Hemorrhage Control Training Promotes Resilience-Associated Traits in Medical Students

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OBJECTIVE: Given rising rates of physician burnout, the potential for clinical skills training programs to develop and reinforce resilience-associated traits in medical students warrants investigation. The primary objective of this study was to examine the impact of a hemorrhage control training program on resilience-associated traits (role-clarity, self-efficacy, and empowerment) in medical students. A secondary objective was to examine the differential impact of additional hands-on skills training.

DESIGN: This was a prospective study of medical students participating in an established hemorrhage control training program, utilizing pre-, mid-, and post-training questionnaires. The program included both an in-person lecture and hands-on skills training. Primary endpoints were self-reported increases in role clarity (when the hemorrhage control skills would and would not be applicable), self-efficacy (confidence in ability to use the skill), and empowerment (to act in a situation where the skill was needed).

SETTING: Harvard Medical School, Boston, Massachusetts.

PARTICIPANTS: One hundred and twenty-six Harvard Medical School students participated.

RESULTS: There was a significant increase at each stage of training in self-reported role clarity about when to apply hemorrhage control skills ($p < 0.01$) and when not to apply them ($p < 0.01$); confidence in application of the skill ($p < 0.01$); as well as empowerment to apply the skill when appropriate ($p < 0.01$).

CONCLUSIONS: Hemorrhage control training, a first response-related clinical skills program, is a promising domain for development and reinforcement of resilience-associated traits in medical students, particularly when the program includes hands-on skills training. Providing experiential learning opportunities that are designed not only for skills-specific outcomes, but also to reinforce such resilience-associated traits as role-clarity, self-efficacy, and empowerment provides an essential integrated perspective. (J Surg Ed 76:77−82. © 2018 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: Hemorrhage control, First Response, Resilience, Burnout, Medical education

COMPETENCIES: Practice-Based Learning and Improvement, Patient Care, Systems-Based Practice, Medical Knowledge

INTRODUCTION

Given the rising rates of both mass casualty incidents and physician burnout in the United States, the potential for clinical skills training programs to develop and reinforce resilience-associated traits in medical students warrants investigation. Resilience serves as an umbrella term capturing a multifaceted set of skills and attributes that contribute to an individual's ability to respond to stressors in ways that are both cognitively and emotionally adaptive. Physicians of every specialty routinely face situations that challenge resources, thus identification of ways to understand and utilize existing curricular modules to nurture resilience-associated traits is an

important component of the profession's recognition and response to these dual trends.

Emergency first response skills provide a valuable domain to couple basic clinical skills with those supporting psychological resilience.[1] Studies of domestic and international disaster responses suggest that skills training mitigates potential progression to psychopathology after disaster response.[2–4] Trauma is the number one cause of death in individuals under 45 and uncontrolled hemorrhage is the leading cause of preventable death, prompting several national initiatives focused on a goal of zero preventable deaths in trauma.[5,6] In this context, addressing exposure to potentially traumatic events where immediate response would be considered within professional domain, even if not within a selected specialty, can be understood as a stress inoculation intervention.[7] Simulation of stressful situations in advance of exposures provides a framework for navigating through "real world" events with increased competence and decreased distress. It can, moreover, contribute to a sense of self-efficacy and empowerment that may increase an individual's willingness to respond. [8,9]

One of these initiatives, The White House's "Stop the Bleed" campaign, began after the mass shooting at Sandy Hook Elementary School in 2012.[10,11] The Stop the Bleed campaign's mission is to train and empower bystanders to act to control hemorrhage while awaiting the arrival of professional public safety professionals (emergency medical services, law enforcement, fire services). To support this aim, the American College of Surgeons (ACS) developed the Bleeding Control (B-Con) basic course, an in-person lecture, and hands-on skills training course.[11] Recognizing that timeliness has a critical impact on prognosis, attention has turned to efficacy and scalability of hemorrhage control training.[12,13] Harvard Medical School includes the B-Con training in the second-year clinical preparation curriculum taken by all medical students regardless of intended training specialty.

The impact of skills-based trainings has implications beyond disaster preparedness. In addition to the role of self-efficacy as a determinant of willingness to respond to critical incidents, it is among the modifiable psychological traits that can improve physical and mental health outcomes.[14–16] Identification of rising rates of physician burnout has increased attention to resilience interventions as a partial antidote.[17] Burnout has been defined as a syndrome that includes emotional exhaustion, depersonalization, and diminished sense of personal accomplishment.[18] While there is recognition that systemic changes in the healthcare practice environment are crucial, interventions have focused on individual physician mindfulness-based and other stress-reduction strategies, discussion, and work environment interventions.[1,19,20] As detailed in a recent systematic review of interventions to foster physician resilience, interventions linked to specific simulation training are rare, and none target all medical students regardless of intended specialty.[1,21] Notably, a recent comprehensive review with recommendations for wellness strategies among medical students and residents does not identify utilization of clinical skill-based trainings that are integral to medical education as domains where individual and community resilience may be fostered.[22]

Our objective was to examine a hemorrhage control training's impact on resilience-associated traits in medical students, specifically role clarity, self-efficacy, and empowerment.

METHODS

As part of the Harvard Medical School Transition to the Principal Clinical Experience course, students who were starting their second year of medical school took the American College of Surgeons B-Con basic course. B-Con is an 1-hour course with an interactive lecture and hands-on skills training in small groups with 1 instructor for every 6 to 8 students. Participants are shown how to effectively pack a wound, apply pressure, and properly apply a commercial tourniquet. Participants are also provided with instruction and examples as to when each skill should not be applied (e.g., cannot apply a tourniquet to a trunk wound). All instructors are either physicians, nurses, or emergency medical technicians, all certified as instructors by the American College of Surgeons.

The Institutional Review Board (IRB)-approved study protocol (Harvard Faculty of Medicine IRB Protocol #IRB17-1232; Partners Healthcare IRB Protocol #2017P001734) consisted of administering questionnaires before the start of training ("pre"), between the lecture and hands-on skills training ("mid"), and upon completion of the full training ("post"). Participants remained in the study until the final questionnaire was completed. Participation in the study was voluntary. Verbal consent was obtained from all subjects prior to participation in the study-related activities. Participants were all 18 years and above. No randomization occurred.

Following consent, study subjects were given a pre-training questionnaire to gather information regarding age, gender, and any prior hemorrhage control or other first aid training. The questionnaire also included questions to determine their self-reported role clarity and mastery of hemorrhage control skills, empowerment to apply these skills, and motivation for further skills training. Answers were presented on a Likert-type scale (see Appendix). After the lecture portion of the ACS B-con training (mid-training), and again after the hands-on portion of the ACS B-con training (post-training), participants were administered an evaluation questionnaire. Primary outcomes were self-reported self-efficacy,

competence, and role-clarity (about when it would or would not be appropriate to apply B-Con skills), assessed after each half of the training.

Statistical Analysis

All data were examined for possible errors or outliers. A total of 126 Harvard Medical Students completed surveys pre-, mid-, and post-training and are included in the analysis. Survey responses were treated as continuous variables. For our primary analysis, linear regression models were used to examine the impact of training on our 4 primary outcome measures, clustered by subject to account for the correlation in each individual's responses over time. Age group, gender, prior hemorrhage control training, and classroom were additionally included as terms in each model. One model was fitted for each outcome measure. Responses to the 4 primary outcome measures were all highly correlated at each time point (Pre: r = 0.52-0.73, p < 0.01; mid: r = 0.28-0.68, p < 0.01; post: r = 0.49-0.72, p < 0.01). Therefore, we did not include adjustment for multiple comparisons and consider p = 0.05 to be evidence of a significant relationship. All analyses were performed using STATA version 14.2 software.

RESULTS

Demographics

One hundred and twenty-six Harvard Medical Students consented to participation and completed this study. The majority (65.9%) were 20 to 24 years old. There was an equal number of males and females. Among the participants, 67% reported having prior first aid training though all had completed basic life support course earlier in the year. Twenty participants (15.9%) reported prior formal hemorrhage control training and among that group, 10 (50%) had utilized their hemorrhage control skills prior to the training (Table 1).

Survey Results

There was a significant increase at each stage of training in participants' role clarity about when to apply hemorrhage control skills (mid: β = 1.65, p < 0.01; post: β = 2.00, p < 0.01), and when not to apply them (mid: β = 1.39, p < 0.01; post: β = 1.96, p < 0.01). This incremental increase at each stage of training was also reported in participants' self-reported confidence in application of the skill (mid: β = 1.71, p < 0.01; post: β = 2.39, p < 0.01), as well as empowerment to apply the skill when appropriate (mid: β = 1.62, p < 0.01; post: β = 2.28, p < 0.01; Table 2 and Fig.).

We assessed several additional factors for a potential impact on resilience outcomes in multivariate models (see Table 2). Prior hemorrhage control training was associated with increased empowerment (p = 0.03), but not role clarity or confidence. Gender was not associated with confidence, empowerment, or role clarity about when to apply the B-Con skills. There was a significant effect of classroom assignment on role clarity to apply B-Con skills (p = 0.009) and empowerment (p = 0.03) but not on confidence or role clarity when to not apply these skills. Age group was not significantly associated with the resilience outcomes (all p > 0.24).
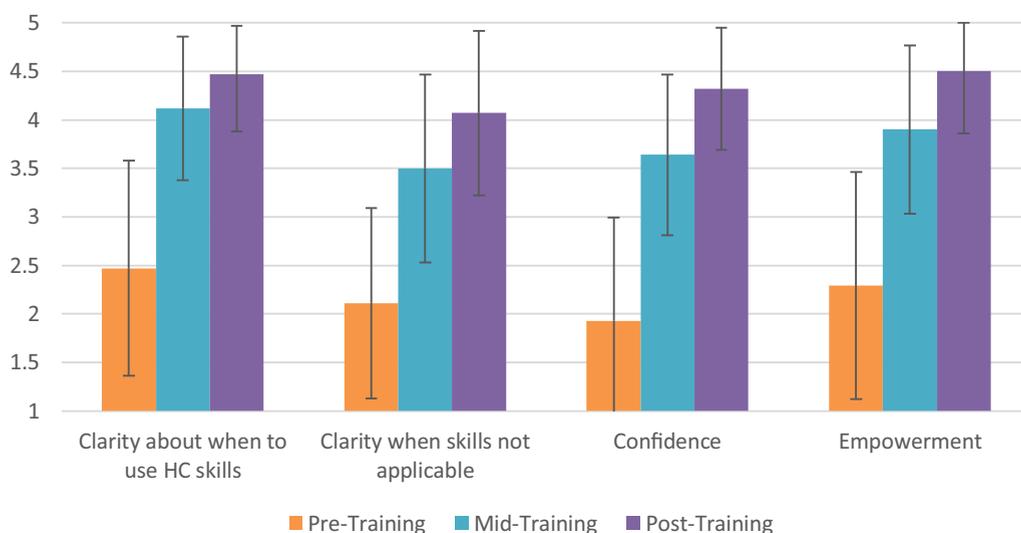
FIGURE. Resilience outcomes pre-, mid-, and post-training.
Pre-, mid-, and post-training mean and standard deviations of responses to resilience questions with 1 = totally disagree and 5 = totally agree. Shown are the mean score for each resilience outcome pre-training, mid-training, and post-training. Error bars represent 1 standard deviation from the mean.

TABLE 1. Demographics and Training History

Characteristics		N = 126
Age (years)	20-24	83 (65.9%)
	≥25	43 (34.1%)
Gender	Male	61 (48.4%)
	Female	61 (48.4%)
Prior first aid training	Yes	85 (67.5%)
	No	41 (32.5%)
Prior hemorrhage control training	Yes	20 (15.9%)
	No	106 (84.1%)
Prior use of hemorrhage control skills	Home/Work/MVA*	8 (6.3%)
	Mass casualty situation	2 (1.6%)

DISCUSSION

This study serves as an important pilot for future research. No single skills training in isolation alters the overall well-being of an individual. Rather, a didactic frame shift that explicitly recognizes the innate psychological dimension of every first response exercise could substantially bolster the impact of resilience-related programming for medical students (and the population in general). Hemorrhage control training efforts are expanding nationally, and evaluation of this program's impact on medical students early in training demonstrates a measurable and incremental improvement in self-reported role clarity, self-efficacy, and empowerment mid-training (lecture-only) and post-training (including hands-on skills training).

Basic first aid skills, including hemorrhage control, are applicable to all physicians in training, not just those interested in emergency preparedness. One surprising finding of this study was the self-reported preparedness in a population that had been uniformly exposed to basic life support training: only 67.5% reported having previously participated in other First Aid skills programs. Education does not necessarily translate into self-efficacy or empowerment, and there is more to understand about this discrepancy between skill-based training and self-reported exposure in this medical school population. Our finding that those reporting prior hemorrhage control training demonstrated greater role clarity, self-efficacy, and empowerment at all stages of the training program is consistent with prior studies.[23]

There was a significant effect of classroom assignment in this study, which could reflect differences at the level of the students or instructors. Given the importance of group cohesion on community resilience, attention to intergroup dynamics during clinical skills trainings may suggest an additional domain of intervention to foster resilience within a social-professional network.[24]

TABLE 2. Multivariate Models for Resilience-Associated Trait Outcomes

Variable	Clarity about use Coefficient (95% CI)	p value	Clarity about no use Coefficient (95% CI)	p value	Confidence Coefficient (95% CI)	p value	Empowerment Coefficient (95% CI)	p value
Age group (reference: 20-24)								
≥25	−0.06 (−0.32, 0.21)	0.68	0.08 (−0.18, 0.34)	0.55	−0.13 (−0.36, 0.09)	0.24	0.02 (−0.28, 0.32)	0.88
Gender (reference: male)								
Female	−0.08 (−0.30, 0.14)	0.49	−0.24 (−0.50, 0.01)	0.07	−0.19 (−0.38, 0.01)	0.06	−0.20 (−0.48, 0.04)	0.10
Prior hemorrhage control training								
Yes	0.70 (−0.04, 1.44)	0.07	0.69 (−0.09, 1.48)	0.09	0.75 (−0.06, 1.56)	0.07	0.84 (0.08, 1.59)	**0.03**
Classroom (reference: A)								
B	0.08 (−0.26, 0.42)	0.60	0.08 (−0.27, 0.43)	0.54	−0.03 (−0.33, 0.26)	0.85	0.01 (−0.36, 0.37)	0.95
C	0.28 (−0.02, 0.58)	0.07	0.05 (−0.27, 0.38)	0.74	0.16 (−0.11, 0.43)	0.25	0.16 (−0.16, 0.49)	0.32
D	0.41 (0.10, 0.72)	0.009	0.18 (−0.21, 0.57)	0.34	0.16 (−0.12, 0.44)	0.25	0.37 (0.03, 0.70)	**0.03**
Training stage (reference: pretraining)								
Mid-training	1.65 (1.84, 2.46)	**<0.001**	1.39 (1.18, 1.60)	**<0.001**	1.71 (1.54, 1.89)	**<0.001**	1.62 (1.43, 1.80)	**<0.001**
Post-training	2.00 (1.81, 2.19)	**<0.001**	1.96 (1.76, 2.15)	**<0.001**	2.41 (2.23, 2.59)	**<0.001**	2.22 (2.02, 2.42)	**<0.001**

CI = confidence interval.

Further investigation is necessary to clarify individual perceptions of first aid skills training, as completion of a skills program without explicitly addressing resilience-related dimensions of the training may suggest a missed opportunity in promoting a sense of personal accomplishment. To our knowledge, widespread incorporation of specific hemorrhage control training is not yet a standard component in medical school curricula in the United States. As broader efforts to empower bystanders to act as "immediate responders" gain momentum, however, strong consideration will be made to incorporate this skill into all medical school curricula.[13] The indications to do so are at least 3-fold: the life-saving potential of the skill itself, stress-inoculation given likelihood of actual exposure in the future, and the potential for skill-based trainings to contribute to essential resilience-promoting skills among physicians.[19]

Follow-up studies are also necessary to clarify the relationship between self-reported confidence measures and objective performance of specific skills at time of training. These future studies would further inform program efforts to optimize the potential for simulation-based domains to complement other curricular elements focused on burnout prevention. Retention of knowledge and skills, as well as self-reported resilience traits including role clarity, self-efficacy, and empowerment, should be tracked months and years after the original training. A randomized control trial that investigated the utility of adding a brief psychoeducation module to make an explicit connection between specific resilience-associated traits supported by the clinical skills training and the general applicability of these domains to professional resilience overall, for example, would be another valuable future study. Concurrent data collection regarding individual participant state/trait attributes that may contribute to response styles would also improve understanding about this dynamic interplay between intrinsic and extrinsic variables that support physician resilience.

Neurobiological markers and longitudinal follow-up would offer opportunities for more nuanced understanding of the impact of first response skills training on short- and long-term resilience-associated traits. It could, moreover, provide an opportunity to titrate intensity of training settings to tolerance and reduce unintended traumatizing exposures. This can further inform efforts to expand access to this clinical skill-based resilience-building modality beyond medical school curricula to a broader population.

CONCLUSIONS

Evaluation of this hemorrhage control training program's impact on medical students early in training demonstrates a measurable and incremental improvement in self-reported role clarity, self-efficacy, and empowerment mid-training (lecture-only) and post-training (including hands-on skills training). As efforts to optimize physician resilience gain momentum, utilization of skill-focused trainings in which all medical students participate may present a valuable domain for intervention. Providing experiential learning opportunities that are designed not only for skill-specific outcomes, but also to reinforce such resilience-associated traits as role-clarity, self-efficacy, and empowerment provides an essential integrated perspective.

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SUPPLEMENTARY INFORMATION