Original Investigation

Collaborative Care Intervention Targeting Violence Risk Behaviors, Substance Use, and Posttraumatic Stress and Depressive Symptoms in Injured Adolescents
A Randomized Clinical Trial

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IMPORTANCE Violence and injury risk behaviors, alcohol and drug use problems, and posttraumatic stress disorder (PTSD) and depressive symptoms occur frequently among adolescents presenting to acute care medical settings after traumatic physical injury.

OBJECTIVE To test the effectiveness of a stepped collaborative care intervention targeting this constellation of risk behaviors and symptoms in randomly sampled hospitalized adolescents with and without traumatic brain injury.

DESIGN, SETTING, AND PARTICIPANTS A pragmatic randomized clinical trial was conducted at a single US level I trauma center. Participants included 120 adolescents aged 12 to 18 years randomized to intervention (n = 59) and control (n = 61) conditions.

INTERVENTIONS Stepped collaborative care intervention included motivational interviewing elements targeting risk behaviors and substance use as well as medication and cognitive behavioral therapy elements targeting PTSD and depressive symptoms.

MAIN OUTCOMES AND MEASURES Adolescents were assessed at baseline before randomization and 2, 5, and 12 months after injury hospitalization. Standardized instruments were used to assess violence risk behaviors, alcohol and drug use, and PTSD and depressive symptoms.

RESULTS The investigation attained more than 95% adolescent follow-up at each assessment point. At baseline, approximately one-third of the participants endorsed the violence risk behavior of carrying a weapon. Regression analyses demonstrated that intervention patients experienced significant reductions in weapon carrying compared with controls during the year after injury (group × time effect, $F_{3,344} = 3.0; P = .03$). At 12 months after the injury, 4 (7.3%) intervention patients vs 13 (21.3%) control patients reported currently carrying a weapon (relative risk, 0.31; 95% CI, 0.11-0.90). The intervention was equally effective in reducing the risk of weapon carrying among injured adolescents with and without traumatic brain injury. Other treatment targets, including alcohol and drug use problems and high levels of PTSD and depressive symptoms, occurred less frequently in the cohort relative to weapon carrying and were not significantly affected by the intervention.

CONCLUSIONS AND RELEVANCE Collaborative care intervention reduced the risk of adolescent weapon carrying during the year after the injury hospitalization. Future investigation should replicate this preliminary observation. If the finding is replicated, orchestrated investigative and policy efforts could systematically implement and evaluate screening and intervention procedures targeting youth violence prevention at US trauma centers.

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Injury is the leading cause of death and disability for children and adolescents in the United States and constitutes a major public health challenge. Estimates suggest that each year approximately 4.3 million adolescents present to acute care medical emergency department and trauma center settings after incurring traumatic physical injuries. Traumatic physical injury accounts for approximately 12% of medical expenditures in the United States and approximately 16% of the world’s burden of disease.

A series of investigations now suggests that the constellation of violence and injury risk behaviors, alcohol and drug use problems, and posttraumatic stress disorder (PTSD) and depressive symptoms are endemic among adolescents presenting to acute care medical settings after traumatic physical injury. Pediatric and adult patients with traumatic brain injury (TBI) may be particularly vulnerable to the development of posttraumatic mental health symptoms and risk behaviors. This constellation of risk behaviors and symptoms is associated with marked functional impairment and societal costs.

Commentary has encouraged the conduct of pragmatic clinical trials with increasing applied relevance to “real world” treatment contexts, such as acute care medical emergency department and trauma center settings. Pragmatic trials are characterized by broad participant eligibility criteria, flexible treatment delivery, and nonspecialist provider interventionists. Recent commentary has also encouraged the conduct of effectiveness-implementation hybrid clinical trials that take policy context into consideration to maximize overall trial public health and population impact.

Large-scale randomized clinical trials have established the effectiveness of collaborative care interventions that integrate care management, evidence-based pharmacotherapy, and cognitive behavioral therapy (CBT) in the treatment of depressive and anxiety disorders in primary care patients. Initial investigation suggested that collaborative care interventions may be effective for pediatric primary care patients. Other investigations suggested that trauma-exposed youth presenting to acute care medical trauma center and emergency department settings may respond to early postinjury motivational interviewing interventions targeting violence risk behaviors and alcohol use problems. Fewer trials targeting PTSD and depressive symptoms among injured youth have been conducted. Two investigations successfully used collaborative care interventions to treat alcohol use problems and PTSD symptoms in adult injury survivors with and without TBI. However, no investigations have tested the effectiveness of collaborative care for injured adolescents presenting to acute care medical settings.

The present investigation was a pragmatic randomized clinical trial designed to assess whether injured adolescents participating in a collaborative care intervention would demonstrate reductions in violence and injury risk behaviors, alcohol and drug use problems, and PTSD and depressive symptoms. The investigation hypothesized that injured adolescent patients receiving the collaborative care intervention would demonstrate clinically and statistically significant reductions in targeted risk behaviors, substance use problems, and PTSD and depressive symptoms compared with adolescents randomized to a usual care control condition. A secondary hypothesis was that the intervention would be equally effective in patients with and without TBI.

### Methods

#### Design, Setting, and Participants

Patients included in the study were adolescent survivors of intentional (eg, injuries associated with human malice, such as physical assaults) and unintentional (eg, motor vehicle crashes) injuries who were admitted to the University of Washington’s Harborview level I trauma center (Harborview) inpatient surgical ward or emergency department for 24 hours or more. All informed consent procedures were approved by the University of Washington’s institutional review board, and full written informed consent was obtained prior to data collection. For patients younger than 18 years, both adolescent assent and parental consent were obtained, and participants and parents received financial compensation. Recruitment for the study occurred between March 1, 2008, and October 31, 2009.

During active recruitment, a research associate downloaded a daily list of all newly admitted injury survivors between the ages of 12 and 18 years from the Harborview electronic medical record. Random number assignments for each adolescent inpatient were generated daily, and each youth was approached in the order dictated by the random number assignments.

Adolescents with severe injuries that prevented participation were excluded from the study, as were adolescents with self-inflicted intentional injuries. Also, any adolescent who was either non-English speaking or for whom both parents were non-English speaking was excluded. Adolescents approached in the surgical ward were evaluated with the Glasgow Coma Scale score and were required to have a cumulative score of 15 at the time of the evaluation, indicating mild brain injury. Adolescent patients were also required to score at least 7 out of 10, indicative of normal on the 2 Mini-Mental State Examination items that assess orientation to location and date.

#### Assessments

All patients received evaluations of violence and injury risk behaviors, alcohol and drug use, and PTSD and depression symptoms, as well as functional impairments and health service use, at baseline in the emergency department or surgical ward before randomization and again after randomization at 2, 5, and 12 months after discharge during telephone follow-up interviews. The baseline adolescent interview occurred in the days and weeks immediately following the acute injury (mean [SD], 10 [17] days after injury).

Ten items from the National Longitudinal Study of Adolescent Health were used to assess a full spectrum of adolescent violence and injury risk behaviors. Risk behaviors assessed included not wearing seat belts, riding motorcycles, drinking and driving, arrests, lawsuits, and weapon carrying. At baseline in the surgical ward, risk behavior items were anchored to the year before the injury event (ie, “During the past year before your injury, did you ever carry a weapon on you...”

Collaborative Care for Injured Adolescents

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The Composite International Diagnostic Index (DSM-IV) was used to assess adolescent alcohol abuse and dependence criteria. The Alcohol Use Disorders Identification Test, a 3-item self-report screening measure used for early identification of problem alcohol use in the acute care setting, was used to augment the Composite International Diagnostic Index. Both measures have established reliability, validity, and responsiveness to change. Adolescent drug use, including amphetamines, cocaine, marijuana, and opiates, was assessed with single-item screens. Because of infrequent use of some substances, alcohol and drug use was collapsed into a single any use (yes/no) variable.

Adolescent posttraumatic stress symptoms were assessed with the adolescent version of the University of California, Los Angeles, PTSD Reaction Index (PTSD-RI) for the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV). The PTSD-RI includes 20 items that evaluate the PTSD DSM-IV intrusion, avoidance, and arousal symptoms. At the initial interview, adolescents were asked to anchor all symptom reports to the injury event (e.g., “How much of the time since your injury did you have dreams about the event in which you were injured or other bad dreams?”). The PTSD-RI can be used to create an algorithm consistent with a diagnosis of PTSD by rating 1 intrusive, 3 avoidant, and 2 arousal symptoms with a rating of moderate severity. This algorithm was used to identify patients with high PTSD symptom levels consistent with a diagnosis of PTSD. The 9-item Patient Health Questionnaire (PHQ-9) depression screen was used to assess depressive symptoms. The PHQ-9 has been previously used to assess depressive symptoms in adolescents and has excellent internal consistency and convergent validity. The PHQ-9 can be used to create an algorithm consistent with a DSM-IV diagnosis of depression, and this algorithm was used to identify patients with high depressive symptom levels consistent with a diagnosis of depression.

Previously developed items assessing postinjury health service use were administered at baseline and at the 2-, 5-, and 12-month follow-up interviews. Interview items contained self-report descriptions of current medication use (i.e., name, dosage, and duration). The investigation determined injury severity at baseline during the index admission from the International Classification of Diseases, 9th Revision, Clinical Modification medical record codes using the Abbreviated Injury Scale and Injury Severity Score. Traumatic brain injury was prospectively identified in the medical record, and TBI severity was coded based on a previously validated algorithm for hospitalized inpatients. Insurance status, length of hospital and intensive care unit stays, and other clinical characteristics were abstracted from the trauma registry and electronic medical record.

Randomization
Randomization occurred in a 1:1 ratio according to random assignments of blocks of 4 or 6 patients that were computer generated by the investigation’s biostatisticians (J.R. and J.W.). Randomization was conducted by an intervention team member (D.Z.) and research associates performing all baseline assessments, and follow-up interviewers were blinded to block sizes and intervention or control group status.

Stepped Collaborative Care Intervention
Patients randomized to the intervention condition received care from a social work and nurse practitioner trauma center-based care management team for 12 months after the injury. The intervention included care management and evidence-based motivational interviewing targeting risk behaviors and substance use as well as pharmacotherapy and CBT elements targeting high levels of PTSD and depressive symptoms.

Usual Care Control Condition
Prior investigation suggests that usual postinjury care includes routine outpatient surgical, primary care, and emergency department visits. Specialty mental health services are occasionally used.

Statistical Analysis
The investigation first examined the extent to which the clinical injury and demographic characteristics of randomly sampled adolescent patients included in the trial were significantly different from or similar to the characteristics of all injured adolescent trauma patients admitted during the study period. Next, the investigation assessed the dichotomized occurrence of violence and injury risk behaviors, alcohol and drug use, and high levels of PTSD and depressive symptoms at baseline and longitudinally for the intent-to-treat sample of 120 randomized adolescents.

To determine whether patients in the 2 groups manifested different patterns of change in risk behaviors, substance use, and PTSD and depressive dichotomous outcomes over the year after injury, we used Poisson regression analysis with robust error variance to estimate relative risks and 95% CIs. For all dependent variables we fit models containing time categories, intervention, and intervention-by-time interactions. To examine the effect of TBI on any observed treatment effects, we fit additional models that included the presence or absence of TBI and the interaction with treatment group and time. When significant interactions or main effects were detected in any of the regression models, change score analyses for each assessment point were performed. The final models presented include no covariates. Finally, we performed sensitivity analyses to assess the effect of including covariates and use of alternative regression formats on the longitudinal outcome assessments. We used SAS, version 9.2 (SAS Institute Inc), and SPSS, version 18.0 (SPSS Inc), for all analyses.

Because no prior investigations of collaborative care interventions had been conducted in injured adolescents, we used previous adult collaborative care interventions targeting alcohol use problems to derive sample size estimates for the current investigation. With 60 patients in each group and a 2-tailed \( \alpha = .05 \), there would be greater than 80% power to detect a 22% difference in alcohol use problems between groups (i.e., 42% in the control group vs 20% in the intervention group).
Results

Adolescent patients included in the study did not differ significantly from other adolescent patients admitted with regard to age (study patients mean [SD], 15.4 [1.9] vs 15.4 [1.8] years; $P = .84$), female sex (25.0% vs 26.2%; $P = .79$), injury severity score (15.7 [11.3] vs 16.3 [13.2]; $P = .06$), and length of stay (6.4 [10.0] vs 5.9 [11.0] days; natural logarithm-transformed $P = .09$). Compared with all other adolescents admitted to the trauma center, the 120 study patients were less likely to be intentionally injured (4.2% vs 12.0%) and have a positive blood alcohol concentration (2.5% vs 9.8%). The investigation attained more than 95.0% follow-up of the participants at 2, 5, and 12 months (Figure 1).

Adolescents randomized to the intervention and control conditions did not substantially differ with regard to injury, clinical, and demographic characteristics, including percentage of patients with TBI (Table 1). A total of 47.5% of the adolescents had incurred head injuries, with 16.7% experiencing mild, 10.0% moderate, and 20.8% severe TBI.

With regard to the frequency of adolescent outcomes for targeting by the intervention, the highest prevalence risk behavior at baseline was the report of carrying a weapon; 32.8% of adolescents reported this violence risk behavior (Table 1). All other individual risk behaviors (eg, not wearing seat belts) were reported by less than 25.0% of the participants. At baseline in the year before the injury, 10.9% of the adolescents reported alcohol use consistent with an abuse and/or dependence diagnosis. The mean Alcohol Use Disorders Identification Test score for the participants was 1.4 (2.5). With regard to drug use, 35.8% of the adolescents reported using marijuana at least once in the year before the injury, 2.5% amphetamine or cocaine, and 0.8% prescription opiates. Symptoms consistent with a diagnosis of PTSD occurred in less than 20.0% of the patients, and symptoms consistent with a diagnosis of depression occurred in 10.0% of adolescents at baseline in the surgical ward (Table 1). In total, 64.2% of the adolescents reported alcohol or drug use, high PTSD or depressive symptom levels, or weapon carrying at baseline. There were no significant differences between intervention and control group patients in any risk behaviors, alcohol and drug use, and high levels of PTSD and depressive symptoms (Table 1).

Intervention Implementation

The mean total time spent with each intervention participant was 13.1 (9.5) hours. Time intensity in the stepped-care procedure gradually decreased during the year after the injury. Seventy-five percent of all intervention activity (9.8 [6.4] hours) occurred within the first 6 months after the injury. Approximately two-thirds of intervention patients (n = 39) received 1 or more motivational interviews targeting either substance use or risk behaviors; 22 intervention patients (37.3%) received at least 1 motivational interview session targeting alcohol and drugs, and 29 (49.2%) received at least 1 motivational interview session targeting weapon carrying or other risk behaviors. Thirty intervention patients (50.8%) received nurse practitioner medication evaluations, 17 patients (28.8%) were offered pharmacotherapy targeting high levels of PTSD and depressive symptoms, and 10 (16.9%) adhered to their medication regimens during the study. Thirty-five patients (59.3%) were assessed for multisession CBT, and 19 (32.2%) received 1 or more CBT elements delivered during routine care management. Only 1 (0.2%) individual entered and completed 5 CBT sessions.62

Treatment Outcomes During the Year After Injury

Intervention patients had clinically and statistically significant reductions in self-reports of carrying a weapon during the year after injury compared with controls (Figure 2 and Table 2) (group × time effect, $F_{3,344} = 3.0; P = .03$). At each follow-up assessment point, intervention patients had a significantly diminished risk of carrying a weapon compared with control patients (Table 3). At 12 months after the injury, 4 (7.3%) intervention patients vs 13 (21.3%) control patients reported currently carrying a weapon (relative risk, 0.31; 95% CI, 0.11-0.90).
Observation of individual case trajectories revealed that 11 (18.0%) adolescents in the control group began new weapon-carrying behaviors after their injury hospitalization compared with 2 (3.4%) intervention patients ($P = .048$). Regression analyses revealed no significant interaction of TBI by treatment group ($F_{1,347} = 0.28; P = .60$), suggesting that patients with TBI responded equally well to the intervention.


cardiac care intervention in reducing the violence risk behavior of weapon carrying in randomly sampled, acutely hospitalized adolescents. The intervention reduced adolescent weapon carrying during the year after acute care injury admission. Patients with and without TBI were equally likely to demonstrate reduced weapon carrying. No significant group differences were observed for alcohol or drug use problems or for PTSD and depressive symptom levels.

In concert with the aims of a pragmatic trial, adolescents were randomly selected for participation in the study from a clinical population of hospitalized injured youth, and the demographic and clinical characteristics of study patients did...
Table 2. Outcomes for Adolescents in Collaborative Care vs Usual Care Control Over Timea

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Baseline</th>
<th></th>
<th>2 mo</th>
<th></th>
<th>5 mo</th>
<th></th>
<th>12 mo</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CC</td>
<td>UC</td>
<td>CC</td>
<td>UC</td>
<td>CC</td>
<td>UC</td>
<td>CC</td>
<td>UC</td>
</tr>
<tr>
<td>Carrying a weapon</td>
<td>20 (34.5)</td>
<td>19 (31.2)</td>
<td>8</td>
<td>14.0</td>
<td>15</td>
<td>25.0</td>
<td>5</td>
<td>88</td>
</tr>
<tr>
<td>Any alcohol or drug use</td>
<td>28 (47.5)</td>
<td>25 (41.0)</td>
<td>18</td>
<td>31.6</td>
<td>14</td>
<td>23.3</td>
<td>19</td>
<td>32.8</td>
</tr>
<tr>
<td>High-level PTSD symptomsb</td>
<td>9 (15.3)</td>
<td>12 (19.7)</td>
<td>11</td>
<td>19.3</td>
<td>12</td>
<td>20.0</td>
<td>9</td>
<td>15.5</td>
</tr>
<tr>
<td>High-level depressive symptomsc</td>
<td>4 (6.8)</td>
<td>8 (13.1)</td>
<td>3.5</td>
<td>5.3</td>
<td>4</td>
<td>6.7</td>
<td>2</td>
<td>3.5</td>
</tr>
</tbody>
</table>

Abbreviations: CC, collaborative care; PTSD, posttraumatic stress disorder; UC, usual care. 

a Data are presented as number (percentage) of patients. Outcomes included for 120 patients: 59 CC and 61 UC.

Table 3. Comparisons of Collaborative Care and Usual Care Control Patient Reports of Carrying a Weapon Over Timea

<table>
<thead>
<tr>
<th>Carrying a Weapon</th>
<th>Baseline to 2 mo</th>
<th>Baseline to 5 mo</th>
<th>Baseline to 12 mo</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Change</td>
<td>Net Difference</td>
<td>Change</td>
</tr>
<tr>
<td>Usual care control</td>
<td>0.80</td>
<td>0.53-1.20</td>
<td>0.68</td>
</tr>
<tr>
<td>Collaborative care</td>
<td>0.41</td>
<td>0.24-0.70</td>
<td>0.51</td>
</tr>
</tbody>
</table>

Abbreviation: RR, relative risk. 

a Outcome results were derived from mixed Poisson regression models that include treatment group, time, and group-by-time interaction terms.

Conclusions

Collaborative care intervention reduced the risk of adolescent weapon carrying during the year after injury hospitalization. Future investigation should replicate this preliminary observation. If the finding is replicated, orchestrated investigative and policy efforts could systematically implement and evaluate screening and intervention procedures targeting youth violence prevention at US trauma centers.

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Author Contributions: Dr Zatzick had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. 
Study concept and design: Zatzick, Jurkovich.

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