


# Can stepped collaborative care interventions improve post-traumatic stress disorder symptoms for racial and ethnic minority injury survivors?

Khadija Abu,<sup>1</sup> Michelle Bedard-Gilligan,<sup>1</sup> Rddhi Moodliar,<sup>2</sup> Eileen M Bulger,<sup>3</sup> Alexandra Hernandez,<sup>3</sup> Tanya Knutzen,<sup>1</sup> Jake Shoyer,<sup>1</sup> Navneet Birk,<sup>1</sup> Cristina Conde,<sup>1</sup> Allison Engstrom,<sup>1</sup> Paige Ryan,<sup>1</sup> Jin Wang,<sup>1</sup> Joan Russo,<sup>1</sup> Douglas F Zatzick <sup>1</sup>

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<sup>1</sup>Psychiatry & Behavioral Sciences, University of Washington School of Medicine, Seattle, Washington, USA

<sup>2</sup>Department of Psychology, University of California Los Angeles, Los Angeles, California, USA

<sup>3</sup>Department of Surgery, University of Washington School of Medicine, Seattle, Washington, USA

## Correspondence to

Dr Douglas F Zatzick; [dzatzick@uw.edu](mailto:dzatzick@uw.edu)

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## ABSTRACT

**Objectives** No large-scale randomized clinical trial investigations have evaluated the potential differential effectiveness of early interventions for post-traumatic stress disorder (PTSD) among injured patients from racial and ethnic minority backgrounds. The current investigation assessed whether a stepped collaborative care intervention trial conducted at 25 level I trauma centers differentially improved PTSD symptoms for racial and ethnic minority injury survivors.

**Methods** The investigation was a secondary analysis of a stepped wedge cluster randomized clinical trial. Patients endorsing high levels of distress on the PTSD Checklist (PCL-C) were randomized to enhanced usual care control or intervention conditions. Three hundred and fifty patients of the 635 randomized (55%) were from non-white and/or Hispanic backgrounds. The intervention included care management, cognitive behavioral therapy elements and, psychopharmacology addressing PTSD symptoms. The primary study outcome was PTSD symptoms assessed with the PCL-C at 3, 6, and 12 months postinjury. Mixed model regression analyses compared treatment effects for intervention and control group patients from non-white/Hispanic versus white/non-Hispanic backgrounds.

**Results** The investigation attained between 75% and 80% 3-month to 12-month follow-up. The intervention, on average, required 122 min (SD=132 min). Mixed model regression analyses revealed significant changes in PCL-C scores for non-white/Hispanic intervention patients at 6 months (adjusted difference -3.72 (95% CI -7.33 to -0.10) Effect Size =0.25, p<0.05) after the injury event. No significant differences were observed for white/non-Hispanic patients at the 6-month time point (adjusted difference -1.29 (95% CI -4.89 to 2.31) ES=0.10, p=ns).

**Conclusion** In this secondary analysis, a brief stepped collaborative care intervention was associated with greater 6-month reductions in PTSD symptoms for non-white/Hispanic patients when compared with white/non-Hispanic patients. If replicated, these findings could serve to inform future American College of Surgeon Committee on Trauma requirements for screening, intervention, and referral for PTSD and comorbidities.

**Level of evidence** Level II, secondary analysis of randomized clinical trial data reporting a significant difference.

**Trial registration number** NCT02655354.

## WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Few large-scale randomized clinical trial investigations have evaluated the potential differential effectiveness of early interventions for post-traumatic stress disorder (PTSD) among injured patients from racial and ethnic minority backgrounds.

## WHAT THIS STUDY ADDS

⇒ Non-white/Hispanic intervention patients demonstrated significant PTSD symptom reductions at the 6-month postinjury time point when compared with non-white/Hispanic usual care control patients.

⇒ No such significant differences were observed for white/non-Hispanic intervention and usual care control patients.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ If replicated, these findings could serve to inform future American College of Surgeon Committee on Trauma requirements for mental health screening, intervention, and referral.

## INTRODUCTION

Traumatic physical injuries are endemic in the USA and are associated with substantial individual suffering and population health burden.<sup>1-3</sup> Each year in the USA, over 30 million individuals visit acute care medical settings after incurring traumatic injuries, and between 1.5 and 2.5 million Americans are so severely injured annually that they require inpatient admission.<sup>1-3</sup> Between 20% and 40% of injury survivors who have been hospitalized later develop post-traumatic stress disorder (PTSD) symptoms and associated comorbidities.<sup>4-8</sup> Following an injury, PTSD and related comorbid conditions are associated with a wide range of functional limitations and significant societal costs.<sup>2,3,6,9</sup>

The risk of developing PTSD and related comorbidity after an injury accentuates the importance of developing mental health screening, intervention, and referral procedures at trauma centers; the American College of Surgeons Committee on Trauma now mandates trauma centers establish protocols that identify patients at a heightened risk of experiencing psychological sequelae following traumatic injuries and have a referral process in

place for patients who receive a positive screening result indicating a high risk.<sup>10</sup>

Injured patients presenting to trauma care systems after life-threatening exposures are often from racial and ethnic minority groups and are at high risk for not receiving high-quality mental health screening, intervention, and referral; the acute care medical setting can be viewed as a de facto safety net healthcare system serving low-income, multicultural patient populations.<sup>11–16</sup> Injured trauma survivors belonging to racial and ethnic minority groups may be at increased risk of developing PTSD and related comorbid conditions.<sup>13–15 17</sup> Non-white racial minority patients (ie, African American, American Indian, and Asian American) and ethnically Hispanic patients experience adverse health disparities in acute medical care settings.<sup>16 18–20</sup> This includes experiencing reduced administration of pain medication for comparable injuries and exhibiting higher postinjury mortality rates compared with white/non-Hispanic patients.<sup>16 18–20</sup> Effectively coordinating acute care with primary care services poses a significant challenge, with racial and ethnic minority patients being particularly susceptible to experiencing disrupted care transitions.<sup>12–14 21–24</sup> Patients from ethnic and minority backgrounds are also vulnerable to community violence and associated traumatic injuries.<sup>11 25–28</sup> Therefore, efforts to improve the overall quality of mental healthcare delivered at trauma centers could lead to diminished health disparities and markedly improved outcomes for racial and ethnic minority injury survivors.<sup>12–15 18 29 30</sup>

Emerging research indicates that stepped care collaborative interventions have proven effectiveness in addressing the symptoms of PTSD and related comorbidities among injured trauma survivors.<sup>12 23 24 31–33</sup> Stepped collaborative care interventions integrate proactive care management, psychotherapeutic elements, and medications to provide comprehensive postinjury patient support. Preliminary research suggests that stepped collaborative care interventions may be effective when tailored to the needs of racially and ethnically diverse patient populations.<sup>12 34–36</sup> The optimal use of stepped screening, intervention, and referral procedures in the delivery of mental health services to diverse patients has the potential to mitigate disparities at trauma centers.

This secondary data analysis examined the impact of a stepped collaborative care intervention for a subgroup of non-white/Hispanic racial and ethnic minority injury survivors recruited from 25 US level I trauma centers. The investigation hypothesized that injury survivors from non-white and Hispanic minority groups would demonstrate greater PTSD symptom improvement when randomized to a collaborative care intervention compared with white, non-Hispanic patients.

## METHOD

### Design overview

The multisite Trauma Survivors Outcomes and Support pragmatic trial orchestration was carried out at the study team's data coordinating center, located at the University of Washington's Harborview Medical Center, in close collaboration with the National Institutes of Health Healthcare Systems Research Collaboratory.<sup>24 37</sup>

Investigative procedures are detailed in prior publications and are briefly described below.<sup>24 37</sup> Sites recruited into the study constituted a representative subsample of all US level I trauma centers.<sup>37</sup> Per the stepped wedge protocol, all sites began recruiting control patients and were randomized sequentially to initiate the intervention. Patients were assessed at baseline in the

surgical ward as trauma inpatients and 3, 6, and 12 months after the injury. Recruitment for the trial began in January 2016 and ended in November 2018; the 12-month patient study follow-up ended in November 2019 (online supplemental file 1).

### Patient inclusion/exclusion criteria

Patients aged  $\geq 18$  years were included in the trial. Prisoners and non-English-speaking patients were excluded. Patients whose index injury was self-inflicted or were actively exhibiting psychotic symptoms and required immediate psychiatric treatment were also excluded from the trial. In order to ensure adequate follow-up rates, patients were required to provide two pieces of contact information. No other exclusionary criteria applied to racial and ethnic group membership.

### Electronic health record PTSD screen

The research team had previously created a comprehensive electronic health record (EHR) assessment comprising 10 domains (table 1) to identify patients at risk for developing PTSD.<sup>29</sup> Patients who were identified as high risk for PTSD based on an EHR assessment with a score of  $\geq 3$  positive domains underwent a formal screening for study participation using the PTSD Checklist (PCL-C) for the Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV).<sup>23 32 38</sup> Patients scoring  $\geq 35$  on the PCL-C were randomized into the trial.

### Randomization and follow-up assessments

Prior to the initiation of patient recruitment, a study biostatistician randomized each of the 25 sites to one of the four waves in the stepped wedge design using a computer-generated algorithm. Recruiters at the 25 sites were aware of each patient's intervention or control group status at the time of the baseline surgical ward interview but were instructed not to inform patients of their status until after completion of the baseline interview. All follow-up interviews were conducted by a survey research team at the University of Washington data coordinating center; follow-up interviewers were masked to the patient's assigned intervention or control group status.

### Enhanced usual care control condition

Patients assigned to the control condition underwent informed consent, both PTSD screenings, baseline surgical ward evaluation, and follow-up interviews. The enhanced aspect of usual care involved nurse notification of each patients' PCL-C score of  $\geq 35$ . Previous investigations have indicated that typical post-traumatic care posthospital discharge involves routine visits to surgical, primary care, and emergency department settings, as well as occasional appointments with mental health specialists.<sup>23 32 39</sup>

### Stepped collaborative care intervention

Acute care medical stepped collaborative care procedures targeting PTSD and related comorbidity have been described previously.<sup>23 32 39</sup> Briefly, stepped collaborative care treatments bring together effective medication and psychotherapeutic intervention elements with proactive care management strategies that aim to reduce care fragmentation for injured patients. The intervention was tailored to patient treatment preferences, and all collaborative care treatment elements were made available to patients. Patients who demonstrate enduring PTSD symptoms after initial treatment receive 'stepped up' care that can include medication adjustments or additional psychotherapy treatment.

**Table 1** Demographic and clinical characteristics of non-white/Hispanic injury survivors (n=350)

Characteristic	Total	Control	Intervention	P value
		N=198	N=152	
<b>EHR risk factor</b>				
Female gender	137 (39.1)	69 (34.9)	68 (44.7)	0.06
ICU admission	186 (53.1)	105 (53.0)	81 (53.3)	0.96
Prior inpatient hospitalization	120 (34.3)	69 (34.9)	51 (33.6)	
Current tobacco use	174 (49.7)	91 (46.0)	83 (54.6)	0.11
Prior psychiatric diagnosis	87 (24.9)	45 (22.7)	42 (27.6)	0.29
Prior PTSD diagnosis	50 (14.3)	24 (12.1)	26 (17.1)	0.19
+BAC/Toxicology or admission diagnosis	88 (27.4)	47 (27.3)	41 (27.5)	0.97
<b>Demographics</b>				
Age (years), mean (SD)	36.9 (13.3)	38.0 (13.6)	35.6 (13.0)	0.09
Education				0.8
<HS	79 (22.6)	45 (22.7)	34 (22.4)	
HS/GED	182 (52.0)	99 (50.0)	83 (54.6)	
Associate's degree	57 (16.3)	35 (17.7)	22 (14.5)	
Bachelor's or graduate degree	32 (9.1)	19 (9.6)	13 (8.6)	
Marital status—married	88 (25.2)	47 (23.9)	41 (27.0)	0.51
Employed	211 (60.8)	115 (58.1)	96 (64.4)	0.23
Insurance				0.79
Private	97 (27.7)	56 (28.3)	41 (27.0)	
Public/Uninsured	253 (72.3)	142 (71.7)	111 (73.0)	
<b>Acute care injury and medical factors</b>				
Intentional injury	181 (51.7)	100 (50.5)	81 (53.3)	0.61
Injury severity score				0.95
0–8	88 (27.9)	47 (27.8)	41 (27.9)	
9–15	107 (33.9)	56 (33.1)	51 (34.7)	
16+	121 (38.3)	66 (39.1)	55 (37.4)	
TBI				0.56
None	229 (72.5)	122 (72.2)	107 (72.8)	
Mild	49 (15.5)	24 (14.2)	25 (17.0)	
Moderate/Severe	38 (12.0)	23 (13.6)	15 (10.2)	
Three or more medical comorbidities	92 (26.8)	54 (28.0)	38 (25.3)	0.58
LOS for injury visit, mean (SD)	12.6 (11.8)	12.8 (11.0)	12.2 (12.8)	0.65
<b>Clinical assessments</b>				
Number of previous traumas ≥5	119 (39.4)	69 (39.7)	50 (39.1)	0.92
Baseline PCL-C V4, mean (SD)	53.1 (12.5)	51.1 (12.0)	55.8 (12.7)	0
Baseline PHQ-9, mean (SD)	13.4 (5.9)	12.9 (5.9)	13.9 (5.9)	0.1
Pre-injury SF-12 PCS, mean (SD)	50.3 (9.2)	49.9 (9.1)	51.0 (9.4)	0.26
Pre-injury SF-12 MCS, mean (SD)	47.3 (12.5)	48.4 (11.5)	45.9 (13.6)	0.08
Pre-injury AUDIT-C score, mean (SD)	3.7 (3.2)	3.6 (3.1)	3.8 (3.3)	0.54
<b>Pre-injury self-report drug use</b>				
Stimulants	77 (22.1)	39 (19.8)	38 (25.2)	0.23
Opioids	20 (5.7)	16 (8.1)	4 (2.7)	0.03
Marijuana	186 (53.5)	106 (53.5)	80 (53.3)	0.97

AUDIT-C, Alcohol Use Disorders Identification Test-Concise; BAC, blood alcohol content; EHR, electronic health record; GED, General Education Development Test; HS, high school; ICU, intensive care unit; LOS, length of stay; MCS, Medical Outcomes Study 12-item Mental Component Summary Score; PCL-C, PTSD Checklist; PCS, Medical Outcomes Study 12-item Physical Component Summary Score; PHQ-9, 9-item Patient Health Questionnaire; PTSD, post-traumatic stress disorder; SF-12, 12-item short form; TBI, traumatic brain injury.

The stepped care intervention and referral elements include both universal patient-centered elements and tailored elements to address the postinjury needs of racially and ethnically diverse injury survivors that extend beyond the symptoms of PTSD and comorbidity to include multiple social determinants of health.<sup>16 40 41</sup>

The early intervention approach to working with racially and ethnically minority injury survivors derives from previous

investigations by the study team and others working to develop mental health interventions for diverse patient populations.<sup>34–36</sup> The study team has observed that patients from diverse backgrounds have unique postinjury concerns which can be explored and integrated into the early intervention.<sup>42</sup> Patients from diverse backgrounds may describe postinjury distress differently, can prefer alternative forms of treatment, and sometimes require multiple/repetitive explanations surrounding the goals of

early intervention.<sup>12,42</sup> Care manager curiosity regarding diverse beliefs and knowledge can facilitate patient communication and ultimately enhance treatment engagement.

### Intervention training

After completion of the usual care control phase recruitment, the principal investigator visited each trauma center in order to conduct a 1 day training for frontline providers. Each of the 25 sites was able to select which frontline providers were to be trained, resulting in a full spectrum of training for social work, nursing, physician, and other healthcare providers.<sup>37</sup> The workshop training provided an overview of the core care management, psychopharmacology, and motivational interviewing and cognitive behavioral therapy elements of the stepped collaborative care intervention. After the 1 day workshop training, the study team initiated regular site supervisory calls in which the site interventionists presented cases to supervising study team members. The 25 sites' intervention and staffing activities were documented in the Research Electronic Data Capture database.

### Approach to racial and ethnic categorization

The approach to racial and ethnic categorization was derived from patient self-report of racial and ethnic background.<sup>43,44</sup> Patients were asked by staff performing the baseline interview at each of the 25 sites, "Are you White, Black, American Indian, Asian, Pacific Islander, Native Hawaiian or Alaskan, or another race?" Each patient was also asked, "Are you of Spanish or Hispanic descent, that is, Mexican, Mexican American, Chicano, Puerto Rican, Cuban, Central or South American, or Spanish?" Patients were allowed to endorse one or more racial groupings. Patients endorsing more than one racial background were grouped into the non-white category.

### Patient-reported outcome assessments

The PCL-C IV was used to assess the symptoms of PTSD, the main outcome of the study. During the baseline assessment in the surgical ward, patients were asked to rate their symptoms since the injury event; the 3-month, 6-month, and 12-month interviews queried patients about their symptoms. The psychometric equivalence of the PCL-C versions based on the DSM-IV and DSM fifth edition has been established through prior investigations, including studies conducted by the research team involving injured patients.<sup>29</sup>

Depressive symptoms were assessed using the 9-item Patient Health Questionnaire (PHQ-9) brief depression severity measure.<sup>45</sup> The Alcohol Use Disorder Identification Test 3-item version (AUDIT-C) was used to assess alcohol use problems.<sup>23,46</sup> The investigation used the Medical Outcomes Study Short Form Physical Components Summary Score (MOS SF PCS) SF-12 at baseline in the surgical ward to assess physical function in the month prior to the injury admission; patients were longitudinally followed up with the MOS SF-36 PCS.<sup>23,47</sup> In terms of pre-injury health service utilization, patients were asked at baseline, "In the year before your injury, have you ever had at least one outpatient visit with a psychiatrist, psychologist, social worker, psychiatric nurse, counselor, or other similar professional about problems with your emotions, nerves, or use of substances?"

Medical record data from the 25 sites' trauma registries were used to derive injury severity scores and injury mechanisms.<sup>48,49</sup> Laboratory toxicology results, insurance status, length of hospital and intensive care unit stays, and other clinical characteristics were obtained from trauma registries.

### Data analyses

All primary statistical analyses were conducted using the intent-to-treat sample. The initial objective of the data analysis was to examine and compare the demographic, clinical, and injury characteristics between patients from non-white/Hispanic backgrounds and patients from white/non-Hispanic backgrounds. Next, the study team sought to determine if patients from non-white/Hispanic backgrounds versus patients from white/non-Hispanic backgrounds manifested different patterns of change in PTSD symptoms over the year after injury. To ascertain group differences, the study team first stratified the sample by non-white/Hispanic versus white/non-Hispanic groups. The study team used mixed effects regression to examine group differences while accounting for repeated measures over time at the individual level and cluster randomization at the site level. The initial regression analyses contained no adjustments for covariates. Sensitivity analyses contained baseline demographics and clinical and injury characteristics identified to be significantly different across the two groups (ie,  $p \leq 0.10$ ); in these sensitivity analyses, age, gender, and baseline PTSD EHR diagnosis were retained in all final analyses as design variables regardless of statistical significance. The above analyses were repeated for secondary study outcomes, which encompassed PHQ-9, AUDIT-C, and MOS SF PCS scale scores. The study team used SAS V.9.4 (SAS Institute) and SPSS V.25 (SPSS Software IBM) for all analyses.

### RESULTS

With regard to participants' flow through the protocol, a total of 171 303 patients were admitted to the 25 participating US trauma centers during the investigation timeframe.<sup>24,37</sup> Of those, a total of 7454 patients were screened for study participation; 3256 were excluded before the EHR screen (eg, discharged before screening occurred), 1601 had less than three risk factors on the EHR screen and 105 met other exclusion criteria, while 811 were either discharged before consent could be attempted or met other exclusion criteria. A total of 1681 patients were approached for consent, with 617 declining participation, 380 patients scoring  $<35$  on the PCL-C, and 49 patients meeting other exclusion criteria.

Of the 635 patients randomized into the trial, 350 were from non-white/Hispanic backgrounds: 218 patients identified as African American, 15 as American Indian/Alaska Native, 8 as Asian/Pacific Islander, and 109 endorsed mixed or other races. One hundred and two patients endorsed Hispanic ethnicity. Two hundred and eighty-five patients were from white/non-Hispanic backgrounds.

The following characteristics differed significantly (ie,  $p < 0.05$ ) between patients in the non-white/Hispanic group and patients in the white/non-Hispanic group (tables 1 and 2): female gender (39% vs 60%), ICU admission (53% vs 67%), tobacco use (50% vs 64%), pre-injury psychiatric diagnosis (25% vs 56%), pre-injury PTSD diagnosis (14% vs 23%), educational attainment less than high school (23% vs 16%), intentional injury (52% vs 19%), and three or more medical comorbidities (27% vs 45%). The mean age was also significantly lower in the non-white/Hispanic group compared with the white/non-Hispanic group (38 years vs 42 years). With regard to baseline PTSD and depressive symptoms, patients in the non-white/Hispanic group, when compared with the white/non-Hispanic, demonstrated significantly higher PCL scores but significantly lower PHQ-9 scores (tables 1 and 2). The non-white/Hispanic group, when compared with the white/non-Hispanic, also exhibited significantly better pre-injury physical and mental health function, as assessed by



**Table 2** Demographic and clinical characteristics of white/non-Hispanic injury survivors (n=285)

Characteristic	White/non-Hispanic			P value
	Total	Control N=172	Intervention N=113	
<b>EHR risk factor</b>				
Female gender	171 (60.0)	92 (53.5)	79 (69.9)	0.01
ICU admission	191 (67.0)	125 (72.7)	66 (58.4)	0.01
Prior inpatient hospitalization	129 (45.3)	88 (51.2)	41 (36.3)	0.01
Current tobacco use	182 (63.9)	120 (69.8)	62 (54.9)	0.01
Prior psychiatric diagnosis	159 (55.8)	96 (55.8)	63 (55.8)	0.99
Prior PTSD diagnosis	65 (22.8)	31 (18.0)	34 (30.1)	0.02
+BAC/Toxicology or admission diagnosis	69 (26.4)	39 (26.0)	30 (27.0)	0.85
<b>Demographics</b>				
Age (years), mean (SD)	41.5 (14.9)	42.1 (15.8)	40.5 (13.4)	0.36
Education				0.37
<HS	44 (15.6)	29 (17.1)	15 (13.4)	
HS/GED	132 (46.8)	82 (48.2)	50 (44.6)	
Associate's degree	61 (21.6)	31 (18.2)	30 (26.8)	
Bachelor's or graduate degree	45 (16.0)	28 (16.5)	17 (15.2)	
Marital status—married	90 (31.6)	52 (30.2)	38 (33.6)	0.55
Employed	165 (58.1)	93 (54.4)	72 (63.7)	0.12
Insurance				0.73
Private	100 (35.1)	59 (34.3)	41 (36.3)	
Public/Uninsured	185 (64.9)	113 (65.7)	72 (63.7)	
<b>Acute care injury and medical factors</b>				
Intentional injury	53 (18.6)	36 (20.9)	17 (15.0)	0.21
Injury severity score				0.83
0–8	49 (19.4)	27 (18.2)	22 (21.2)	
9–15	90 (35.7)	53 (35.8)	37 (35.6)	
16+	113 (44.8)	68 (46.0)	45 (43.3)	
TBI				0.14
None	159 (63.1)	86 (58.1)	73 (70.2)	
Mild	52 (20.6)	34 (23.0)	18 (17.3)	
Moderate/Severe	41 (16.3)	28 (18.9)	13 (12.5)	
Three or more medical comorbidities	121 (44.8)	68 (42.8)	53 (47.8)	0.42
LOS for injury visit, mean (SD)	13.3 (13.7)	13.4 (13.6)	13.2 (13.8)	0.92
<b>Clinical assessments</b>				
Number of previous traumas $\geq 5$	116 (47.7)	65 (45.1)	51 (51.5)	0.33
Baseline PCL-C V4, mean (SD)	50.8 (11.1)	50.3 (10.4)	51.6 (12.1)	0.31
Baseline PHQ-9, mean (SD)	15.0 (5.5)	15.1 (5.4)	14.8 (5.7)	0.68
Pre-injury SF-12 PCS, mean (SD)	48.3 (10.2)	48.3 (10.3)	48.2 (10.0)	0.9
Pre-injury SF-12 MCS, mean (SD)	41.7 (13.8)	41.4 (13.7)	42.2 (13.9)	0.63
Pre-injury AUDIT-C score, mean (SD)	3.8 (3.7)	3.8 (3.6)	3.6 (3.7)	0.61
<b>Pre-injury self-report drug use</b>				
Stimulants	58 (20.4)	38 (22.1)	20 (17.9)	0.39
Opioids	42 (14.8)	28 (16.3)	14 (12.5)	0.38
Marijuana	116 (40.7)	71 (41.3)	45 (39.8)	0.81

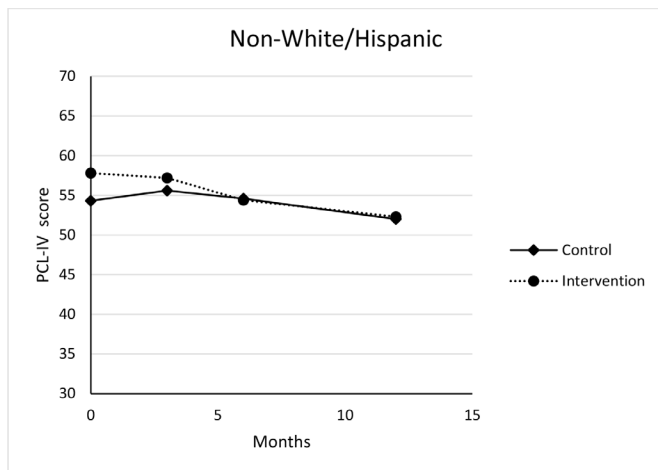
AUDIT-C, Alcohol Use Disorders Identification Test-Concise; BAC, blood alcohol content; EHR, electronic health record; GED, General Education Development test; HS, high school; ICU, intensive care unit; LOS, length of stay; MCS, Medical Outcomes Study 12-item Mental Component Summary Score; PCL-C, PTSD Checklist; PCS, Medical Outcomes Study 12-item Physical Component Summary Score; PHQ-9, 9-item Patient Health Questionnaire; PTSD, post-traumatic stress disorder; SF-12, 12-item short form.

the MOS SF-12 PCS and MCS scale scores (tables 1 and 2). Finally, non-white/Hispanic patients had reported significantly lower frequencies of pre-injury mental health service utilization when compared with white/non-Hispanic patients (24% vs 46%,  $\chi^2 = 27.5$ ,  $p < 0.01$ ).

Beyond the design variables of age, gender, and baseline PTSD diagnosis, characteristics that differed at the  $p \leq 0.10$  level for the non-white/Hispanic group were pre-injury opioid use, baseline

PHQ-9, and pre-injury SF-12 MCS (table 1). For the white/non-Hispanic group, characteristics beyond designed variables that differed at the  $p \leq 0.10$  level for the white/non-Hispanic group were ICU admission, pre-injury hospitalization, and tobacco use (table 2).

The investigation attained follow-up rates of 80.2% at 3 months, 77.3% at 6 months, and 75.1% at 12 months. Follow-up



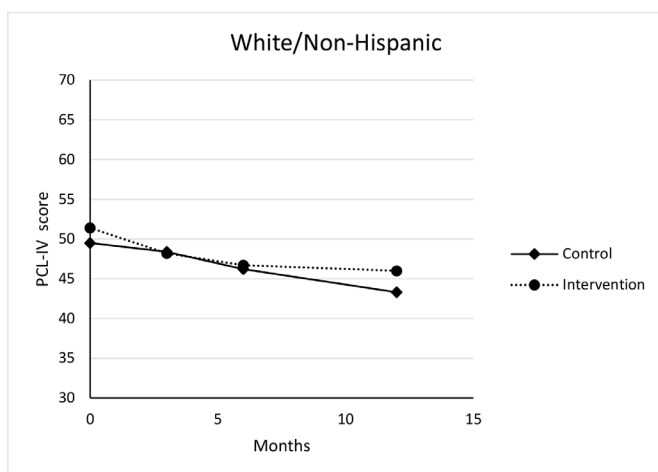
**Figure 1** PTSD Checklist (PCL-C) symptom levels over time for non-white/Hispanic patients (n=350). \*Analyses are adjusted for age, gender, prior PTSD diagnosis, pre-injury opioid use, baseline Medical Outcome Study 12-item Mental Health Summary Scale Score, Patient Health Questionnaire 9-item Depression score. PTSD, post-traumatic stress disorder.

rates did not substantially differ for non-white/Hispanic and white/non-Hispanic patients.

The intervention, on average, required 122 min (SD=132 min). Stepped care intervention delivery occurred across trauma center inpatient, acute care outpatient, primary care and community service delivery sectors. Approximately 70% of intervention activity occurred within the initial 3 months postinjury, 20% occurred between months 3 and 6, and 10% transpired subsequent to the 6-month postinjury time point.

Non-white/Hispanic intervention versus usual care control patients, when compared with white/non-Hispanic intervention versus usual care control patients, manifested different patterns of change over time on the PCL-C (figures 1 and 2). No significant differences were observed overtime for PHQ-9, AUDIT-C, and MOS SF PCS outcome assessments between groups.

In both adjusted and unadjusted mixed model regression analyses, non-white/Hispanic patients randomized to the intervention



**Figure 2** PTSD Checklist (PCL-C) symptom levels over time for white/non-Hispanic patients (n=285). \*Analyses are adjusted for age, gender, prior PTSD diagnosis, intensive care unit admission, prior inpatient hospitalization, and tobacco use. PTSD, post-traumatic stress disorder.

group demonstrated significant 6-month PCL reductions when compared with non-white/Hispanic patients randomized to the control group (table 3). In contrast, adjusted and unadjusted mixed model regression analyses did not reveal any significant group differences for white/non-Hispanic patients at the 6-month postinjury time point (table 3). No other significant differences were observed for any group comparisons at the 3-month and 12-month postinjury time points.

## DISCUSSION

This is the first multisite trauma center investigation that compared PTSD symptomatic outcomes between non-white/Hispanic and white/non-Hispanic patients receiving a collaborative care intervention. These findings corroborate and extend the observations of previous collaborative care trials among physically injured trauma survivors.<sup>23 24 32 39</sup> Prior single site collaborative care trials conducted in acute care medical settings have documented significant PTSD symptom reductions among intervention patients when compared with patients receiving usual care. It is noteworthy that the patients recruited into the current study had experienced multiple prior traumatic life events and exhibited histories of pre-index hospitalization PTSD symptoms. These observations may, in part, explain the generally more modest treatment effects documented in collaborative care effectiveness trials compared with PTSD efficacy trials conducted in mental health specialty settings, where patients are more likely to have experienced a lower cumulative burden of lifetime trauma exposures.<sup>9 50</sup>

The study documents significant PTSD symptom reductions for non-white/Hispanic patients receiving the intervention at the 6-month postinjury time point. In contrast, no significant 6-month differences were observed for white/non-Hispanic stepped care intervention patients.<sup>34-36</sup> The original trial also found 6-month but not 3-month and 12-month intervention differences between usual care and the stepped care intervention. These findings extend the results from the trial and suggest that the previously reported 6-month treatment effects derive predominantly from intervention-related PTSD symptom improvements in non-white/Hispanic patients relative to white/non-Hispanic patients.

The observation that racial and ethnic minority patients demonstrated greater improvement in this acute care medical setting trial complements findings from other research groups that suggest that collaborative care interventions can differentially improve mental health symptoms for racial and ethnic minority patients in primary care.<sup>34-36</sup> There are a number of potential explanations for the observation that the current collaborative care intervention yielded greater treatment effects for non-white/Hispanic patients. To begin, the stepped care intervention and referral elements include both universal, patient-centered components and tailored elements designed to address the postinjury needs of multicultural injury survivors that extend beyond the symptoms of PTSD and comorbidity and incorporate multiple social determinants of health.<sup>16 40 41</sup> Another possible explanation for the observed treatment effects is that the collaborative care model integrates shared decision-making, which has been hypothesized to enhance engagement in care for multicultural patient populations at risk for health-care inequities.<sup>12 34</sup> An additional potential mechanism through which collaborative care may ameliorate mental health symptoms for racial and ethnic minority patients is to improve access to care<sup>12 34</sup>; data from the investigation suggest that in the year before the injury almost half of white/non-Hispanic patients had

**Table 3** Change over time in PTSD Checklist symptom levels for non-white/Hispanic versus white/non-Hispanic intervention and usual care control patients

Group	Change baseline to 3 months			Change baseline to 6 months			Change baseline to 12 months		
	Change mean (95% CI)	Net difference mean (95% CI)	Effect size	Change mean (95% CI)	Net difference mean (95% CI)	Effect size	Change mean (95% CI)	Net difference mean (95% CI)	Effect size
Unadjusted									
Non-white/Hispanic									
Usual care control	1.00 (-1.07 to 3.07)	Reference	---	0.14 (-2.15 to 2.43)	Reference	---	-2.73 (-5.39 to 0.07)	Reference	---
Intervention	-0.64 (-3.01 to 1.73)	-1.64 (-4.78 to 1.51)	0.12	-3.46 (-6.20 to 0.72)	-3.60 (-7.17 to -0.03)*	0.25	-5.66 (-8.91 to 2.41)	-2.93 (-7.12 to 1.27)	0.17
White/Non-Hispanic									
Usual care control	-1.19 (-3.21 to 0.83)	Reference	---	-3.41 (-5.70 to 1.11)	Reference	---	-6.23 (-8.89 to 3.57)	Reference	---
Intervention	-2.81 (-5.21 to 0.41)	-1.62 (-4.76 to 1.52)	0.14	-4.24 (-6.98 to 1.49)	-0.83 (-4.41 to 2.75)	0.06	-5.15 (-8.39 to 1.90)	1.08 (-3.12 to 5.28)	0.07
Adjusted									
Non-white/Hispanic†									
Usual care control	1.32 (-0.74 to 3.39)	Reference	---	0.39 (-1.94 to 2.72)	Reference	---	-2.23 (-5.00 to 0.54)	Reference	---
Intervention	-0.54 (-2.87 to 1.80)	-1.86 (-4.97 to 1.25)	0.14	-3.32 (-6.09 to 0.56)	-3.72 (-7.33 to -0.10)*	0.25	-5.46 (-8.81 to 2.12)	-3.24 (-7.58 to 1.10)	0.19
White/Non-Hispanic†									
Usual care control	-1.13 (-3.16 to 0.90)	Reference	---	-3.38 (-5.69 to 1.07)	Reference	-	-6.21 (-8.89 to 3.53)	Reference	---
Intervention	-3.16 (-5.57 to 0.74)	-2.02 (-5.18 to 1.13)	0.17	-4.67 (-7.43 to 1.91)	-1.29 (-4.89 to 2.31)	0.1	-5.41 (-8.69 to 2.13)	0.80 (-3.43 to 5.04)	0.05

\* P<0.05. All other comparisons were not statistically significant.

†Adjusted for age, gender, prior PTSD diagnosis, pre-injury opioids use, and baseline MCS and PHQ-9 scores.

#Adjusted for age, gender, prior PTSD diagnosis, intensive care unit admission, prior inpatient hospitalization, and tobacco use.

MOS SF-12 MCS, medical outcomes study 12-item short form mental components summary score; PHQ-9, 9-item Patient Health Questionnaire; PTSD, post-traumatic stress disorder.

accessed mental health services compared with approximately a quarter of non-white/Hispanic patients. As an example of this potential mechanism, a preliminary investigation conducted by the study team included a pilot randomized trial of a culturally tailored, brief stepped care intervention for American Indian/Alaska Native injury survivors.<sup>12</sup> The investigation, titled ‘Staying Connected’, engaged American Indian/Alaska Native patients at the bedside through post-traumatic concern elicitation and established proactive linkages between trauma centers and distant tribal communities. While no significant differences between the intervention and control groups were discernible in terms of PTSD and depressive symptoms in this limited pilot investigation (n=32), it is noteworthy that 75% of the participants reported finding the intervention as helpful.<sup>12</sup>

### Limitations

This investigation has limitations. The study team acknowledges that there are multiple approaches to the categorization of racial and ethnic subgroups; while the current categorization into non-white/Hispanic and white/non-Hispanic facilitates subgroup analyses for the sample of 635 patients across intervention and control conditions, some nuanced implications of racial and ethnic subgroup membership could be obscured by this rudimentary dichotomization.<sup>43,44</sup> Future large-scale prospective clinical trial investigations could routinely incorporate preplanned subgroup analyses, necessitating prespecification of racial and ethnic subgroups. Prespecification could enhance scientific rigor by requiring a priori subgroup definitions and hypotheses. Additionally, the study team acknowledges that the exclusion of non-English-speaking patients is a study limitation. Prior study team investigation documents remarkable linguistic diversity at US trauma centers; in a random sample of non-English-speaking injury survivors, >40 languages were represented, with only approximately 20%–25% being Spanish speaking. Earlier investigations have indicated that the translation across language groups in the current multisite investigative context might be impractical.<sup>13,14</sup> Additionally, the investigation is limited by the use of only a single item to assess pre-injury mental health service utilization. A previously described limitation of the study is the observed baseline elevation in PCL-C scores with intervention patients demonstrating greater PTSD symptomatic distress relative to control patients.<sup>24</sup> Also, as previously described, due to variance in reporting practices and the quality of implementation across sites, some of the data regarding patient flow through the study exclusions may contain errors.<sup>24</sup> Finally, the 6-month study results revealed significant reductions in non-white/Hispanic patients randomized to the intervention group relative to non-white/Hispanic patients randomized to the control group. However, no significant differences were observed across all groups 3 or 12 months after the injury. The study team notes that approximately 90% of the intervention activity occurred within the first 6 months after the injury, which may in part explain the temporal patterning of treatment effects.

### CONCLUSIONS

Beyond these considerations, this investigation contributes to a growing literature regarding the delivery of stepped collaborative care interventions at trauma centers nationwide. In secondary analyses, a brief stepped collaborative care intervention was associated with greater 6-month reductions in PTSD symptoms for non-white/Hispanic patients relative to white/non-Hispanic patients. If replicated, these findings could serve to inform future American College of Surgeon Committee on Trauma

requirements for screening, intervention, and referral for PTSD and related comorbid conditions. As an example, the College currently requires trauma centers to screen patients at high risk for PTSD after injury but does not specify the use of a particular screening approach.<sup>10</sup> While multiple screening measures have been recommended, automated EHR screening can simultaneously screen for PTSD symptom risk and has the capacity to prioritize patients from non-white/Hispanic backgrounds.<sup>23,29</sup> If replicated, the results of the investigation could inform future research that focuses on refining screening approaches that simultaneously characterize psychological symptom risk and racial/ethnic group status in order to optimally inform college-required procedures.

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**Competing interests** DFZ has provided forensic expert consultation/testimony related to post-traumatic stress disorder for the Washington State Attorney General, the City of Seattle, and other agencies/firms.

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**Data availability statement** Data are available on reasonable request. The study data will be shared; details of data sharing are currently being worked out by the investigative team.

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### ORCID iD

Douglas F Zatzick <http://orcid.org/0000-0001-7339-1020>

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