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POSTTRAUMATIC STRESS DISORDER AFTER
PEDIATRIC TRAFFIC-RELATED INJURY

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List of abbreviations used in text

ASD   Acute stress disorder

CARIT   Child and Adolescent Reactions to serious Injury and Trauma, the research
            program of which this study is a part

CAPS-CA   Clinician Administered PTSD Scale for Children and Adolescents

CASQ   Child Acute Stress Questionnaire

CBCL   Child Behavior Checklist

CHOP   The Children's Hospital of Philadelphia

CSRC   Child Stress Reactions Checklist

DSM-IV   Diagnostic and Statistical Manual of Mental Disorders - Fourth Edition

ED   Emergency Department

EMSC   Emergency Medical Services for Children Program

PCL   PTSD Checklist

PCL-C/PR   PTSD Checklist for Children - Parent Report

PTSD   Posttraumatic stress disorder

PTSIC   Posttraumatic Stress Inventory for Children

SASRQ   Stanford Acute Stress Reaction Questionnaire

STEPP   Screening Tool for Early Predictors of PTSD

TBI   Traumatic brain injury

Please see Table 1 for a complete list of titles and abbreviations for measures used in this study.

Executive Summary

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POSTTRAUMATIC STRESS DISORDER AFTER PEDIATRIC TRAFFIC-RELATED INJURY

Statement of the Problem
Trauma care for children injured in traffic crashes has focused on resuscitation and medical/surgical treatment of injuries, with far less attention given to the psychological consequences of the injury for the child and his/her family. Posttraumatic stress disorder (PTSD) has been identified as a central component in the trauma management of child victims and witnesses of abuse, violence and disasters, but has not yet been adequately studied as a potential consequence of unintentional injury in children. The effect of a child's injury on the development of PTSD in parents has also been largely unexplored. While studies of adult crash victims have documented psychological sequelae including PTSD, few studies have followed children prospectively after traumatic injury to be able to quantify the prevalence of acute and chronic traumatic stress responses, or to carefully assess the role of risk and protective factors. One challenge in identifying and treating PTSD post-injury is that symptoms may not manifest until months after the injury event. As a consequence, many patients may develop PTSD after trauma medical follow-up has ended, highlighting the importance of developing risk screening methods applicable in the acute care setting.

Research Objectives
The broad, long-term objective of this research project is to reduce the morbidity associated with pediatric traffic-related injury by identifying the key risk factors for posttraumatic stress disorder (PTSD) in injured children and their parents and incorporating this knowledge into new diagnostic and treatment strategies.

The specific aims of this study were to:
Specific Aim 1. Determine the prevalence of PTSD in children and their parents/guardians which develops within 4 months after pediatric traffic-related injuries;
Specific Aim 2. Determine the contribution of several specific risk factors to the development of PTSD within 4 months after pediatric traffic-related injuries;
Specific Aim 3. Develop and validate a PTSD risk assessment screening tool for use in the acute care setting.
Supplemental Aim 1. Analyze, in greater detail, several key risk or protective factors identified in the conceptual model of PTSD development after injury
Supplemental Aim 2. Evaluate and refine a model of the mechanisms through which parent symptoms may have an impact on child PTSD development.
Supplemental Aim 3. Conduct analyses that lay the groundwork for wider dissemination of a refined brief PTSD risk assessment tool.

Study Design and Methods
A prospective cohort of 360 children admitted to a Level 1 Pediatric Trauma Center for treatment of traffic-related injury was enrolled. Data collection methods included structured interviews and self-report checklists for children and parents, as well as abstraction of data from

medical records and the hospital's Trauma Registry. Children and their parents were assessed during the first month post-injury and again at least 3 months post-injury. The acute assessment included pre-injury individual and family characteristics and traumatic experiences, circumstances and perceptions of the index injury event, and acute stress reactions and pain ratings. Information regarding injury diagnoses and acute treatment was collected from the medical record and the hospital Trauma Registry. The follow-up assessment included measurement of the presence and severity of PTSD in the child and his/her parents as well as coping methods; pain ratings; functional, behavioral and family stress outcomes; and post-discharge treatment. A brief PTSD risk assessment tool was developed concurrently, as part of this study. A preliminary 45-item Pilot PTSD Risk Assessment Tool was administered to each subject as soon as possible after consent was obtained, but always prior to the administration of the acute assessment battery. A final, shorter screening tool was created based on modeling (separately) both child and parent PTSD outcome.

Findings
This research highlights the unmet psychological needs of children and their parents following injury and provides a new, theoretically-derived, empirically-based tool to aid in the delivery of improved services through triaging – the STEPP screener. Results of this study provide strong evidence that injured children and their parents may be affected by traumatic stress disorders and that early screening for PTSD risk is possible. The study also identified key factors in the etiology of PTSD that can inform development of preventive and treatment interventions. Many children and parents participating in this study experienced at least a few acute stress disorder (ASD) symptoms within the first month post-injury, suggesting that it is normative to experience at least transient traumatic stress after a child is hospitalized for traffic crash-related injuries. However, about 1 in 4 children and 1 in 3 parents experienced more severe and distressing ASD symptoms during the first month after a traumatic injury, and at the time of follow-up assessments (conducted an average of 6 months post-injury), about 1 in 6 children and parents still had clinically significant PTSD symptoms. Predictors of PTSD outcome for children included pre-existing factors (prior PTSD, behavioral/emotional concerns, family stress), factors associated with the event and its aftermath (exposure to frightening sights and sounds, acute pain), acute responses (elevated heart rate, child's and parent's acute stress symptoms), and factors occurring in the recovery period (degree of child's physical recovery, family stress, social support). A 12 item screening measure (named the Screening Tool for Early Predictors of PTSD, or STEPP), was developed. The STEPP demonstrated excellent screening tool properties: very high sensitivity and reasonable specificity for prediction of later PTSD outcome in injured children and in parents of injured children.

Recommendations
This study provides a strong scientific justification for the incorporation of psychological care into the treatment of injured children and their parents. These research findings and the known high exposure of children to traffic crashes and other injury events support the Emergency Medical Services for Children priority on development of model Emergency Department (ED) protocols to address mental health issues, and provide evidence for the importance of "developing and evaluating methods for screening and prevention of negative psychological sequelae, particularly traumatic stress, after unintentional pediatric injury" (an Emerging Issue for EMSC). These results also point to the need to incorporate further investigation in traumatic

stress into the research and care priorities for MCHB. Screening for and treatment of traumatic stress responses, particularly ASD and PTSD in the injured child and his/her parent, should be incorporated into the care of the injured child. The STEPP screener, after further validation and refinement, could be used in the acute care setting as a way to detect children and their parents at risk for developing later PTSD outcome, for purposes of triaging preventive mental health services. Knowledge of the development of PTSD following child injury, gained from this prospective study, should be incorporated into the creation of interventions for the secondary prevention of posttraumatic stress disorder following injury.

List of Products
Peer-reviewed articles

Kassam-Adams, N. & Fein, J. (in press: Clinical Pediatric Emergency Medicine). Posttraumatic stress disorder and injury.

Kassam-Adams, N., & Newman, E. (2002). The Reactions to Research Participation Questionnaires for Children and Parents (RRPQ-C and RRPQ-P). General Hospital Psychiatry, 24: 336-342.

Winston, F. K., Kassam-Adams, N., Vivarelli-O'Neill, C., Ford, J., Newman, E., Baxt, C., Cnaan, A., & Stafford, P. (2002). Acute stress disorder symptoms in children and their parents after pediatric traffic injury. Pediatrics. 109 (6): e90.

Baxt, C., Kassam-Adams, N., Nance, M., Vivarelli-O'Neill, C., & Winston, F.. (manuscript submitted). Assessment of pain in the pediatric injury patient: Child and parent perceptions.

Kassam-Adams, N. & Newman, E. (manuscript submitted). Child and parent reactions to participation in clinical research.

Kassam-Adams, N. & Winston, F. K. (manuscript submitted). The relationship between acute stress disorder and posttraumatic stress disorder in injured children and their parents.

Winston, F. K., Kassam-Adams, N., Garcia-España, J. F., Ittenbach, R., & Cnaan, A. (manuscript submitted). A new method for assessing risk of persistent posttraumatic stress in injured children and their parents.

Abstracts

Kassam-Adams, N.. Acute stress disorder in injured children: Assessment challenges and dilemmas. Presented at the 15th Annual Meeting of the International Society of Traumatic Stress Studies (ISTSS), Miami, November 1999.

Kassam-Adams, N. & Winston, F.K. Parents' posttraumatic stress symptoms after traffic-related injuries in children. Paper presented at the World Conference of the ISTSS, Melbourne, Australia, March 2000.

Winston, F.K. & Kassam-Adams, N. Meeting the psychological and emotional needs of children & parents after traffic-related injuries. Paper presented at the 2nd National Congress on Childhood Emergencies, Baltimore, March 2000.

Winston, F.K., Kassam-Adams, N., Vivarelli, C., Miller, G., & Cnaan, A.. Can parents accurately report acute stress responses in their injured children? Presented at the Regional Meeting of the Ambulatory Pediatrics Association, Boston, May 2000.

Kassam-Adams, N., Winston, F.K., & Vivarelli-O'Neill, C. Parent and child reports of acute stress disorder. Presented at the Annual Meeting of the American Academy of Child and Adolescent Psychiatry, New York City, October 2000.

Vivarelli-O'Neill, C., Kassam-Adams, N., & Winston, F.K. Examining acute stress disorder in children with traffic-related injuries. Presented at the Annual Meeting of the American Academy of Pediatrics, Chicago, October 2000.

Kassam-Adams, N., Winston, F.K., Vivarelli-O'Neill, C., & Stafford, P. Injury surveillance in a Level I Pediatric Trauma Center: Looking at acute stress disorder symptoms in children and parents after traffic crashes. Presented at the Annual Meeting of the American Public Health Association, Boston, November 2000.

Kassam-Adams, N., Winston, F., & Vivarelli-O'Neill, C. Acute stress symptoms in parents of injured children. Presented at the 16th Annual Meeting of the ISTSS, San Antonio, November 2000.

Vivarelli-O'Neill, C., Kassam-Adams, N., & Winston, F.K. Is pain related to acute stress disorder in injured children? Presented at the 16th Annual Meeting of the ISTSS, San Antonio, November 2000.

Kassam-Adams, N., Ittenbach, R., Winston, F.K., Vivarelli-O'Neill, C., & Cnaan, A. Screening for PTSD risk in traumatically injured children and teens. Paper presented at the 17th Annual Meeting of the ISTSS, New Orleans, December 2001.

Baxt, C., Kassam-Adams, N., & Winston, F. K. Correlates of acute stress symptoms in children after traffic injury. Poster presented at the 18th Annual Meeting of the ISTSS, Baltimore, November 2002.

Kassam-Adams, N., Winston, F. K , Baxt, C., Fein, J., Ittenbach, R. & Cnaan, A. Integrating screening for PTSD risk in the emergency medical setting. Poster presented at the 18th Annual Meeting of the ISTSS, Baltimore, November 2002.

Kassam-Adams, N., Winston, F. K., & Baxt, C. ASD and PTSD after pediatric traffic injuries. Paper presented at the 18th Annual Meeting of ISTSS, Baltimore, November 2002.

Kassam-Adams, N., Baxt, C., & Winston, F. K. Pediatric injury: Posttraumatic stress, recovery, and family impact. Paper presented at the 18th Annual Meeting of the ISTSS, Baltimore, November 2002.

Kassam-Adams, N. & Winston, F.K. ASD and PTSD in children injured in traffic crashes. Paper presented at the European Conference on Traumatic Stress, Berlin, Germany, May 2003.

Presentations

Kassam-Adams, N. Posttraumatic stress disorder in children and parents. Invited Advocacy Keynote at the Society for Pediatric Anesthesia / American Academy of Pediatrics, Section on Anesthesiology Winter Meeting, San Diego, February 2001.

Winston, F.K. & Kassam-Adams, N. Mental Health and Emergency Medical Services for Children. Invited plenary session at the 3rd National Congress on Childhood Emergencies, Dallas, April 2002.

Kassam-Adams, N. Screening and early intervention for children after trauma. Presentation (in Pre-Meeting Institute on Early Intervention after Trauma) at the 18th Annual Meeting of the ISTSS, Baltimore, November 2002.

Kassam-Adams, N. Pediatric injury and the Emergency Department: Posttraumatic stress responses in children and parents. Invited symposium lecture at the Annual Meeting of the American Pain Society, Chicago, March 2003.

Final Report: Posttraumatic Stress Disorder after Pediatric Traffic-Related Injury

I. Introduction

Nature of the Research Problem

Despite advances in the prevention and treatment of traffic-related injury, pedestrian, bicyclist, and motor vehicle occupant injuries remain the leading causes of death and acquired disability in children in the United States.[1] To date, trauma care has focused on resuscitation and medical/surgical treatment of injuries with the goal of full functional recovery[2], with far less attention given to the psychological consequences of the injury for the child and his/her family.[3, 4] Posttraumatic stress disorder (PTSD) has been identified as a central component in the trauma management of child victims and witnesses of abuse, violence and disasters,[5-9] but has not yet been adequately studied as a potential consequence of unintentional injury in children. Further, the effect of a child's injury on the development of PTSD in the parent/guardian has been largely unexplored. While studies of adult crash victims have documented psychological sequelae including PTSD, [10] the development and course of PTSD in children may vary from what is seen in adults[11] because posttraumatic responses in children and adolescents occur within the context of dynamic ongoing psychological and emotional development. [12] In addition, it is possible that children may manifest PTSD symptoms differently from adults. [13, 14] One challenge in identifying and treating PTSD is that symptoms may not manifest until months after the injury event. As a consequence, many patients may develop PTSD after trauma medical follow-up has ended, highlighting the importance of developing risk screening methods applicable in the acute care setting.

Objective & Hypotheses

The broad, long-term objective of this research project was to reduce the morbidity associated with pediatric traffic-related injury by identifying the key risk factors for PTSD in injured children and their parents and incorporating this knowledge into new diagnostic and treatment strategies.

The central hypotheses of the project were: 1) that the prevalence of psychological distress in children (including PTSD) after crashes is significant and warrants clinical attention; and 2) that those at risk for developing PTSD can be identified during the acute phase of care.

MCH Research Program Priorities Addressed

This investigator-initiated research project supported the 1998 Maternal and Child Health Bureau's research agenda, the aim of which was to facilitate applied research that promises substantial contributions to the advancement of maternal and child health services. The study contributes to the advancement of these services by improving the ability of health professionals to identify the need to deliver mental health services to children and their families following unintentional injury. The research addresses the following issues/priorities (as of 1998 when the study was proposed) of the MCH Research Program:

Primary – 5.4.6 Health care reform and managed care will likely bring about a shift from inpatient to outpatient care. Conduct studies that seek to document the impact of such a conversion on access to services, organization of services, and health status outcome. This issue has also been identified as a program-directed priority for FY 97-98. The shift from inpatient to outpatient care may also be seen in the delivery of trauma services. By definition, PTSD cannot be diagnosed until at least 1 month after the traumatic event; i.e., after the acute hospitalization has concluded and outpatient care has begun. Managed care may play a significant role in the identification and treatment of long-term sequelae of pediatric trauma, including PTSD. Managed care's current emphasis on the development of practice guidelines and on anticipatory care provides an opportunity to identify and then treat those at risk for PTSD following traffic-related injuries, thus potentially reducing psychological morbidity. In this study, the prevalence of PTSD was quantified in a population of patients who had been discharged from the hospital and a brief PTSD risk assessment tool was designed and tested. Future studies will test interventions guided by this tool.

Secondary – 1.11 – Conduct longitudinal studies on the consequences of children's chronic disorders on the health of individual mothers and fathers, particularly their physical health. As the leading cause of acquired disability in children, traffic injuries may also result in chronic disorders. The study quantified the prevalence of PTSD not only in children but also in their parents/guardians following pediatric traffic-related injury. PTSD, as a consequence of pediatric trauma, was assessed 4 months after the child's injury event (consistent with the time course to development of PTSD symptoms after other traumatic incidents).

Secondary - 5.1.7 – Conduct incidence and prevalence studies of injury morbidity in school-age children, and conduct randomized clinical trials of interventions designed to reduce exposure to the risk of injury in the environment. The study estimated the prevalence of psychological morbidity in children and their parents/guardians following traffic-related injury as manifested by PTSD. (In this study, no randomized clinical trials were conducted.)

This study also supports the EMSC priority on development of model Emergency Department (ED) protocols to address mental health issues (Objective A7 of the EMSC Five Year Plan) and many of the priority issues delineated in the interagency program announcement (PA 01-044) on research on emergency medical services for children. This work has contributed to the development of EMSC's work on mental health issues in emergency medical services for children. Preliminary findings were discussed at two relevant consensus conferences under EMSC auspices (see List of Products), and were presented in plenary sessions at the Second and Third National Congresses on Childhood Emergencies.

Purpose, Scope and Methods of the Investigation
The purposes of the research investigation were to quantify the prevalence of PTSD in children and parents following hospitalization for pediatric traffic-related injuries, to investigate the contributions of specific risk and protective factors for PTSD following traffic-related injury, and to develop a brief PTSD risk assessment tool practical for use in the acute care setting to identify those children at greatest risk for developing PTSD (who might benefit from further assessment and intervention). Risk factors investigated include the child's and family's pre-injury functioning; characteristics of the traumatic event and the injuries sustained; characteristics of

acute and follow-up care; the acute post-injury responses of children and parents; the child's post-injury behavioral and functional outcomes; and the child's and parent's stress and coping in the post-injury phase. The underpinning of these analyses was a theoretical model for the development of injury-related PTSD in children.

The specific aims of this study were to:

Specific Aim 1. Determine the prevalence of PTSD in children and their parents/guardians which develops within 4 months after pediatric traffic-related injuries;

Specific Aim 2. Determine the contribution of several specific risk factors to the development of PTSD within 4 months after pediatric traffic-related injuries;

Specific Aim 3. Develop and validate a PTSD risk assessment screening tool for use in the acute care setting to predict child PTSD outcomes.

In the final year of the original 3 year project period, a number of supplemental aims were identified for completion during the 4th (supplemental) year of project funding:

Supplemental Aim 1. Detailed analyses of several key risk or protective factors identified in the conceptual model of PTSD development after injury

    Supp. Aim 1a Describe child and parent assessment of the child's acute post-injury pain, and the relationship of this to later PTSD risk for injured children.

    Supp. Aim 1b. Describe child coping, parent coping, and the coping assistance that parents and friends provide to children post-injury.

Supplemental Aim 2. Evaluate and refine model of the mechanisms through which parent symptoms may have an impact on child PTSD development.

Supplemental Aim 3. Conduct analyses that lay the groundwork for wider dissemination of a refined brief PTSD risk assessment tool.

    Supp. Aim 3a. Extension of analyses regarding optimal PTSD risk assessment screening tool to develop a tool that predicts <u>parent</u> PTSD in addition to child PTSD.

    Supp. Aim 3b. Assess the equivalence of the screener's performance in several key sub-groups (grouped by injury severity, child age, and race/ethnicity).

In addition to these initial and supplemental aims, the research team added **secondary analyses** to determine the prevalence of acute stress disorder (ASD) in children and in parents, within the first month post-injury.

<u>Overview of study design and methods</u>

A prospective cohort of 360 children admitted to a Level 1 Pediatric Trauma Center for treatment of traffic-related injury was enrolled. Data collection methods included structured interviews and self-report checklists for children and parents, as well as abstraction of data from medical records and the hospital's Trauma Registry.

Children admitted to The Children's Hospital of Philadelphia (CHOP) for the treatment of traffic-related injuries over a 28 month period (July 1999 through October 2001) were eligible to participate in the study. Children and their parents were assessed during the first month post-injury and again at least 3 months post-injury. The acute assessment included pre-injury individual and family characteristics and traumatic experiences, circumstances and perceptions of the index injury event, and acute stress reactions and pain ratings. In addition, information

regarding injury type and severity and the nature of acute treatment was collected from the medical record and the hospital Trauma Registry. The follow-up assessment included measurement of the presence and severity of PTSD in the child and his/her parents as well as coping methods; pain ratings; functional, behavioral and family stress outcomes; and post-discharge treatment.

Recognizing the need to identify, during acute medical treatment, those children at greater risk for later PTSD, a brief PTSD risk assessment tool was developed concurrently with the comprehensive study described above. This approach afforded an efficient means of collecting detailed risk and protective factor data to contribute to the study of PTSD development in children while also providing a practical tool for use in the acute care setting. Based on literature review, preliminary findings and the extensive clinical experience of the Research Team, a preliminary 45-item Pilot PTSD Risk Assessment Tool was developed and administered to each subject as soon as possible after consent was obtained, but always prior to the administration of the acute assessment battery. A final, shorter screening tool was created based on modeling (separately) both child and parent PTSD outcome from items that were part of the Pilot PTSD Risk Assessment Tool.

Nature of the Findings
This study provides strong evidence that injured children and their parents may be affected by traumatic stress disorders and that early screening for PTSD risk is possible. The study also identified key factors in the etiology of PTSD that can inform development of preventive and treatment interventions.

Many children and parents participating in this study experienced at least a few ASD symptoms within the first month post-injury, suggesting that it is normative to experience at least transient traumatic stress after a child is hospitalized for traffic crash-related injuries. However, more severe distress was observed in a substantial subset of children (24%) and parents (35%) in the first month, and at the time of follow-up (on average, 6 months post-injury), 18% of children and 16% of parents still had clinically significant PTSD symptoms.

Predictors of PTSD outcome for children included (1) pre-existing factors: pre-existing PTSD symptoms, prior behavioral/emotional functioning as reported by the parent, prior family stress, (2) factors related to the event and immediate aftermath: degree of exposure to traumatic elements of the crash, elevated heart rate at ED triage, acute pain, (3) acute stress responses: child ASD severity, parent ASD severity, and (4) factors associated with the recovery period (assessed at follow-up): poorer physical recovery, family stress, social support. A 12 item screening measure (named the Screening Tool for Early Predictors of PTSD, or STEPP), was developed. The STEPP has excellent screening tool performance properties: sensitivity and reasonable specificity for prediction of later PTSD outcome in injured children and in parents of injured children.

II. Review of the Literature

Psychosocial consequences of pediatric trauma
Pediatric trauma has pervasive psychosocial consequences for the injured child and his/her family. Behavioral disturbances in children after trauma are common. [13, 15] Fears, school problems, anger and depression may follow traumatic injury. Personality changes, irritability, school learning difficulties, and memory and attention deficits are common following head injury in children. [16, 17] Psychological sequelae have also been described following fractures, spinal cord injuries, and burns[18-20]and occur regardless of the severity of the received injuries. Basson *et al.*[21] report a 35% prevalence of "chronic new substantial behavioral dysfunction" in traumatically injured children with relatively minor injuries, based on a retrospective telephone survey of parents using the Child Behavior Checklist (CBCL). A comparison group of children who had emergency appendectomies did not experience similar behavioral dysfunction, suggesting a primary role for the traumatic event itself rather than for the sudden hospitalization and surgery. While this study documented the presence of emotional and behavioral dysfunction in children following injury, the retrospective, cross-sectional study design could not account for pre-morbid conditions and had limited ability to assess the etiology of the behavioral changes. Among the potential psychosocial consequences of pediatric trauma, PTSD has not been adequately studied. [22]

Definitions of posttraumatic stress disorder (PTSD) and acute stress disorder (ASD)
PTSD is a constellation of symptoms and psychological reactions that may follow a traumatic experience. The hallmark symptoms of PTSD are alternate re-experiencing and avoidance of the trauma, with concurrent changes in arousal. [14] Re-experiencing symptoms include intrusive, unwanted thoughts and images related to the trauma. Avoidance symptoms can involve both physical avoidance of situations which resemble the traumatic experience, and psychological numbing or avoidance of reminders of the trauma.

The Diagnostic and Statistical Manual of the American Psychiatric Association (DSM-IV) sets out diagnostic criteria for PTSD which require that : 1) there be a traumatic stressor; 2) the person have at least 1 re-experiencing symptom, 3 avoidance symptoms, and 2 hyper-arousal symptoms; and 3) the disorder last for at least 1 month and cause significant impairment in functioning. [14] PTSD, in this conceptualization, is not limited to experiences of direct violence or injury. It may, in fact, follow an event or series of events in which the individual experiences intense fear, helplessness or horror, and in which there is actual or threatened death or serious injury to oneself or other people, [14] i.e., a parent/guardian can develop PTSD after witnessing or learning of his/her child's injury. The DSM-IV formulation of PTSD, while based primarily on studies of adults, does recognize some developmental differences in the way that children's symptoms may be manifested. For example, children may show fear, helplessness, or horror through "disorganized or agitated behavior" and may re-experience the trauma through repetitive play that re-enacts some aspect of the event. [14]

Symptoms of PTSD appear to be experienced by different individuals on a spectrum or continuum of severity, and even those who do not meet full diagnostic criteria for PTSD may experience clinically significant impairment in daily life. [23, 24] Thus, subsyndromal PTSD has been identified as worthy of clinical and research attention.

The diagnostic entity called ASD was added to the DSM diagnostic nomenclature in 1994. ASD consists of immediate psychological distress in response to trauma (the diagnosis of ASD is made when symptoms have endured for at least 2 days and no longer than 4 weeks). The ASD diagnosis requires the same constellation of symptoms as PTSD (re-experiencing, avoidance, and hyperarousal), with the addition of dissociative responses during and after the event ("peri-traumatic" dissociation). [14] Dissociative phenomena include the feeling that things are unreal, feeling "spaced out" or in a daze, and an inability to recall important aspects of the trauma. Individuals who do not meet diagnostic criteria for the dissociation symptoms of ASD may still experience significant distress and appear to be at risk for persistent posttraumatic stress symptoms, thus sub-syndromal ASD (meeting all criteria other than dissociation) has been identified as warranting clinical and research attention.[25]

Acute stress as a predictor of PTSD
ASD is hypothesized to be a primary indicator of risk for later PTSD[26, 27], though there are no studies documenting this in children. A number of adult studies have suggested that peri-traumatic dissociation may be especially predictive of an individual's higher risk for PTSD. [26, 28] Several prospective studies of adult survivors of motor vehicle crashes have found strong links between ASD symptoms and later PTSD. [29] In a 7-year follow-up of young adults who were involved in a bus-train collision as children, Tyano et al. found that acute stress symptoms were strongly related to long-term maladjustment. [30] For children, parents' acute reactions have also been identified as a potentially powerful predictor of later PTSD development. [31, 32] The identification of ASD as a potentially useful predictor of risk has led to suggestions that acute assessments might be used to guide intervention efforts. McFarlane observed that "victims with high levels of acute distress should be targeted for subsequent interventions." [33] Lundin raised the possibility that the development of PTSD can be prevented by treating ASD through the use of crisis intervention, focused psychotherapy and psychopharmacology. [34] March[35] suggested that EMS providers, with appropriate acute risk assessment at the emergency care setting, might be able to provide effective early interventions to minimize psychological sequellae of trauma.

PTSD in children and adolescents
PTSD has been identified in adults who sustain traumatic injury. [10, 36-40] However, very few published empirical studies have followed children prospectively after unintentional traumatic injury to examine the prevalence of PTSD. Children and adolescents experiencing (or witnessing) family and community violence, natural disasters, war, and other traumas have been diagnosed with PTSD. [41] Prevalence rates range from 6% for children exposed to natural disaster to 58% for children exposed to a sniper attack at school. [42] According to a comprehensive review by Fletcher, [13] children traumatized by a variety of stressors on average have an incidence rate of 30% for each of the DSM-IV criteria for PTSD and children are at least as likely as adults to be diagnosed with PTSD. In comparing victims of "acute, non-abusive" stressors (such as traffic accidents) to victims of chronic or abusive stressors, Fletcher found that the former were more likely to experience intrusive memories, hypervigilance, generalized anxiety, difficulty concentrating, somatic complaints, decreased interest in activities, and social withdrawal. [13] For children who sustain physical injuries, Basson et al.[21] concluded that "pediatric post-traumatic behavioral dysfunction appears common and substantial" and called for further study of the relationship of these behavioral disturbances to PTSD.

An evolving understanding of PTSD in children has led clinicians and researchers to begin to elucidate the ways in which children's posttraumatic presentation may vary from adults'. [11, 12]For example, children may demonstrate re-experiencing of traumatic material in repetitive play themes, while a child's emotional constriction or avoidance of traumatic reminders may be quite private and go unnoticed by adult caretakers. The developmental implications of trauma for children have also been explored. [12, 43]Each child's developmental stage and competencies form the context within which he or she experiences and understands a traumatic event. Additionally, children's posttraumatic responses both affect and are affected by normal ongoing processes of cognitive, emotional and social/interpersonal development.

Prospective studies of pediatric PTSD following unintentional injury
Di Gallo et al.[27] conducted the first published prospective study of PTSD in children following traffic-related injuries. (The only one published before the current study was underway.) Participants were 57 children involved in traffic crashes and treated at hospital EDs in Scotland. Children were assessed for posttraumatic stress symptoms acutely and 3 to 4 months following injury. 36% of these children at initial assessment, and 14% at follow-up, reported moderate to severe PTSD symptoms. This study suggested the presence of significant posttraumatic stress symptoms in children following traffic injuries; however, determination of PTSD status, based on DSM-IV diagnostic criteria, was not established.

While the current study was underway, several reports of investigations of posttraumatic stress in injured children were published. Stallard et al[44] assessed 119 children aged 5-18 years involved in traffic crashes in Bath, England by semi-structured interviews conducted between 3 weeks and 11 weeks after the crash. The prevalence of PTSD, according to DSM-IV criteria, was 34%. Only 3% of a control group of sports-injured children suffered PTSD, suggesting the importance of the traffic crash as a precipitant for PTSD. Aaron et al[45] found that 22.5% of a sample of 40 children reported significant PTSD symptoms 3 to 7 weeks after hospitalization for traumatic injury. Daviss et al[46] found that 12.5% of a sample of 48 children hospitalized for a traumatic injury had diagnostic PTSD when assessed 1 to 9 months post-injury. Levi et al[47] compared rates of "clinically significant post-traumatic stress symptoms" (but not diagnostic PTSD) 6 and 12 months post-injury among 59 children hospitalized for orthopedic injury (22% at 6 months; 29% at 12 months), 44 hospitalized for moderate TBI (18% at 6 months; 21% at 12 months), and 37 hospitalized for severe TBI (42% at 6 months; 49% at 12 months). These studies did not include comprehensive assessment of risk factors for PTSD, and the incidence of PTSD in parents of injured children was not assessed.

PTSD as a complex multi-factorial process
Multiple risk factors for PTSD have been hypothesized. In a review of the PTSD literature, Meichenbaum[48] found 58 general vulnerability factors classified into 3 factors that affect PTSD outcome in adults: objective characteristics and subjective meanings of the disaster (or traumatic event), the post-disaster response (of the individual, group, and family) and pre-disaster characteristics (demographics, previous traumatization, recent life events, psychiatric history, coping and social support). In children, as in adults, the development of PTSD is a complex, multi-factorial process. A common finding is that the risk of developing PTSD is related to the type, severity and level of exposure to the traumatic event (i.e., severe, sudden, unexpected and

prolonged), mediated by the pre-existing psychological health and coping resources of the child and the child's social network. [5, 49-52]

The literature on PTSD strongly indicates that the individual's pre-existing psychological functioning plays a role in determining the outcome of trauma exposure. In particular, pre-existing psychiatric or behavioral syndromes may predispose a child to problematic responses to trauma. [13] In addition, previous exposure to multiple traumas increases the chance that a child will exhibit PTSD symptoms. [13] The literature suggests that secondary stressors and additional traumatic events will increase an individual's likelihood of developing PTSD. [48] Children's experiences during EMS ambulance transport and during acute treatment have not been extensively studied as potential contributors to acute and chronic posttraumatic psychological sequelae. Intrusive procedures may in themselves be traumatic. For example, case reports suggest that intubation after respiratory arrest may lead to posttraumatic symptoms in children and in family members. [53, 54] In the aftermath of injury, the role of persisting physical limitations[55] or of behavioral disturbances[56] has been highlighted by different investigators as a primary determinant of parental distress and disrupted family functioning. Families caring for an injured child may face challenges for which they are not prepared and may experience significant distress. Persistent limitations of physical function are common following pediatric trauma and range from 50% to 80% at six months post-discharge and from 38% to 70% at one year. [55, 57-59] Osberg et al.[60] documented a significant impact of pediatric injuries on families' work lives and economic status, with 40% of families still reporting work and economic effects at 6 months post-injury. Wesson et al.[55] found that mothers of trauma patients, regardless of injury severity, reported a significant level of anxiety and depression symptoms, greater than those reported by mothers of emergency appendectomy patients.

Pain, as a risk factor for the development of PTSD, has not been explored in children. Pain has been reported to be a key component of the psychological sequelae to motor vehicle accidents in adults. [61, 62] Ptacek et al.[63] found, in a study of adult burn patients, that higher pain levels in the acute care period predicted poorer psychological adjustment, and that social support moderated the effects of pain on PTSD risk. One Israeli case study[64] of a severely injured adult suggested that pain may be a strong enough stressor in traumatic circumstances to cause development of PTSD, thus highlighting the importance of prompt and adequate pain management in survivors of traumatic injury.

Summary of literature review
Significant psychosocial consequences, including psychological distress and behavior changes, have been observed in children involved in traffic crashes. These psychological sequelae often go unrecognized and untreated in children. The relatively few empirical studies published to date concerning the development of posttraumatic symptoms in children following traffic crashes suggest that these symptoms may be fairly common. The development of PTSD is influenced by the characteristics of the traumatic event, by the pre-existing psychological functioning of the individual and his/her family, and by the individual's post-event reactions and experiences. Acute stress responses of individuals have been found to be strong predictors of the risk of developing later PTSD. For children, preliminary results of other studies available at the time this study was conceived indicated that parents' acute responses may be crucial. Other risk factors include pain, the child's experiences during emergency transport and treatment, persisting

physical limitations, and behavioral changes in the child. Families caring for an injured child may experience considerable distress and increased financial and psychological burdens.

Few studies have followed children prospectively after traumatic injury to be able to delineate the prevalence of acute and chronic traumatic stress responses (ASD and PTSD), or to carefully assess the role of risk and protective factors. The current study addressed gaps in the research literature to date by a) utilizing a prospective study design to follow a large cohort of children treated for traffic-related injuries, b) employing measures of ASD and PTSD that allow for DSM-IV diagnoses and a continuous measure of symptom severity, and c) testing the contribution of a number of key risk factors that may predict the development of later PTSD in injured children and their parents, in order to design a brief PTSD risk assessment tool that can guide the identification and treatment of children and parents at highest risk for PTSD.

Figure 1: Conceptual model for development of child PTSD after injury
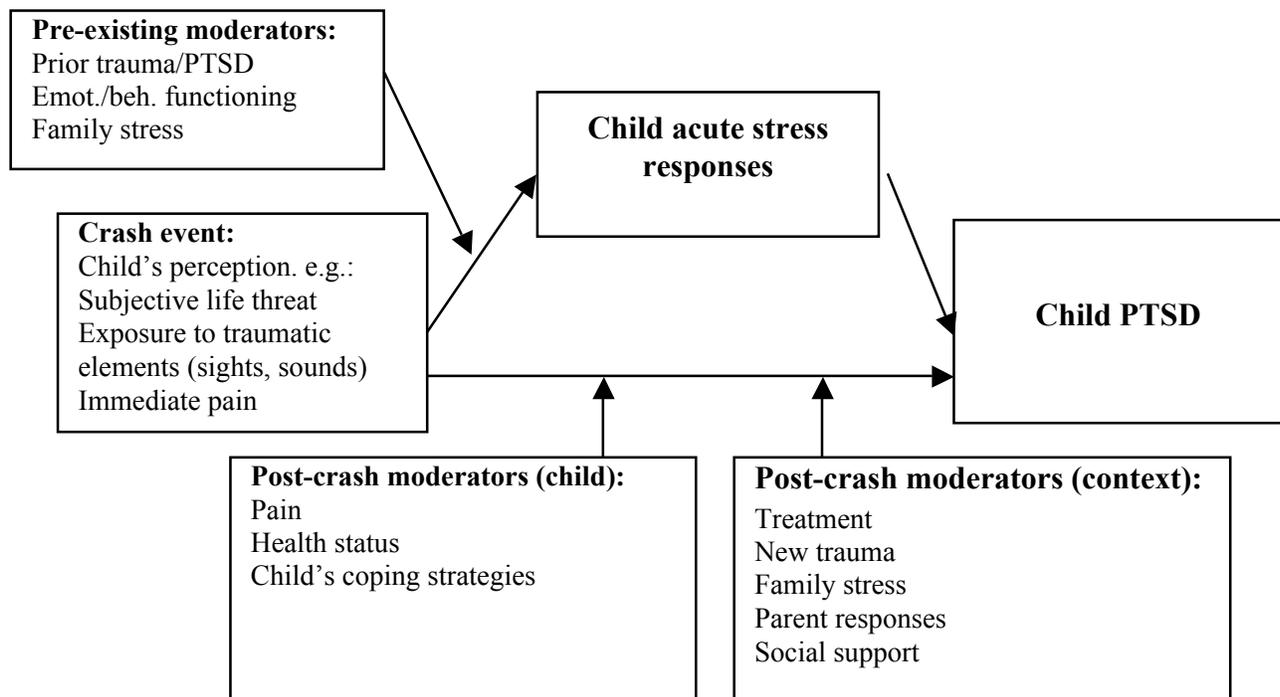
III. Study Design and Methods

A. Study Design

A prospective cohort of children admitted to a Level 1 Pediatric Trauma Center for treatment of traffic-related injury was enrolled. In this cohort, the prevalence and development of PTSD in children post-injury was examined. The underpinning of the analysis was a theoretical model for the development of injury-related PTSD in children. (See Figure 1.) Concurrently, using the same cohort, a clinically useful brief PTSD risk assessment tool was developed. A prospective cohort design was chosen because our pilot data suggested a high prevalence of PTSD in children and parents/guardians following traffic-related injuries, which appears to develop over a relatively short period of time. The prospective nature of our cohort design had the advantage of minimal selection bias because the diagnosis of PTSD was not known at the time of enrollment of the subjects. PTSD following unintentional injury is largely undiagnosed and cannot, by definition, be diagnosed immediately following a traumatic event. Finding cases more than one month post-injury would be difficult and would introduce significant retrospective recall bias concerning pre-existing, event-specific, and acute care descriptions.

B. Methods

We enrolled a consecutive cohort of children (age 5 to 17) hospitalized at a Level I Pediatric Trauma Center for injuries sustained as a pedestrian, bicyclist, or motor vehicle passenger, and we enrolled one parent per child. Children were not eligible for the study if they or their parents did not speak English well enough to complete an interview, if the child had cognitive limitations that would preclude responding to an interview, or if they lived beyond a 2-hour travel distance from the hospital (to enable the team to complete home-based interviews). To be eligible to participate, an adult had to be a custodial parent (or guardian), live with the index child, and have (or share) primary responsibility for the child's care. Interviewers spoke to the first available parent (or guardian) who met these criteria. In accordance with an IRB-approved protocol, after receiving a complete description of the study, parents of eligible children were asked for written consent to their child's and their own participation in the study; after parental consent was obtained, children were asked for their own verbal or written assent to participate.

Initial administration of the pilot screening tool was done as soon as possible after consent was obtained, often during the child's hospital stay. In order to reduce participant burden and promote inclusion of as many participants as possible, acute and follow-up interviews were conducted in the family's home by field-based interviewers. ASD symptoms were assessed within one month of injury, and PTSD symptoms were assessed at least three months post-injury. At each assessment point, separate interviews with the child and the parent were conducted. Throughout each interview, interviewers assessed the child's level of participation, and watched for signs of fatigue or distress, and suggested breaks between interview segments if needed. All participants were reminded at the end of each interview of the availability of the hospital's trauma social worker for assistance.

C. Measures and Instruments Used

Table 1: SUMMARY OF TESTS / MEASURES FOR EACH CONSTRUCT

Construct / variable	Measure(s)
Predictors of PTSD risk	
Predictors from multiple domains	45-item Pilot PTSD Risk Assessment Screening Tool
Pre-existing	
Child's pre-injury behavior	Child Behavior Checklist (CBCL)
Child's previous trauma	Traumatic Events Screening Inventory (TESI-C & TESI-P) *child & parent report versions*
Child's prior PTSD	Child and Adolescent Trauma Survey (CATS) symptom scale
Family stress	Life Experiences Survey (LES)
Parent social support	Duke Social Support Scale (DSSS)
Traumatic event and injury	
Severity of exposure to event	**Exposure survey (child & parent report) created for this study**
Injury severity	Injury Severity Score (ISS)
Acute phase	
Pain	Bieri Faces Pain Scale (BFPS) & Colored Analogue Scale (CAS) *both scales used for child & parent report*
Child acute stress symptoms	Child ASD Questionnaire (CASQ) - child report Child Stress Reaction Checklist (CSRC) - parent report
Parent acute stress symptoms	Stanford Acute Stress Reaction Questionnaire (SASRQ)
Acute treatment	Data obtained from hospital Trauma Registry
Post-hospital phase	
"New" traumatic events	Brief parent-report version of TESI-P
Post-hospital treatment	Treatment Checklist (completed by parents) created for this study
Pain	Bieri Faces Pain Scale (BFPS) & Colored Analogue Scale (CAS) *both scales used for child & parent report*
Functional status & physical recovery	Child Health Questionnaire (CHQ) - physical health subscales
Family stress	Impact on the Family Scale (IFS)
Parent coping	Coping Health Inventory for Parents (CHIP)
Parent social support	Duke Social Support Scale (DSSS)
Parent PTSD	PTSD Checklist (PCL)
Primary outcome of interest (dependent variable)	
Child PTSD (child report)	8 & older: Clinician-Administered PTSD Scale for Children and Adolescents (CAPS-CA) 7 & under: Posttraumatic Stress Inventory for Children (PTSIC)
Child PTSD (parent report)	PTSD Checklist for Children / Parent Report (PCL-C/PR)

<u>D. Statistical techniques employed</u>

1. Sample demographic and injury characteristics
Demographic and injury characteristics of the sample were summarized using descriptive statistics, and we examined key variables graphically to explore key relationships between variables. Cronbach's alpha was calculated, for all appropriate measures, to assess the internal consistency of these measures in the current sample.

Demographic and injury characteristics of participants completing the follow-up assessment were compared to those lost to follow-up with student's t-tests or Wilcoxon tests for continuous variables and with Chi-square or Fisher's exact tests for categorical variables.

2. Prevalence of PTSD (Specific Aim 1) and ASD (Secondary Analysis)

For PTSD outcomes, in addition to scoring each PTSD measure for the presence of PTSD by DSM-IV symptom criteria, we also scored each measure for the presence of "sub-syndromal PTSD", defined as at having least one moderate to severe symptom in each category (re-experiencing, avoidance and hyper-arousal) and impairment from these symptoms.

For ASD outcomes, in addition to scoring each ASD measure for the presence of ASD by DSM-IV symptom criteria, we also scored each measure for the presence of "sub-syndromal ASD", defined as meeting all symptom criteria for ASD except the dissociation criterion.

Prevalence estimates for child PTSD were generated by calculating the proportion of children:
- with a diagnosis of PTSD using the CAPS-CA data (child interview for age 8 -17)
- with a diagnosis of PTSD using the PTSIC data (child interview for age 5 - 7)
- with sub-syndromal PTSD, using the CAPS-CA data
- with sub-syndromal PTSD, using the PTSIC data

Confidence intervals for these proportions were calculated using exact binomial 95% confidence intervals.

Prevalence estimates for parent PTSD were generated, using the PCL (parent report of self) data, by calculating the proportion of parents
- with a diagnosis of PTSD
- with sub-syndromal PTSD

Confidence intervals for these proportions were generated using exact binomial 95% confidence intervals.

Prevalence estimates for child ASD were generated by calculating the proportion of children:
- with a diagnosis of ASD, using the CASQ (child report) data.
- with sub-syndromal ASD, using the CASQ data.

Confidence intervals for these proportions were generated using exact binomial 95% confidence intervals.

Prevalence estimates for parent ASD were generated, using SASRQ (parent report of self) data, by calculating the proportion of parents:
- with a diagnosis of ASD

- with sub-syndromal ASD

Confidence intervals for these proportions were generated using exact binomial 95% confidence intervals.

3. Severity of PTSD (Specific Aim 1) and ASD (Secondary Analysis)

The following analyses were performed for CAPS-CA and PTSIC severity scores (to describe child PTSD severity) and for PCL severity score (to describe parent PTSD severity):
- General descriptions of severity were carried out using measures of central tendency, variability, skewness, and kurtosis. Boxplots and histograms were generated to visually illustrate distributional properties. Continuous variable distributions differing markedly from normality were transformed by using the square root function.

The following analyses were performed using CASQ (child self-report) and CSRC (parent report) severity scores to describe child ASD severity, and using SASRQ severity score to describe parent ASD severity.
- General descriptions of severity were carried out using measures of central tendency, variability, skewness, and kurtosis. Boxplots and histograms were generated to visually illustrate distributional properties. Continuous variable distributions differing markedly from normality were transformed by using the square root function.

4. Association of potential risk or protective factors with PTSD outcome (Specific Aim 2)

Bivariate associations of potential risk or protective factors with PTSD outcome were calculated via spearman rank-order correlation tests. Key factors associated with PTSD outcome were considered candidate predictors for further analyses. A multiple linear regression analysis was performed to model PTSD outcomes for children 8 to 17 years of age. Since the PTSD severity score was not normally distributed, a square root transformation of the dependent variable was applied.

5. PTSD Risk Assessment Screening Tool (Specific Aim 3)

The final screening tool was derived from a pool of 50 items (45 from the Pilot PTSD Risk Assessment Tool plus 5 items easily obtainable from the child's medical record). Among these 50 items, 32 were hypothesized to predict child posttraumatic stress. A distinct but overlapping set of 32 items was hypothesized to predict parent posttraumatic stress. Children age 8 to 17, and their parents, who had completed both the Pilot Brief PTSD Risk Screening Tool and a follow-up interview, were included in these analyses. (Children age 5 to 7 and their parents were not included because of concerns about differing scoring rules for the PTSD outcome measure used to assess these younger children.) For purposes of prediction a positive PTSD "case" was defined as meeting criteria for PTSD or for subsyndromal PTSD (as defined above in Section III.D.2).

Data analysis to create the final tool proceeded in several stages. First, the frequency and variability of each potential predictor item and its association with the outcome were assessed;

those items associated with the child or parent PTSD outcome at the p<.20 level were retained as candidate predictors for further analyses.

Second, multiple logistic regression analyses were performed separately to model PTSD outcomes for children (Aim 3) and parents (Supplemental Aim 3a). We used a best subset approach, in which the best models containing one, two, or three variables, and so on, were selected at each step. A best model was identified based on comparing the log likelihood estimates. No more variables were added to models when addition did not produce a significant increase in the log likelihood. In this approach, it was possible to have more than one best model with comparable likelihood. In selecting between models with equivalent performance, we examined these quantitative results in light of theoretical considerations (coverage of key domains for PTSD etiology) and practical considerations (e.g., the generalizability of item wording to various types of pediatric injury beyond traffic-related injuries).

Once the best models were identified, we constructed the receiver operating characteristic (ROC) curves, examined the area under the curves (AUC), and determined the cut-off scores that achieved maximum sensitivity while maintaining reasonable specificity, accounting for positive and negative predictive values. A scoring rule was generated for clinical use of the final child and parent screening tools, and odds ratios, with 95% confidence intervals, were calculated.

6. Supplemental Aim 1a. Describe child and parent assessment of the child's acute post-injury pain, and the relationship of this to later child PTSD risk.

Pain ratings of the child (Bieri FPS and CAS), by parents and children, were summarized using descriptive statistics. The relationship between parent and child ratings of child acute worst pain was assessed by Spearman correlations (because the distribution of the pain scores was skewed) and by graphic representations of parent vs. child ratings. Agreement between parent and child ratings of child pain was assessed with Kappa statistics. Discrepancy scores (parent minus child rating of the child's pain) were calculated.

Spearman correlations and scatterplots were used to evaluate associations between: a) child pain reports and child PTSD severity and b) parent-child discrepancy scores (for pain ratings) and child PTSD. Examination of scatterplots strongly suggested a curvilinear relationship between parent-child discrepancy and child PTSD severity. We fitted a regression model having child PTSD severity as the dependent variable and the parent-child discrepancy score as the predictor; a linear as well as quadratic terms were included.

7. Supplemental Aim 1b. Describe child coping, parent coping, and the coping assistance that parents and friends provide to children post-injury.

Child coping strategies (Kidcope), parent coping strategies (CHIP), and coping assistance provided to child by parents and friends (CCAC) were summarized with descriptive statistics.

8. Supplemental Aim 2. Evaluate and refine model of the mechanisms through which parent ASD symptoms may have an impact on child PTSD development.

To test the hypothesis that parent ASD symptoms were associated with the degree of discrepancy between parent and child ratings of the child's ASD severity, we created discrepancy scores for parent vs. child ratings of the child's ASD symptom severity. We first standardized the distribution of the child-report and parent-report child ASD scores. As a second step, we calculated the difference between parent rating and child rating by subtracting the standardized child rating from the standardized parent rating. We created scatter plots of these discrepancy scores (y-axis) versus the parent rating of his/her own ASD symptom severity (x-axis).

To test the hypothesis that the degree of parent-child discrepancy concerning the child's ASD symptoms and severity was associated with child PTSD outcome, we examined the relationship between this discrepancy and child PTSD severity scores. Spearman correlations and scatterplots were used to evaluate associations between parent-child discrepancy scores (for ASD severity) at the time of the acute assessment and child PTSD severity at follow-up. Examination of scatterplots strongly suggested a curvilinear relationship between parent-child discrepancy and child PTSD severity. We fitted a regression model having child PTSD severity as the dependent variable and the parent-child discrepancy score as the predictor; a linear as well as quadratic terms were included.

9. Supplemental Aim 3a. Extension of analyses regarding optimal PTSD risk assessment screening tool to develop a tool that predicts <u>parent</u> PTSD in addition to child PTSD.

Analyses conducted as part of analyses for Aim 3 (see above.)

10. Supplemental Aim 3b. Assess the equivalence of the screener's performance in several key sub-groups (grouped by injury severity, child age, race/ethnicity, and gender).

To assess the performance of the STEPP screening tool in predicting PTSD outcome in several key sub-groups, we calculated the sensitivity and the specificity of the STEPP within each group. The key sub-groups were: children with and without an AIS2+ injury, children 8 to 11, children 12 to 17, Black children, White children, boys, and girls.

IV. Presentation of Findings

<u>Sample demographics & injury characteristics</u>

Over a 28-month recruitment period (July 1999 through October 2001), we enrolled 360 subjects in the cohort. (413 subjects completed the Pilot PTSD Risk Assessment Tool, and 360 of these completed an acute assessment). Of these subjects, 302 subjects and their parents completed both acute and follow-up assessments. Acute assessments of injured child and one parent took place within a month of injury (mean = 17 days post-injury, range 3 - 43 days; 90% were conducted within 30 days post-injury). Follow-up assessments took place at least 3 months post-injury (mean = 6.5 months, range 3 - 13 months; 93% were conducted within 9 months post-injury). No differences were found in demographic characteristics, mechanism of injury, admission to the intensive care unit, or severity of injury between those who completed both assessments and those lost to follow-up.

Table 2. Child demographic and injury characteristics for all cases with an acute interview (N = 360), and characteristics of parents who completed an acute interview (N = 353):

	N (%)	Mean (SD) or Median; Range
Child age		9.8 (3.2); 5 to 17 years
5 - 7 years	106 (29%)	
8 – 11 years	140 (39%)	
12 – 17 years	114 (32%)	
Child gender		
Male	259 (72%)	
Female	101 (28%)	
Race / ethnicity		
White	138 (38%)	
Black	203 (56%)	
Other race / ethnicity	19 (6%)	
Circumstances of child injury		
Pedestrian struck by vehicle	135 (38%)	
Motor vehicle passenger in crash	63 (18%)	
Bicyclist struck by vehicle	68 (19%)	
Bicycle fall	94 (26%)	
Injury & admission characteristics		
At least one moderate to severe injury (AIS 2+)	302 (84%)	
Extremity fracture	153 (43%)	
Loss of consciousness	63 (18%)	
Injury Severity Score	--	Median = 5; 1 to 38
Glasgow Coma Score (at ED admission)	--	Median = 15; 3 to 15
Length of hospital stay	--	Median = 2 days; 1 to 35 days
Admitted to ICU	102 (28%)	
Parent relationship to child		
Mother	287 (81%)	
Father	34 (10%)	
Other legal guardian	32 (9%)	
Parent involvement in crash		
Directly involved – injured	15 (4%)	
Directly involved – not injured	50 (14%)	
Eyewitness	12 (3%)	
Not present at time of crash	276 (78%)	

Specific Aim 1: PTSD prevalence

Children
- 5% [95% CI: 3% - 8%] of the children in the study developed PTSD,
- an additional 13% [95% CI: 9% - 18%] developed sub-syndromal PTSD.

- Among children age 8 to 17, regardless of diagnostic status, 46% [95% CI: 20% - 33%] reported some impairment from PTSD symptoms.

- Among children age 5 to 7, regardless of diagnostic status, 14% of their parents [95% CI: 8% - 23%] reported that the child had impairment from PTSD symptoms (self-reported impairment was not assessed in this youngest age group).

Parents
- 10% [95% CI: 7% - 14%] of parents developed PTSD themselves,
- an additional 6% [95% CI: 3% - 9%] developed sub-syndromal PTSD.

- Regardless of diagnostic status, 27% [95% CI: 22% - 32%] of the parents reported some impairment from PTSD symptoms.

Secondary analysis: ASD prevalence

Children
- 10% [95% CI: 7% - 13%] of the children in the study developed ASD,
- an additional 14% [95% CI: 10% - 18%] developed sub-syndromal ASD,

Parents
- 11% [95% CI: 8% - 15%] of parents developed ASD themselves,
- an additional 24% [95% CI: 19% - 28%] developed sub-syndromal ASD.

Specific Aim 2: Risk and protective factors for PTSD development in children

The following analyses were limited to children age 8 to 17 and their parents. Analyses of children age 5 to 7 included in this study will be conducted separately due to the need to use a different, developmentally-appropriate PTSD outcome measure.

Table 3 presents associations between key variables (potential predictors hypothesized in our conceptual model for PTSD development) and PTSD severity.

Table 3. Univariate associations with child or parent PTSD severity
Children 8 to 17 (N=243) and their parents (N=234); p value listed if less than .20

	Child PTSD result (p)	Parent PTSD result (p)
Child age	r = .10 (.17)	r = .14 (.09)
Child sex	Girls higher (.04)	(NS)
Child race	(NS)	Black > White (.00)
Prior anxiety/depression (CBCL Internalizing score)	r = .26 (.001)	r = .19 (.03)
Prior behavior/attention problems (CBCL Externalizing score)	r = .27 (.001)	r = .27 (.001)
Prior traumatic events experienced by child (TESI)	r = .26 (.001)	-------
Parent response to prior traumatic events experienced by child	---------	r = .18 (.02)
Prior traumatic events for parent (TESI)	---------	r = .27 (.001)
Pre-existing child PTSD symptoms (month before crash)	r = .40 (.001)	r = .20 (04)
Prior stressors for family (LES)	r = .18 (.02)	r = .27 (.001)
Degree of exposure to crash event (e.g., sights, sounds)	r = .16 (.04)	-------
Participating parent was directly exposed to the crash	----------	(NS)
Injury severity (ISS)	r = -.01 (NS)	r = .20 (.02)
Injury severity -- presence of moderate/severe injury (AIS 2+)	r = .01 (NS)	r = .23 (.005)
Glasgow Coma Score	r = -.13 (.09)	r = -.13 (.13)
Loss of consciousness	r = .15 (.05)	r= .16 (.06)
Heart rate at ED triage	r = .13 (.09)	------
Child's worst pain in first month	r = .31 (.000)	r = .29 (.000)
Child ASD severity (self report)	r = .56 (.000)	r = .31 (.000)
Child ASD severity (parent report)	r = .39 (.000)	r = .58 (.000)
Parent ASD severity	r = .36 (.000)	r = .55 (.000)
# of school days child missed	r = .20 (.01)	r = .36 (.001)
# of work days missed by parent	--------	r = .14 (.11)
Other illnesses after index injury	r = .09 (NS)	-------
Child's physical recovery (by time of follow-up)	r = -.35 (.001)	r = -.49 (.001)
Child's pain at follow-up	r = .38 (.000)	r = .49 (.000)
Interim traumatic events (after index event)	r = .14 (NS)	r = .30 (.000)
Ratings of impact on family from injury event	r = .35 (.001)	r = .45 (.001)
# of types of coping child used	r = .58 (.000)	-------
Specific types of coping used by child	r's = .16 to .43	-------
Specific types of coping assistance provided by parent	r's = -.02 to .17	r's = -.05 to .19
Specific types of coping assistance provided by friends	r's = -.03 to .27	--------
Parent reports seeking help for child (from any source)	r = .30 (.000)	r = .38 (.000)
Child social support from different sources	r's = -.13 to -. 33	--------
Specific types of coping used by parent	--------	r's = -.15 - .12
Parent social support assessed acutely	--------	r = .08 (NS)
Parent social support assessed at follow-up	--------	r = -.27 (.002)
Parent reports seeking help for self (from any source)	r = .23 (.002)	r = .25 (.004)
Child PTSD severity (self report)	--------	r = .41 (.000)
Parent PTSD severity	r = .41 (.000)	--------

A linear multiple regression model, having child PTSD severity (the square root transformation of the CAPS –CA severity score) as the dependent variable and key univariate predictors was carried out.

Independent significant risk and protective factors (p < .05) for PTSD outcome in children were:

> Child ASD severity score (higher ASD severity associated with higher PTSD severity)
> Parent ASD severity score (higher ASD severity associated with higher PTSD severity)
> Gender (females had higher PTSD severity)
> Child lost consciousness (children who lost consciousness had higher PTSD severity)
> Kidcope: Child used social withdrawal (children who engaged in social withdrawal had higher PTSD severity)
> CHQ: Child physical health summary score (better physical recovery score associated with lower PTSD severity)
> SSSCA: classmate support (more support associated with lower PTSD severity)
> Acute child rated worst pain (higher pain associated with higher PTSD severity)
> TESI-CP: # traumatic events experienced by child (higher number of previous traumatic events associated with higher PTSD severity)
> High heart rate at admission to ED (High heart rate associated with higher PTSD severity)
> > o > 104 for children 8-11 years old
> > o > 97 for children 12-17 years old

The model explained 57% of the variance of the PTSD severity. Additional predictors entered into the model, but not achieving statistical significance as independent predictors: presence of extremity fracture, LES negative change score (for family life events pre-injury), CBCL Internalizing T-score (pre-injury child anxiety / depression symptoms as reported by parent), CBCL Externalizing T-score (pre-injury child behavior / attention problems as reported by parent), SSSCA: parent support score (social support from parent as reported by child), CCAC: assistance from parents overall score (coping assistance from parents as reported by child), and mechanism of injury (struck by a motor vehicle vs. other mechanisms of injury).

Secondary analysis: Relationship between ASD and PTSD for children and for parents
ASD and PTSD severity scores were strongly associated (r = .56 for children; r = .55 for parents). Having ASD is not a sensitive predictor of PTSD for children, but does somewhat better in this regard for parents -- see Kassam-Adams & Winston (manuscript under review) for more detail on these ASD to PTSD relationships.

Specific Aim 3: Development of a PTSD risk assessment screening tool

The final screening tool was derived from a pool of 50 items: a 45-item Pilot PTSD Risk Assessment Tool (20 questions asked directly of the injured child and 25 of the parent), with the addition of 5 items easily obtainable from the child's medical record. Among these 50 items, 32 were hypothesized to predict child posttraumatic stress. A distinct but overlapping set of 32 items was hypothesized to predict parent posttraumatic stress. See Table 4 for the domains covered in the original pool of items.

Table 4. Domains covered by items in the posttraumatic stress risk factor survey from which the STEPP screening tool was derived.

Domains hypothesized to predict child posttraumatic stress	Domains hypothesized to predict parent posttraumatic stress
Child age and gender	Child age and gender
Child's prior exposure to traumatic / stressful events	Child's prior exposure to traumatic / stressful events
Child's pre-existing behavioral and emotional functioning	Child's pre-existing behavioral and emotional functioning
Child's degree of exposure to potentially traumatic elements of the injury event (e.g., sights, sounds) and its aftermath	Parent's degree of exposure to the traumatic injury event and its aftermath
Separation from parents during crash & its aftermath	Knowing child was separated from parent during crash & its aftermath
Nature and severity of injury	Nature and severity of child's injury
Pain severity	Parent rating of child's pain severity
Parent's acute psychological response	Parent's acute psychological response
Child's acute psychological response	Child's acute psychological response
Child's acute physiological response	
Violation of safe, trusted place	
Child's perceived responsibility/ guilt/ control	

Analyses to derive the final brief screening tool were limited to those children 8 and over, and their parents. Complete data (Pilot Screening Tool and follow-up PTSD outcome data) were available for 147 children and 162 parents. No differences were found in demographic characteristics, mechanism of injury, admission to the intensive care unit, or severity of injury between those with complete data and those lost to follow-up.

Twenty-five (16%) of the children and 25 (15%) of the parents were classified as positive cases for PTSD outcome (defined as having PTSD or subsyndromal PTSD). Details of modeling and analyses to create the optimal final screening tool are detailed in the Statistical Analysis section above.

We were able to create a screening measure that predicted both child and parent PTSD outcome, accomplishing Specific Aim 3 as well as Supplemental Aim 3a. The final screening tool, now named the Screening Tool for Early Predictors of PTSD (STEPP) contains four dichotomous questions asked of the child; four asked of one parent; and four items obtained easily from the emergency medical record. 8 of these items are used to create a child score; 6 items are used to create a parent score. Children with 4 or more (of 8 items) positive and parents with 3 or more (of 6 items) positive are considered to screen positive on the STEPP.

STEPP sensitivity in predicting posttraumatic stress was .88 for children and .96 for parents with negative predictive values exceeding .95 for both children and parents. The odds ratio {95% CI}

in predicting persistent child PTSD symptoms was 6.45 {1.8-22.8} and, for parent PTSD symptoms, was 26.59 {3.5-202.1}. See Appendix A for a copy of the STEPP. Scoring instructions and any current updated psychometric data are available from the authors.

Supplemental Aim 1a.   Describe child and parent assessment of the child's acute post-injury pain, and the relationship of this to later child PTSD risk.

Clinically significant and severe pain at some time during the injury and post-injury recovery was reported by the vast majority of children. While children reported their worst post-injury pain across the full range of possible ratings (0 to 6), fully 94% gave ratings between 3 and 6, denoting a clinically significant level of pain. The highest possible value on the BFPS (a rating of 6) was reported by 53% of the sample.

In contrast, children's reports of their current pain at the time of the acute assessment interview clustered at the low end of the scale. While ratings spanned the full range of possible scores (0 to 6), the median rating was 1. More than three-quarters of the sample had a current pain rating of 2 or less (i.e., not clinically significant pain) at the time of the acute assessment, with less than 5% of the sample reporting a rating of 5 or greater. In general, parents' report of their child's pain was distributed in the same manner as child self-report. Parent and child ratings of the child's acute pain were moderately correlated (r = .50 for current pain; r = .40 for worst pain).

Child acute ratings of worst pain were associated with later PTSD severity (r = .31). See Supplemental Aim 2 below for discussion of relationship of parent-child pain rating discrepancy with child PTSD severity.

Supplemental Aim 1b. Describe child coping, parent coping, and the coping assistance that parents and friends provide to children post-injury.

Coping strategies endorsed by children, in order of frequency of endorsement, were as follows: wishful thinking (86%), try to see the good side of things (81%), social support - spending time with others (74%), try to forget about it (69%), emotional regulation (67%), problem solving (53%), social withdrawal (47%), resignation (38%), blame others (29%), blame self (21%). The mean number of coping strategies (of the 10 listed above) was 6.

Parental coping was assessed with a scale (the CHIP) focused on coping with child health problems (with subscales assessing Maintaining Family Integration; Social Support / Self Care; & Efforts to Understand the Health Care System). Parents almost universally (93-94%) reported using each coping subscale to some extent. Parents reported using many different coping approaches -- of the 45 items on the scale, the mean number endorsed by parents was 40. Mean helpfulness ratings for each kind of coping were 2 or higher on a 0 - 3 scale. The responses of parents in our sample (scores on each subscale) appear to be very similar to responses of parents of children with chronic illness, cardiac illness, or diabetes (other samples reported by the scale's authors [65]).

Coping assistance that children received from their parents was assessed both from the child's point of view and from the parent's point of view. 40% of children, and 66% of parents,

reported that parents provided help by talking about (or otherwise processing) what happened and the child's feelings ("Emotional Processing"). 86% of children, and 90% of parents, reported that parents provided help with getting back to normal activities ("Roles and Routines"). 63% of children, and 89% of parents, reported that parents helped the child by doing something fun or helping get his/her mind off of what happened ("Distraction").

Coping assistance that children received from their friends was assessed with items paralleling those for parent coping assistance. 30% of children reported that friends provided help by talking about (or otherwise processing) what happened and the child's feelings ("Emotional Processing"). 81% of children reported that friends provided help with getting back to normal activities ("Roles and Routines"). 71% of children reported that friends helped by doing something fun or helping get his/her mind off of what happened ("Distraction").

Supplemental Aim 2. Evaluate and refine model of the mechanisms through which parent ASD symptoms may have an impact on child PTSD development.

Our model for the impact of parent ASD symptoms on child PTSD development hypothesized that parents with more severe ASD symptoms would have greater difficulty assessing their child's acute distress (ASD symptoms) and that in turn, this greater discrepancy would impair parents' ability to provide appropriate support and thus lead to greater risk of child PTSD. These hypotheses were only partially supported by the data.

Parent ASD severity did not appear to be associated with the degree of parent-child discrepancy about the child's ASD symptoms or pain (i.e., parent-report as compared with child self-report or child's ASD symptoms or pain). Thus, contrary to one of our secondary hypotheses, it does not appear that parent accuracy about the child's ASD symptoms decreases among parents who are more symptomatic themselves.

However, it does appear that parent ratings of children are influenced by the parent's own symptom level -- parents with low severity of ASD themselves tended to under-rate the child's symptoms, and high ASD severity parents appeared to slightly over-rate the child's symptoms. Parent discrepancy (from the child's rating) of child ASD symptoms does appear to be predictive of child PTSD outcomes -- a discrepancy in either direction is associated with higher child PTSD severity months later. This relationship is also observed (less strongly) for parent discrepancy in ratings the child's worst acute pain.

Supplemental Aim 3a. Extension of analyses regarding optimal PTSD risk assessment screening tool to develop a tool that predicts parent PTSD in addition to child PTSD.

See findings for Aim 3 above.

Supplemental Aim 3b. Assess the equivalence of the screener's performance in several key sub-groups (grouped by injury severity, child age, and race/ethnicity).

The sensitivity and specificity of the STEPP screener in predicting PTSD outcome among different sub-groups was:

Children with an AIS2+ injury: sensitivity, 0.91, specificity, 0.48
Children without an AIS2+ injury: sensitivity, 0.67, specificity, 0.52
Children 8 to 11 years old: sensitivity, 0.83; specificity, 0.44
Children 12 to 17 years old: sensitivity, 0.92, specificity, 0.54
Black children: sensitivity, 0.80, specificity, 0.46
White children: sensitivity, 0.93, specificity, 0.51
Boys: sensitivity, 0.93, specificity, 0.54
Girls: sensitivity, 0.82, specificity, 0.24

V. Discussion of Findings

A. Conclusions

This research highlights the unmet psychological needs of children and their parents following injury and provides a new, theoretically-derived, empirically-based tool to aid in the delivery of improved services through triaging – the STEPP screener. Results of this study provide strong evidence that injured children and their parents may be affected by traumatic stress disorders and that early screening for PTSD risk is possible. The study also identified key factors in the etiology of PTSD that can inform development of preventive and treatment interventions. Many children and parents participating in this study experienced at least a few ASD symptoms within the first month post-injury, suggesting that it is normative to experience at least transient traumatic stress after a child is hospitalized for traffic crash-related injuries. However, about 1 in 4 children and 1 in 3 parents experienced more severe and distressing ASD symptoms during the first month after a traumatic injury, and at the time of follow-up assessments (conducted an average of 6 months post-injury), about 1 in 6 children and parents still had clinically significant PTSD symptoms. Predictors of PTSD outcome for children included pre-existing factors (prior PTSD, behavioral/emotional concerns, family stress), factors associated with the event and its aftermath (exposure to frightening sights and sounds, acute pain), acute responses (elevated heart rate, child's and parent's acute stress symptoms), and factors occurring in the recovery period (degree of child's physical recovery, family stress, social support). A 12 item screening measure (named the Screening Tool for Early Predictors of PTSD, or STEPP), was developed. The STEPP demonstrated excellent screening tool properties: very high sensitivity and reasonable specificity for prediction of later PTSD outcome in injured children and in parents of injured children.

B. Limitations

The population in this study involved injured children in an urban pediatric trauma center who were admitted for treatment of traffic-related injuries. The study population was broadly representative of the patient population of that hospital – predominantly African-American and White. As such, the results of this study may not be broadly generalizable to children from other populations (e.g., rural, Hispanic) or children who experienced crashes but suffered no injuries or injuries not warranting hospitalization. Further, the study was conducted with a population of traffic-injured children. While our findings have implications for other populations of injured

children and adults (both intentional and unintentional injuries), the results are not directly generalizable to these populations. The study was conducted in English, precluding generalizability of the results to native speakers of other languages.

C. Comparison with findings of other studies

This is one of the first studies to quantify PTSD in children after injury, using DSM-IV diagnostic criteria, relying on children's own report of their symptoms rather than parent report. Its findings are generally consistent, but slightly lower, than others who have published prevalence of PTSD symptoms in injured children. The lower prevalence of diagnostic child PTSD in the present study (5%), in comparison with the few prior published studies [44-46] that have assessed PTSD in injured children (reporting rates from 13% to 34%), is likely due in part to the timing of assessment. Studies that assessed PTSD in injured children less than three months after injury found substantially higher rates of PTSD. In addition to the timing of assessment, the available published studies of child PTSD post-injury differ with regard to the types of injury included, the rural vs. urban setting, and the ethnicity of the sample. Any of these differences may have influenced symptom presence or symptom reporting.

Compared with studies of injured adults [66-68], prevalence of parent PTSD was substantially lower. A key dimension may be that most of the parents in this sample (81%) had not been directly involved in the traffic crash in which their child was injured.

This study was the first to quantify ASD in children and their parents after a child's injury. The findings are comparable to levels of ASD found after adult injury and the relationship between child ASD and later PTSD, found in this study, paralleled previous research that demonstrated this relationship for adults.[67] Other predictors for child and parent PTSD development were consistent with previous literature on predictors of PTSD after traffic crash injury in adults.[67, 69, 70] The STEPP screener is new in both the child and adult traumatic stress research literature.

D. Applications of findings to MCH health care

The findings of this study offer strong support for the importance of clinicians' attention to psychological sequelae of pediatric injury, for both children and parents. The finding that 1 in 6 children and parents experienced persistent and impairing PTSD symptoms many months post-injury provides compelling evidence for the inclusion of psychological screening and follow-up as part of optimal medical care for pediatric injury. Screening for and treatment of traumatic stress responses, particularly ASD and PTSD in the injured child and his/her parent, should be incorporated into the care of the injured child.

This study provides a foundation for the development of evidence-based interventions for secondary prevention of PTSD post-injury. The STEPP represents a new method to alert clinicians to those patients and their parents in need of closer monitoring and supervision for PTSD. The STEPP screener, after further validation and refinement, could be used in the acute care setting as a way to detect children and their parents at risk for developing later PTSD outcome for purposes of triaging preventive mental health services.

E. Policy Implications

These research findings and the known high exposure of children to traffic crashes and other injury events provide a strong scientific justification for the development and dissemination of protocols that incorporate psychological care into the treatment of injured children and their parents. The research supports the Emergency Medical Services for Children priority for the development of model ED protocols to address mental health issues and points to the need to incorporate further investigation in traumatic stress into the research and care priorities for MCHB.

It is not necessary to refer all injured children and their parents for mental health services. The majority suffer symptoms acutely but only a minority go on to develop PTSD. Screening protocols (using empirically sound measures such as the STEPP) should be implemented to guide clinicians in making evidence-based decisions for the allocation of scarce mental health resources for traumatic stress. This approach is likely to be more effective than universal debriefing after trauma that recent evidence suggests may be ineffective or harmful. The implementation of validated screening tools for triaging mental health services is also consistent with NIMH models for best practice in preventive care and with the Surgeon General's call for integration of child mental health promotion into medical care. A screening tool like the STEPP is needed to guide appropriate delivery of mental health services that ensure appropriate psychological support for injured children and their parents, thereby meeting unmet psychological needs of injured children and their parents.

F. Suggestions for future research

Knowledge of the development of PTSD following child injury, gained from this prospective study, should be incorporated into the creation of interventions for the secondary prevention of posttraumatic stress disorder following injury. Findings of this study regarding predictors of PTSD in injured children and regarding factors that appear to promote resilience (e.g., greater parent accuracy in assessing the child's acute symptoms, greater classmate support) or that appear to lead to more severe PTSD symptoms (e.g., more severe acute stress symptoms, use of social withdrawal as a coping strategy) should guide the development of practical early interventions to reduce or prevent the occurrence of PTSD after traffic crash injuries in children.

Further research is needed to evaluate the feasibility and predictive utility of screening protocols incorporating the STEPP (administered by health care personnel rather than research staff) into trauma care in the context of a busy acute care setting. Assessment and revision or refinement of the STEPP is also needed to assure its utility for non-English speakers and for diverse populations in terms of cultural and other demographic characteristics, mechanisms of injury, and injury severity. In addition, protocols utilizing the STEPP to guide subsequent assessment and intervention will need to developed and evaluated in these diverse populations.

VI. List of Products

Results of this research project, and implications of these results for clinical practice, have been disseminated by the research team
- to a wide range of professional audiences (from the fields of pediatrics, psychology, psychiatry, anesthesiology, emergency medicine, trauma surgery, nursing, public health),
- to specialists in traumatic stress and in pain management,
- to professionals-in-training (residents in pediatrics, psychiatry, and emergency medicine, clinical and pediatric psychology interns, graduate students in school and pediatric psychology), and
- to the general public.

Dissemination of results has taken the form of scholarly publications, training and didactic sessions for students or professionals, and presentations at professional meetings, as well as general media coverage. Members of the research team participated in two related consensus group meetings in which preliminary findings from this study helped to inform the expert consensus process -- the June 1999 Consensus Conference on Mental Health Aspects of Emergency Medical Services for Children[71] and the October 2001 Multidisciplinary Panel on Pediatric Mental Health Emergencies.[72]

Peer-reviewed papers published:
Kassam-Adams, N. & Fein, J. (in press: Clinical Pediatric Emergency Medicine). Post traumatic stress disorder and injury.

Kassam-Adams, N., & Newman, E. (2002). The Reactions to Research Participation Questionnaires for Children and Parents (RRPQ-C and RRPQ-P). General Hospital Psychiatry, 24: 336-342.

Winston, F. K., Kassam-Adams, N., Vivarelli-O'Neill, C., Ford, J., Newman, E., Baxt, C., Cnaan, A., & Stafford, P. (2002). Acute stress disorder symptoms in children and their parents after pediatric traffic injury. Pediatrics. 109 (6): e90.

Papers currently in review:
Baxt, C., Kassam-Adams, N., Nance, M., Vivarelli-O'Neill, C., & Winston, F.. (manuscript submitted). Assessment of pain in the pediatric injury patient: Child and parent perceptions.

Kassam-Adams, N. & Newman, E. (manuscript submitted). Child and parent reactions to participation in clinical research.

Kassam-Adams, N. & Winston, F. K. (manuscript submitted). The relationship between acute stress disorder and posttraumatic stress disorder in injured children and their parents.

Saxe, G., Chawla, N., Stoddard, F., Kassam-Adams, N., Courtney, D., Cunningham, K., Lopez, C., Sheridan, R., King, D., & King, L. (manuscript submitted). The Child Stress Disorders Checklist: A measure of ASD and PTSD in children. (includes data from our study)

Winston, F. K., Kassam-Adams, N., Garcia-España, J. F., Ittenbach, R., & Cnaan, A. (manuscript submitted). Screening for risk of persistent posttraumatic stress in injured children and their parents.

Papers currently in preparation:

Kassam-Adams, N., Baxt, C., Fein, J., & Winston, F. K. (manuscript in preparation). Peri-traumatic exposure, emotional response, and PTSD in injured children and their parents.

Kassam-Adams, N., Garcia-España, J.F., Fein, J., & Winston, F. K. (manuscript in preparation). Heart rate and PTSD in injured children.

Research abstracts / presentations at professional meetings:

Kassam-Adams, N.. Acute stress disorder in injured children: Assessment challenges and dilemmas. Presented at the 15th Annual Meeting of the International Society of Traumatic Stress Studies, Miami, Florida, November 1999.

Kassam-Adams, N. & Winston, F.K. Parent's posttraumatic stress symptoms after traffic-related injuries in children. Paper presented at the World Conference for the International Society of Traumatic Stress Studies, Melbourne, Australia, March 2000.

Winston, F.K. & Kassam-Adams, N. Meeting the psychological and emotional needs of children & parents after traffic-related injuries. Paper presented at the 2nd National Congress on Childhood Emergencies, Baltimore, MD, March 2000.

Winston, F.K., Kassam-Adams, N., Vivarelli, C., Miller, G., & Cnaan, A.. Can parents accurately report acute stress responses in their injured children? Presented at the Regional Meeting of the Ambulatory Pediatrics Association, Boston, MA, May 2000.

Kassam-Adams, N., Winston, F.K., & Vivarelli-O'Neill, C. Parent and child reports of acute stress disorder. Presented at the Annual Meeting of the American Academy of Child and Adolescent Psychiatry, New York City, October 2000.

Vivarelli-O'Neill, C., Kassam-Adams, N., & Winston, F.K. Examining acute stress disorder in children with traffic-related injuries. Presented at the Annual Meeting of the American Academy of Pediatrics, Chicago, IL, October 2000.

Kassam-Adams, N., Winston, F.K., Vivarelli-O'Neill, C., & Stafford, P. Injury surveillance in a Level I Pediatric Trauma Center: Looking at acute stress disorder symptoms in children and parents after traffic crashes. Presented at the Annual Meeting of the American Public Health Association, Boston, November 2000.

Kassam-Adams, N., Winston, F., & Vivarelli-O'Neill, C. Acute stress symptoms in parents of injured children. Presented at the 16th Annual Meeting of the International Society of Traumatic Stress Studies, San Antonio, Texas, November 2000.

Vivarelli-O'Neill, C., Kassam-Adams, N., & Winston, F.K. Is pain related to acute stress disorder in injured children? Presented at the 16th Annual Meeting of the International Society of Traumatic Stress Studies, San Antonio, Texas, November 2000.

Kassam-Adams, N., Ittenbach, R., Winston, F.K., Vivarelli-O'Neill, C., & Cnaan, A. Screening for PTSD risk in traumatically injured children and teens. Paper presented at the 17th Annual Meeting of the International Society of Traumatic Stress Studies, New Orleans, Louisiana, December 2001.

Baxt, C., Kassam-Adams, N., & Winston, F. K. Correlates of acute stress symptoms in children after traffic injury. Poster presented at the 18th Annual Meeting of the International Society of Traumatic Stress Studies, Baltimore, MD, November 2002.

Kassam-Adams, N., Winston, F. K , Baxt, C., Fein, J., Ittenbach, R. & Cnaan, A. Integrating screening for PTSD risk in the emergency medical setting. Poster presented at the 18th Annual Meeting of the International Society of Traumatic Stress Studies, Baltimore, MD, November 2002.

Kassam-Adams, N., Winston, F. K., & Baxt, C. ASD and PTSD after pediatric traffic injuries. Paper presented at the 18th Annual Meeting of the International Society of Traumatic Stress Studies, Baltimore, MD, November 2002.

Kassam-Adams, N., Baxt, C., & Winston, F. K. Pediatric injury: Posttraumatic stress, recovery, and family impact. Paper presented at the 18th Annual Meeting of the International Society of Traumatic Stress Studies, Baltimore, MD, November 2002.

Kassam-Adams, N. & Winston, F.K. ASD and PTSD in children injured in traffic crashes. Paper presented at the European Conference on Traumatic Stress, Berlin, Germany, May 2003.

Other presentations and professional training:

Kassam-Adams, N. Posttraumatic stress disorder in children and parents. Invited Advocacy Keynote at the Society for Pediatric Anesthesia / American Academy of Pediatrics, Section on Anesthesiology Winter Meeting, San Diego CA, February 2001.

Winston, F.K. & Kassam-Adams, N. Mental Health and Emergency Medical Services for Children. Invited plenary session at the 3rd National Congress on Childhood Emergencies, Dallas TX, April 2002.

Kassam-Adams, N. Screening and early intervention for children after trauma. Presentation (in Pre-Meeting Institute on Early Intervention after Trauma) at the 18th Annual Meeting of the International Society of Traumatic Stress Studies, Baltimore, MD, November 2002.

Kassam-Adams, N. Pediatric injury and the Emergency Department: Posttraumatic stress responses in children and parents. Invited symposium lecture at the Annual Meeting of the American Pain Society, Chicago, IL.; March 20, 2003

Kassam-Adams, N. Current state of the art and current challenges in screening and early intervention for children exposed to trauma. Presentation (in Pre-Meeting Institute on Promoting Evidence Based Early Intervention Services That Improve The Quality of Survivor's Recovery Environments) at the European Conference on Traumatic Stress, Berlin, Germany, May 2003

Measure:

Winston, F. & Kassam-Adams, N. (2002). Screening Tool for Early Predictors of PTSD (STEPP). Children's Hospital of Philadelphia.

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APPENDIX A: Screening Tool for Early Predictors of PTSD (STEPP)

	YES	NO		
Ask parent:	**YES**	**NO**		
1 Did you <u>see</u> the incident (accident) in which your child got hurt?	1	0		
2 Were you with your child in an ambulance or helicopter on the way to the hospital?	1	0		
3 When your child was hurt (or when you first heard it had happened), did you feel <u>really helpless</u>, like you wanted to make it stop happening, but you couldn't?	1	0		
4 Does your child have any behavior problems or problems paying attention?	1	0		
Ask child:	**YES**	**NO**		
5 Was anyone else hurt or killed (when you got hurt)?	1	0		
6 Was there a time when you didn't know where your parents were?	1	0		
7 When you got hurt, or right afterwards, …..did you feel <u>really afraid</u>?	1	0		
8 …..did you think you might die?	1	0		
Record from medical record:	**YES**	**NO**		
9 Suspected extremity fracture?	1	0		
10 Was pulse rate at ED triage: > 104 if child is under 12 ? . . . . or > 97 if child is 12 or older?	1	0		
11 Is this child 12 or older?	1	0		
12 Is this a girl?	1	0		
ADD TOTAL FOR EACH COLUMN:				
			Child Screen +: 4 or more	**Parent Screen +: 3 or more**