



Eunice Kennedy Shriver National Institute of Child Health and Human Development



Advances in Pediatric Trauma and Critical Illness Research :

**BUILDING THE FIELD—
ADVANCING THE SCIENCE**



ACTION AGENDA

2015

Pediatric Trauma and Critical Illness Branch

Eunice Kennedy Shriver National Institute of Child Health and Human Development

National Institutes of Health

Bethesda, Maryland



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of Child Health and Human Development



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The NICHD Pediatric Trauma and Critical Illness Branch (PTCIB) supports research and research training in pediatric trauma, injury, and critical illness across the continuum of care.

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Introduction

Ensuring that all children have the chance to achieve their full potential for healthy and productive lives free from disease and disability is at the heart of the mission of the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (NICHD). In addition, the NICHD aims to achieve a fuller understanding of processes that lead to less-than-optimal health conditions and behavioral outcomes for infants, children, and adolescents. That's why the NICHD supports research that seeks to shed light on the reasons for these outcomes and to ameliorate the effects of the factors that affect well-being. In addition, the NICHD supports research to generate novel solutions, interventions, and therapies that ultimately lead to the healthy functioning of all infants, children, youth, and families.

Given the compelling statistics on trauma, injury, and critical illness cited in this document (see sidebar at right) as well as in the PTCIB's strategic plan, *Advances in Pediatric Trauma and Critical Illness Research: Building the Field—Advancing the Science*, the need for a greater investment in preventing, reducing, and treating these conditions was recognized.

Every year in the United States, more than 9,000 children die due to unintentional injury (equivalent to 150 school buses loaded with children). Almost 9 million are treated for their injuries in hospital emergency departments (Centers for Disease Control and Prevention [CDC], 2012). Nearly half a million U.S. children receive intensive care for critical illness every year (Watson & Hartman, 2007). Many more children suffer psychological trauma, often in combination with a physical injury. Yet most treatments for injured and critically ill children are based on treatments intended for adults. The Pediatric Trauma and Critical Illness Branch (PTCIB) aims to change this situation by supporting research dedicated to children, here and abroad.



A conservative estimate is that 1 out of 500 children will require intensive care annually in the United States (Shudy et al., 2006). The stress of critical illnesses has profound effects on the entire family.

While in its history the NICHD had made investments in the areas of childhood trauma, injury, and critical illness, the research and career development training had been supported within different Branches and without a unified mission.

Several meetings were held to advise the Institute's leadership on critical priorities that would help the NICHD achieve its vision for the next decade and chart the scientific course for the newly established Branch. Members of the Branch also met with leaders of other Institutes at the National Institutes of Health (NIH) and representatives of federal agencies to determine areas of mutual interest and priority. Building on their guidance, the Institute created the PTCIB.

The PTCIB is addressing some of the most important causes of illness, injury, and death in the pediatric population. This new branch is the home for analyzing these problems, generating new knowledge, testing hypotheses, and developing evidence-based solutions in the areas of pediatric trauma (both physical and psychological), injury prevention, and critical illness.

The Challenges

Emphasis on these factors is important because injury is the leading cause of death and disability among children 10 to 19 years old worldwide

(Peden et al., 2008). In the United States, unintentional injuries account for more than a third of fatalities among children and adolescents between 1 and 19 years of age; for newborns and infants under the age of 1, these injuries are the fifth leading cause of death (Child Trends Databank, 2014). These include injuries caused by falls, motor vehicle crashes, pedestrian and cyclist accidents, fires and burns, drowning, firearms, poisoning, and participation in sports.

Psychological trauma has profound effects on a child's well-being. Such trauma can be the result of exposure to violence—such as child physical or sexual abuse, domestic violence, or assault—or a consequence of natural disasters, accidents, or war. Young children also may experience traumatic stress in response to painful medical procedures or the sudden loss of a parent or caregiver (International Society for Traumatic Stress Studies, 2000). Importantly, psychological and physical trauma can interact, with psychological trauma complicating recovery from physical injury, and the physical injury causing distress and psychological trauma.

Critical illness in childhood includes diseases and injuries that pose threats to life or limb or result from respiratory failure, cardiovascular collapse, severe infection, neurological emergencies, or multiple organ dysfunction syndrome—the abnormal or impaired function of several organs

in an acutely ill patient. Children with critical illnesses have unique needs that require specialized care and equipment, and they are generally cared for in pediatric intensive care units (PICUs).

The needs of children who have experienced psychological trauma, physical injury, or critical illness differ from the needs of adults. For this reason, a priority of the PTCIB is to support research elucidating these differences, thereby increasing our understanding of the biology and psychology of trauma and critical illness to optimize treatment outcomes and prevent future difficulties.

The PTCIB is addressing the compelling needs of traumatized, injured, and critically ill children and their families. Research in trauma and in critical illness overlap and connect in many ways, but also they are unique. The PTCIB therefore is encouraging collaborative science involving many disciplines to foster the development of novel ways to identify, understand, prevent, and treat conditions stemming from childhood trauma and critical illness.

Mission of the PTCIB

Through transformative research, education, training, and collaboration, the PTCIB aims to prevent and reduce all forms of childhood trauma, injury, and critical illness to enhance healthy outcomes across the continuum of care. To accomplish this mission, the Branch established a series of overarching goals:

1. Support research that advances scientific knowledge, highlights and addresses research gaps, and fosters collaborative inquiry processes leading to discoveries that improve the quality of life for children and families who have experienced trauma, critical illness, or both.
2. Support the training of researchers, physicians, clinicians, practitioners, and scientists in all disciplines related to the Branch's continuum-of-care model.
3. Educate the public regarding all aspects of childhood trauma and injury (including prevention) and critical illness.
4. Disseminate novel research findings to inform the research field, enhance clinical knowledge, and improve practice in areas of the Branch's mission.
5. Identify opportunities of mutual interest across federal agencies, within the NIH, and through public-private partnerships to advance the goals of the Branch.

Our Vision for the PTCIB

To reduce all forms and aspects of childhood trauma, injury, and critical illness and, in doing so, improve the health and well-being of all children, families, and society to the greatest extent possible.



The PTCIB: New Beginnings

The PTCIB began with research transferred from other Branches of the NICHD, as well as the Institute's National Center for Medical Rehabilitation Research. The transferred projects formed the basis for the PTCIB's emerging research agenda. With this foundation in place, we identified three interdependent areas of research that served as our starting point for building the field and advancing the science over which we have stewardship.

These areas include:

- The Pediatric Critical Care Research Program involves research into critical aspects of life-threatening illness and injury in children and their effects on families. This program supports research on treatment; acute rehabilitation; family coping; and the management of outcomes such as impaired physical and psychological functioning, disability, and death.
- The Pediatric Trauma and Emergency Care Research Program supports research designed to advance the science of emergency medical and trauma care for pediatric populations to achieve the goal of reducing death and illness among children. The program supports research that sheds light on the specific tools, technologies, devices, and standards of care needed to address the unique needs of children with regard to preventing injury and minimizing the long-term impact of injury on children's health and well-being.
- The Pediatric Injury and Violence Research Program focuses on inflicted injuries, such as acute forms of child maltreatment and interpersonal and community violence, as well as unintentional injuries, including falls, concussions, fire-related burns and inhalation injuries, drowning, poisoning, animal bites, injuries caused by motor vehicles and man-made or natural disasters, and other injuries. The program's priorities include research on violence and violence-related injuries and on the prevention, treatment, biomedical, and psychological outcomes of violence.

The PTCIB's new plan of action, described later in this document, builds on these beginnings and coalesces them into two comprehensive program areas—the Pediatric Critical Care Research Program and the Pediatric Trauma Research Program—to call attention to both the distinct and overlapping priorities these areas of science represent. We aim to encourage multidisciplinary collaboration that will lead to new and innovative methods of identifying, understanding, preventing, and treating conditions associated with or stemming from these areas. We are establishing portfolios of research and training to achieve the aims of these program areas.



A Guiding Framework for Our Research

The Branch's broad mission highlights the need for an organizing framework to guide the work of the Branch over the next 5 years and to help identify its hallmark science. Toward that end, we have modified the concept of the continuum of care to focus our efforts and ensure a unified and cohesive approach for launching the Branch's strategic research agenda.

The continuum-of-care framework underscores the importance of coordination and continuity in multidisciplinary care provided for vulnerable, injured, and critically ill children and their families. As the term "continuum of care" implies, supported research using this concept must promote broad examinations of the factors that elucidate the psychosocial and biological markers of risk for trauma, physical injury, or critical illness. In our view, this will allow us to better understand factors that influence children's well-being and safety and to develop effective strategies to prevent or minimize risks.

The PTCIB version of the continuum-of-care framework will also guide our efforts toward understanding how to treat or manage mental or physical health conditions once trauma or critical illness has occurred. Such an understanding must include the support systems and processes in place in the community, hospitals, or other care settings that provide windows of opportunity to prevent further injury or trauma. Our research will include prevention efforts in the community, acute care and treatment in hospital settings, short-term rehabilitation after discharge from a hospital, and psychosocial support to families coping with grief and loss.

Within the contexts represented in this framework, the Branch intends to support research that highlights effective practices, treatment guidelines, and other strategies to:

- Prevent trauma (psychological and physical), with an emphasis on high-risk or vulnerable populations.
- Prevent disease or underlying disorders from progressing to critical illness, disability, or death.
- Prevent the effects of traumatic experiences from progressing to mental illness, high-risk behavior, disease, disability, or death.
- Improve treatment methods to optimize patient outcomes and minimize or eliminate negative consequences of critical illness.

The continuum-of-care framework also allows the Branch to support research that explores such important questions as these examples:

- How do we best prevent and treat self-injurious behaviors in adolescents?
- Which “on-the-ground” interventions are best suited to minimize exposure to hazards to ensure that children who are exposed to them rebound as quickly as possible?
- What response systems are needed to expeditiously and effectively identify and treat unintentional injuries?
- What processes, tools, or interventions are needed to accurately assess the causes and severity of pediatric injuries to prevent reinjury and to manage injuries in a way that promotes optimal recovery?

- Which interventions can avert death, help children heal from a critical illness, promote post-hospital rehabilitation, and ensure a return to optimal physical and psychological health?

Answering questions like these requires experts from multiple disciplines to work together to hasten the discovery of new therapies, tools, and technologies to prevent, reduce, treat, and ultimately eliminate childhood trauma, critical illness, and negative aftereffects on the child and his or her family.

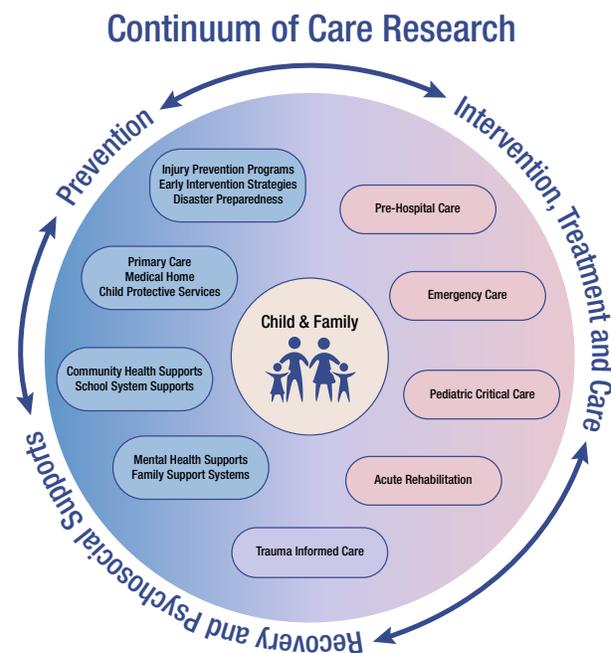


Figure 1. With the well-being of the child and family as the central focus of our research agenda, the continuum-of-care principles reflected in this diagram show how this framework will guide our work and help us achieve the Branch’s strategic goals over the next 5 years.



A Closer Look at the Pediatric Critical Care Research Program

Through this program, the PTCIB supports research and training opportunities to inform the practice of health care providers who stabilize, diagnose, and manage the care of critically ill children of all ages. Such research focuses on investigating the safety and effectiveness of treatment and management strategies for all sorts of pediatric critical illness and injury, including sepsis (blood infection), multiple organ dysfunction syndrome, acute lung injury, and traumatic brain injury (TBI). In addition, we will support research focused on the care of critically ill children with complex chronic health problems and on the toll that such illness takes on the family.

To address significant knowledge and practice gaps in the field of pediatric critical care over the next 5 years, we will target four strategic areas of research:

- Developing a better understanding of the causes and disease processes of critical illness and life-threatening injury among children.
- Adding to our knowledge base on the physical and psychosocial effects of critical illness and life-threatening injury on children and their families.
- Finding effective therapies and treatments that work across the continuum of care.
- Building more research capacity in the field to pursue understudied questions in pediatric critical care.

The following sections go into greater detail about the Program's strategic goals and objectives.



STRATEGIC GOAL #1:

Support research and training that addresses knowledge gaps in the understanding of the causes of and disease processes involved in critical illness and life-threatening injury among children.

This goal supports important research and aims to train a scientific workforce to address some of the main causes of critical illnesses among children:

- TBI is a leading cause of traumatic death in American children, according to the CDC (Faul, Xu, Wald, & Coronado, 2010). TBI is responsible for most emergency room visits, hospitalizations, and deaths combined among children under age 5 and

among adolescents. The Program aims to encourage research to garner scientific data needed to guide the treatment of children affected by TBI.

- Sepsis, or infection of the blood and organs, is a leading cause of death among children worldwide; however, nearly all studies are done in adults (Hartman, Linde-Zwirble, Angus, & Watson, 2013). Consequently, much remains to be learned about pediatric sepsis, its causes, and its treatments. The Program will support research about the disease processes involved in sepsis as well as studies of potential treatments to improve outcomes among children with sepsis.
- Multiple organ dysfunction syndrome is a major cause of death and disability in children, yet the condition is understudied, mainly because of the challenges of studying more than one organ system at a time. The Program will bring scientists together at meetings to encourage basic research on this cross-cutting but poorly understood topic.
- Acute lung injury is unfortunately common among children admitted to PICUs. The problem is that most research aimed at finding new treatments has been carried out in adults, making it challenging for health care providers to get the information they need to make well-informed recommendations (Bateman & Arnold, 2000). Through collaboration with other Institutes and

Multiple organ dysfunction syndrome is a major cause of death and disability in children, yet the condition is understudied, mainly because of the challenges of studying more than one organ system at a time.

Children with multiple chronic conditions are vulnerable to critical illness, as well as physical, developmental, behavioral, and emotional conditions.

Centers of the NIH, we will support studies to better understand acute lung injury in infants and children and investigate the effectiveness of mechanical ventilation and other interventions in PICU patients.

- People with multiple chronic diseases and special health care needs account for more than two-thirds of America's health care costs. Approximately 15 percent of U.S. children have a chronic health condition, such as asthma, cystic fibrosis, or diabetes. Children with multiple chronic conditions are vulnerable to critical illness, as well as physical, developmental, behavioral, and emotional conditions. Program staff will examine the state of the science to identify research gaps and identify high-priority research needs to find better ways to care for children affected by multiple chronic conditions and equip families with strategies for coping with the challenge of caring for a chronically ill child.

Strategic Goal #1 of the Pediatric Critical Care Research Program encompasses five research objectives:

- 1.1** Support research and training in pediatric multiple organ dysfunction syndrome.
- 1.2** Support research and training in understanding pediatric sepsis, its epidemiology, and its management.
- 1.3** Support research and training in pediatric TBI.

1.4 Support research and training in the area of acute lung injury among critically ill infants and children.

1.5 Encourage investigator-initiated research on the critically ill child with complex chronic conditions.

STRATEGIC GOAL #2:

Support research that addresses knowledge gaps in the understanding of the physical and psychosocial effects of critical illness on children and families, as well as other aspects of critical illness, such as grief, palliative care (comfort care given to a patient who has a life-threatening disease), and ethical considerations related to the complex nature of critical care practice.

The continuum-of-care framework requires a commitment to the injured or critically ill child that includes helping to find ways to support critically ill children and their families to maximize their coping skills and ensure that quality of life is optimal, even if the outcome of illness is death. Through Strategic Goal #2, the Pediatric Critical Care Research Program will meet the challenge of building an evidence base to find the best ways to help these children and their families:

- The Program will work with other NIH Institutes and Centers to understand how to improve the quality of life for children and their families during and after critical illness. We aim to understand factors causing

stress during a child's critical illness, and we plan to find ways to help children and their families cope and improve their quality of life. Clinical trials (human studies) will help identify the most effective types of care to improve outcomes, and these studies will seek to identify strategies for effective communication among caregivers, patients, and families.

- Until now, little research has dealt with the topic of palliative care for seriously ill or injured children. The Program will encourage and support research in this understudied aspect of care to help children and families cope with stress and maximize their quality of life during a child's critical illness.

- The PICU environment is stressful, and critical care is complex. As a result, there is a need to ensure that decisions around issues of withdrawal or limitation of care, organ donation, and assessment of quality of life are made in accordance with the highest ethical standards. In partnership with other NIH Institutes and Centers and federal agencies, we will foster research to better understand the complex care environment for critically ill or injured children and improve the quality of care for these children and their families.

Strategic Goal #2 of the Pediatric Critical Care Research Program encompasses three research objectives:

- 2.1** Encourage research on the physical and psychosocial effects of critical illness on children and their families.
- 2.2** Encourage research related to the provision of palliative care in the PICU, including end-of-life care and bereavement support.
- 2.3** Examine the complex nature of providing care to critically ill children, including the ethical issues that are uniquely associated with that care environment.

STRATEGIC GOAL #3:

Advance the science assessing effective therapies and treatments in all aspects of critical illness and life-threatening injury in children.

Through the Pediatric Critical Care Research Program, the PTCIB will continue its support of research in all aspects of care for critically ill or seriously injured children. Caring for children with these conditions requires collaboration of many types of health care providers to give affected



children the best possible chance of optimal function after illness and injury. The Program, therefore, will undertake several lines of research:

- New technologies and treatments need to be evaluated for safety, effectiveness, and cost. In many cases, the long-term benefits of treatments are unknown. Therefore, we will place high priority on research projects addressing all aspects of care for the critically ill child. Especially important is research that has the potential to have an immediate effect by saving lives or reducing potential future disability.
- Intensive care therapies have the potential to cause adverse side effects, and hospitalization raises the risk for certain types of infections. Along with partner organizations and agencies, the Program will support research to minimize adverse events associated with drugs and medical devices, reduce the chances of medical errors, and decrease the risk of hospital-acquired infections, thereby improving outcomes for critically ill children.

Strategic Goal #3 of the Pediatric Critical Care Research Program encompasses three research objectives:

- 3.1** Support research to investigate all aspects of the multidisciplinary care of critically ill children.
- 3.2** Support research to identify new therapies and approaches to reduce illness and death associated with critical illness in children.
- 3.3** Target research to reduce and eliminate health problems that may co-occur with the primary disease or disorder in the treatment of critical illness in children. This may include hospital-acquired infections



and complications related to diagnosis or treatment of the illness (iatrogenic injuries).

STRATEGIC GOAL #4:
Increase the ability of researchers in the field to pursue understudied questions in pediatric critical care.

Health care professionals who work in pediatric critical care must possess expertise in many pediatric disciplines to coordinate and facilitate the care for the sickest children, who typically have a wide variety of problems. Balancing these demands with the opportunity to perform effective research is a major challenge. The Pediatric Critical Care Research Program will therefore do the following:

- The program will expand training opportunities to foster the development of a diverse, geographically distributed workforce of well-trained physicians and other health care professionals who will carry out cutting-edge research in the fields of pediatric critical illness and life-threatening injury.

By bringing together experts from diverse fields, we will be able to plan future research initiatives and encourage the sharing of knowledge about the many aspects of care for critically ill children.

- New researchers can benefit from mentoring by more experienced scientists. For this reason, we will provide novel funding opportunities to increase the number of mentors who can guide the training and career development of early-career investigators. Beyond training in clinical specialty areas, pediatric critical care researchers require mentored training in biostatistics, study design, the presentation of results, and scientific writing.
- Through conferences, meetings, and collaborations, the Program will promote multidisciplinary training opportunities in high-priority program areas. By bringing together experts from diverse fields, we will be able to plan future research initiatives and encourage the sharing of knowledge about the many aspects of care for critically ill children.

Strategic Goal #4 of the Pediatric Critical Care Research Program encompasses four research objectives:

- 4.1** Use a variety of training mechanisms to support the development of a well-trained workforce in the field of pediatric critical care research.
- 4.2** Use both existing and novel funding opportunities to increase career development opportunities for scientists from diverse backgrounds and fields of study.
- 4.3** Through novel funding opportunities, increase the number of mentors who can provide training and career development support to early-career investigators.
- 4.4** Through conferences, meetings, and collaborations, promote multidisciplinary training opportunities in those program areas that have high scientific priority.



A Closer Look at the Pediatric Trauma Research Program

Through the Pediatric Trauma Research Program (which incorporates the Pediatric Injury and Violence Research Program and the Trauma and Emergency Care Program portfolios), the PTCIB will continue to support research aimed at advancing the science of trauma and injury prevention and care for pediatric populations, with the goal of reducing death, critical illness, and disability in children.

The Program will focus on the full continuum of care, including prevention, treatment, short-term rehabilitation, and psychosocial support to foster recovery, resilience, and well-being. It supports research on both inflicted and unintentional injuries, on the diagnosis and treatment of acute forms of child maltreatment—including abusive head trauma, sexual abuse, victimization, physical and psychological abuse, and all forms of child neglect—and on the effects of both human-caused and natural disasters.

The Program, over the next 5 years, will place special emphasis on research on violence and violence-related injuries, as well as the prevention, treatment, and medical outcomes of violence. The scope of program-supported research will include a variety of studies on the causes of trauma in children, risk factors, and potential preventive measures and treatments. We will also encourage efforts to develop new methods and measurement tools to improve medical outcomes.

To advance the field of research in pediatric trauma, we will target a series of strategic goals, highlighted in the following sections, focusing on reducing illness, injury, and death among traumatized children.

Injury is a leading cause of death and disability in the United States, particularly for children and young adults between the ages of 1 and 21.

STRATEGIC GOAL #1:

Support research and research training on the epidemiology (the study of disease patterns, causes, and effects) of unintentional traumatic injuries in children as well as the prevention and treatment of such injuries.

Injury is a leading cause of death and disability in the United States, particularly for children and young adults between the ages of 1 and 21 (CDC, 2013). Leading causes of death from unintentional injuries include motor vehicle crashes, accidental poisoning, drowning, and fires and burns.

The research agenda of the Pediatric Trauma Research Program covers many facets of traumatic injury occurring in childhood, and we propose a variety of strategies to address them:

- According to the Institute of Medicine (1985, 1999), injury is probably the most underrecognized major health problem facing the nation. Also, injury prevention is the only major field of public health for which few, if any, sustained training programs exist. To build research capacity in the fields of

pediatric injury prevention and treatment, the Program supports research training of professionals involved across the continuum of care. This objective includes physicians, emergency medical technicians, ED staff, psychologists, social workers, nurses, and other family support personnel.

- The Program supports research on the epidemiology and prevention of unintentional traumatic injuries in those areas where there are gaps in knowledge, including how individual, physical, environmental, and social factors interact and possibly affect risk of unintentional injury.
- Children in some populations are at greater risk of unintentional injury. These disparities can arise from differences in age, gender, race, socioeconomic status, and geographic location. Currently, however, little research explores disparities in injury patterns, treatments, and outcomes. Through this Program, the Branch will address disparities in its portfolio of research.
- TBI is a leading cause of traumatic death in U.S. children, accounting for 6,200 deaths and 60,000 hospitalizations each year (Faul,



In 2013, nearly 10 million children under the age of 21 were treated in EDs for an injury, making injury the leading cause of pediatric ED visits (CDC, 2013). Our research will shine a light on the unique treatment needs of pediatric trauma patients transported by ambulance or seen in EDs.

Xu, Wald, & Coronado, 2010). Of particular interest to the Program is research on forces involved in TBI, diagnostic markers of TBI, protective gear to prevent such injury, and treatment and outcomes of TBI.

- Serious penetrating injuries include injuries to the head, chest, and abdomen, often caused by stabbing or a gunshot. Blunt abdominal trauma is often the result of a motor vehicle crash. The Program will support research on these potentially severe injuries to reduce their number and improve outcomes of pediatric patients.
- Collaborations with the National Highway Traffic Safety Administration, the Health Resources and Services Administration, and other relevant agencies could help address targeted research gaps in emergency services for children with traumatic injuries.

Strategic Goal #1 of the Pediatric Trauma Research Program encompasses five research objectives:

- 1.1** Support research on the epidemiology and prevention of unintentional traumatic injuries in those areas where gaps in knowledge exist.
- 1.2** Support research on disparities in injury patterns, treatment, and outcomes.
- 1.3** Promote targeted research efforts on potentially severe injuries in pediatric patients, such as TBI, major penetrating trauma, major blunt trauma, blast injury, and crush injury.
- 1.4** Support clinical and translational research to determine the best diagnostic and treatment strategies for pediatric trauma patients from prehospital care through emergency care. This includes best practices, treatment decision making, and practice guidelines.

- 1.5** Build research capacity in the fields of pediatric injury prevention and treatment through support of training and career development award mechanisms.

STRATEGIC GOAL #2:

Advance the science on the diagnosis, treatment, and prevention of all forms of child maltreatment, including physical abuse, abusive head trauma, psychological abuse, sexual abuse, and neglect.

Maltreated children are at risk for a variety of physical and emotional problems, usually depending on their age (Child Welfare Information Gateway, 2013). Children can suffer from brain injury, including concussions, seizures, and death. Children may also develop behavioral and psychological problems, such as depression, anxiety, and post-traumatic stress disorder (PTSD). Early detection of abuse could help decrease death, illness, and psychological trauma related to this major public health problem.



Calling attention to the need for research on aspects of abuse for which the physical and psychological implications are less well understood, we will seek ways to prevent and assess physical and psychological effects of abuse.

The Program will support research focused on accurate detection of physical abuse and ways to distinguish abuse from unintentional injuries. Currently, little research is being done on the use of diagnostic tools in health care settings other than hospital EDs.

Specific areas of emphasis will include the following:

- We will encourage research into new diagnostic tools, interventions, and treatments to prevent, care for, and manage complications from abusive injuries or neglectful behavior.
- Calling attention to the need for research on aspects of abuse for which the physical and psychological implications are less well understood, we will seek ways to prevent and assess physical and psychological effects of abuse. This is critical because an estimated 1 child in 10 is sexually abused before the age of 18 (Townsend & Rheingold, 2013). Fewer than 40 percent of child victims, however, disclose their abuse (London, Bruck, Ceci, & Shuman, 2005).
- Because many different health care professionals could help in diagnosing child abuse, the Program will underscore the importance of multidisciplinary training and career development in understanding, diagnosing, and treating maltreated children

and providing abused children with social support.

- Because legal and social systems are often engaged when cases of abuse are suspected or substantiated, the Branch will support research to illuminate the ways in which these systems are engaged, the implications of system involvement for medical professionals, and the impact of this involvement on children's physical and psychological well-being. Engagement with legal and social systems is an important process in the continuum-of-care model.

Strategic Goal #2 of the Pediatric Trauma Research Program encompasses four research objectives:

- 2.1** Support research focused on the accurate and early detection and diagnosis of child maltreatment, including injuries sustained from the various forms of abuse and health complications that arise from undiagnosed abusive injuries or neglectful behavior.
- 2.2** Support research on novel diagnostic tools, interventions, therapies, and treatments to prevent, treat, and manage complications from abusive injuries or neglectful behavior.
- 2.3** Support research on aspects of abuse for which the physical and psychological implications are less well understood, including their assessment, aftereffects, and prevention.

The Program will encourage research that examines the ways in which physical and psychological trauma interact to affect children's health outcomes and overall well-being.

2.4 Support multidisciplinary training and career development in understanding, diagnosing, and treating maltreated children and providing them with social support.

STRATEGIC GOAL #3:
Encourage studies on the psychological trauma and emotional processes that occur along with physical trauma and that affect treatment, recovery, and well-being.

An estimated 19 percent of children with injuries experience significant post-traumatic stress symptoms (Kahana, Feeny, Youngstrom, & Drotar, 2006). Currently, most research supported by the NICHD and the PTCIB examines psychological and physical trauma independent of their interactive effects. That's why the Program will encourage research that examines the ways in which physical and psychological trauma interact to affect children's health outcomes and overall well-being. Our objectives and strategies under this strategic goal include:

- Identify which children are at greatest risk for psychological distress and develop

early-intervention strategies to mitigate this risk. The PTCIB's research will shed light on the ways in which psychological and physical trauma interact to affect recovery and well-being of injured and traumatized children.

- We will support the research necessary to develop assessment tools, intervention strategies, and treatments for children whose recovery from physical trauma is complicated by psychological trauma and distress. Developing trauma-screening instruments to be used in schools, primary care, and other settings is also an important priority.

Strategic Goal #3 of the Pediatric Trauma Research Program encompasses three research objectives:

- 3.1** Encourage research that examines the ways in which physical and psychological trauma interact to affect children's health outcomes and overall well-being.
- 3.2** Identify which children are at greatest risk for psychological distress and symptoms in response to trauma and develop early-intervention strategies.



Up to 60 percent of children and adolescents have been exposed to at least one trauma, including abuse, violence, death of a loved one, refugee status, war, or life-threatening illness or injury (Copeland, Keeler, Angold, & Costello, 2007). These rates are especially high among urban minority youth.

Because children suffering from disaster-related mental health issues require developmentally appropriate interventions, the Program intends to explore optimal timing of targeted interventions—inside and outside the hospital setting—to learn which interventions are most successful at different developmental stages, and to understand the mechanisms of successful adaptation.

3.3 Support the development of assessment tools, intervention strategies, and treatments for children whose recovery from physical trauma is complicated by psychological trauma and distress.

STRATEGIC GOAL #4:
Support the next generation of research on violence, exposure to violence, and violence-related injuries.

According to the Institute of Medicine (2012), there has been a shift from the assumption that violence is inevitable to the recognition that violence is preventable. Researchers have recognized the tendency for violent acts to cluster, spread, and mutate just as a virus causes disease symptoms and spreads. This strategic goal, therefore, aims to support several lines of research:

- An estimated 60 percent of children have been exposed to violence (Finkelhor, Turner, Shattuck, & Hamby, 2013). Exposure to

violence, whether as a victim or as a witness, is often associated with long-term physical, psychological, and emotional harm. To quell the “contagion of violence,” the Program seeks to enhance the understanding of why and how violence is instigated and the role that context plays in its spread.

- This Program will support research to help illuminate effective strategies across the continuum of care to prevent, intervene in, and reduce intergenerational violence.
- The Branch will continue calling for research on the topic of violence in general and promoting studies that address the prevention, treatment, and care of injuries and subsequent health conditions that are due to gun violence in particular.
- The Branch will support research to understand the mechanisms through which chronic exposure to violence relates to negative outcomes, including the psychological and biological pathways through which these experiences leave their mark.



Contagion of Violence

According to the Institute of Medicine (2012), there has been a shift from the assumption that violence is inevitable to the recognition that violence is preventable.



Strategic Goal #4 of the Pediatric Trauma Research Program encompasses two research objectives:

- 4.1** Support research on the contagion of violence that enhances our understanding of why and how violence is instigated and the role that context plays in its spread.
- 4.2** Support research that examines the different types of violence, the effects of short-term versus long-term exposure to violence, and the health consequences of such exposures.

**STRATEGIC GOAL #5:
Increase understanding of the effects of disasters on children and develop responses and preparedness to prevent trauma from these incidents.**

Disasters, including large events like Hurricane Katrina and local events such as house fires, disrupt the lives of millions of children each year. Children who are exposed to disaster are at risk for PTSD and other psychological disorders such as depression (Osofsky & Osofsky, 2013).

The Branch's Pediatric Trauma Research Program fosters research on the long- and short-term consequences of disasters for children. Studies will examine the biological and psychological effects on children and their families when they are exposed to disaster.

In addition, the Program has these aims:

- Children have unique needs in the wake of a disaster. Responders require specialized training to respond appropriately. In collaboration with emergency response networks, other Branches of the NICHD, additional Institutes and Centers of the



NIH, and other federal agencies, the PTCIB seeks to develop and evaluate the effectiveness of immediate responses intended to minimize disaster-related physical and psychological trauma.

- Because children suffering from disaster-related mental health issues require developmentally appropriate interventions, the Program intends to explore optimal timing of targeted interventions—inside and outside the hospital setting—to learn which interventions are most successful at different developmental stages, and to understand the mechanisms of successful adaptation.

Strategic Goal #5 of the Pediatric Trauma Research Program encompasses three research objectives:

- 5.1** Support research on the long-term effects of exposure to disaster on children.
- 5.2** Increase the understanding of appropriate responses to children immediately following a disaster.
- 5.3** Develop and evaluate treatments for disaster-related physical and psychological trauma.



Each year, violence and injury lead to nearly 900,000 deaths among the world's children, and tens of millions require hospital care for nonfatal injuries. Simply reproducing safe strategies that work for adults does not protect children sufficiently. Prevention programs that take into account the vulnerability of children and use a multidisciplinary approach are the most effective for reducing child deaths as a result of injury (Peden et al., 2008).

Pediatric Trauma, Injury Prevention, and Critical Illness in Global Contexts

Although trauma and injuries affect everyone regardless of age, gender, socioeconomic status, or geographic region, some populations are more vulnerable than others.

Risks Faced by Children Around the World

The World Health Organization and the United Nations Children's Fund indicate that children in developing countries are at higher risk for trauma and critical illness, because they face challenges associated with poverty and low income as well as other hazardous situations every day. Pedestrians, particularly children, on unsafe, poorly maintained roads, are vulnerable to injuries from road traffic, a leading cause of death and disability. Young children living in close daily contact with water for work, travel, and domestic and agricultural use, such as open canals, are at very high risk of drowning. People living in homes lacking safety devices and precautions are more vulnerable to the risk of fires and burns. Children without access to adequate nutrition, clean water, and sanitation facilities are at greater risk of dying from infection and critical illness, as are children without access to necessary vaccines.



The burden imposed by trauma is not confined to the physical consequences of a single, acute event. There is a risk of significant mental health consequences of child abuse, criminal victimization, domestic violence, rape, torture, war, terrorism, and natural and technological disasters.

Because the stresses of economic disadvantage and lack of resources have been linked to child maltreatment, children in low- and middle-income countries (LMICs) may be more vulnerable to various forms of child abuse, including human trafficking. Furthermore, exposure to violence and war in some countries may give rise to psychological trauma as well as physical trauma. Unfortunately, many regions have a shortage of mental health professionals and other health care providers available to respond to those needs.

Trauma can be devastating in LMICs, in part because of inadequate systems of emergency care at both the community and hospital levels as well as inadequate infrastructure, such as a dearth of paved roads, making emergency transport difficult. Compounding the problem is the fact that responsibility for injury prevention cuts across many administrative domains, including public health, criminal justice, and road safety (Fogarty International Center, 2010).

In light of these public health concerns, we offer the following strategic goal and objectives.

STRATEGIC GOAL #1:

Collaborate with the Fogarty International Center and other NIH Institutes and Centers to determine areas of mutual interest and where the Branch may make a unique contribution to the funded research portfolios.

The burden imposed by trauma is not confined to the physical consequences of a single, acute event. There is a risk of significant mental health consequences of child abuse, criminal victimization, domestic violence, rape, torture, war, terrorism, and natural and technological disasters. In addition to psychiatric disorders that can last for years, such as PTSD and depression, increased risk for severe functional impairment and disability creates a need for interdisciplinary researchers (e.g., public health professionals, psychiatrists, psychologists, nurses, neuroscientists, biologists, and researchers in prevention) to identify risk and protective factors to develop and share innovative models to prevent and treat trauma-related disorders and associated adverse functioning among children and adolescents living in LMICs (Fogarty International Center, n.d.).

The risk factors, treatment, and outcomes for critically ill children differ significantly across the spectrum of LMICs. These differences are a call to action to eliminate disparities and to ensure the best possible treatment around the globe for all critically ill children. More than that, however, these differences should be analyzed and utilized to improve outcomes for both ends of the economic continuum.

Strategic Goal #1 for the Branch’s global priorities encompasses five research objectives:

- 1.1** Conduct an analysis of currently funded projects to determine where there are opportunities for supplementing or extending research in LMICs that is of interest to the NICHD and consistent with the Branch’s priorities.
- 1.2** Build the field of researchers in disciplines across the PTCIB’s research continuum by supporting funding opportunities for training and career development.
- 1.3** Develop relationships with international researchers to find opportunities for collaboration.
- 1.4** Participate in or host an international meeting focused on the prevention of pediatric injury and best practices in pediatric emergency care and critical care for injured children.
- 1.5** Collaborate with partners throughout the NIH and other federal and international agencies to initiate a funding opportunity announcement calling for interdisciplinary researchers to address the spectrum of risks associated with trauma and injury among pediatric populations in global contexts.



Looking Ahead: Action Steps

Over the next 5 years, the Branch will put forward a number of efforts to achieve its mission and goals.

Scientific Research Initiatives

Through the Pediatric Critical Care Research Program, the Branch has renewed its focus on collaborative research and training. Both the Collaborative Pediatric Critical Care Research Network and the K-12 Pediatric Critical Care and Trauma Scientist Development Program were recompleted and funded, each for an additional 5-year project period.

The Branch launched a new initiative—the NICHD Consortium for Research on Pediatric Trauma and Injury Prevention—that will build research capacity by creating a consortium of collaborative teams to target critical gaps in research on pediatric trauma and injury prevention. Through this initiative, we expect to fund researchers to devise breakthrough ideas, concepts, and approaches to therapies in pediatric trauma and injury research. Through the collective expertise of the funded researchers, we hope to establish a national research agenda on pediatric trauma and injury prevention that will help us bring to fruition our vision of eliminating all forms of childhood trauma and critical illness.

Going forward, the Branch will use every funding mechanism available to it to initiate programs for which the NICHD is the lead Institute. In addition, it will collaborate with other Branches within the NICHD and seek out opportunities to join with federal and private partners to collaboratively fund research of mutual interest and priority.



more comprehensive and collaborative approach to addressing areas where multidisciplinary perspectives are needed.

We will identify targeted areas where focused attention is needed to resolve seemingly intractable public health problems and will create research programs focused on these targeted lines of inquiry. This will require us to use a combination of strategies, including supporting investigator-initiated research, letting contracts, and soliciting research projects.

Scientific Conferences and Meetings

Much of the work of federal program officials is accomplished through “the power of convening.” Scientific conferences and meetings allow us to shine a light on research and training gaps. They also provide an opportunity to bring together experts from across a variety of disciplines to share insights on leading-edge research, lend their expertise to the analysis of new developments in science and clinical practice, and produce recommendations to guide future research.

The Branch sponsored conference on multiple organ dysfunction syndrome to elucidate its disease process, causes, and unique clinical picture. We also plan to co-sponsor meetings with scientific societies as well as other partners to disseminate information to the scientific community and to the general public.

Research Portfolio Development

The Branch has a growing portfolio of research on a variety of topics in pediatric trauma and critical illness. However, we recognize the need to build a portfolio that captures the elements of our continuum-of-care framework to foster a

Where appropriate, we will participate in trans-NIH funding initiatives and assume secondary assignment on projects of particular relevance to the respective portfolios.

Special Projects

Over the next 5 years, the Branch will initiate special projects to help identify scientific topics in which it wishes to have a stronger investment or to discern whether such an investment is prudent. These projects may focus on a special population or on an emerging public health concern. The projects will be limited in time and scope. A prime example is the Branch’s special research program on children in military families with special health care needs.

We will also engage with various NICHD offices, such as the Office of Legislation and Public Policy, the Office of Health Equity, the Office of Global Health, and the Office of Science Policy Analysis and Communication, to participate in outreach campaigns, congressional briefings, and other activities to call attention to the specific populations of interest as well as the novel areas of science we support.

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