Efficacy of Medical Students as Stop the Bleed Participants and Instructors

Rebecca Schroll, MD,* Alison Smith, MD, PhD,* Tyler Zeoli, BA,* Marcus Hoof, BS,* Patrick Greiffenstein, MD,† Margaret Moore, MD,† Patrick McGrew, MD,* Juan Duchesne, MD,* and Jennifer Avegno, MD†

*Tulane University School of Medicine, New Orleans, Louisiana; and †Louisiana State University School of Medicine, New Orleans, Louisiana

OBJECTIVE: The Stop the Bleed (STB) program trains lay rescuers to identify and control life-threatening bleeding. Recently, medical students were allowed to become coinstructors. The aim of this study was to assess the efficacy of medical student course participation as both learners and instructors. No previous study to date has provided a critical objective assessment of medical student learners and educators of STB courses.

STUDY DESIGN: Participants anonymously self-reported pre- and postcourse confidence in 6 major skill areas using a 5-point Likert scale. At the end of the course, students' ability to perform STB skills was assessed using an internally validated 15-point objective assessment tool.

SETTING: Two US medical schools (Tulane University School of Medicine and Louisiana State University in New Orleans) which represent private and state institutions, respectively.

PARTICIPANTS: A total of 423 medical students were enrolled in the course. A pilot group of medical students volunteered to be instructors and their ability to effectively teach the course was objectively assessed.

RESULTS: Overall precourse confidence was highest in holding pressure on a wound and lowest in identification of severe active bleeding. Postcourse participant confidence increased significantly in all 6 core areas, including confidence to teach hemorrhage control skills to others. Objective assessment of medical students by STB instructors found 72.4% of medical students achieving perfect scores on their skill proficiency assessments. An assessment of 48 medical student instructors found that all students were able to proficiently serve as instructors.

CONCLUSIONS: This study demonstrates that medical students can effectively master STB skills and can also serve as competent course instructors. Future program development should focus on continued training of medical students and their involvement as instructors to help increase the availability of STB courses. (J Surg Ed 76:975–981. © 2019 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: trauma, Stop the bleed, medical student education, hemorrhage control, teaching evaluation

COMPETENCIES: Medical Knowledge, Practice-Based Learning and Improvement, Interpersonal and Communication Skills

INTRODUCTION

Effectiveness of battlefield trauma care techniques in hemorrhage control has been well established from military studies.[1,2] Tactical Combat Casualty Care (TCCC)/Tactical Emergency Combat Casualty Care (TECCC) guidelines were first implemented in prehospital battlefield trauma and led to the aggressive use of tourniquets and dressings to control hemorrhage.[1] The proven success of TCCC/TECCC resulted in its widespread implementation in the setting of civilian prehospital trauma treatment.[1,2] With growing concern over preventable deaths in the myriad of mass casualty incidents that have become more common, the Hartford Consensus, a joint committee to create national policy aimed at enhancing survivability from intentional mass-casualty and active shooter events, was published.[3] This consensus helped to translate military-based lifesaving hemorrhage control techniques to the civilian world by stressing the importance of early hemorrhage control as a shared responsibility and urging community focused training to increase the involvement of

Correspondence: Inquiries to Alison Smith, MD, PhD, Tulane School of Medicine, 1430 Tulane Ave, Dept. of Surgery, SL-22, New Orleans, LA 70112; e-mail: alison.annette.smith@gmail.com

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non-medical bystanders.[4] As a result, the American Colleges of Surgeons (ACS) Committee of Trauma launched the Stop the Bleed (STB) campaign to teach nonmedical bystanders early hemorrhage control techniques.[5] The STB course is also referred to as the Bleeding Control Basic (BCon) Course by the ACS.

These skills included tourniquet use and wound packing and direct pressure application, and to make bleeding control kits containing tourniquets and other hemostatic supplies more widely available to the lay public for use in bleeding emergencies.[6,7]

With uncontrolled hemorrhage as the leading cause of potentially preventable traumatic deaths, the STB course aims to decrease mortality through active in-person training sessions.[7] While previous efforts have focused on training medical personnel and hospital employees on effective military adapted prehospital hemorrhage control, the STB initiative sought to maximize the skills and confidence of lay rescuers.[8] Despite the proven benefits of prehospital tourniquets demonstrated by military data,[9] tourniquets have only recently been used for civilian trauma.[10-14] As shown with out-of-hospital cardiac arrest, lay rescuer provided cardiopulmonary resuscitation prior to Emergency Medical Service (EMS) arrival significantly increases patients' survival rate, similar results are theorized for widespread STB training.[15]

Instructors of BCon courses are identified as instructors or providers of Pre-Hospital Trauma Life Support, TCCC/TECCC, Advanced Trauma Care Nursing/Trauma Nursing Core Course, Emergency Medical Responder, Emergency Medical Technician, paramedic, RN, PA, or MD, Advanced Trauma Life Support instructor or provider, or any National Association Emergency Medical Technician continuing education course instructor who has successfully completed a BCon Provider Course.[16] When the STB campaign was first launched, medical and other health professions students were not permitted to serve as instructors.[16] However, this policy changed in 2017 and medical students can currently receive permission from the ACS to teach as coinstructors for STB courses. This change has provided a unique opportunity for medical students to be involved in this campaign as it becomes more widespread across the country. To date, the proficiency of medical students as both STB course participants and instructors has not been adequately assessed using a standardized metric.[17] Accordingly, the primary objective of this study was to evaluate the success of medical students as both learners and educators for the STB course.

METHODS

Students from 2 Liasion Committee on Medical Education (LCME) accredited US medical schools were enrolled in the STB course from April 2017 to October 2018. Institutional Review Board approval was obtained prior to conducting the study. In April 2017, STB was incorporated into the medical school curriculum during the third year clerkship by the Tulane University School of Medicine and into a required fourth year course at Louisiana State University School of Medicine. Additional students were recruited to take the course on a voluntary basis via institutionwide emails distributed at varied intervals leading up to the course dates. All 4 medical student class years from both schools were represented, and participants were allowed to freely sign up, with no discrimination based upon race, age, gender, grades, or class year. Participants completed anonymous pre- and postcourse surveys to assess knowledge level of the material covered in the course. Furthermore, they were surveyed using a 5-point Likert scale on self-reported confidence levels in 6 major skill areas: (1) identifying life-threatening bleeding, (2) identifying a victim in need of a tourniquet and effectively applying one, (3) identifying a wound requiring pressure and effectively applying pressure, (4) identifying a wound requiring packing and effectively packing the wound, (5) overall knowledge and skills needed to treat severe active bleeding in a mass casualty incident, and (6) ability to teach bleeding control techniques to others. Participant demographics that were collected included level of medical training, gender, and age.

Following training, participants' abilities to perform STB skills were assessed using an internally validated 15-item objective assessment tool. Data collected included the ability to assess scene safety prior to proceeding, the use of both hands when packing gauze into open wounds and tightening of the windlass of the tourniquet until bleeding stops (or pulse goes away). This data were collected using a binary scale, which discerned whether the task was completed correctly (1) or not (0). At the end of the course, a pilot group of medical students volunteered to be instructors for subsequent STB courses. They taught the courses within several weeks to months of completing their initial training. A 13-item objective assessment was utilized to assess the efficacy of their instructor skills (Table 1). This data were collected using a 3-point scale of outcomes including: not done/done poorly (0), done correctly (1), and done well (2). Utilizing a pilot group of students, the objective testing and teaching assessments were internally validated by having 2 independent evaluations by STB instructors with a comparison of results for reliability and reproducibility. The overall response rate for precourse and postcourse surveys was also determined.

While some students' participation in the STB course was a mandatory part of their curriculum, their participation in our study was completely voluntary. They were allowed to opt-out of survey participation and data

TABLE 1. Assessment of Teaching Efficacy by Medical Student Instructors

Teaching Skill Evaluated	Not Done or Done Poorly	Done Correctly	Done Well
Cleary identifies the learning objective of the session	0	1	2
Clearly explains how to hold direct pressure	0	1	2
Clearly explains all the steps in tourniquet use	0	1	2
Clearly explains the common mistakes of holding direct pressure	0	1	2
Clearly explains the common mistakes in tourniquet application	0	1	2
Clearly demonstrates the use of direct pressure	0	1	2
Clearly demonstrates the steps in tourniquet use	0	1	2
Solicits and thoroughly answers students' questions	0	1	2
Identifies and appropriately corrects improper technique	0	1	2
Clarifies misunderstandings	0	1	2
Treats all students with equal respect	0	1	2
Rates student performance fairly and without bias	0	1	2
Uses effective oral communication style for lecture delivery	0	1	2

collection without academic penalties or other ramifications. Data were analyzed using unpaired 2 tailed Student's *t* test for continuous variables and Pearson's chi-squared test for categorical variables (GraphPad Prism, version 5- La Jolla, CA). A p value of ≤ 0.05 was considered significant. Results are presented as average $\pm$ standard error of the mean (SEM) unless noted otherwise.

RESULTS

Demographics

A total of 423 medical students completed postcourse surveys. The overall survey response rate for participants who completed both pre- and postcourse surveys was 35.9%. A total of 220 (51.9%) participants were men and 203 (48.1%) women. The average age was 26.1 $\pm$ 0.2 years.

Precourse Efficacy as Measured by Knowledge and Confidence

Precourse knowledge and confidence assessments were completed by 152/423 medical student participants (50.7% junior level, 28.9% senior level, and 20.4% unknown level). Prior to the course, only 5 students (3.3%) were aware of the Hartford Consensus, 68 (44.7%) were aware of the STB campaign, and 34 (22.4%) felt that that they were familiar with steps to take in the event of an active shooter or other mass casualty incident. Precourse, only 6 (3.9%) participants could accurately define the ABCs of bleeding control. Participants' average precourse self-assessed confidence ratings based on the 5-point Likert scale are shown in Table 2. In general, precourse participants rated their confidence in their knowledge and ability to provide various bleeding control techniques ranging from 1 to 5 on the Likert scale. Precourse confidence was highest in holding pressure on a wound (3.1 $\pm$ 0.1) and lowest in identification of severe active bleeding (2.0 $\pm$ 0.1). In comparison of junior vs. senior medical students, a higher percentage of junior medical students were familiar with the compression of bleeding from the ABCs of bleeding control ($p = 0.0032$). Senior medical students expressed higher precourse confidence levels in holding pressure, packing a wound, and the treatment of severe active bleeding ($p < 0.05$). The lowest level of precourse confidence for both groups was in the management of severe active bleeding (1.6 $\pm$ 0.1 vs. 2.1 $\pm$ 0.2, $p = 0.01$). These results are shown in Table 2.

Postcourse Knowledge and Skill Confidence

Following the course, participants' knowledge was assessed using a posttest. Overall, participants expressed significantly enhanced knowledge of the Hartford Consensus, STB, and familiarity with steps to take in the event of an active shooter or other mass casualty incident ($p < 0.0001$). Postcourse confidence increased significantly in all areas ($p < 0.0001$). The skill with the largest increase in participant confidence was in the management of severe active bleeding. At the end of the course, 317 (74.9%) of participants felt very confident and 91 (21.5%) of participants felt moderately confident that they could teach basic bleeding control skills to others. These results are shown in Table 3. Interestingly, 100% of participants were in agreement that the STB course is an important course for students at their level of training.

Course Difficulty

On average, medical students rated the difficulty level of the STB course as easy (1.7 $\pm$ 0.2), with 194 (46.0%) rating it 1/very easy, 152 (36.0%) 2/easy, 75 (17.8%) 3/just right, 1 (0.2%) 4/a little difficult, and 0 students rated the course as 5/very difficult. One participant did not answer this question.

TABLE 2. Knowledge and Critical Objective Assessment of the Management of Severe Hemorrhage by Medical Students Stratified by Level of Training Prior to Stop the Bleed Training. Confidence level was Reported on a 5 Point Likert Scale with 1 = Not Confident at all, 5 = Very Confident

	Junior Medical Student	Senior Medical Student	p Value
	n = 71*	*n* = 44*	
Precourse knowledge, *n* (%)			
Familiar with Hartford consensus	0	1 (2.8)	0.38
Familiar with Stop the Bleed	22 (31.0)	21 (47.7)	0.08
Familiar with steps to take in event of active shooter	10 (14.1)	12 (27.3)	0.09
Able to define "A" of ABC	8 (11.3)	1 (2.3)	0.15
Able to define "B" of ABC	11 (15.5)	4 (9.1)	0.40
Able to define "C" of ABC	24 (33.8)	4 (9.1)	0.0032
Confidence in skills, avg (SEM)			
Identification of life-threatening bleeding	2.6 (0.1)	2.8 (0.1)	0.18
Appropriate tourniquet use	2.2 (0.1)	2.4 (0.1)	0.18
Ability to apply direct pressure	2.8 (0.1)	3.2 (0.2)	0.05
Ability to pack a wound	1.9 (0.1)	2.4 (0.2)	0.01
Treat severe active bleeding	1.6 (0.1)	2.1 (0.2)	0.01
Teach bleeding control techniques to others	2.5 (0.2)	2.6 (0.2)	0.74

* 31 students did not report their medical school level

TABLE 3. Knowledge and Critical Objective Assessment of Medical Student Skills to Manage Severe Hemorrhage Before and After Stop the Bleed Training. Confidence Level was Reported on a 5 Point Likert Scale with 1 = Not Confident at all, 5 = Very Confident

	Precourse	Postcourse	p Value
	n = 152	*n* = 423	
Precourse knowledge, *n* (%)			
Familiar with Hartford consensus	5 (3.3)	296 (70.0)	<0.0001
Familiar with Stop the Bleed	68 (44.7)	414 (97.9)	<0.0001
Familiar with steps to take in event of active shooter	34 (22.4)	347 (82.0)	<0.0001
Able to define "A" of ABC	10 (6.6)	403 (95.3)	<0.0001
Able to define "B" of ABC	16 (10.5)	415 (98.1)	<0.0001
Able to define "C" of ABC	30 (19.7)	390 (92.2)	<0.0001
Confidence in skills, avg (SEM)			
Identification of life-threatening bleeding	2.7 (0.1)	4.7 (0.02)	<0.0001
Appropriate tourniquet use	2.4 (0.1)	4.7 (0.02)	<0.0001
Ability to apply direct pressure	3.1 (0.1)	4.8 (0.02)	<0.0001
Ability to pack a wound	2.2 (0.1)	4.7 (0.02)	<0.0001
Treat severe active bleeding	2.0 (0.1)	4.6 (0.02)	<0.0001
Teach bleeding control techniques to others	2.5 (0.1)	4.7 (0.03)	<0.0001

Skills Proficiency

One hundred percent of participants were able to demonstrate satisfactory bleeding control skills with a total average score of 14.6/15 on postcourse objective assessments as evaluated by STB instructors. Average postcourse scores for each item are shown in Table 4. The skill item most commonly missed or done incorrectly was securing the windlass of the tourniquet (78.8%), while the skill items done correctly by all medical students were: applying pressure with 2 hands, firm and continuous pressure, packing the wound, applying the tourniquet above the site of injury, avoiding placing the tourniquet on the knee or elbow, tightening the tourniquet, and securing the lock rod on the tourniquet.

TABLE 4. Comparison of Objective Assessment of Stop the Bleed Skills for Medical Student Participants

Skill assessed	Students Achieving Proficiency (%)
Personal safety/active response	
Ensure scene safety	98.2
Put on gloves	96.5
Call 911 or ask someone to call	98.8
Identifies life-threatening bleeding	100.0
Asks for a trauma first-aid kit	95.9
Holding direct pressure	
Uses 2 hands for direct pressure	100.0
Applies firm and continuous pressure	100.0
Packs gauze into open wound	100.0
Tourniquet application	
Applies above bleeding site	100.0
Avoids placing over knee or elbow	100.0
Removes slack before twisting windlass	96.5
Tighten windlass until bleeding stops or pulses disappears	100.0
Locks rod in place in windlass clip	100.0
Adheres remaining strap around extremity	99.4
Secures windlass strap	78.8

Teaching Efficacy

Participants who volunteered to teach a STB course as assistant instructors underwent objective assessment of their ability to effectively teach the course by full-fledged STB instructors. The average total score on participants' objective assessments was 23.35/26 (range 20-26), with 16 (33.3%) achieving perfect scores for teaching efficacy. The average scores for each item are shown in Table 5. The teaching item most difficult to teach was appropriate tourniquet application, which was poorly demonstrated by 3/48 students (6.3%). All student instructors received perfect teaching scores in the following areas: identification and appropriate correction of improper technique, clarification of misunderstandings, treating all students with equal respect, and rating student performance fairly and without bias.

DISCUSSION

Despite the proven effectiveness of military based prehospital hemorrhage control techniques, there continues to be difficulty integrating these skills into the

TABLE 5. Fifteen Point Teaching Efficacy Scores for 48 Medical Student Instructors of Stop the Bleed. Grading Scale was: 0 = Not Done/Done Poorly; 1 = Done Correctly; 2 = Done Well

Teaching Skill Evaluated	Average Score
Cleary identifies the learning objective of the session	2.00
Clearly explains how to hold direct pressure	1.96
Clearly explains all the steps in tourniquet use	1.96
Clearly explains the common mistakes of holding direct pressure	1.96
Clearly explains the common mistakes in tourniquet application	1.96
Clearly demonstrates the use of direct pressure	1.96
Clearly demonstrates the steps in tourniquet use	1.94
Solicits and thoroughly answers students' questions	2.00
Identifies and appropriately corrects improper technique	2.00
Clarifies misunderstandings	2.00
Treats all students with equal respect	2.00
Rates student performance fairly and without bias	2.00
Uses effective oral communication style for lecture delivery	2.00

civilian world.[1,2] Recent events, such as the Boston Marathon bombing of April 2013, highlighted the lack of training and resources that are translated from the theater of war to the civilian setting.[18] Current efforts have sought to combat these issues through training programs geared toward the education and empowerment of lay rescuers in situations of uncontrolled bleeding. Just as in many other lay rescuer driven medical interventions, such as out-of-hospital cardiopulmonary resuscitation, there remain multiple barriers to participation.[15] The STB course serves as an education intervention for civilians of any training background, and aims to combat the barriers to action by improving self-efficacy and reported willingness to help.[19]

When the STB campaign was initiated, medical students were not allowed to serve as instructors. This decision was made to concerns about maintaining quality control over the efficacy of this important yet untested educational program. Though medical students were eventually allowed to serve as coinstructors, concerns remained about the ability of someone with little to no practical experience to teach bleeding control techniques. Thus, there remains a need to evaluate the efficacy of this training program. A study by Fridling et al. describes their experience with teaching 210 medical students and training of 34 medical students from this pool from January to August 2018.[17] This study provides an in-depth look at developing a curriculum to train medical students as both learners and instructors, which was similar to our program for medical students. However, the paper largely focuses on how this curriculum was developed and does not provide any specific data on student performance while taking the STB course or teaching. The authors did not provide any objective assessment of the medical student skills as STB course participants or their abilities as instructors. Therefore, the primary goal of our study was to assess the efficacy from our 18-month experience teaching STB to medical students through a systematic analysis of medical their ability to learn the content, as well as to then teach the course to a lay rescuer audience using the same standardized assessment tools.

Our study demonstrated that medical students can effectively learn bleeding control techniques in the STB course, as evidenced by their dramatic increases in confidence as well as structured evaluation of their ability to perform basic bleeding control techniques. We also found that a self-selected volunteer group of medical students were able to effectively teach these bleeding control techniques to others. It is our goal that by increasing involvement of medical students as STB instructors, and the removal of any continued barriers to this effort will help to facilitate STB efforts across the country to reach an even larger audience.

Previous studies on hemorrhage control education have not addressed long term follow-up of participants' confidence levels, willingness to help, and ability or opportunity to utilize the skills learned.[8,17,19] With the proven efficacy of medical students as STB instructors, future research can focus on addressing the other aforementioned aspects of the STB training, including frequency, follow-up and mode of dissemination (online vs. in-person). A recent study by Navpreet et al. evaluated all American College of Surgeons Bleeding Control Basic (B-Con) class participants within an 8-month window, and reported participants indicated a >95.5% likelihood of packing a wound, applying a tourniquet, and applying pressure.[20] Interestingly, a 1 month follow-up concluded that few participants went on to acquire the proper materials to implement the skills they learned.[20] This observation clearly suggest that while self-reported confidence and willingness to help may improve following a STB intervention, actual implementation of skills requires both the acquisition of necessary materials, as well as a suitable setting. It is unclear whether participants who take the STB course are able to retain the skills learned over time, particularly if they are not using these skills frequently, or at what time frame these individuals should seek recertification. Future research should focus on this topic. By demonstrating that medical students who take STB were able to effectively teach the course to other learners at a later date, we demonstrated that they had retained the information sufficiently well enough not only to perform bleeding control techniques, but also to teach them to other participants.

Our study has several limitations that merit discussion. First, our study was limited in a lack of long-term follow-up on knowledge and skill retention and quality of teaching. It is possible that there was some loss of skills and knowledge that could not be assessed in our study. Future studies should focus on the optimal time for both course participants and instructors to renew their skills. In addition, our study did not compare objective performances of medical students to clinically more experienced instructors. Medical students may have had difficulty explaining or demonstrating some skills, which could have been reflected by their lower scores in demonstrating skills compared to the other variables assessed. We also did not collect information on if medical students had experience in the healthcare field prior to attending medical school and how this influenced outcomes. However, the students serve as coinstructors with more experienced faculty who can help navigate difficult concepts. Finally, our study may be affected by selection bias since not all students were required to teach a course. However, we feel that this is likely inconsequential since STB instruction is itself a voluntary activity, so only ability of instructors to teach effectively matters.

CONCLUSIONS

Our study demonstrates that medical students can effectively serve as instructors for the STB course. These results also validate the need for more widespread inclusion of medical students in the instruction of prehospital hemorrhage control techniques to lay rescuers. With the wide geographic distribution and number of medical students throughout the United States, this data also suggests the need for continued efforts to involve medicals students in STB training courses within their local communities. Future research should continue to evaluate the efficacy of all aspects of the STB course, particularly in relation to recertification of skills and individual barriers to teaching.

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