Froedtert Hospital–Medical College of Wisconsin CIREN Center

CIREN Program Report

Directors: Thomas A. Gennarelli, MD, Dennis J. Maiman, MD, PhD

This Center is sponsored by the administration of the Medical College of Wisconsin (MCW) and its Department of Neurosurgery and Froedtert Hospital, a principal adult teaching hospital of the College. The Department directs

nationally recognized comprehensive head and spinal cord injury care centers with long-term follow-up care. The Department includes clinicians, biomedical engineers, and research scientists with strong reputations in impact biomechanics. Facilities include the Neuroscience Laboratories, established in 1964 and incorporating over 25,000 square feet of research space. Research functions range from studies of neurotrauma on a cellular level to full-scale vehicular crashworthiness capabilities. While head and spine trauma is a specialty, this laboratory has been assisting NHTSA in various aspects of biomechanical research. Since 1988 the Laboratory has been supported by the Center for Disease Control and since 1978 by the Department of Veterans Affairs.

Frontal impact, side impact, rear impact, and pediatric trauma research have been in progress for studying human tolerance, mechanisms of injury, and evaluation of anthropomorphic test devices.

Froedtert Hospital and the Children's Hospital of Wisconsin are Level One trauma centers located on the MCW campus. The catchment area is approximately 2,000,000 people. The Flight for Life program includes helicopters in Milwaukee and northern Illinois and serves a 200-mile radius. This unique integration of engineers, scientists, and clinicians all committed to the study of neurotrauma, in a facility incorporating two major trauma centers and a long history of injury research, makes the Medical College of Wisconsin an ideal site for CIREN activities.

Objectives

- Investigate real-world crashes to:
- Reconstruct and understand crash and injury causation
- Improve prognosis and treatment for accident trauma patients
- Follow-up of treatment regimen
- Reduce recovery time and treatment costs
- Simulate crash scenarios in laboratory environment
- Disseminate data to industry, regulatory and public agencies
- Develop strategies to reduce fatalities and injuries in automobile accidents
- Provide information to improve public infrastructure to reduce accidents
- Develop and disseminate safety messages to the public
- Train health care providers in vehicular safety and associated care

Unique Focus:

- This CIREN Center will be the first to focus its activities on brain and spinal cord injuries in the vehicular environment, and
- On vehicular injuries to the entire age spectrum especially to the very young and the elderly, and
- On assuring quality improvement measures for injury scaling and crash investigation

Mission

Mission of the CIREN Center with the Medical College of Wisconsin (MCW) is to:

- Teach and train doctors and scientists of tomorrow while enhancing the skills of today's health professionals.
- Create new knowledge in basic and clinical science through biomedical and health services research
- Provide patient care humanely and expertly
- Provide leadership in health services
- Forge local, regional, national, and global partnerships in education, health care, and research for the betterment of human health
- Be a national repository for impact biomechanics and biomedical research

The MCW and Froedtert Hospital system is the oldest trauma care system and one of the two adult Level I trauma centers in Wisconsin. It serves a population of approximately two million. The catchment area includes the eastern half of the Upper Peninsula, northern Illinois, especially Lake and northern Cook counties, and neighboring Racine, Kenosha, Waukesha, Washington, and Ozaukee counties. Milwaukee County alone is approximately 240 square miles. The Flight for Life helicopter serves approximately 200-mile radius. Over 850 full-time faculty and professionals (MD and PhD) have appointments at MCW.

Proven partnerships and collaboration exists between treating physicians, other health care providers, emergency personnel, and biomedical researchers. MCW is fully committed to biomedical research and training.

CIREN Center at MCW derives its uniqueness and strength from a) internationally renowned surgeons and researchers at the trauma center, b) world-class biomechanics and engineering investigators, and c) the unparalleled impact testing facilities. The close collaboration between these groups, housed on a single campus, allows seamless operation and provides the environment to achieve the Center's objectives and further its mission.

Clinical Facilities

Both an adult-care hospital and a pediatric-care hospital (Children's Hospital of Wisconsin, CHW) are located on the MCW campus. These hospitals house the comprehensive trauma centers with a common Emergency Room (ER) facility. Two helicopters (Flight for Life) support the emergency needs. The trauma team has an excellent relationship with the Milwaukee County Medical Examiner, Emergency Medical Services (EMS), and the Milwaukee Police Department. The Clinical faculty at MCW, with the unique ability to access out-of-hospital databases, directs the out-of-hospital care and is closely involved with the ER.

MCW is the largest provider of EMS in the State of Wisconsin. The EMS system has a computerized database of all patient care records for individuals transported by the Milwaukee County paramedics units. The Traffic Incident Management Enhancement program (developed in-house) includes video ramp metering and video monitoring of local major highways. This real-time information is provided to the Sheriff and the hospital. The medical director of EMS is a faculty member of the Department of Emergency Medicine and a pediatric specialist at MCW. As a trauma center, the SICU, ICU, and NICU are well established with full facilities. Follow-up care is possible with capabilities for prospective data collection.

Collaboration

CIREN Center is a collective effort of several nationally recognized MCW departments and their faculty.

The Department of Neurosurgery directs comprehensive head and spinal cord injury care centers. The department's faculty is internationally reputed in neurotrauma and in impact biomechanics. Proven and ongoing research collaboration exists with faculty from other departments including Emergency Medicine, Neurology, Orthopaedic Surgery, Physical Medicine and Rehabilitation, Radiology, and Surgery, Trauma and Critical Care.

The Department of Emergency Medicine is a leader in out-of-hospital care and provides core leadership in the initial

evaluation of trauma patients. Research programs include trauma registry development for public policy implications on intentional injuries and international travel safety.

The Department of Physical Medicine and Rehabilitation provides comprehensive follow-up care for trauma patients from consultation in the trauma ICU to community re-entry for all age groups.

The Department of Radiology has unique access to media such as teleradiology and advanced imaging devices such as CT and MR scanners. Through a strong relationship with GE Medical Systems, the department has access to the most advanced imaging systems including world-renowned testing facilities at GE.

The Department of Orthopaedic Surgery has significant interest in trauma cases, and clinicians from this group are well known in the community for patient care.

The Department of Surgery, Trauma and Critical Care forms the principal core for outcome studies. Investigation in this area is intensely pursued by trauma physicians in adult and pediatric hospitals. Nationally recognized clinical and biomedical investigators lead the respective teams. Community outreach activities are also a part of the agenda.

Applied research in areas of impact biomechanics and outcomes are an integral part of our mission. The faculty is fully committed to gather, analyze, and disseminate information to the scientific community and public. Present accomplishments include authoring books on motor vehicle-related head and neck injuries; contributing chapters on numerous injury-related issues; peer-reviewed journal articles; presentations at conferences such as Stapp, IRCOBI, and AAAM; active participation in committees such as Injury Scaling, Stapp Association, AAAM, IRCOBI, NIH, CDC, NIDRR, and DOE; working closely with regulatory bodies such as US DOT NHTSA; acting as faculty at national and international courses such as those organized by SAE professional development seminars and TOPTEC, AAAM; serving as members of advisory committees of local and national Injury Centers; providing periodic annual technical briefs to agencies such as NHTSA; informing the public through media such as newspapers and television interviews; and acting as consultants to private organizations.

Key Personnel Fact Sheet

Co-Directors

Thomas A. Gennarelli, MD

Professor and Chair Department of Neurosurgery

Current Injury Activities and Leadership Positions:

- International Neurotrauma Society: President
- International Research Council on the Biomechanics of Impact (IRCOBI): Board of Directors
- World Federation of Neurosurgical Societies: Neurotraumatology Committee
- Association for the Advancement of Automotive Medicine: Board of Directors
- International Injury Scaling Committee: Co-Chair
- American Brain Injury Consortium: Executive Committee
- Coalition for American Trauma Care: Board of Directors 1993-
- American Association for the Surgery of Trauma: Organ Injury Scaling Committee

Past Positions:

- American Association of Neurological Surgeons and Congress of Neurological Surgeons: Joint Section on Neurotrauma and Critical Care; Chairman 1988-1990
- American Association for the Surgery of Trauma: Board of Managers (Directors) 1986-1988
- Association for the Advancement of Automotive Medicine: President 1992
- Eastern Association for the Surgery of Trauma: Founding Member; Board of Directors 1987-1990
- Stapp Car Crash Conference: Board of Directors 1990-1999
- The National Neurotrauma Society: Councilor (Board of Directors) 1993-1997
- American College of Surgeons: Committee on Trauma 1983-1993
- American College of Surgeons: Advanced Trauma Life Support (ATLS) Committee; National ATLS Faculty 1987-90

Dennis J. Maiman, MD, PhD

Professor of Neurosurgery

- Director: Spinal Cord Injury Center, Froedtert Hospital
- North America Spine Society:
  - Resident-Fellow Education Committee
  - Award Committee
  - Research Planning Committee
- Director: Spine Care, Department of Neurosurgery
- Director: Spine Fellowship, Department of Neurosurgery

- American Paraplegia Society
- American Society for Biomechanics
- American Spinal Injury Association: Task Force on State SCI Incidence Reporting
- Cervical Spine Research Society: Nominating Committee
- AANS Professional Development Committee

Key Personnel:

Department of Neurosurgery

Narayan Yoganandan, PhD
Professor of Neurosurgery and Bioengineering
Chair: Biomedical Engineering
Fellow: Association for the Advancement of Automotive Medicine

Frank A. Pintar, Ph.D.
Professor of Neurosurgery and Bioengineering
Director: Neuroscience Research Laboratories
Board of Directors: Stapp Car Crash Conference

Elaine Petrucelli Wodzin, PhB
Adjunct Instructor in Neurosurgery
Former Executive Director: Association for the Advancement of Automotive Medicine
Co-Chair: International Injury Scaling Committee

Murray MacKay, DSc
Adjunct Professor of Neurosurgery
President: International Research Council on the Biomechanics of Impact (IRCOBI)
Co-Chair Program Committee and former President: Association for the Advancement of Automotive Medicine

Irma G. Fiedler, PhD
Associate Professor of Physical Medicine and Rehabilitation
Adjunct Professor of Neurosurgery

Department of Surgery

John Weigelt, MD, DVM
Professor of Surgery
Trauma Director: Froedtert Hospital
Former Chair: American College of Surgeons Committee on Trauma

Keith T. Oldham, MD
Professor of Surgery
Chief of Pediatric Surgery: Children's Hospital of Wisconsin

Andrea Winthrop, MD
Assistant Professor of Surgery
Trauma Director: Children's Hospital of Wisconsin

Karen J Brasel, MD
Assistant Professor of Surgery
Associate Trauma Director: Froedtert Hospital

Other Departments

Stephen Hargarten, MD, MPH
Professor of Emergency Medicine
Chair: Department of Emergency Medicine
Director: Injury Research Center

Jeffery Jentzen, MD
Professor of Pathology
Milwaukee County Medical Examiner

Richard Marks, MD
Assistant Professor Orthopaedic Surgery

Neil Mandel, PhD
Professor of Medicine
Associate Chief of Staff for Research: VAMCH

Facilities

Neuroscience Research Laboratories (25,000 sq feet)

The neuroscience laboratories are directed by Frank A. Pintar, PhD. They are equipped and staffed for a full spectrum of clinical and basic science investigations. Facilities include:

Biomechanics Laboratory
Neurophysiology Laboratory
Neurohistology Laboratory
Computer Analysis Facility
Machine and Electronics Shop

Medical College of Wisconsin

US Department of Transportation, NHTSA Cooperative Agreement

Directed by professors Narayan Yoganandan, PhD and Frank A. Pintar, PhD

The Department of Neurosurgery of the Medical College of Wisconsin has had a cooperative agreement with the US DOT, NHTSA, since September 1989. The work centers on biomechanical testing of human surrogates and is conducted at the Neuroscience and Biomechanics Research Laboratories housed at the Zablocki VA Medical Center in Milwaukee, Wisconsin. In general, the goals of the research are to provide data on the mechanisms and tolerance of the human body to injury in a vehicular crash. The federal government directly uses this data in establishing and upgrading federal motor vehicle safety standards. There is also a direct benefit to the constant improvement and redesign of the complete family of crash test dummies. This cooperative agreement has been renewed until 2002.

Major Accomplishments

- A series of simulated frontal impact tests were done with a new device called the "chestband" to assess chest injury criteria. The results of these studies were directly used in the recent proposal to upgrade the FMVSS 208.
- A series of tests were done to assess chest and pelvic injury in a side impact crash. This series also used the chestband to recommend new injury criteria for side impact protection and investigate possibilities of harmonization with international standards.
- A series of tests were completed providing data on the tolerance of the human forearm and specifically the smaller sized occupant to bending injuries. This data can be used in the design of safer airbags when the driver has their arm over the airbag module just prior to a crash.
- A series of tests were done to quantify neck compression injuries. Results provide direct data as to the tolerance of the human neck with respect to age, gender, and rate of load application. This data can be used for development of standards for protection in vehicle crashes.
- Investigations were completed to define the tolerance of the human foot and ankle under vehicle crash conditions. This data established initial injury criteria for use in development of improved crash test dummy foot and future safety standards.
- A series of rear impact tests were completed to assess improvements in the vehicle headrest standards.
- A series of tests to assess the potential harm of side airbags to child and small female occupants is being conducted. Preliminary information has been used to inform consumers of the potential dangers associated with occupants positioned too close to a side airbag.
- A series of tests is being conducted to provide data to improve the redesign of airbags to reduce the potential for severe neck injury to children and small female occupants.
- Many articles have been published covering the above topics in more detail. To further disseminate the above research information, numerous presentations have been given to the government and at technical conferences throughout the world.

The following is a limited list of recent injury-related publications.

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