# An Evaluation of Hemorrhage Control in a Field Environment

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**Abstract**

Massive hemorrhage is the number one cause of battlefield mortality followed by tension pneumothorax and airway trauma. As a result of this, hemorrhage control has been at the forefront of battlefield medicine. Lifesaving intervention can be performed at the most basic level of Self Aid Buddy Care. With its success, the civilian population is incorporating hemorrhage control into the echelon of pre-hospital emergency care.

Programs, including Stop the Bleed are providing training and education in tourniquet use to the most likely first responders and bystanders. The program, presented through UNC trauma, was assessed for Strengths, Weaknesses, Opportunities and Threats (SWOT). One strength of the program is that it's nationally recognized. Weaknesses include a lack of training requests and volunteer instructors. Opportunities include increased awareness of potential for mass casualties and improvements in technology. The analysis also looked at threats to the program such as the lack of a certifying assessment. Overall, the programs are vital as tourniquet use has been shown to be an invaluable tool in controlling life threatening hemorrhage.

# An Evaluation of Hemorrhage Control in a Field Environment

## Introduction

Because of its profound epidemiological implications, hemorrhage control is widely discussed in medicine and public health. The need for hemorrhage control outside of the battlefield has only recently become evident. There is a need to train civilians, perhaps the entire population, due to an increasing number of massive casualties. One of the most recent occurred in Thousand Oaks, California. According to an article published in USA Today, this was the 307th mass shooting this year, making it the 307th mass shooting in 311 days.[1] I have conducted an analysis to determine the ability of the program Stop the Bleed to reach a wide-range of participants and impart, given a two-hour block of instruction, the skills needed to task, condition, and standard a tourniquet.

## Literature Review

Trauma is at epidemic levels in the United States, with intentionally caused massive casualties on the rise. Deaths due to bleeding can occur within seconds after events such as motor vehicle crashes, workplace injuries, bombings, or mass shootings. Hemorrhage is the second most common cause of death among civilian trauma patients,[2] at approximately 30% to 40% of trauma related deaths among civilian patients, hemorrhage is second only to traumatic brain injury as the most common cause of death.[3] Massive hemorrhage is typically defined as either loss of entire blood volume within twenty-four hours or loss of 50% of blood volume within three hours.[4] With the American College of Surgeons' 2013 commitment to trauma casualty prevention campaigns,[5] tourniquets have gained momentum as a way to perform damage control through interventions.

*History and Public Perception*

The tourniquet has played a role in emergency preparedness since the beginning of the 18th century. In 1945, during World War II, the strap and buckle tourniquets used were of little value and rarely controlled bleeding. In 1975, during the war in Vietnam, there were 2500 deaths due to massive hemorrhage from extremity wounds. In 1990, 45 years later, there was still no good solution with respect to hemorrhage control.[5] The US military was still issuing strap and buckle tourniquets, and medics were being discouraged from using them. The tourniquet design of that time was failing to control massive hemorrhage. It was not until late in the Global War On Terrorism when the lessons learned from previous engagements were addressed. Renewed interest and a redesign created a permanent and lasting role for tourniquets as a staple in battlefield medicine.

Tourniquets have a long history in the military, going through numerous iterations over time to improve speed, reliability, and efficiency. Tourniquets have not always been accepted without controversy, tourniquets were believed to do more harm than good at one point.[6] This was in part due to side effects and complications of the original designs which included increased bleeding, higher mortality rates, limb loss, and significant tissue damage. Among the claims leading to negative public perception was the fear that the longer a person remained in a tourniquet, the greater the risk of damage to or loss of a limb. Fortunately, studies eventually provided the evidence to show this was not a valid concern. Technology, education, and increased awareness also shifted public perception in support of tourniquet use.

*Tourniquet Design*

The pneumatic tourniquet (commonly used in the operating room) has the ability to occlude blood flow at a predetermined pressure. It does this by using a cuff with an internal

bladder similar to a blood pressure cuff, which is plugged into a machine through an air pressured line and is pneumatically inflated. The pressure of inflation is then projected onto a digital screen where it can be read and adjusted (Appendix A).

Pneumatic tourniquets rely on too many factors which cannot be controlled in a field setting. Failure might be caused by bladder damage, cut or crimped lines, loss of power to the unit, or the bulk weight of the machine outside of a hospital setting. Pneumatic tourniquets are too big, too bulky, and have too many moving parts. In a prehospital setting, interventions must be easily accessible, compact, and perform rapidly. Tourniquets designed for a prehospital setting are smaller and lightweight. They can be used with one hand, and applied to oneself.

Most field tourniquet designs incorporate "a non-elastic strap, some type of buckle allowing a 180° strap direction change (strap re-direct), a strap securing mechanism, and a mechanical advantageous tourniquet tightening mechanism."[7] Modern designs include the use of hook-and-loop fabric which allow the user to secure the strap against any possible backsliding. Hook-and-loop fabric is less desirable in design choices when the re-direct buckle has a rough surface or edge[7] as found in devices such as the Combat Application Tourniquet (CAT) (Appendix A). Smooth, low-friction, and rounded re-directing buckles provide the most efficient transduction of an applied pulling force to tourniquet pressure at the strap. The re-directing buckle, which should not interfere with the pulling force, serves to forgive users who inadvertently apply the tourniquet outward facing. They will have to pull the strap out and away from the affected limb to gain the initial pulling force occlusion pressures prior to the mechanical advantage tightening system.[7]

Considerations for adequate occlusion includes more concerns than only pressure applied to the extremity; being able to apply a moderate pressure over a safe tourniquet width is essential to proper application and must be considered whenever a tourniquet is indicated.[8,9]

A study published in the European Journal of Applied Physiology considered the effects of cuff width on arterial occlusion. The study examined a narrow cuff (5 cm), and a wide cuff (13.5 cm). The narrow cuff obtained arterial occlusion at 235 mmHg whereas the wide cuff obtained arterial occlusion at 144 mmHg.[10] Although width is not the only factor to consider when applying a tourniquet, there is a definite correlation between width and pressure applied. Occlusion pressure has been at the center of controversies surrounding tourniquet use because too much pressure can potentially lead to limb neuropathy, vascular injury, or limb loss. It is, therefore, important to understand what amount of occlusion pressure is needed for safe use based on the width of the tourniquet.

Several surgeons were interviewed about occlusion pressure as part of my background research. One surgeon at UNC speculated that the numerical value of optimal pressure would be "one millimeter of mercury higher than systolic." An article published in Military Medicine stated limb occlusion pressure varies more than systolic blood pressure.[9] This is due to both the circumference of the limb to be occluded and also the width of the tourniquet. These pressures can be accurately established for an individual using the occlusion pressure formula of $P = R \times 16.67 + 67$.[11] This formula takes into account the ratio of the limb circumference to the device width, and then multiplies that by the constant 16.67, and finally adds a second constant 67.[9]

In 2011, the U.S. male soldier proximal thigh circumference was 71.46 cm (28.13 inches) at the 99th percentile.[9] Thus, the CAT's occlusion pressure (the standard issue tourniquet in the US military) would have to be 380 mmHg to be effective and not cause extremity damage.

However, in another study on occlusive pressures, the CAT, with a 3.8 cm width, had an average occlusion pressure of 360 mmHg-20 mmHg lower than the desired pressure identified in the occlusion pressure formula. Given various types of users, the study found variable pressures from 147 mmHg to 745 mmHg. Nearly 20% of the tourniquets applied were done so with a force greater than 500 mmHg.[8]

The Stretch Wrap and Tuck Tourniquet (SWAT-T) is a multipurpose elastic bandage dressing that measures approximately 10.4 cm wide (Appendix A). It can be used as an elastic bandage, pressure dressing, or tourniquet. In a study comparing occlusion pressures, the SWAT-T showed an average occlusion pressure at application of 290 mmHg. Among the 61 individuals tested, pressures ranged from 136 mmHg to 449 mmHg.[8] Given the soldier's thigh diameter of 71.46 cm at the 99$^{th}$ percentile, occlusive pressure with the SWAT-T would need to reach 181 mmHg to be effective.

Unfortunately, occlusion pressure issues are also related to body composition. When downward force is applied, the width of a tourniquet that is occluding arteries and veins becomes smaller as residual strap material is displaced upwards and outwards. This occurs as a result of elasticity of the skin and pliability of the tourniquet material. The process is easier to observe on an extremity containing more subcutaneous fat than muscle which causes the tourniquet to displace sooner than on athletic body habitus. For these reasons, carrying a larger width tourniquet does not always resolve the problems surrounding occlusion pressure.

Another major issue surrounding tourniquets is time related ischemic injuries or the time that a patient has a tourniquet applied for. Orthopedic surgeons use tourniquets in the operating room on a regular basis and pressures and times are always considered, especially during longer joint replacement operative procedures where time on a tourniquet may be over four hours. Dr.

William Carson, an Orthopedic surgeon with over 30 years of experience, follows a time tested guide he has always used in practice with zero incidence of vascular or neurologic damage. He adheres to 350 mmHg pressure to any lower extremity surgery with the tourniquet placed mid femur and 250 mmHg pressure to any upper extremity surgery with placement at the proximal humorous.

More recently he has determined limb occlusion pressure using a Zimmer tourniquet, but the suggested pressure varies little from the aforementioned pressures. In keeping with what Dr. Carson has been doing in practice for years, a recent study on safe tourniquet use looked at decreases in tissue function along with nerve damage in pressures at 350 mmHg for a two-hour duration. It found 21% decrease in function in tissue from baseline at two days postoperative and also showed observable injury to the nerve when EMG study was performed.[12] Damage to the nerve was observed for 51 days on average and decrease in tissue function was found to be reversible and rarely resulted in functional deficiency.[12] Nerve damage was noted to be the most vulnerable aspect of the tissue pressure gradient.[9] In an article by John Holcomb, he states, "prehospital transport time, time spent in the emergency department, followed by the time in the operating room, [it] currently takes 2.1 hours to achieve definitive truncal hemorrhage control."[13]

Another article, put out by Military Medicine, titled Tourniquets and Occlusion: The Pressure of Design, conducted research on the CAT. The results indicated the CAT was saving lives with low incidence of tourniquet-related neuropathy.[8] No cases of amputation were found to be caused from tourniquet use alone.[14] With constant improvements on the original tourniquet design, one company I interviewed was looking to radically shift tourniquets towards a lever operated design. They believe this shift will be an improvement to compensate for weaknesses of the CAT, SOFTT, SWAT and others currently in production. This new tourniquet variation

identifies many weaknesses and attempts to correct them. The Hemorrhage Assist Lever Operated (HALO) tourniquet is a recently (2018) patented design by Bill Carson M.D., a combat experienced Orthopedic surgeon, Dan Cedrone of Poly Tech Industrial, manufacturer of the CAT, and Will Cannon, a combat experienced Army medic.

Carson elaborated on the HALO in a white paper draft that he intends to publish soon:

> "The HALO tourniquet's most striking feature is its ease of use requiring little manual dexterity, frequently lacking under stress. The Halo can be tightened with the palm of the hand, using a lever mechanism, far simpler than windless type tourniquets. A buckle permits donning on entrapped limbs and presetting to lengths appropriate for legs or arms. Application and training time is markedly reduced.
>
> By eliminating a windless, the tourniquet can be applied more proximal on an extremity. It is easily applied high in the groin and may eliminate the need for more difficult to apply junctional tourniquets.
>
> The HALO incorporates subtle design features in its base that lessen the pinch while deployed, a frequent complaint with current models. Deflection of the base lessens the pinch felt by the casualty.
>
> The strap at 1.75 inches decreases occlusion pressure to a pressure that is less likely to cause neural damage.
> The HALO is lighter and packs smaller than existing models. Modifications such as IR tagging, combat patterns, strap length, and material composition can all be changed for different applications. A salt water resistant version for SOCOM use is available.
>
> The ease in application allows the HALO to be used in unconventional ways. Placed over the hip greater trochanters it can serve as a pelvic binder. When placed over a dressing applied to a wound, with less force than required for arterial occlusion, it can take the place of a well-positioned hand."
>
> Carson M.D. | Veterans Affairs Hospital Beckley, Virginia

*Mass Casualties to the Forefront*

Tourniquets gained traction in military operations during the war in Vietnam. Their perceived value increased exponentially with Operation Enduring Freedom and Operation Iraqi Freedom in 2004. Cedrone the founder and CEO of Poly-Tech Industrial, who assisted in the early development and manufacturing of the CAT, recalled being asked to increase production during our interview.

At the time, the manufacturing plant was producing around 50 tourniquets a day. A general in the United States Army had come to talk to the inventor, Cedrone and the rest of the team, and tour the facility. She thanked them for producing a product that had saved approximately 37 lives the month prior. The general requested the team to increase production immediately to a million tourniquets that year. Today, the company is manufacturing 10,000-12,000 tourniquets every day.

In contrast to its obvious and well-known value in the military, the tourniquet's value for the civilian sector was not discussed until after the shootings at Sandy Hook elementary school in 2012. At that time, a joint committee was created by the American College of Surgeons to enhance survivability from mass casualty events including active shooters. The committee was composed of healthcare experts and government officials.

Following three meetings in Hartford Connecticut, the group produced recommendations for local, state, and national policies intended to improve the outcome of mass casualty events.[5] These shifts would be brought about through use of hemorrhage control and tourniquet training. The Hartford Consensus defined a protocol in response to an active shooter using the acronym THREAT:

1. **Threat** suppression

2. **Hemorrhage** control

3. **Rapid** Extrication to safety

4. **Assessment** by medical providers

5. **Transport** to definitive care

In one paper released, they provided a common language and defined terms related to active/Mass shooting events. They also outline the importance of developing joint protocols for responding. Lastly, they recommended the inclusion of active shooter drills to familiarize all potentially affected entities.

In a second paper, they outline the continuum of care used to prevent uncontrolled hemorrhage. In the continuum of care, the initial response comes from bystanders, identified as any uninjured or minimally injured victims at a scene. These individuals are able to immediately respond to control hemorrhaging by simply applying pressure with their bare hands or any equipment found near the scene. The level of care is then escalated to professional first responders, such as law-enforcement, followed closely after by fire, rescue, and EMS. Ultimately, the escalation of care ends in the Emergency Department or a trauma center where definitive treatment is provided by skilled professionals.[15]

A third paper discusses education through courses like Bleeding Control for the Injured or B-Con, which is offered for individuals with little or no medical knowledge through the National Association of Emergency Medical Technicians. The paper also discusses strategies that could empower bystanders to provide emergency care such as expanding the Good Samaritan Law to include a provision about hemorrhage control.[16]

The first goal of the Hartford Consensus is to empower concerned citizens and law-enforcement officers to, at the minimum, carry a hemostatic dressing, tourniquet, and a pair of

gloves. The second goal is to make hemorrhage control kits more accessible in public venues, much like Automated External Defibrillators (AED).

Due to shifts in public perception and increased need, programs such as the nationally implemented Stop the Bleed are growing. These programs expand the reach of trauma training to locations such as schools, community centers, faith-based institutions and social clubs. Stop the Bleed wants to provide lay persons a basic understanding of first aid strategies in traumatic situations. The program has gained the attention of major institutions, in particular UNC Hospitals Trauma department:

> "In 2016, the North Carolina Committee (NC COT) in collaboration with the American College of Surgeons (ACS) initiated a [statewide] initiative to promote and disseminate Stop the Bleed.
>
> As a Level I Adult and Pediatric Trauma Center, the UNC Trauma Program (Tar Heel Trauma) engaged by developing a strategic plan to promote, train and equip clinicians and lay persons within UNC Hospitals, our local area and the trauma region (Mid Carolina Regional Advisory Committee).
>
> Our primary strategy was to seek opportunities to train potential instructors who can then train their own organizations. This "train-the-trainer" approach enables the exponential dissemination of the program while building resiliency within the community.
>
> Tar Heel Trauma administers the STB Program within UNC Hospitals and across the trauma region (through the Trauma Outreach Coordinator in collaboration with the Trauma Program Manager and Injury Prevention and Administrative Coordinators.) Salary support for the program is provided by UNC Hospitals while additional funding for equipment was provided through UNC and state grants.
>
> Through these efforts, Tar Heel Trauma has provided STB classes as an important component of our outreach efforts training over 230 individuals across the region. In addition to providing direct training, Tar Heel Trauma also offers STB Training Kits that are available to the public. Each of our eight training kits contains two simulators, tourniquets, gauze and STB posters."
>
> Alberto S. Bonifacio RN, BSN, MHA, CEN | UNC Trauma Program Manager

## Methods

A Strength, Weakness, Opportunity, Threat (SWOT) analysis was performed on the Stop the Bleed program to determine if those most likely to become the first line of defense in a crisis or mass casualty situation could be taught to task, condition, and standard a tourniquet given a two-hour block of instruction. (Appendix B)

The first step of the evaluation process involved reading over the Hartford Consensus and speaking with Al Bonifacio with the UNC TarHeel Trauma Team. The goals outlined in the Hartford Consensus were used as a benchmark against which to measure accomplishments of the program. I attended training with Stop to Bleed to become familiarized with the program. I went through the process Stop the Bleed uses to certify instructors.

Numerous interviews were conducted through the course of my evaluation to supplement my background research. I spoke with several surgeons in regards to occlusion pressure. I also spoke with doctors and advanced practice providers in the emergency department, pediatrics emergency department, internal medicine, and in general surgery to gain insights from their knowledge and experience on hemorrhage control and tourniquet use. I traveled to Huntersville, North Carolina to interview the CEO of polytechnical industries and manufacturer of the CAT. Lastly, I spoke with other Special Forces soldiers about tourniquet use and hemorrhage control in regards to methods and key learning aspects. Over the course of my research, I looked at multiple different tourniquets and methods of hemorrhage control. I also reviewed military training to see where the programs overlapped and diverged.

## Results

The US military uses Tactical Combat Casualty Care (TCCC) as their platform for training on hemorrhage control while the civilian population conducts their training through the

National Association of Emergency Medical Technicians (NAEMT). Given the previous success of these two programs, it was a natural fit for collaboration. Stop the Bleed worked in conjunction with the two programs in creating content and modes of delivery.

Stop the Bleed differs from TCCC and NAEMT in that it needed a model for training unskilled bystanders rather than soldiers in hemorrhage control. While military personnel expect to be inserted into situations that may require hemorrhage control, bystanders found in such situations are surprised and caught off guard. The training provided to persons in the military through TCCC is very matter-of-fact. It covers key concepts in a very concise manner, while the training provided by Stop the Bleed uses a much softer tone. This is intended to make the material more palatable to civilian audiences. This shift in tone may have been implemented because they are training people from a variety of fields and participants range from school-age children to older members of faith groups.

## Discussion

### *Strengths*

Strengths describe the positive attributes, tangible and intangible, internal to an organization.[17] The program evaluation revealed many strengths with Stop the Bleed's training program. Most notably was the current tie it has with UNC Tar Heel Trauma Team. UNC is a strong name in medicine as well as a very well recognized name with its 10 hospitals and hospital systems serving North Carolina's 100 different counties.[18]

Stop the Bleed also has national recognition with strong backing from the Assistant Secretary for Preparedness and Response, Combat Casualty Care Research Program, Department of Homeland Security, Federal Bureau of Investigation, Federal Emergency Management Agency, Johnson and Johnson, Major Cities Chiefs Police Association, National Association of

Emergency Medical Technicians, Tactical Combat Casualty Care, U.S. Department of Defense, and U.S. Fire Administration.[6]

Another major strength of the program is its reach into the community, as it will train anyone with interest in saving lives through hemorrhage control at no cost to the participants or organizations who request the training. The programs material covers all of the pertinent topics in an order that builds on knowledge as the program progresses. There is a logical progression, from less to more invasive and from simple to complex techniques.

*Weaknesses*

Weaknesses are aspects of a business that detract from the value offered or create a competitive disadvantage.[17] Businesses need to enhance these areas in order to compete with the competition. One weakness of Stop the Bleed's program is a lack of requests. With such a large backing of supporting agencies, one might expect greater demand from the community beyond the ongoing programs offered at the hospitals. If the numerous organizations that fall underneath the supporting agencies were all requesting training, the program would be unable to meet the demand. The reality, in contrast, is Stop the Bleed has only 135 participants completed the program through external requests in 2018.

As for the organizations' trainers at UNC, having a volunteer driven program could act as a rate limiting step. Volunteers have high turnover rates, are less dependable, and cannot be increased easily to meet demand. This definitely has the potential, at some point, to limit the availability of training offered.

Using volunteers has an effect on the caliber of instructor as well. Experience may be harder to come by with this demand, and it limits the rigor of the training that can be set up for instructor certification. Due to this constraint, Stop the Bleed promotes certification to instructor

level with little to no discretion. The trainers I observed lacked knowledge and experience in applying products swiftly and efficiently in high stress environments, an important skill that is required in a traumatic situation. This was a larger concern given that law enforcement officers were among those attending the training. The presenters did not address the way situations may require them to remain tactical. Lack of knowledge in this area, and not knowing how to properly train audiences could lead to injury or lost lives.

The greatest weakness I found in the training was with the content itself. First, Stop the Bleed only talks about routing the extremity through the tourniquet and does not mention undoing the tourniquet from the redirect buckle. While this option will still put the tourniquet to effective use, it makes it significantly harder for the user to apply and more painful for the patient.

For example, with an injury to the lower extremity, while the user may elevate the foot to slide the tourniquet around the limb and pull it up to the proximal thigh, which may still provide occlusion at the end of application, un-routing the tourniquet from the redirect and passing it underneath the popliteal fossa will not only be easier for the user and less painful for the patient but significantly faster in application. This standard method was not covered in the presentation slides.

The presentation slides also talk about twisting the “windlass rod until bleeding has stopped, now bleeding is controlled,” but makes no mention of how many twists should be expected in proper application of a CAT. There is also no information about when it is recommended to place the tourniquet high on the extremity rather than just above the wound. Failing to recognize this distinction could lead to improper placement of a tourniquet. The

training should recommend constant reassessment of the intervention whether tourniquet or pressure dressing, in order to address failures of application as soon as possible.

Training should also talk about marking the patient who has a tourniquet by either writing a time stamp on the patient's forehead or marking the forehead with a "T" for easy identification. Also, informing EMS providers of the intervention should be taught to all individuals learning about interventions for bleeding control.

Stop the Bleed does touch on some mistakes made with past applications of the tourniquet, but leaves out several important points that should be talked about. These additions do not necessarily need to be addressed at length, but awareness should be brought to ensure coverage of this topic is presented in a thorough manner. The following mistakes are not currently being covered:

- Not pulling slack out of tourniquet before tightening
- Using a tourniquet for minimal bleeding
- Applying too proximal when wound is in sight
- Must stop bleeding AND eliminate distal pulse
- Continually reassessing the casualty

Lastly, tourniquets used by Stop the Bleed are not ideal for the pediatric population. They are only using the CAT which is designed for an adult extremity, and would be too large to occlude a smaller extremity. Although more suitable tourniquets are available, they are not utilized by the program.

*Opportunities*

Opportunities are external, attractive factors that represent reasons a business is likely to prosper.[17] I found Stop the Bleed has four opportunities that I wanted to focus on in my analysis.

First, with mass casualty shootings and bombings occurring more frequently and receiving more publicity, there is a raised awareness of the potentially devastating effects. Secondly, tourniquet technology has advanced exponentially, making them an easy and effective means of massive hemorrhage control for a wide range of ages. Thirdly, with the simplification of hemorrhage control, Stop the Bleed has been able to develop a program with lifesaving potential that can be taught to almost any age or ability. Lastly, training in hemorrhage control could extend a participant's basic medical knowledge to a level of understanding that positions them, should they become a bystander in a crisis, to be more effective in either self-aid or buddy aid.

*Threats*

Threats include external factors, beyond the control of the organization, that could place their strategy at risk. The organization generally has no control over these.[17]

Stop the Bleed does not have a formalized process for assessing and certifying participants. Informally, someone may watch a participant place each hemorrhage control technique into operation. There is no way, at this time, to verify learning at the end of training. Because of this, everyone who attends passes. This is concerning as it could give participants a false sense of confidence. Furthermore, Stop the Bleed wants to produce trainers, in order to provide more opportunities for educating the public about hemorrhage control. Therefore, those who were never even formally assessed for certification may go on to volunteer as training instructors.

Another threat to educating broad audiences is a perceived political tension around tourniquets and the second amendment. During my interviews, some of the other instructors on the UNC Tar Heel Trauma Team expressed concern about bringing tourniquet training to events aimed at gun enthusiasts. They feared the training might conjure up feelings of defensiveness, believing the organization was opposing their rights to bear arms.

Lastly, historically there have been occasionally poor perceptions of tourniquets, which influences some people today. Having heard these myths and misconceptions, prospective participants may choose not to attend. Those attending might have preconceived ideas about tourniquet use which interfere with their learning.

## Conclusion

Unlike the military, Stop the Bleed has one very large obstacle which is to educate the public on the need for the training. Part of this will be conveying the importance of empowering bystanders to act as the first line of defense in the continuum of care during crisis situations. Once audiences are convinced of the value of the education, they should be provided with clear and concise guidance. This guidance will ideally be presented with different verbiage tailored towards target audiences. Law enforcement officers, and certain other groups, might also benefit from additions to the core material, such as providing hemorrhage control in a tactical environment or simulated scenarios adding to the difficulty in application.

To ensure the participants are leaving with the skills necessary, a formal assessment needs to be put into place. This should evaluate both the knowledge gained and a level of physical proficiency and competence applying a tourniquet. To achieve this level of competence, participants would need to have multiple opportunities to practice and develop “hands-on” experience. Ideally, this experience would be with tourniquets used on both adults and children.

My analysis was limited to identifying areas that could provide opportunities or potentially threaten the goals of the program. I did, however, construct a survey which could be utilized as a starting point for the next level of evaluation of the program (Appendix C). This would serve as just one step in ensuring the program was bringing a community closer to the recommendation outlined in the Hartford Consensus.

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Appendix A- Tourniquets

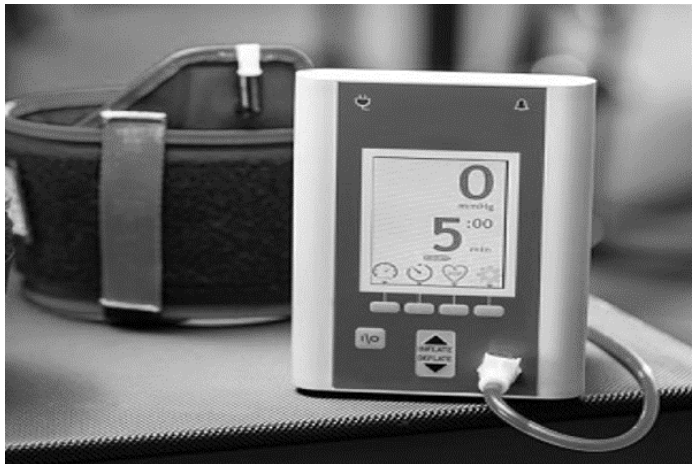
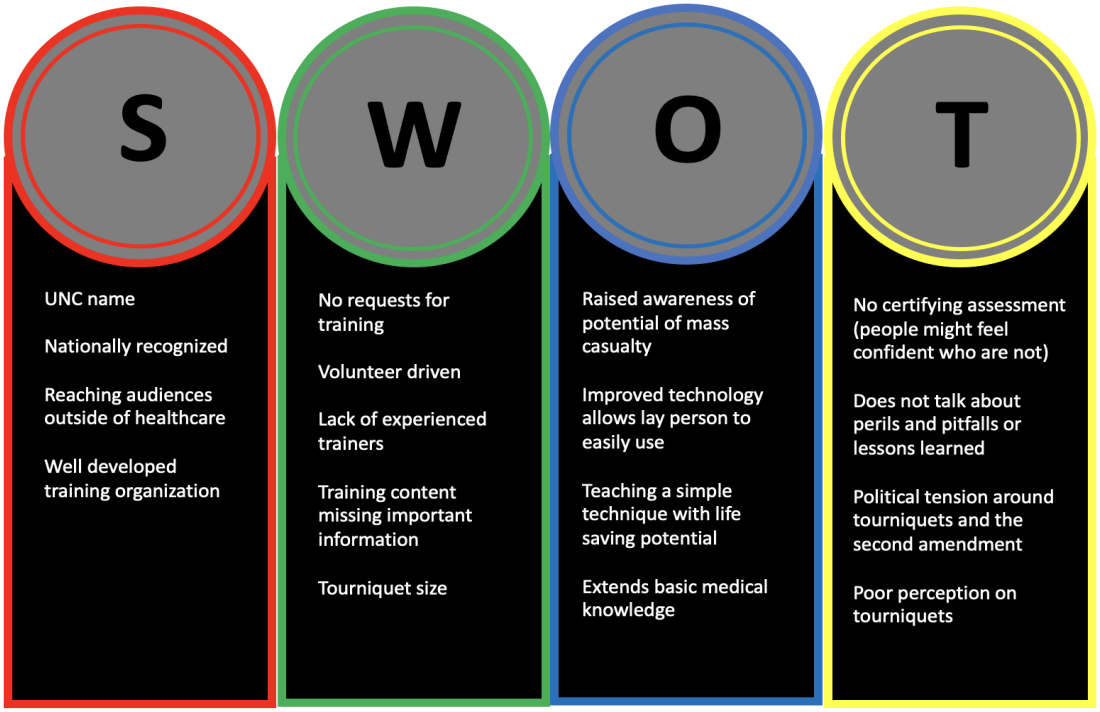



Figure 1: pneumatic tourniquet

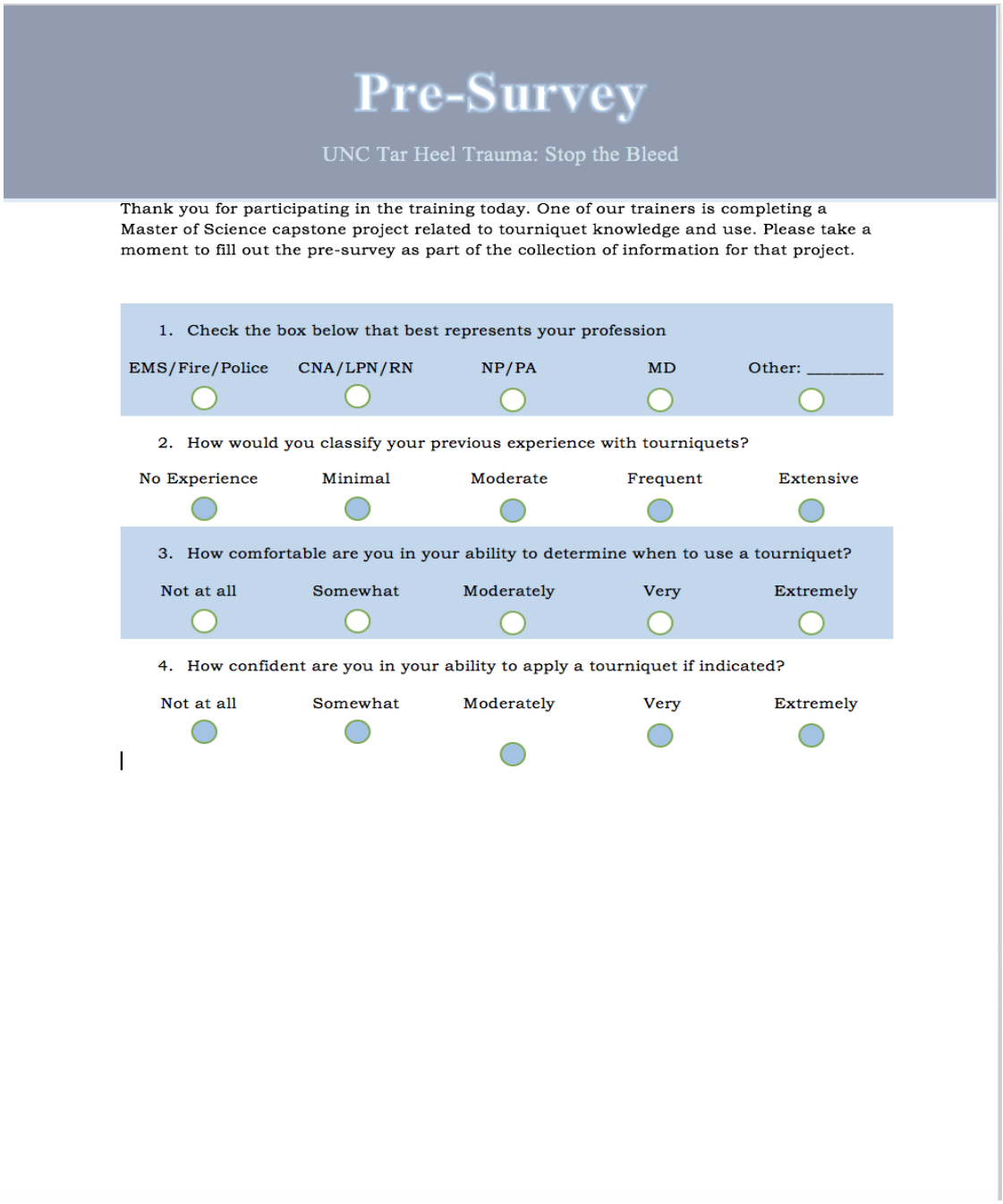
Figure 2*:* Combat Application Tourniquet (CAT)


Figure 3*:* The Stretch Wrap and Tuck Tourniquet (SWAT-T)

Appendix B- Strength, Weakness, Opportunities, Threat (SWOT) analysis



Appendix C



# Pre-Survey

UNC Tar Heel Trauma: Stop the Bleed

Thank you for participating in the training today. One of our trainers is completing a Master of Science capstone project related to tourniquet knowledge and use. Please take a moment to fill out the pre-survey as part of the collection of information for that project.

1. Check the box below that best represents your profession

EMS/Fire/Police ○ CNA/LPN/RN ○ NP/PA ○ MD ○ Other: _____

2. How would you classify your previous experience with tourniquets?

No Experience ○ Minimal ○ Moderate ○ Frequent ○ Extensive

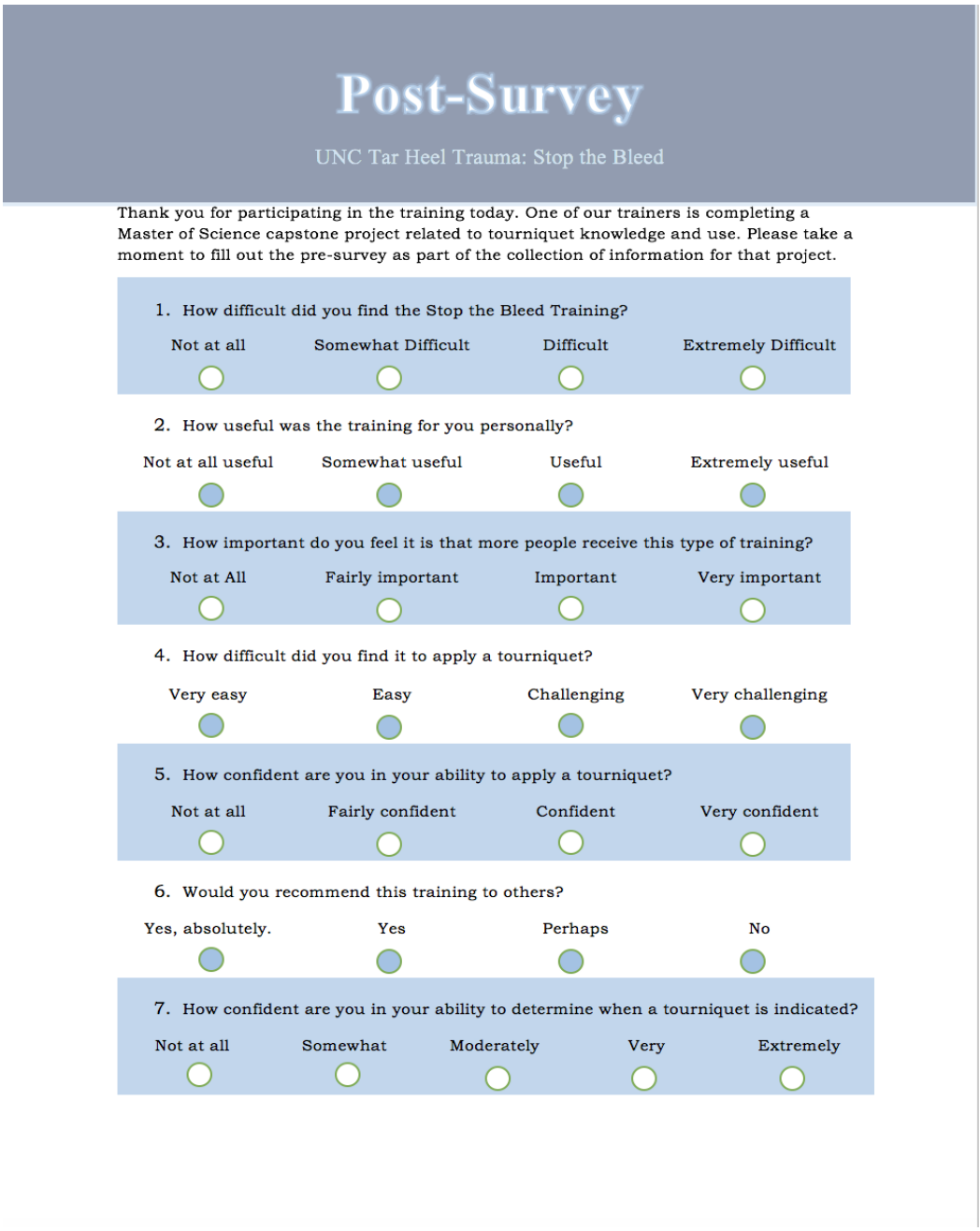
3. How comfortable are you in your ability to determine when to use a tourniquet?

Not at all ○ Somewhat ○ Moderately ○ Very ○ Extremely

4. How confident are you in your ability to apply a tourniquet if indicated?

Not at all ○ Somewhat ○ Moderately ○ Very ○ Extremely

Figure 1: Pre-Survey



# Post-Survey

UNC Tar Heel Trauma: Stop the Bleed

Thank you for participating in the training today. One of our trainers is completing a Master of Science capstone project related to tourniquet knowledge and use. Please take a moment to fill out the pre-survey as part of the collection of information for that project.

1. How difficult did you find the Stop the Bleed Training?

Not at all | Somewhat Difficult | Difficult | Extremely Difficult

2. How useful was the training for you personally?

Not at all useful | Somewhat useful | Useful | Extremely useful

3. How important do you feel it is that more people receive this type of training?

Not at All | Fairly important | Important | Very important

4. How difficult did you find it to apply a tourniquet?

Very easy | Easy | Challenging | Very challenging

5. How confident are you in your ability to apply a tourniquet?

Not at all | Fairly confident | Confident | Very confident

6. Would you recommend this training to others?

Yes, absolutely. | Yes | Perhaps | No

7. How confident are you in your ability to determine when a tourniquet is indicated?

Not at all | Somewhat | Moderately | Very | Extremely

Figure 2: Post Survey