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ORIGINAL PAPER

Association of trauma informed service learning with students' knowledge, attitudes and confidence

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Abstract

Up to 90% of American adults have had prior exposure to trauma but medical education in Trauma Informed Care (TIC) remains limited. We integrated a TIC curriculum into a pre-clerkship medical student service learning program and measured its association with TIC knowledge, attitudes and confidence after year 1. 353 students participated in the pretest. 103 matched pairs are included in the final analysis. To assess gains from the curriculum, we utilized three instruments: Attitudes Towards Trauma Informed Care, a confidence instrument originally designed for social work students, and a knowledge assessment. We used paired t-tests to assess for score differences between administrations and fit a predictive model for change in score using a generalized estimating equations model. The average unadjusted sum score on the pretest was high—23.5 out of 30 (IQR 22.0–25.3). 69.7% of students somewhat or strongly agreed they had previously heard of TIC. Statistically significant negative associations were found between sum score, Black, Asian/PI, and biracial identities, second-year medical student status and prior familiarity with TIC. Average posttest scores in the matched cohort increased by 1.37 points (95% CI, 0.82–1.91). In the GEE model, Asian/PI race, biracial identity and being a second-year medical student remained statistically significant

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predictors of lower TIC scores, while identifying as a woman was positively associated. Further study is needed to contextualize these scores and to continue seeking effective resources for increasing clinicians' capacity to practice TIC.

Keywords Trauma informed care · Medical student · Assessment · Attitudes

Abbreviations

ACE Adverse childhood experience
AHSS Arts, humanities, and social science
TIC Trauma informed care
SW Social work

Introduction

As many as 90% of American adults have prior exposure to at least one traumatic event and up to 70% were exposed during childhood (Kilpatrick et al. 2013). Contemporary definitions of trauma encompass physical, psychological and emotional injury, and include experiencing abuse, discrimination, and violence. Trauma increases a person's lifetime potential for engaging in health-risk behaviors, negatively impacts physical and behavioral health, and interferes with access to or use of health services (Hughes et al. 2017).

Although trauma is increasingly being recognized as incredibly prevalent and clinically relevant, few physicians have had formal training in Trauma Informed Care (TIC), an organizational approach to creating environments and service providers sensitive to the needs of patients who have experienced trauma (Substance Abuse and Mental Health Services Administration (SAMHSA), 2014; Substance Abuse and Mental Health Services Administration 2014). TIC shows promise as a framework for patient-centered care that promotes healing, decreases the risks of inadvertent emotional injury during healthcare encounters and improves the therapeutic alliance between patient and provider (Weinreb et al. 2007; Machtinger et al. 2015; Tuck et al. 2017; Chaudhri et al. 2019). Implementing TIC has been shown to improve patient-centered communication skills regardless of patients' specific trauma history (Green et al. 2015). Despite this, medical students and resident physicians report low rates of formal training and lack of confidence translating didactic knowledge into clinical practice (Strait and Bolman 2017; Tink et al. 2017; Goldstein et al. 2018; Elisseou et al. 2019; DeAndrade et al. 2020). Teaching medical trainees the science of trauma theory and principles of TIC is a critical step towards creating a trauma aware workforce that is more adequately prepared to address trauma in clinical encounters and organizational design. Investing in the education of medical students seems especially high yield, because in their prospective careers many will head clinical teams, lead in administrative and operational roles, and set research agendas that will influence the future of the profession.

Investigations to assess change in skills, knowledge, attitudes, confidence or other measures that represent mastery of TIC principles as a result of curricular initiatives are limited; and none are specifically designed for physician trainees. Examples from curricula designed for nursing trainees, mixed allied health professional students and educators suggest TIC training is perceived as acceptable by course participants, and often increases knowledge and confidence in the subject matter (Choi and Seng 2015; Stokes et al. 2017; Li et al. 2019; Cannon et al. 2020; Bilbrey et al. 2022). In this study, we describe a revised pre-clerkship curriculum at an urban academic medical program that incorporated formal exposure to TIC for the 2019–2020 academic year through the mandatory pre-clerkship service learning program. We explored the use of existing TIC survey tools for applicability in our population of students.

TIC was incorporated into the service learning curriculum because the skills needed for physician competency in the TIC framework overlaps significantly with skills gained in service learning programs. Service learning (SL) is a form of community engaged, experiential education where students build skills and knowledge through cycles of action and reflection with guidance from trained faculty and community leaders (What is Service Learning or Community Engagement? 2020). Properly calibrated service learning experiences are associated with increased abilities in cross-cultural communication, empathetic behavior and civic engagement (Laks et al. 2016; Hand et al. 2018; White et al. 2020). The experiential learning environment provides a guided opportunity to explore concepts like the social determinants of health (SDOH), cultural humility and health disparities (Sabo et al. 2015; Stewart and Wubbena 2015; Rinaudo 2017; Rodriguez 2017). For these reasons, many medical schools in the United States use service learning as a method to build patient-centered skills necessary for professionalism. Given the high levels of individual and community level violence experienced in neighborhoods in proximity to many urban academic medical centers, the TIC framework is an important skill set to develop in advance of the clerkship years.

To assess the association between the change in curriculum and students' knowledge, attitudes and perceived confidence in TIC, we administered a survey at the beginning (pretest) and end (posttest) of the 2019–2020 academic year. We hypothesized that exposure to the didactic and experiential curriculum would result in gains in knowledge of TIC, positive attitude towards TIC and confidence in implementation of principles of TIC. We further hypothesized that baseline scores or score increases, particularly in the attitude measurement, may differ based on students' racial and gender identity or educational background – that black and Latinx students, students identifying as women and students with backgrounds in the humanities would score higher at baseline or have larger score increases between pre and post assessments. This hypothesis builds on growing literature demonstrating white, male and biomedical science undergraduate majors tend to score lower on self-reported surveys measuring humanistic characteristics like compassion, perception of others pain and empathy (Thomas 1978; Gunderman and Kanter 2008; Berg

et al. 2015; Hoffman et al. 2016; Ratzan 2019; American Medical Association 2020; Hojat et al. 2020).

Methods

Participants and setting

The survey was administered to first- and second-year medical students in an academic medical center affiliated with an urban teaching hospital. The pre-clinical curriculum includes didactic sessions and small group workshops on health disparities and the social determinants of health as well as longitudinal service learning (SL) experiences in local community settings where students are encouraged to contextualize the lecture material and work on skills that may eventually inform their clinical practice.

In 2019, the curriculum was modified to include both a formalized TIC training module and the addition of trained trauma-informed educators at SL sites. First year (M1) students received a 60 minute didactic session that introduced (1) TIC theory and background, including relevant associated topics such as Adverse Childhood Experiences (ACEs) and the impact of trauma on epigenetic change, (2) individual and community-level signs and symptoms of trauma, and (3) best practices for interactions with people who have experienced trauma. The lecture emphasized systematic, systemic, and historical traumas such as poverty and discrimination.

Second year (M2) students received the same lecture at the beginning of the year, and had a second 60 minute didactic session on translating TIC to the bedside just prior to their transition to clerkships. This lecture (1) briefly reviewed trauma theory and symptoms of trauma from the fall introductory session, (2) invited students to share vignettes from their SL sites in order to provide contextualized examples of real-world examples of behavior influenced by history of trauma, and (3) reviewed trauma informed history taking and physical examination skills. Of note, M2 students may have heard the terms “trauma informed care” or “trauma sensitive care” at the discretion of individual instructors during their M1 year, but did not receive formal instruction in TIC prior to the start of this pilot curriculum.

To develop the curriculum we utilized references from SAHMSA’s National Center on Trauma Informed Care to describe TIC, the CDC and seminal articles to describe ACEs and epigenetics, the Diagnostic and Statistical Manual of Mental Disorders to describe symptoms of PTSD, white papers and other non-peer reviewed scholarship generated from the nonprofit sector to discuss community level trauma, community and structural violence (Center for Substance Abuse Treatment 2014; Hurst and Shoemaker 2015; The Annie E. Casey Foundation 2015; Beidas et al. 2016; Menshner and Maul 2016). We drew from books by scholars such as Bruce Perry, Nadine Burke Harris and Bessel van der Kolk.

Students were verbally consented to participate in the survey, M1 students prior to their TIC didactic session, and M2 students during their SL orientation. Pretest survey data was collected from September 2 to September 9, 2019 and posttest

survey data from February 1 to March 31, 2020. Both surveys were collected in REDCap, version 8.11.3. The Institutional Review Board of Temple University determined the study to be exempt non-human subjects research.

Measures

Although TIC is an organizational framework, application of the principles requires that individuals embrace the underlying constructs, commit to new processes and develop or refine skills necessary for successful implementation. Few psychometric tools have been developed to easily identify and track proxy metrics of individual competency such as attitudes towards, confidence in or knowledge of TIC (Champine et al. 2019). Surveys in populations of medical students have been limited in scope and scale, involving convenience samples of self-selecting students who are interested in TIC or evaluations of single center didactic experiences (Baker et al. 2016). Of the existing instruments, we know of only one validated tool oriented towards individuals rather than organizations, the Attitudes Related to Trauma Informed Care (ARTIC) scale (Wilson and Nochajski 2016). Of note, healthcare providers were included in the validation but not considered separately from other social and human service providers, and no students were included in the sample. In addition to ARTIC, we identified and used one other instrument that assessed confidence in TIC skills in SW students (see appendix for instruments) (Helitzer et al. 2011).

ARTIC-10 uses a 7-point bipolar Likert scale contrasting favorable and unfavorable attitudes to TIC, with higher scores indicating more favorable attitudes (Green et al. 2016). The confidence measurement tool uses a 100-point scale reflecting confidence (0 = none; 100 = extremely) in applying TIC skills in clinical practice (Dichter et al. 2018). We modified this to a 10-point Likert scale for ease of scoring and to make the subscales within our instrument more consistent. We additionally modified some statements to reflect the role of the medical student as a learner rather than autonomous decision-maker in the clinical setting. Most changes were minor, for example, "I" to "we" to indicate team membership. On three occasions, we modified the confidence instrument statements with the opening phrase, "given appropriate supervision by an attending" to more accurately reflect medical students' role within the hierarchy of an academic healthcare team.

We asked about familiarity with TIC (whether students had heard of, attended training in or had experience implementing TIC) on a 4-point Likert scale. We included a 9-item knowledge survey with true/false responses that reflected the content of the TIC curriculum. The questions were generated by the TIC lecturers, vetted with others with TIC expertise (including community based behavioral health educators with experience in facilitating trauma informed care trainings, a therapist, and a social worker) for quality, then administered to a group of 30 adults unaffiliated with the project to ensure question clarity. Demographic information collected included year in school, self-identified race, gender, highest level of parental education as a proxy for socioeconomic status, undergraduate major (dichotomized to STEM vs. arts, humanities and social science—AHSS majors), and whether the students were pursuing or planning to pursue a dual MD/Master's Degree in Urban Bioethics, a group of students we anticipated would be more likely

to have strong positive attitudes towards TIC. We had an a priori hypothesis that in addition to enrollment in the MA program, prior exposure to TIC, AHSS undergraduate majors and students with marginalized identities (Black, Latinx, gender minorities) may be correlated with higher baseline knowledge, attitude and confidence scores or larger changes between pre- and post- test administrations. Students spent on average 15 minutes completing the survey.

Analysis

We calculated sub-scores for knowledge (9 item yes/no responses, maximum raw score 9), attitude (10 items on a 7-point Likert scale, maximum raw score 7), and confidence (10 items on a 10-point Likert scale, maximum raw score 10). To lessen the effect of the differences in scales between the survey instruments, we used minimum-maximum normalization to convert each sub-score to a 10 point scale. We calculated a composite score from the sums of the three subscales (maximum score = 30). For the pretest, we examined the unadjusted relationships between sub and sum scores, demographic and educational variables using t-tests for continuous variables and Pearson's chi-squared tests for categorical variables. We tested a predictive model for variation in score based on demographic and educational variables using a linear regression model with backward elimination to determine model fit. We tested interactions between year in medical school and familiarity with TIC, to explore the relationship between additional medical training and baseline knowledge of TIC. We also tested interactions of race with parental education since SES and race are often colinear, and undergraduate major with gender, since women are overrepresented in the population of medical students with non-STEM degrees (National Research Council Panel on Race 2004; American Academy of Arts and Sciences 2017).

For the posttest, we matched participants' pre- and posttest responses based on the unique study ID each student created at time of pretest survey completion. We calculated sub and sum scores, then used paired t-tests to assess for significant differences in score between administrations. We fit a predictive model for change in score based on demographic and educational variables using a generalized estimating equations (GEE) model to account for within participant correlation of pre- and posttest scores. All analyses were performed in SAS, Version 9.4 (SAS Institute, Cary, NC) and STATA SE, Version 14.2 (StataCorp, College Station, TX).

Outcomes

200 M1 students and 180 M2 students were eligible to participate in the survey. A total of 199 M1 and 154 M2 students (total n = 353) responded to the pretest. 24 participants were excluded from the pretest because their pattern of responses were non-differentiated and consistent with straightlining. Of the remaining 329, 8 were excluded from the final regression model because of missing demographic data. Data from a student who identified as nonbinary was excluded due to low sample size and the inability to collapse them into another category. Results did not significantly differ when the excluded respondents were reintroduced to the model.

For the pretest, we report on 320 participants, representing a combined final response rate of 84.2% (320/380) with 89.0% (178/200) response rate from M1 and 78.9% (142/180) response rate from M2 students. Table 1 shows demographic characteristics of the 320 participants, stratified by years in medical school. Overall, the demographics of the combined pre-clerkship respondents were diverse; 53.4% were women, 20.7% were underrepresented racial minorities and 14.4% identified as Latinx. 26.9% obtained a non-STEM degree in college. 60.6% of students had at least one parent with a graduate or professional degree. Classes were similar demographically with the exception of the age distribution and number of students enrolled in the dual MD/MA program.

Reporting first on the pre-test, the average unadjusted sum score was 23.5 out of 30 (IQR 22.0–25.3). The average unadjusted sub-scores on knowledge, attitudes and

Table 1 Participant demographics

	Total cohort (n = 320)		First year medical students (n = 178)		Second year medical students (n = 142)		
	n	%	n	%	n	%	*p*-value
Age							0.03
20–24	209	65.3	125	70.2	84	59.2	
25–29	96	30.0	43	24.2	53	37.3	
30–34	11	3.4	6	3.4	5	3.5	
≥35	4	1.25	4	2.2	0	0.0	
Gender							0.67
Man	149	46.6	81	45.5	68	47.9	
Woman	171	53.4	97	54.5	74	52.1	
Race							0.42
White	203	63.4	108	60.7	95	66.9	
Black	44	13.8	29	16.3	15	10.6	
Asian/PI	51	15.9	28	15.7	23	16.2	
Biracial/other	22	6.9	13	7.3	9	6.3	
Ethnicity							0.65
Latinx	46	14.4	27	15.2	19	13.4	
Highest level parental education							0.68
<College degree	50	15.6	28	15.7	22	15.5	
Associates or bachelor degree	76	23.8	39	21.9	37	26.1	
Graduate or professional degree	194	60.6	111	62.4	83	58.5	
AHSS undergraduate degree	86	26.9	53	29.8	33	23.2	0.19
Enrolled or plan to enroll in MAUB	49	15.3	37	20.8	12	8.5	<0.01

Abbreviations: AHSS arts, humanities or social science, *MAUB* master of arts in urban bioethics

confidence sections were, 7.9 (IQR 7.8–8.9), 8.0 (IQR 7.4–8.7) and 7.6 (IQR 6.9–8.4), respectively. 69.7% of students somewhat or strongly agreed they had previously heard of TIC, while only 27.8% indicated they had experience implementing TIC skills prior to medical training (Table 2). Levels of familiarity differed significantly between classes, with a higher proportion of M2s reporting both awareness of and formalized training in TIC.

In the linear regression model (Table 3), we found that Black racial identity (−1.01, −1.95 – −0.18), Asian/PI racial identity (−1.31, −2.11 – −0.51), biracial identity (−1.57, −2.70 – −0.45), and being a M2 student (−0.82, −1.42 – −0.23) were significantly associated with a lower sum score. For Black and 2nd year students, differences in scores were driven by the attitude toward TIC sub-score, while Asian students scored lower on confidence. Prior familiarity with TIC (0.92, 0.04–1.80) and identifying as a woman (0.95, 0.35–1.51) were predictors of a higher sum score, driven by their attitude sub-scores. We found no association between sum score and identifying as Latinx, participation in the dual MD/MA program or prior history of an AHSS undergraduate degree. No significant associations were found between demographic variables and scores on the knowledge subscale. We tested for interaction between TIC familiarity and medical school class, but this was not statistically significant.

Table 2 Familiarity with trauma informed care by year in medical school

	Total cohort (n = 320)		First year medical students (n = 178)		Second year medical students (n = 142)		
	n	%	n	%	n	%	*P* value
Remember learning about TIC in M1 year	–	–	–	–	142	76.1	
Familiarity							
Heard of TIC							<0.0001
Strongly disagree	48	15.0	45	25.3	3	2.1	
Somewhat disagree	49	15.3	42	23.6	7	4.9	
Somewhat agree	115	35.9	61	34.3	54	38.0	
Strongly agree	108	33.8	30	16.9	78	43.9	
Attended a TIC training							<0.0001
Strongly disagree	148	46.3	117	65.7	31	21.8	
Somewhat disagree	73	22.8	32	18.0	41	28.9	
Somewhat agree	70	21.9	18	10.1	52	36.6	
Strongly agree	29	9.1	11	6.2	18	12.7	
Experience implementing TIC							<0.0001
Strongly disagree	144	45.0	103	57.9	41	28.9	
Somewhat disagree	87	27.2	34	19.1	53	37.3	
Somewhat agree	63	19.7	30	16.9	33	23.2	
Strongly agree	26	8.1	11	6.2	15	10.6	

Abbreviations: TIC trauma informed care

Table 3 Association between socio-demographic factors, pretest sum score and subscale scores

	Sum score	*p*	Knowledge	*p*	Confidence	*p*	Attitude	*p*
Unadjusted scores	23.5 (IQR 22.0–25.3)		7.9 (IQR 7.8–8.9)		7.6 (IQR 6.9–8.4)		7.99 (IQR 7.4–8.7)	
Adjusted scores	21.8 (CI 18.8–24.7)	<0.0001	7.4 (CI 6.3–8.5)	<0.0001	7.1 (CI 5.6–8.5)	<0.0001	7.4 (CI 6.3–8.5)	<0.0001
Black	−1.07 (−1.95 – −0.18)	0.02	−0.40 (−0.83–0.03)	0.11	−0.27 (−0.71–0.16)	0.22	−0.40 (−0.73 – −0.07)	0.02
Asian/PI	−1.31 (−2.11 – −0.51)	0.001	−0.36 (−0.75–0.03)	0.07	−0.60 (−0.99 – −0.21)	0.003	−0.22 (−0.43 – −0.007)	0.04
Biracial/other	−1.57 (−2.70 – −0.45)	0.006	−0.40 (−0.96–0.15)	0.15	−0.53 (−1.09–0.10)	0.06	−0.42 (−0.71 – −0.12)	0.01
Latinx	−0.25 (−1.09–0.59)	0.55	−0.17 (−0.63–0.28)	0.46	0.15 (−0.26–0.56)	0.47	−0.16 (−0.38–0.05)	0.15
Women	0.93 (0.35–1.52)	0.002	0.24 (−0.07–0.56)	0.13	0.30 (0.01–0.58)	0.04	0.28 (0.13–0.43)	0.0004
2nd year med student	−0.82 (−1.42 – −0.22)	0.007	−0.04 (−0.36–0.29)	0.82	−0.13 (−0.43–0.16)	0.37	−0.45 (−0.61 – −0.30)	<0.0001
MAUB student	0.58 (−0.30–1.45)	0.20	0.37 (−0.10–0.85)	0.13	−0.17 (−0.60–0.26)	0.45	0.26 (0.03–0.49)	0.03
AHSS Degree	0.44 (−0.22–1.10)	0.19	0.23 (−0.12–0.58)	0.21	0.0004 (−0.32–0.32)	1.00	0.15 (−0.02–0.32)	0.09
Familiar w/TIC	0.92 (0.04–1.8)	0.04	0.05 (−0.43–0.53)	0.84	0.46 (0.03–0.89)	0.04	0.29 (−0.06–0.52)	0.01

169 students completed the posttest. Posttest survey recruitment was significantly impacted by the disruption in the academic environment created by the COVID-19 pandemic. Of the 169 respondents, 66 were excluded due to an inability to match their study ID to a pretest ID. The demographic composition and posttest scores of the unmatched posttest participants did not differ in a statistically significant manner from the matched cohort.

Results from the posttest are found in Table 4. The final posttest retention rate was 32.2% (103/320). 36.0% (64/178) of M1 students and 27.5% (39/142) of M2 students who completed a pre-test responded for the post-test. The average unadjusted sum score on the posttest was 24.9 (IQR 23.3–26.8). The average unadjusted sub-scores on knowledge, attitudes and confidence sections were, 8.6 (IQR 7.8–8.9), 8.3 (IQR 7.7–9.1) and 8.0 (IQR 7.4–9.0), respectively. Accounting for clustering of scores by participant, students in the matched cohort gained 1.37 points between pre and posttests. We found Asian/PI racial identity (−1.62, −2.79 – −0.45) and biracial identity (−3.71, −6.59 – −0.82) were significantly associated with lower posttest sum score. For students identifying as Asian, the decrease was driven by lower knowledge and confidence sub-scores, while students identifying as biracial had lower subscores in all three domains. Identifying as a woman (1.40, 0.53–2.26) was the sole predictor of a higher posttest sum score, with the increase in score driven by gains on both attitude and confidence sub-scores. The other variables remained unassociated or fell out of the model.

Discussion

Results from the study suggest the TIC curriculum within the service learning program had a modest but statistically significant association with pre-clerkship students' knowledge, attitudes and confidence regarding TIC. In a diverse cohort of pre-clerkship medical students we identified much higher levels of familiarity with the term TIC than has been found in previous studies, even among first year medical students (Goldstein et al. 2018). Prior familiarity with TIC and identifying as a woman were most positively associated with higher posttest scores on the assessment. The sum score increases were driven by knowledge and confidence in providing TIC with minor gains in attitudes towards TIC, although less than a third of students reported experience with developing or refining TIC skills. M2 students were more likely to have higher scores on the pretest but did not maintain a statistically significant advantage on the posttest. In fact, being in the second year class trended toward a lower posttest sum score.

To our knowledge, we are the first to report on both the modification of existing psychometric tools for a pre-clerkship student population and on associations between socio-demographics and measures of students' knowledge, attitude and confidence towards TIC. Additional research is needed to contextualize these scores, particularly high confidence scores in a population of students who report very little formal skill in TIC. Overall, baseline scores on the survey were higher than anticipated based on our review of existing literature. This may be related to the higher levels of familiarity with TIC across the cohort. High pretest scores may

Table 4 Association between time, socio-demographic factors and posttest sum score and subscale scores

	Sum score	*p*	Knowledge	*p*	Confidence	*p*	Attitude	*p*
Unadjusted scores	24.9 (IQR 23.3–26.8)		8.6 (IQR 7.8–8.9)		8.0 (IQR 7.4–9.0)		8.3 (IQR 7.7–9,1)	
Adjusted scores	18.5 (CI 14.8–22.3)	<0.0001	6.4 (CI 4.37–8.48)	<0.0001	4.86 (CI 2.9–6.8)	<0.0001	7.3 (CI 6.0–8.6)	<0.0001
Time	1.37 (0.82–1.91)	<0.0001	0.77 (0.44–1.11)	<0.0001	0.42 (0.17–0.68)	<0.0001	0.18 (−0.03 −0.38)	0.09
Black	−0.65 (2.07–0.75)	0.36	−0.65 (−1.20 – −0.10)	0.02	−0.17 (−1.1–0.73)	0.72	0.15 (−0.29–0.60)	0.50
Asian/PI	−1.62 (−2.79 – −0.45)	0.007	−0.55 (−0.94 – −0.16)	0.008	−0.74 (−1.48 – −0.004)	0.05	−033 (−0.78–0.11)	0.23
Biracial/other	−3.71 (−6.59 – −0.82)	0.01	−0.99 (−2.28 −0.29)	0.13	−1.18 (−2.35 – −0.02)	0.05	−1.5 (−2.68 – −0.37)	0.01
Latinx	0.99 (−0.14–2.12)	0.08	0.06 (−0.49–0.60)	0.91	0.56 (0.06–1.07)	0.03	0.37 (−0.18–0.91)	0.19
Women	1.40 (0.53–2.26)	0.002	0.19 (−0.19–0.56)	0.32	0.61 (0.15–1.06)	0.009	0.59 (0.24–0.94)	0.001
2nd year med student	−1.02 (−2.02 – −0.02)	0.05	−0.05 (−0.44 −0.33)	0.78	−0.20 (−0.65–0.24)	0.37	−0.80 (−1.23 – −0.38)	0.0002
MAUB student	0.79 (−0.95–2.52)	0.37	0.28 (−0.40 −0.95)	0.42	0.20 (−0.57–0.98)	0.6	0.31 (−0.23–0.85)	0.26
AHSS degree	0.03 (−0.88–0.95)	0.96	0.25 (−0.09 −0.60)	0.15	−0.25 (−0.76–0.25)	0.3	0.03 (−0.32–0.37)	0.88
Familiar w/TIC	0.44 (−0.78–1.67)	0.48	−0.26(−0.93–0.40)	0.44	0.44 (−0.09–0.97)	0.1	0.23 (−0.22 −0.68)	0.32

decrease the usefulness of these instruments by creating a ceiling effect that limits the ability to detect change over time. This must be taken into consideration as awareness of TIC becomes more commonplace such that baseline familiarity is likely to continue to rise. We explored whether our adjustment to the phrasing of 3 confidence questions drove the high confidence scores but found no significant differences between responses to these 3 questions and the other 7 in the subscale.

We investigated the relationship between survey scores and socio-demographics, in line with emerging medical education perspectives on the relationship between humanistic characteristics like empathy and students' backgrounds in liberal arts education, or holding specific minoritized identities. We hypothesized students with these identities may have higher scores at baseline or larger gains over time. Instead, the picture was mixed and suggests the need for further study of the relationship between identity and self-reported measurements of humanistic characteristics as well as the particular ways this relates to perception of TIC.

One potential explanation for our results is that pre-clerkship students' lack of clinical experience prevents them from accurately assessing future behavior. They may be responding with their "best guess" or the most socially appropriate response rather than a reflective, internally consistent one. If this is the case, students with lower scores may be signaling more thoughtful consideration of the complexity in delivering TIC effectively in clinical settings. In particular, this could explain the trend towards lower posttest scores in the second year medical students, who were transitioning into clerkships at the time of posttest administration and had acquired many more hours of experiential learning than their first year counterparts, including service learning, standardized patients and observational clinical opportunities.

There are limitations to this study. The strength of the relationship between change in score and the content of the curriculum is limited by the lack of an unexposed comparison group of medical students. Future research could be conducted with a partner institution interested in TIC, or through staged implementation of the curriculum. Second, the attitudes instrument was designed for practicing health professionals and the confidence instrument for social work students who, at the time of the posttest, have completed more field exposure than a comparable medical student. There may be a minimal amount of experiential learning necessary to have an appropriate context for these questions. Qualitative exploration of both pre-clerkship and clerkship students' responses to the survey instrument will be a useful next step in understanding how best to use a TIC instrument in assessment of curriculum by tracking changes over time. Third, the relationship between survey responses and actual behavior in a clinical encounter remains unclear. Future approaches to determining the relationship between TIC curriculum and pre-clerkship students' knowledge, skills and attitudes will include observed assessments of standardized patients both as a gold standard for measuring acquisition of TIC skills and potentially as a means to correlate survey responses with real world behavior.

Two previous studies measuring the impact of TIC training on physicians have evaluated patient-provider communication through evaluation of standardized patient and real clinical encounters (Helitzer et al. 2011; Green et al. 2016). While these forms of evaluation are critically important and these studies

represent important building blocks in the TIC knowledge base, real time measurement of behavior is resource and time intensive. This may add additional barriers to implementation. The potential impact of such barriers is an important consideration. Lack of time and a champion to spearhead implementation were significant barriers to providing or enhancing existing TIC training in a recent survey of U.S. Family Medicine residency program directors (Dichter et al. 2018). Time constraints also exist in undergraduate medical education, including a fixed amount of instructional time with multiple competing academic foci and constraints of availability for clinical faculty who have direct experience in trauma theory/TIC implementation.

As TIC training extends to the field of medical education, accurate and cost effective means to measure TIC training outcomes will become imperative. Widespread adoption of TIC practices in health care settings will remain limited without the development of low barrier instruments that can guide the development of best practices, assist health systems and academic centers in comparative assessment, and measure individual and organizational change over time. This will improve our ability to teach skills in trauma informed care to the maximal benefit of vulnerable patients.

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Code availability Not applicable.

Declarations

Ethical approval This protocol was deemed exempt from review by the Institutional Review Board of Temple University.

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