Predicting Posttraumatic Distress in Hospitalized Trauma Survivors With Acute Injuries

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Objective: Each year approximately 2.5 million Americans are hospitalized after sustaining traumatic physical injuries. Few investigations have comprehensively screened for posttraumatic symptomatic distress or identified predictors of posttraumatic stress disorder (PTSD) in representative samples of surgical inpatients.

Method: The subjects were 101 randomly selected survivors of motor vehicle crashes or assaults who were interviewed while hospitalized and 1, 4, and 12 months after injury. In the surgical ward, inpatients were screened for PTSD, depressive, and dissociative symptoms, for prior trauma, for pre-event functioning, and for alcohol and drug intoxication. Patient demographic and injury characteristics were also recorded. Random coefficient regression models were used to assess the association between these clinical, injury, and demographic characteristics and PTSD symptom levels over the year after the injury.

Results: Of the 101 surgical inpatients, 73% screened positive for high levels of symptomatic distress and/or substance intoxication. At 1, 4, and 12 months after the injury, 30%–40% reported symptoms consistent with a diagnosis of PTSD. High ward PTSD symptom levels were the strongest and most parsimonious predictor of persistent symptoms over the course of the year. Greater prior trauma, stimulant intoxication, and female gender were also associated with higher symptom levels. Increasing injury severity, however, was not associated with higher PTSD symptom levels.

Conclusions: Clinical and demographic characteristics readily identifiable at the time of surgical inpatient hospitalization predict PTSD symptoms over the year after injury. Effectiveness trials that test screening and intervention procedures for at-risk inpatients should be developed.

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Traumatic life events and posttraumatic stress disorder (PTSD) are endemic among American civilians (1). Each year, approximately 2.5 million individuals in the United States incur traumatic physical injuries so severe that they require inpatient hospitalization (2). Studies undertaken by mental health researchers (3, 4) and trauma surgeons (5, 6) document that high levels of PTSD symptoms develop in 10%–40% of Americans over the course of the year after traumatic physical injury. In veterans (7), refugees (8), and physically injured civilians (5, 6, 9), PTSD makes a unique contribution to posttraumatic functional limitations and diminished quality of life above and beyond the impact of injury severity and medical comorbidity. Thus, the early evaluation and treatment of PTSD among physically injured trauma survivors may be an important component of public health efforts targeting injury control and rehabilitation (2).

Prior investigations suggest that greater symptomatic distress at the time of the trauma (3–5, 10–14), female gender (3, 11), and prior history of emotional disturbance (3, 11, 13) are consistent predictors of the development of PTSD symptoms in the wake of traumatic injury. Some (4, 5), but not all (11, 12), previous investigations showed that greater injury severity predicts the subsequent develop-

ment of PTSD. Few of these seminal investigations used representative sampling procedures (3, 4, 12, 14), included vulnerable groups of trauma survivors, such as substance abusers (10), or used statistical methods that allow for the optimal modeling of longitudinal data (15–17).

Commentators (18, 19) have encouraged the development of investigations that integrate efficacy, effectiveness, and public health approaches with the goal of addressing the mental health treatment needs of clinical populations who seek care in day-to-day, "usual care" service delivery settings. Trauma surgeons (20) have argued that the time of the surgical inpatient admission represents an ideal opportunity for identification of psychosocial problems and for intervention.

Thus, the current investigation is a population-based study of the predictors of PTSD among trauma survivors hospitalized for physical injuries. Clinical, injury, and demographic characteristics were identified, and PTSD symptoms were prospectively followed in a randomly selected cohort of trauma surgery inpatients. In this investigation we sought to answer the question, What characteristics present at the time of the surgical ward hospitalization are associated with high levels of PTSD symptoms over the course of the year after a traumatic injury?

Method

Participants and Procedure

The study setting and recruitment procedures have been described previously (21). The University of California–Davis Medical Center admits between 2,500 and 3,000 physically injured trauma survivors each year. Approximately 70% of the patients admitted are victims of violent assaults (i.e., intentional acts such as stabbings, gunshots, or direct physical attacks) or motor vehicle crashes (i.e., unintentional incidents such as automobile, motorcycle, or bicycle accidents or collisions of pedestrians and motorized vehicles).

The patients recruited into the study were English-speaking survivors of violent assaults and motor vehicle crashes between the ages of 14 and 65 years. Adolescent patients were included in the investigation as they are routinely hospitalized with adults on the trauma surgical service. Written informed consent was obtained from the participants after the study procedures had been fully explained; for participants aged 14–17, adolescent assent and parental consent were obtained (also see reference 21).

On weekdays, newly admitted trauma surgery inpatients were randomly selected for participation by using numerical assignments from a table of random numbers. Patients who were alert and oriented (scoring 15 on the Glasgow Coma Scale [22]) were approached for consent. Of 397 considered for the study, 241 patients were ineligible or not approached. Fifty-four of these patients were ineligible because they spoke only one non-English language, 37 either were too severely injured or had physical impairments that prevented participation, 76 were discharged or transferred to other hospitals before they were approached, 55 were unavailable (e.g., undergoing surgery), and the remaining 19 patients had other, miscellaneous reasons for exclusion (e.g., current incarceration).

Of the 156 patients approached for consent, 29 declined participation and 10 consented but did not finish the interview (eight subjects were transferred or discharged before completion, and two subjects declined ongoing participation). Sixteen subjects were recruited into a pilot intervention protocol, leaving 101 participants in the longitudinal investigation. These 101 subjects were less likely to live alone than the 16 subjects in the intervention protocol (Yates-corrected χ^2=3.6, df=1, p=0.06) but did not differ on any other characteristic.

All 101 participants were administered a 1-hour face-to-face interview while hospitalized and were reinterviewed over the telephone 1, 4, and 12 months after the traumatic injury by trained research associates.

Psychiatric Symptoms

We used the PTSD Checklist—Civilian Version (23), a 17-item self-report questionnaire with Likert responses (scale=1–5), to assess the intrusive, avoidant, and arousal PTSD symptom clusters. Blanchard et al. (24) reported a correlation of 0.93 between the total scores on the PTSD Checklist and the Clinician Administered PTSD Scale. A score of 45 or greater has been recommended as a cutoff point for high PTSD symptom levels (24). In order to assess the symptoms of hospitalized surgical inpatients, we modified the measure to read, "How bothered have you been by these experiences since the event that brought you to the hospital?"

The Center for Epidemiological Studies Depression Scale (25), a 20-item self-report instrument with Likert responses (scale=0–3), was used to assess depressive symptoms. A score of 27 or greater has been suggested as a conservative indicator of high levels of depressive symptoms (26, pp. 256–257). We modified the administration of the measure by asking inpatients, "How often you have felt this way since the event that brought you to the hospital?"

Dissociative symptoms at the time of the traumatic event were assessed by using the 8-item interview version of the Peritrau-

matic Dissociative Experiences Questionnaire (27). The measure has been demonstrated to be internally consistent, and evidence supports its convergent, discriminant, and predictive validity (27).

Injury Characteristics and Substance Intoxication

Injury severity was abstracted from surgical records by using a conversion software program (28) that transforms recognized ICD-9-CM codes into scores on the Abbreviated Injury Scale (29) and, subsequently, injury severity scores. The injury severity score is defined as the sum of the squares of the highest score on the Abbreviated Injury Scale for each of the three most severely injured body regions.

Alcohol and drug use at the time of admission to the hospital was assessed with blood alcohol and urine drug toxicology screens. Because opiates and benzodiazepines are frequently administered to patients by emergency personnel, only positive results for stimulants (amphetamines or cocaine) were included as positive drug screens. Two questions from the Addiction Severity Index (30) were used to assess the number of days of alcohol and drug use in the month before the hospitalization.

Patient Background

To assess prior traumatic life events, we used a modified version of the traumatic event inventory that accompanies the Composite International Diagnostic Interview as developed for the National Comorbidity Survey (1). We modified the inventory by asking, "For each event, please tell me if it has happened to you before the event in which you were injured."

Comorbid chronic medical conditions were also derived from ICD-9-CM diagnostic codes. Limitations in physical functioning in the month before the traumatic event were assessed with a modified version of the Medical Outcomes Study 12-Item Short-Form Health Survey physical components summary (31). The perpetration of violence in the month before the event was assessed with three items from the nine-item scale for severe violence of the Conflict Tactics Scale (32). Two questions from the Structured Clinical Interview for DSM-III-R (33) were modified in order to screen for prior history of psychiatric disorders or substance abuse in the patient or immediate relatives. Eight items from the Medical Outcomes Study Social Support Survey were used to assess social support (34).

Statistical Analyses

Using automated data from the University of California–Davis trauma surgery registry (35), we first compared the demographic, injury, and clinical characteristics of patients included in the investigation with the characteristics of all patients admitted to the surgical service during the time period of the study.

Next, we examined the longitudinal course of PTSD symptoms over the year following the injury and constructed a model that used variables present at the time of the surgical ward hospitalization to predict PTSD symptom levels after hospital discharge. Longitudinal data collected prospectively from hospitalized trauma survivors is characterized by correlated intraindividual observations, missing data, and dropout; random coefficient regression methods were selected because of their superior ability to model longitudinal data with these characteristics (15–17). Independent variables representing demographic, injury, and clinical predictors were included in the model as fixed effects. Independent variables representing the fixed and random effects of time since the event (i.e., 1 month, 4 months, or 12 months posttrauma) were also included in the model. The scale scores for symptoms of posttraumatic stress at 1, 4, and 12 months were the dependent variable.

The final regression model was developed in three steps. In step 1 we created a preliminary model that included all independent variables ascertainable at the time of the surgical ward hos-

pitalization. These variables included demographic characteristics (age, gender, race, income, educational level), patient's and relatives' histories of psychiatric or substance use disturbances, pre-event functioning (physical functioning and perpetration of violence), current social support, prior trauma, the nature and severity of the injury, chronic medical conditions, alcohol and drug use before the injury, toxicology screen results, and PTSD symptoms while the patient was on the surgical ward.

All independent variables that were associated with higher posthospitalization PTSD symptom levels at a significance level of p<0.10 were retained and entered into a second, reduced model. A literature review suggested that three demographic and injury characteristics—gender, age, and injury severity—should be retained in the reduced model regardless of level of significance. Because the amount of time since the event was found to have a significant fixed effect in the reduced model, time-by-predictor interaction terms were created and tested. Interaction terms were entered one by one in the reduced model. This reduced model retained only the independent variables and interaction terms that were significant at the p<0.05 level.

Finally, in order to determine which surgical ward symptoms most strongly predicted higher PTSD symptoms over the course of the year, surgical ward PTSD, depressive, and peritraumatic dissociative symptoms alone and in all possible permutations were entered and compared in a stepwise fashion. The Akaike information criterion and likelihood ratio test (36) were used for model selection, in particular to determine which among the reasonably well-fitting models would provide the most parsimonious explanation of higher PTSD symptom levels over the course of the year.

Results

The median length of stay for the hospitalized patients was 4 days (range=1–27), and on average patients were interviewed 3 days (SD=4) after the hospital admission. The investigation achieved 86% follow-up at 1 month (N=87), 77% at 4 months (N=78), and 72% at 12 months (N=73). Over 90% of the patients completed two or more assessments. Patients who did not complete the 12-month interview were significantly more likely to be male (Yates-corrected χ^2=3.9, df=1, p<0.05) and assault survivors (Yates-corrected χ^2=5.0, df=1, p<0.05) and to have annual incomes less than $15,000 (Yates-corrected χ^2=4.9, df=1, p<0.05).

The mean age of the patients in the study was 34 years (SD=12), and the mean injury severity score (possible range=0–34) for the study cohort was 9 (SD=7). Approximately one-third of the study patients (35%) were women (N=35), and about two-thirds (65%) were survivors of unintentional injury (N=66). The demographic and injury characteristics of the study participants resembled the characteristics of all patients admitted for traumatic injury during the 9-month duration of the investigation. There were no significant differences between the two groups in gender, age, injury type or severity, number of chronic medical conditions, or urine toxicology screens. The percentage of patients who were screened for alcohol and who subsequently tested positive was significantly higher in the study patients (χ^2=7.3, df=2, p<0.05).

A positive screen result for alcohol or stimulant intoxication and/or a high level of PTSD or depressive symptoms

FIGURE 1. Course of PTSD Symptoms Over the 12 Months After Hospitalization in 101 Survivors of Motor Vehicle Crashes or Assaults With Acute Injuries[a]
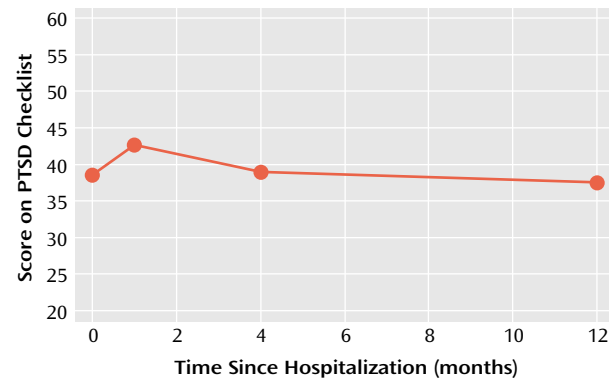
[a] PTSD symptoms were assessed with the PTSD Checklist—Civilian Version (23). Over the 1 year after hospitalization, the number of subjects declined from 101 to 87 at 1 month, 78 at 4 months, and 73 at 12 months.

was found in 73% of the 101 surgical inpatients (N=74). A positive result for alcohol was obtained for 37% (N=37), while 16% of the patients (N=16) screened positive for stimulants. PTSD Checklist scores of 45 or higher were obtained by 31% (N=31), while 41% (N=41) had depression scale scores of 27 or higher. On the surgical ward, the mean PTSD Checklist score was 38.5 (SD=14.0), the mean depression score was 25.1 (SD=10.9), and the mean score for peritraumatic dissociation was 1.9 (SD=0.6). The PTSD and depressive symptom scores were strongly positively correlated (r=0.61, N=97, p<0.001), as were PTSD and dissociative symptom levels (r=0.38, N=95, p<0.001) and depressive and dissociative symptom levels (r=0.34, N=95, p<0.001).

Over 90% of the patients reported having had at least one prior traumatic life event before the event that brought them to the hospital; 59% of the patients (N=60) reported four or more prior lifetime traumas. Sixty percent of the assault victims (21 of 35) and 42% of the victims of motor vehicle crashes (28 of 66) had experienced a life-threatening accident before the event that brought them to the hospital. A prior physical attack had been experienced by 74% of the assault survivors (26 of 35) and 56% of the motor vehicle crash survivors (37 of 66).

Levels of PTSD symptoms increased during the first month after the injury and then gradually declined over the course of the year (Figure 1). At the 1-month assessment 41% of the patients (36 of 87) met the DSM-IV symptomatic criteria for PTSD. At the 4-month assessment 40% of the patients (31 of 78) met the PTSD criteria, while at 12 months 30% (22 of 73) met the PTSD criteria.

Thirteen percent of the patients (N=13) met the DSM-IV symptomatic criteria for PTSD at all three posthospitalization assessments. Nine percent of the patients (N=9) met the criteria at 1 month and 4 months but not at 12 months. Overall, 24% of the patients (N=24) demonstrated symptoms consistent with a diagnosis of PTSD at one or more

TABLE 1. Random Regression Predicting PTSD Symptom Levels Over the 12 Months After Hospitalization in 101 Survivors of Motor Vehicle Crashes or Assaults With Acute Injuries[a]

Fixed-Effect Variable[b]	Estimate	SE	t	df	p
Intercept	15.43	6.63	2.33	140	0.02
Time after event	−0.70	0.83	−0.84	140	0.41
Square of time after event	0.10	0.05	2.00	140	<0.05
Interaction of time after event and PTSD symptom levels during hospitalization	−0.03	0.01	−2.53	140	0.01
PTSD symptom levels during hospitalization	0.64	0.10	6.19	85	<0.0001
Level of prior trauma[c]	1.85	0.51	3.61	85	0.0005
Gender	−5.48	2.73	−2.01	85	<0.05
Urine toxicology screen positive for stimulants at admission	9.65	3.58	2.69	85	0.01
Age	−0.09	0.10	−0.83	85	0.41
Injury severity	0.13	0.17	0.78	85	0.44

[a] PTSD symptoms were assessed with the PTSD Checklist—Civilian Version (23) during hospitalization and 1, 4, and 12 months after hospitalization.
[b] Time after the event was a random effect with intercept=9.75, variance component=0.66, correlation interval=−0.037, residual=8.50.
[c] Prior trauma was assessed with a modified version of the Composite International Diagnostic Interview (1).

posthospitalization assessments. The remaining 54% of the patients (N=55) did not demonstrate symptoms consistent with a diagnosis of PTSD at any posthospitalization assessment.

The final random regression model revealed five significant predictors of higher PTSD symptom levels over the course of the year after hospital discharge (Table 1). Higher levels of surgical ward PTSD symptoms, greater prior trauma, toxicology screen positive for stimulants at admission, and female gender were all associated with higher PTSD symptom levels over the course of the year. The interaction of time after the event and surgical ward PTSD symptoms was the fifth significant predictor.

This final model, which included surgical ward PTSD symptoms, provided the most parsimonious explanation of PTSD symptom development over the course of the year. Models that added all possible permutations of surgical ward depressive and dissociative symptoms did not add significantly to the prediction of PTSD. Surgical ward PTSD symptoms, however, remained a significant predictor when entered simultaneously into models that contained depressive and dissociative symptoms.

Discussion

This investigation used clinical, injury, and demographic characteristics present at the time of the surgical ward inpatient hospitalization to predict later PTSD symptoms in a representative sample of physically injured trauma survivors. At 1, 4, and 12 months after the injury, 30%–40% of the surgical inpatients reported symptoms consistent with a diagnosis of PTSD. This finding that PTSD symptoms are prevalent among American survivors of intentional and unintentional injuries is corroborated by findings in prior investigations (3–5). Of note, some European studies (37, 38) have indicated substantially lower levels of PTSD symptoms among survivors of unintentional injuries.

Higher PTSD symptom levels on the surgical ward, a higher number of prior traumas, female gender, and stimulant intoxication at admission were significant predic-

tors of higher PTSD symptom levels in the year after the injury. Injury type and severity, pre-event functioning, and demographic characteristics, such as income and education, were not significant predictors of PTSD symptom development.

The hospitalized surgical patients had substantial histories of prior trauma. Whereas only 10% of American civilians have experienced four or more lifetime traumas (1), almost 60% of these surgical inpatients reported four or more traumatic events before the event that brought them to the hospital. It is interesting that over 50% of both the assault and motor vehicle crash survivors had experienced a prior assault and over 40% of the patients from both groups reported a prior life-threatening accident. Previous clinical studies conducted by mental health professionals have tended to sample and follow trauma survivors who had experienced either unintentional (3, 4, 6, 11, 12, 13, 37, 38) or intentional (39) injuries. The current investigation corroborates observations of chronic recidivistic traumatic injury among surgical inpatients (40–42) and supports the public health/population-based approach to sampling that characterizes investigations conducted by trauma surgeons and injury epidemiologists (5, 6).

In attempting to bridge public health and clinical mental health approaches, the current investigation faced a number of limitations and compromises (18, 19). From a public health perspective, this investigation excluded important subgroups of injured trauma survivors, including monolingual non-English-speaking patients and survivors of traumatic life events other than motor vehicle crashes or assaults. These exclusions limit the generalizability of our findings. Future population-based investigations should attempt to include these subgroups of patients.

A critique from the clinical efficacy perspective is that the investigation used screens rather than structured diagnostic assessments to evaluate posttraumatic distress and prior histories of psychiatric disturbance. In particular, prior psychiatric disturbance is an established risk factor for the development of PTSD (3). The cursory screen we used as part of the 1-hour surgical ward interview may not

have adequately captured prior history of psychiatric disorders. Thus, our finding that prior history was not a significant predictor in this sample should be interpreted with caution. An active area for future investigation will be adapting existing methods of assessing psychiatric histories to "real world" settings for care of acute conditions.

Another consideration is that we assessed histories of prior trauma in the surgical ward immediately after the traumatic physical injury. So as to examine the issue of potential recall bias and establish the reliability of surgical ward assessments, future investigations may need to reassess trauma history when the injured patients return to the community.

Finally, this research used both face-to-face and telephone interviews to assess PTSD symptom levels. Some (43, 44) but not all (45) studies suggest the relative equivalence of face-to-face and telephone interviews for depressive and anxiety disorders. A preliminary investigation (46) suggested that telephone interviews may be a valid method of collecting information regarding traumatic life experiences and PTSD. Our literature review, however, revealed no studies that have directly established the equivalency of face-to-face and telephone assessments with the PTSD Checklist.

Beyond these considerations, this investigation has direct implications for the early evaluation and treatment of hospitalized trauma survivors with physical injuries. In the current investigation, surgical inpatients demonstrated moderate levels of immediate postevent distress, including PTSD, depressive, and peritraumatic dissociative symptoms. In the surgical ward these symptom clusters were highly correlated with one another. However, surgical ward PTSD symptoms alone were the strongest and most parsimonious predictor of PTSD symptoms over the course of the year after the injury.

Previous reports (3–5, 10–14, 37) implicate multiple domains of immediate distress as risk factors for the development of subsequent psychiatric disturbance among injured trauma survivors. Freedman et al. (47), after comparing the predictive value and timing of administration of instruments assessing intrusive, avoidant, anxiety, and dissociative symptoms, suggested that early screening procedures for injured trauma survivors should be guided by clinical relevance and resource availability. Also, in their review of the diagnosis of acute stress disorder, Marshall et al. (48) questioned the mandatory inclusion of peritraumatic dissociative symptoms as well as the separation of continuous clinical phenomena (i.e., acute stress disorder and PTSD) by a 1-month criterion.

These research findings and commentaries are of great relevance to inpatient settings for surgical care of acute conditions. Requiring pragmatically oriented providers in trauma centers to identify multiple posttraumatic symptom clusters with varying time courses may distract these front-line clinicians from the essential task of screening for trauma survivors at risk. This is not meant to deny the

historical importance of dissociative symptoms for psychiatrists or to discourage basic phenomenological research into the acute psychological response to traumatic life events. However, in trauma surgery, diagnostic clarity and simplification can only enhance interdisciplinary efforts targeting the mental health component of injury control (2). In turn, randomized effectiveness trials of interventions delivered from trauma surgical wards and other settings for care of acute conditions could inform the development of evidence-based treatments for the millions of physically injured Americans who suffer from posttraumatic behavioral and emotional disturbances.

References

1. Kessler RC, Sonnega A, Bromet E, Hughes M, Nelson CB: Posttraumatic stress disorder in the National Comorbidity Survey. Arch Gen Psychiatry 1995; 52:1048–1060
2. Bonnie RJ, Fulco CE, Liverman CT: Reducing the Burden of Injury: Advancing Prevention and Treatment. Washington, DC, National Academy Press, 1999
3. Ursano RJ, Fullerton CS, Epstein RS, Crowley B, Kao T-C, Vance K, Craig KJ, Dougall AL, Baum A: Acute and chronic posttraumatic stress disorder in motor vehicle accident victims. Am J Psychiatry 1999; 156:589–595
4. Blanchard EB, Hickling EJ, Taylor AE, Loos W, Forneris CA, Jaccard J: Who develops PTSD from motor vehicle accidents? Behav Res Ther 1996; 34:1–10
5. Michaels AJ, Michaels CE, Moon CH, Smith JS, Zimmerman MA, Taheri PA, Peterson C: Posttraumatic stress disorder after injury: impact on general health outcome and early risk assessment. J Trauma 1999; 47:460–467
6. Holbrook TL, Anderson JP, Sieber WJ, Browner D, Hoyt DB: Outcome after major trauma: 12-month and 18-month follow-up results from the Trauma Recovery Project. J Trauma 1999; 46: 765–771; discussion, 771–773
7. Zatzick DF, Marmar CR, Weiss DS, Browner WS, Metzler TJ, Golding JM, Stewart A, Schlenger WE, Wells KB: Posttraumatic stress disorder and functioning and quality of life outcomes in a nationally representative sample of male Vietnam veterans. Am J Psychiatry 1997; 154:1690–1695
8. Mollica RF, McInnes K, Sarajlie N, Lavelle J, Sarajlie I, Massagli MP: Disability associated with psychiatric comorbidity and

health status in Bosnian refugees living in Croatia. JAMA 1999; 282:433–439

9. Zatzick DF, Jurkovich GJ, Gentillelo LM, Wisner DH, Rivara FP: Posttraumatic stress, problem drinking and functional outcome after injury. Arch Surg 2002; 137:200–205

10. Shalev AY, Freedman S, Peri T, Brandes D, Sahar T: Predicting PTSD in trauma survivors: prospective evaluation of self-report and clinician-administered instruments. Br J Psychiatry 1997; 170:558–564

11. Ehlers A, Mayou R, Bryant B: Psychological predictors of chronic posttraumatic stress disorder after motor vehicle accidents. J Abnorm Psychol 1998; 107:508–519

12. Koren D, Arnon I, Klein E: Acute stress response and posttraumatic stress disorder in traffic accident victims: a one-year prospective, follow-up study. Am J Psychiatry 1999; 156:367–373

13. Mayou R, Bryant B, Duthie R: Psychiatric consequences of road traffic accidents. Br Med J 1993; 307:647–651

14. Bryant RA, Harvey AG: Relationship between acute stress disorder and posttraumatic stress disorder following mild traumatic brain injury. Am J Psychiatry 1998; 155:625–629

15. Gibbons RD, Hedeker D, Elkin I, Waternaux C, Kraemer HC, Greenhouse JB, Shea MT, Imber SD, Sotsky SM, Watkins JT: Some conceptual and statistical issues in analysis of longitudinal psychiatric data. Arch Gen Psychiatry 1993; 50:739–750

16. Crystal S, Sambamoorthi U: Functional impairment trajectories among persons with HIV disease: a hierarchical linear models approach. Health Serv Res 1996; 31:469–488

17. King D, King L, Bachrach P, McArdele J: Contemporary approaches to missing data: the glass is really half full. PTSD Res Q 2001; 12:1–6

18. Wells KB: Treatment research at the crossroads: the scientific interface of clinical trials and effectiveness research. Am J Psychiatry 1999; 156:5–10

19. Bridging Science and Service: A Report by the National Advisory Mental Health Council's Clinical Treatment and Services Research Workgroup. Washington, DC, National Institute of Mental Health, 1999

20. Gentilello LM, Donovan DM, Dunn CW, Rivara FP: Alcohol interventions in trauma centers: current practice and future directions. JAMA 1995; 274:1043–1048

21. Ruzek J, Zatzick D: Ethical considerations in research participation among acutely injured trauma survivors: an empirical investigation. Gen Hosp Psychiatry 2000; 22:27–36

22. Teasdale G, Jennet B: Assessment of coma and impaired consciousness: a practical scale. Lancet 1974; 2:81–84

23. Weathers FW, Huska JA, Keane TM: The PTSD Checklist—Civilian Version. Boston, National Center for PTSD, Boston VA Medical Center, 1991

24. Blanchard EB, Jones-Alexander J, Buckley TC, Forneris CA: Psychometric properties of the PTSD Checklist. Behav Res Ther 1996; 34:669–673

25. Radloff LS: The CES-D Scale: a self-report depression scale for research in the general population. J Applied Psychol Measurement 1977; 1:385–401

26. McDowell I, Newell C (eds): Measuring Health: A Guide to Rating Scales and Questionnaires. New York, Oxford University Press, 1996

27. Marmar CR, Weiss DS, Metzler TJ: The Peritraumatic Dissociative Experiences Questionnaire, in Assessing Psychological Trauma and PTSD. Edited by Wilson JP, Keane TM. New York, Guilford, 1997, pp 412–428

28. The Johns Hopkins Health Services Research and Development Center: Determining Injury Severity From Hospital Discharges: A Program to MAP ICD-9CM Diagnoses Into AIS and ISS Severity Scores. Baltimore, Johns Hopkins University Press, 1989

29. Committee on Injury Scaling: The Abbreviated Injury Scale, 1985 Revision. Morton Grove, Ill, American Association for the Advancement of Automotive Medicine, 1985

30. McLellan AT, Luborsky L, Woody GE, O'Brien CP: An improved diagnostic evaluation instrument for substance abuse patients: the Addiction Severity Index. J Nerv Ment Dis 1980; 168:26–33

31. Ware JE, Kosinski M, Keller SD: A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. Med Care 1996; 34:220–223

32. Straus M: The conflict tactics scale and its critics: an evaluation and new data on validity and reliability, in Physical Violence in American Families: Risk Factors and Adaptation to Violence in 8,145 Families. Edited by Straus M, Gelles R. New Brunswick, NJ, Transaction, 1990, pp 49–73

33. Spitzer RL, Williams JBW, Gibbon M: Structured Clinical Interview for DSM-III-R—Patient Version (SCID-P). New York, New York State Psychiatric Institute, Biometrics Research, 1987

34. Sherbourne CD, Stewart A: The MOS Social Support Survey. Soc Sci Med 1991; 32:705–714

35. Zatzick DF, Kang S, Kim S, Leigh P, Kravitz R, Drake C, Sue S, Wisner D: Patients with recognized psychiatric disorders in trauma surgery: incidence, inpatient length of stay, and cost. J Trauma 2000; 49:487–495

36. Akaike H: A new look at the statistical model identification. IEEE Transactions on Automatic Control 1974; 19:716–723

37. Malt UF: The long-term psychiatric consequences of accidental injury: a longitudinal study of 107 adults. Br J Psychiatry 1988; 153:810–818

38. Schnyder U, Moergeli H, Klaghofer R, Buddeberg C: Incidence and prediction of posttraumatic stress disorder symptoms in severely injured accident victims. Am J Psychiatry 2001; 158:594–599

39. Brewin CR, Andrews B, Rose S, Kirk M: Acute stress disorder and posttraumatic stress disorder in victims of violent crime. Am J Psychiatry 1999; 156:360–366

40. Dowd MD, Langley J, Koepsell T, Soderberg R, Rivara FP: Hospitalizations for injury in New Zealand: prior injury as a risk factor for assaultive injury. Am J Public Health 1996; 86:929–934

41. Poole GV, Griswold JA, Thaggard VK, Rhodes RS: Trauma is a recurrent disease. Surgery 1993; 113:608–611

42. Sims DW, Bivins BA, Obeid FN, Horst HM, Sorensen VJ, Fath JJ: Urban trauma: a chronic recurrent disease. J Trauma 1989; 29:940–947

43. Paulsen AS, Crowe RR, Noyes R, Pfohl B: Reliability of the telephone interview in diagnosing anxiety disorders. Arch Gen Psychiatry 1988; 45:62–63

44. Wells KB, Burnam MA, Leake B, Robbins LN: Agreement between face-to-face and telephone-administered version of the depression section of the NIMH Diagnostic Interview Schedule. J Psychiatr Res 1988; 22:207–220

45. Cacciola JS, Alterman AI, Rutherford MJ, McKay JR, May DJ: Comparability of telephone and in-person structured clinical interview for DSM-III-R (SCID) diagnoses. Assessment 1999; 6:235–242

46. Dansky BS, Saladin ME, Brady KT, Kilpatrick DG, Resnick HS: Prevalence of victimization and posttraumatic stress disorder among women with substance abuse disorders: comparison of telephone and in-person assessment samples. Int J Addict 1995; 30:1079–1099

47. Freedman S, Brandes D, Peri T, Shaley AY: Predictors of chronic post-traumatic stress disorder: a prospective study. Br J Psychiatry 1999; 174:353–359

48. Marshall RD, Spitzer R, Liebowitz MR: Review and critique of the new DSM-IV diagnosis of acute stress disorder. Am J Psychiatry 1999; 156:1677–1685