
Research Portfolio



July 2016

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Research Portfolio



Current Projects

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
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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.

A new focus for the project period 3 is the first effort, to our knowledge, to collect head impact data sustained by female youth soccer players over the course of a season of practice and games. Two age levels, Under 14 and Under 16 players, are equipped with a newly developed, novel mouth guard for collection of head impact data. Deployment and data collection are planned for the 2017 season.

Award period: 6/30/2012-7/1/2017

Award amount: \$212,000 (Project period 1); \$150,000 (Project period 2); \$75,000 (Project period 3)

Project title: **Saving Children in Rural America: The Impact of a Mobile, Simulation-based Educational Outreach Initiative on Pediatric Trauma Care and Outcomes in a Rural Trauma System**

Principal Investigator: Eric A. Toschlog, MD and Shannon Longshore, MD

Project classification: ACUTE CARE, EDUCATION, INFRASTRUCTURE BUILDING

Project status: in progress

Project summary: Despite the regionalization of trauma systems and significant advances in the care of the injured, outcome disparities between urban and rural pediatric trauma patients persist. Many factors are contributory, ranging from differences in speed and access to care, to provider education and expertise. Eastern North Carolina poses extraordinary challenges in the care of injured children, combining remote and rural geography with extreme differences in pediatric trauma provider expertise, compounded by repressed socioeconomic status. Based upon the confluence of challenges to the care of pediatric trauma patients in Eastern North Carolina, the global purpose of our study is to design a mobile, simulation-based pediatric trauma educational program that will positively impact the care and outcomes of injured children within our unique trauma system.

Award period: 1/1/2015-12/31/2016

Award amount: \$250,000

Project title: **Pilot Test for the Need of a Virtual Trauma Network**

Principal and co- investigators:* Teri Sandall*, BS, REMT
Laura Cassidy, MS, PhD
Katrina Altehofen, MPH
Nels Sandall, PhD

Project classification: ACUTE CARE, INFRASTRUCTURE BUILDING

Project status: in progress

Project summary: The goal of this pilot project is to measure the perceived need and support for a virtual trauma network among Critical Access Hospitals (CAH). Traditional telemedicine requires expensive equipment that is often difficult to operate and requires substantial bandwidth to be effective. The VTN that is envisioned will transcend current telemedicine with a variety of web-based support options available 24x7/365 including pediatric training, just in time treatment algorithms, low cost audio and visual connections using commonly available technology such as tablets and smartphones as well as more sophisticated telemedicine opportunities. Before implementing a virtual trauma network, a needs assessment of a representative sample of hospitals is essential to guide future efforts. Desired features from the end users' perspective will be explored as part of this pilot project. Structured, face to face surveys will be conducted with a sample of CAH in three different states. Additional interviews will be conducted by telephone in a fourth state.

Award period: 7/1/2016-6/30/2017

Award amount: \$40,000

Project title: **ATV Safety Intervention Feasibility Trial, 'SIFT'**

Principal investigators: Laura Veach, PhD, Thomas Pranikoff, MD, Andrea Doud, MD

Project classification: PREVENTION, EDUCATION, INFRASTRUCTURE BUILDING

Project status: in progress

Project summary: A number of studies have revealed that the routine safety recommendations for ATV drivers (including use of a helmet and other protective gear, as well as avoidance of high speeds, paved roads and unfamiliar territory) are not followed by many children who operate these vehicles. Based on effective models of screening and brief intervention (SBI) counseling services for hospitalized patients in Level I Trauma Centers, we developed an ATV safety intervention SBI model tailored for injured youth aged 13-16. Further, it is critical to understand the challenges to the effective delivery of ATV safety screening and education with youth seen in the pediatrician's office setting so that (1) a primary prevention program can be put into place without sacrificing other necessary health maintenance tasks performed by a child's primary pediatrician, (2) the child, parent and pediatrician are not inconvenienced or frustrated by the SBI and (3) the day-to-day tasks of the office are not interrupted or stalled. This study is a pilot investigation of the feasibility of a primary ATV safety and injury prevention program in an outpatient pediatrician office setting and an ATV brief intervention in an acute inpatient trauma center setting.

Award period: 7/1/2016-6/30/2017

Award amount: \$15,788

Research Portfolio



Completed Projects

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

Principal investigator: Joel Stitzel, PhD

Project classification: PREVENTION

Project status: completed; Final Report available upon request.

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 available upon request.

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 period: 12/1/2009-5/30/2010

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 available upon request.

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: completed; Final Report available upon request.

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: completed; Final Report in preparation.

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: completed; Final Report available upon request.

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 available upon request.

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 available upon request.

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

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: completed; Final Report available upon request.

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: 9/1/2012-6/30/2014

Award amount: \$5,600

Project title: **ATV Injury in Children and Youth: A Review of the Literature**

Principal Investigator: Thomas Pranicoff, MD

Project classification: PREVENTION, EDUCATION

Project status: completed; Final Report in preparation

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/powerful 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: \$10,000

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: completed; Final Report in preparation

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: completed; Final Report available upon request.

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: 1/1/2014-6/30/2015

Award amount: \$75,000

Project title: **Pre-Hospital Care of Children with Traumatic Brain Injury**

Principal Investigator: Lawrence J. Cook, PhD

Project classification: ACUTE CARE, INFRASTRUCTURE BUILDING

Project status: completed; Final Report available upon request.

Project summary: Trauma is the leading cause of mortality for children aged 1-17 years in the United States, and traumatic brain injury (TBI) causes substantial morbidity in those who survive. Understanding how field actions taken by pre-hospital providers affect outcomes of seriously injured children with TBI is an important step to improving pediatric trauma care. The major hurdle to conducting such a study is that no single database contains the information needed to adequately analyze pediatric trauma care from when emergency medical services (EMS) arrives at the scene through admission to, and eventual discharge from the hospital. We propose the following two aims to address this problem. Aim 1: Probabilistically link the Utah state pre-hospital database (POLARIS), the Utah trauma registry (UTR), and the Pediatric Health Information System (PHIS) database over five years (2009-2013). Results from Aim 1 will serve as a pilot project for a larger proposal to create a comprehensive, national linked pediatric TBI database by linking a national pre-hospital database, a national trauma registry, and PHIS. Aim2: Test the impact of time to definitive pediatric care on intensive care unit (ICU) and hospital length of stay and mortality in hospitalized children with moderate (Glasgow Coma Scale {GCS} score 9-12) or severe (GCS \leq 8) TBI. For some children with TBI, good quality referring hospital care or transport team care may be more important than getting to a higher level trauma center marginally faster. This aim is designed to help determine how best to make transport mechanism decisions for children with moderate or severe TBI.

Award period: 1/1/2015-12/31/2015

Award amount: \$75,000