proposal and hope to submit it the end of this year. We have sufficient pilot data to support moving ahead with a larger randomized trial. In addition, we plan to submit an abstract to several conferences and a manuscript to a peer-reviewed journal. We will certainly acknowledge the Childress Institute for Pediatric Trauma on all publications.

Budget Report
Attached you will find the final report on this account generated by the Controller’s Office. As noted in the report, we had unspent funds primarily in salary and fringe ($7,343). These funds were unspent because we did not use the DAU and the staff member who assisted with the data management replaced a higher paid employee who left last summer. In addition, it was not necessary for the PI to make a trip to Los Angeles. She and Dr. Milburn were able to work on the project via phone and email without the need for a face-to-face meeting. The only correction to the budgeted is that an additional $125 was credited back to the court after the final statement was generated. These funds were unspent participant incentives. Thus, the total unspent funds to be returned were $9,270.
APPENDIX IV

Final Report on HITS in Wake Forest University Football Players
Memorandum

To: Barbara K. Yoza, PhD
From: Joel D. Stitzel, PhD
CC: J. Wayne Meredith
Subject: Head Impact Telemetry System (HITS) CIPT Project Summary Report

PROJECT OVERVIEW

During the CIPT funding support period of August 1, 2010 through July 31, 2011, we bought the Head Impact Telemetry System (HITS), recruited Wake Forest University football players to participate in the study, and collected data during spring practice from the Wake Forest University football team.

The CIPT funding of $28,195, assisted partially in the purchase of the Head Impact Telemetry System (HITS). This funding support was used to purchase the following items:

- Portable Field Case [Wireless data acquisition system]
  - Total Cost = $35,768
- 52 Mx encoders [Helmet accelerometer sensors]
  - Total Cost = $30,068
- Other Hit System Services
  - Total Cost = $2,360

We spent about 50 man/hours setting up the equipment, recruiting players, and collecting data from the players. During the spring practice, we collected approximately 400 impacts from 30 players. The Spring Practice data collection effort allowed us to become familiar with the HITS as well as coordination with the football team and training staff, which facilitated data collected during the regular fall season.

During the fall semester, we also made addendums to the IRB to include medical imaging of the players and the transmission of confidential data to Simbex (HITS vendor) for data processing.
**SCIENTIFIC PROGRESS**

The head impact acceleration data collected from the Wake Forest football team has provided us with the experience necessary to transition our study to the highschool and youth league levels. In the future, the equipment purchased partially with the CIPT funding can also be used for these studies.

**FUTURE DIRECTIONS**

We plan to continue our study of the Wake Forest football team in Fall of 2012. We also hope to obtain additional awards to grow our study beyond the collegiate level to the high school and youth levels of competitive football.
APPENDIX V

Final Report on Neuropsychological and Functional Imaging Studies in TBI (pending)
APPENDIX VI

Final Report on Pediatric Pre-hospital Trauma Care Educational Initiative: Phases 1 & 2
# Childress Institute for Pediatric Trauma

## Pediatric ITLS Project Report-2012

### Courses Completed

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**Total** 422  $7596.00
Course materials such as provider manuals, instructor/coordinator manuals and instructional slide sets were purchased throughout the year to support the programs. The costs of these materials was $15,162.00

Travel expense for a Coordinator providing multiple courses in Hillsborough for one week was $725.96.

A total of $23,483.96 was identified during the 2012 grant cycle to provide and promulgate the Pediatric International Trauma Life Support program in North Carolina. Volunteer man hours contributed by coordinators, medical directors and instructors, nor the overall mileage related to course travel is reflected in this report.

Supporting documentation for course fees, materials and travel is attached.

All courses included a brief summary of the role of CIPT through its work in research, education and awareness of the pediatric trauma problem. Access to learn more about CIPT was provided to both instructors and participants in the course. All participants were told that the programs were provided through financial support from CIPT.

Two courses were cancelled due to low registration (3). These included a provider course and instructor course scheduled to be taught in conjunction with EM Today. One course was rescheduled from November 2012 until February 2013. Since approval for the course was complete and manuals had been distributed, the 2013 course was included in the 2012 grant cycle. We have some provider books instructor books and coordinator CDs remaining for use. In the spirit of supporting continuing courses offered in a cost neutral manner, we would like to distribute these books as approved by Dr. Roy Alson and/or Vickey Lewis, who have managed the courses over the past two years with this grant. WFBH’s Life Support Education will continue to offer annual PITLS courses at low cost until provider book supplies are depleted as well as promoting the program long term in conjunction with EMS agencies throughout the state. Additional funds for a third year of the grant will not be needed, as we have found increasing difficulty in moving forth the programs to be managed in regions by “local” instructors.

Participants who have taken the PITLS course have reported having increased levels of confidence and competence in their ability to assess and intervene on behalf of the pediatric trauma patient. It is clear from this project’s outcomes that pre-hospital care providers benefit from the content delivered in this course and use it to improve the outcomes for pediatric trauma victims.
APPENDIX VII

Final Report on the Prevalence of Protein and Vitamin D Malnutrition in Pediatric Orthopaedic Trauma Patients
Protein and Vitamin D Malnutrition in Pediatric Orthopaedic Trauma Patients

Authors
Peter J. Apel, MD, PhD
Cait Barbarita, BS
Patrick W. Whitlock, MD, PhD
Leah Passmore Griffen, MS
Bettina M. Gyr, MD

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Corresponding Author
Bettina M. Gyr, MD
bgyr@wakehealth.edu

Level of Evidence
Level I Prognostic study (Investigating the Effect of a Patient Characteristic on the Outcome of Disease)
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<td>Vitamin D deficiency</td>
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Background
Protein and vitamin malnutrition are known to negatively affect fracture healing (1-3). Over the last 20 years, there has been a well-documented increase in childhood obesity (4,5) and a decrease in physical activity levels (6). In adults undergoing orthopaedic surgery for trauma, over 60% had insufficient or deficient vitamin-D levels (7). The prevalence of protein malnutrition in adult and pediatric trauma patients is unknown. In our practice, we have observed a high incidence of malnourished pediatric trauma patients with subsequent morbidity from delayed union and nonunion of long bone fractures. Protein and vitamin malnutrition are well known to negatively affect fracture healing and are potentially modifiable risk factors for poor outcomes following trauma.

Purpose
The purpose of this study was to determine the incidence of protein and vitamin D malnutrition in a pediatric trauma population and to identify physical, demographic or fracture characteristics that are risk factors for protein and vitamin D malnutrition.

Methods
Enrollment
Patients were prospectively enrolled at a Level 1 Pediatric Trauma Center from June 2011 through September 2012. Patients with a fracture requiring operative stabilization were invited to participate. Two hundred and thirty patients were eligible, 45 declined, leaving 185 enrolled patients. Data were prospectively collected on age, BMI, ethnicity and insurance class and fracture classification. Serum was collected in the operating room at the time of surgery and analyzed for vitamin D level and prealbumin (transthyretin), a well-established marker of protein nutritional status. Patients received operative stabilization per the operating surgeons' preference. All patients received routine follow-up treatment. There was incomplete or insufficient data collection for 25 patients, leaving 160 patients (85%) included for analysis. Note should be made that the current study was only on serum markers of vitamin and protein nutrition and no data on clinical outcomes is reported here.

Statistical Analysis
All data was analyzed using SAS (SAS Institute, Cary, NC). Descriptive statistics were performed for all data. Means and standard deviations for linear data were calculated. Simple linear regressions were performed for each variable. Categorical data was analyzed with the Chi-square test. Mixed regression models were created to analyze the covariance of each of the significant variables. Data are presented at mean (+/- standard deviation).
Results

Enrollment
The average age of the enrolled patients was 8.2 years (+/- 4.4 years). There were 96 males and 64 females. Average BMI was 19.3 (+/- 6.9). There were 102 (64%) Caucasian, 33 (21%) Hispanic, 20 (12.5%) African-American and 4 (2.5%) other patients. Sixty-four patients (40%) had private insurance and 92 (57.5%) had Medicaid. Four (2.5%) had no insurance.

Protein Deficiency (Low Prealbumin)
Overall, 16% (26/158) patients had prealbumin levels below 14 mg/dL, the established threshold for adequate protein nutrition.

**Age:** The patients that were protein deficient had an average age of 5.9 years and those that were not protein deficient had an average age of 8.5 years. The comparison of these two mean ages was statistically significant at p=0.002. [Figure 1]

**BMI:** BMI was found to be a significant predictor of prealbumin levels, with higher BMI associated with higher prealbumin levels. [Figure 2]

**Insurance status:** Of the patients that were protein deficient, 53.9% had private insurance, 42.3% were on Medicaid, and 3.9% had no coverage. Of those that were not protein deficient, 40.2% had private insurance, 56.8% were on Medicaid, and 3.0% had no coverage. There was no statistically significant relationship between insurance status and protein nutrition (p=0.3972).

**Fracture type:** The mean prealbumin levels for the fracture types were 16.1 mg/dL for supracondylar humerus, 16.0 mg/dL for lateral humeral condyle, 19.0 mg/dL for forearm, and 18.1 mg/dL for all other fracture types. Fracture type is a significant predictor of prealbumin levels, with supracondylar humerus and lateral humeral condyle fractures having a significantly lower prealbumin than other fracture types. However, fracture type itself was not an independent predictor of prealbumin levels, due to the close association (covariance) of fracture type and age. [Figure 3]

Vitamin D deficiency
Sixteen (10%) patients were vitamin D deficient (<20ng/dL) and 86 (55%) were borderline (20-32ng/dL). Neither age nor BMI had a significant relationship with vitamin D levels. However, race was a significant predictor of vitamin D levels, with the highest levels seen in Caucasians, followed by Hispanics and African-Americans.
Conclusions
Protein and vitamin D malnutrition are common in pediatric patients presenting with acute fractures. Race is a predictor of vitamin D malnutrition, while age, BMI and presence of a supracondylar humerus or lateral condyle humerus fracture are predictors of protein malnutrition.

Significance
The surgeon caring for children with operative fractures should consider the nutritional status of the patient, and if needed, recommend protein and vitamin D supplementation.

Future Direction
Future studies should examine if protein and vitamin malnutrition contribute to fractures in children and if intervention (either community-based or post-operatively) can decrease the morbidity of fractures.
Figures & Tables

Figure 1 – Prealbumin vs age
Figure 2 – BMI vs Prealbumin
Figure 3 – Prealbumin by fracture type

Prealbumin level by fracture type (mg/dL)

Supracondylar humerus  | Lateral condyle  | Forearm  | Other
16                     | 16              | 18       | 17
14                     | 14              | 18       | 17
12                     | 12              |          | 17
10                     | 10              |          | 17

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<table>
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<th>Table 1 - Protein Deficiency</th>
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<td>Lateral condyle</td>
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<tr>
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<td><strong>Fracture Type (3 main groups)</strong></td>
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References


APPENDIX VIII

Final Report on Using Impedance Cardiography to study Hemodynamic Changes in Pediatric Trauma Patients
Childress Institute for Pediatric Trauma
Project Summary Report-Final

Alison Gardner
Award Period: 7/1/11-6/30/13

Project Overview and Scientific Progress

Year 1-
I successfully completed 32 hours of class-work towards my master’s degree in Clinical and Population Translational Science, finished my fellowship in pediatric emergency medicine, and joined the faculty in pediatric emergency medicine as an assistant professor. I prepared an original manuscript regarding head injury as a cause of shock in trauma using data from the Wake Forest Trauma Registry. I served as a co-investigator in two grant submissions to the CDC and the NC EMSC regarding research in head injury. I also began collecting pilot data using impedance cardiography in trauma patients and normal controls to study cardiovascular changes in injured children.

Year 2-
I continued work on my master’s thesis, with a thesis defense and graduation planned for December of this year. Additionally, my thesis work will result in a publishable manuscript in the area of shock and head injury using data from the National Trauma Data Bank, and this data has been accepted for presentation at the national American College of Emergency Physicians meeting in October of this year.

The manuscript entitled, “Isolated Head Injury as a Cause of Shock in Pediatric Trauma Patients,” drafted in my first year of this award, has been accepted for publication in Pediatric Emergency Care in August 2013. Data from this manuscript was also presented at the national Pediatric Academic Society Meeting in Washington DC in May of 2013.

I continue to work with the Emergency Medicine Research Core to collect pilot data using impedance cardiography on pediatric trauma patients. This pilot data has been used to support grant funding applications. In addition, I have been invited to be a member of the newly created Center for Critical Illness and Injury at Wake Forest University Medical Center, and I have been accepted to the Translational Science Academy Scholars Program at Wake Forest University.

Future Directions

I have assembled a team of mentors and co-investigators. Dr. Debra Diz with the Hypertension Vascular Research Center, has agreed to serve as a research mentor, along with the clinical mentorship of Dr. John Petty in pediatric trauma and Dr. Michael Walsh in pediatric cardiology, and the expertise of Dr. Chad Miller in Emergency Medicine and Dr. Janet Tooze in biostatistics. We were able to use the pilot data obtained with impedance cardiography to support a 2 year mentored grant to the American Heart Association for further research regarding shock in pediatric head trauma.

Pending Grant Applications
American Heart Association: Mentored Clinical Scientist Award, Cardiovascular Shock in Pediatric Head Injury. Award: 154,000 over 2 year period 1/1/14-12/31/15.

Publications and Presentations

Gardner AR, Miller CD, Tooze JA, Petty J. “Isolated Head Injury is a Cause of Shock in Pediatric Trauma Patients.” Pediatric Emergency Care; (in press).

Gardner AR. “Isolated Head Injury is a Cause of Shock in Pediatric Trauma Patients.” Poster presentation national meeting of the Pediatric Academic Society in Washington DC, May 2013.