When Direct Pressure Is Not Enough: An Educational Technique for Teaching Wound Packing in Athletic Training Education

Ashley B. Thrasher, EdD, LAT, ATC, CSCS*; Edward J. Strapp, BS, LAT, ATC, FP-C, NRP[†] *School of Health Sciences, Western Carolina University, Cullowhee, NC; [†]Sports Medicine Emergency Management, Baltimore, MD.

Context: Uncontrolled hemorrhage is a major cause of preventable death. Wound care and managing external hemorrhage are important skills for athletic trainers.

Objective: Describe a laboratory activity used to allow students to practice managing uncontrolled external hemorrhage and wound packing.

Background: The prevalence of active shooter and other mass casualty events has grown, and a trend to move militarybased emergency skills into civilian casualty care has emerged. Athletic trainers are uniquely positioned to respond to catastrophic events at the time of injury. Controlling hemorrhage and rapidly applying a tourniquet or administering wound packing have a great effect in preventing death due to severe hemorrhage.

Description: An educational technique using a pork shoulder was implemented to provide students with experience in wound packing.

Clinical Advantage(s): Students describe this activity as a beneficial way to gain experience on an important skill not often seen in the clinical education setting.

Conclusion(s): Faculty may consider implementing wound packing using a pork shoulder as a laboratory activity when teaching wound care and external hemorrhage management.

Key Words: Hemorrhage, hemostatic agents, wound care

Dr Thrasher is currently Assistant Professor in the School of Health Sciences at Western Carolina University. Please address correspondence to Ashley B. Thrasher, EdD, LAT, ATC, CSCS, School of Health Sciences, Western Carolina University, 3721 Little Savannah Road, Cullowhee, NC 28723. ashleybthrasher@gmail.com.

Full Citation:

Thrasher AB, Strapp EJ. When direct pressure is not enough: an educational technique for teaching wound packing in athletic training education. *Athl Train Educ J.* 2021;16(4):278–286.

When Direct Pressure Is Not Enough: An Educational Technique for Teaching Wound Packing in Athletic Training Education

Ashley B. Thrasher, EdD, LAT, ATC, CSCS; Edward J. Strapp, BS, LAT, ATC, FP-C, NRP

KEY POINTS

- Uncontrolled hemorrhage leads to death if left untreated. Wound packing can be used to manage external hemorrhage.
- Athletic trainers may be exposed to mass trauma events with external hemorrhage and must be prepared to treat patients with external hemorrhage.
- Using a pork shoulder with simulated blood provides students with a realistic activity to practice wound packing.

INTRODUCTION

Over the last decade, a surge in mass casualty events has resulted in injury and severe hemorrhage, from bus crashes, bombings, and even active shooters. Uncontrolled hemorrhage is the most common cause of preventable deaths after trauma.^{1,2} An individual can die from blood loss within 3–5 minutes with severe hemorrhaging.³ Controlling hemorrhage as soon as possible after an injury through direct pressure, tourniquet use, wound packing, or hemostatic dressings improves outcomes and saves lives.^{4,5} While these instances are not common, it is important for athletic trainers to understand how to deal with traumatic wounds because although emergency medical services (EMS) respond quickly, athletic trainers are positioned to be the first on the scene in many of these cases.

Wound care is an important skill for athletic trainers. In the 2020 Commission on Accreditation of Athletic Training Education (CAATE) Standards for accreditation of professional athletic training programs,⁶ Standard 70 states:

Evaluate and manage patients with acute conditions including triaging conditions that are life threatening or otherwise emergent. These include (but are not limited to): Internal and External Hemorrhage (including use of tourniquet and hemostatic agents) and Wounds (including care and closure).^{6(p13)}

Athletic trainers need to demonstrate competence in managing external hemorrhage even though extreme external hemorrhage is not something seen daily in athletic training. The American College of Surgeons Committee on Trauma strongly recommend tourniquets to control significant hemorrhaging if direct pressure is ineffective or impractical.^{1,7,8} Tourniquets are commonly used as an early option to control external hemorrhage and have a great deal of evidence to support their use. However, tourniquets cannot be used in junctional areas such as the neck, groin, or axilla; therefore, other options, such as wound packing and hemostatic dressing, are necessary.⁹

Wound packing is the process of using cloth or dressing, such as sterile packing gauze, to fill a soft tissue wound to compress the bleeding vessel enough to control hemorrhage.¹⁰ Hemostatic dressings are gauzelike dressings containing an agent to enhance the natural clotting cascade and are used to

supplement traditional wound packing materials to promote clot formation while providing direct pressure.^{11,12} There are 3 primary types of hemostatic dressings: factor concentrators, mucoadhesive agents, and procoagulant supplementers. Factor concentrators absorb fluid content in the blood while simultaneously promoting clot formation; examples of these include QuikClot (Z-Medica, Newington, CT) and Trauma-Dex (MedaFor Inc, Minneapolis, MN). Mucoadhesive dressings, such as Hemcon (Tricol Biomedical, Inc, OR) or WoundStat (TraumaCure, Inc, Bethesda, MD), react with blood to physically adhere to tissue and seal the bleeding wound. Procoagulant supplementers enhance coagulation by delivering procoagulant factors such as thrombin, fibrinogen, and calcium to the wound to stimulate the intrinsic coagulation cascade.^{11,13} QuikClot Combat Gauze (Z-Medica, Newington, CT) is an example of a procoagulant. Hemostatic dressings can stop bleeding within 2 minutes, do not require any mixing or other preparation, are simple to apply, and are inexpensive.¹²

Wound packing has historically been used in the military setting and is now becoming more prevalent in tactical EMS and civilian EMS teams.⁹ The American College of Surgeons Committee on Trauma has recommended that prehospital personnel are trained in hemostatic agents, proper wound packing, and pressure application techniques to enhance patient outcomes.¹ Additionally, the Stop the Bleed campaign¹⁴ teaches lay responders how to apply direct pressure, pack wounds, and apply tourniquets. Due to the rising prevalence of life-threatening bleeding and serious disasters to which athletic trainers may be exposed, it is important for athletic training programs to include these skills in the curriculum and find effective ways to teach these skills. One approach to provide students with a realistic experience for wound packing is to create a wound packing simulator using a pork shoulder with simulated blood and allowing students to practice packing a wound to stop external hemorrhage. The purpose of this paper is to describe an educational technique using wound packing for athletic training students. In accordance with the Common Rule and federal definition of research, the university institutional review board did not require review of this educational strategy because it was an educational technique that was completed as a part of educational practice and was not considered research.

ASSIGNMENT DESCRIPTION AND PURPOSE

This laboratory activity was integrated into an emergency care for the athletic trainer course as a part of a larger section dedicated to wounds and emergency wound care. This course occurs in the students' first semester in the athletic training program. Before the wound care section, students learned about recognizing and treating shock; therefore, they had knowledge of hemorrhagic shock and the importance of managing hemorrhage. For this lab, students had stations in which they performed various wound care tasks, such as wound irrigation, wound debridement, basic wound closure Figure 1. Overview of key concepts for laboratory activities. *The wound packing activity described in this educational technique manuscript is 1 station during this laboratory session. The wound packing station focuses on hemorrhage control, while the other stations focus on wound care.

•The purpose of this lab is to expose students to common wound care and bleeding control techniques including debridement, basic wound closure (e.g., steri-strips), and wound packing*. Objectives •Students will learn to evaluate and manage patient(s) with acute conditions including triaging conditions that are life threatening or otherwise emergent. • Overview of the three stations Review types of debridement Introduction • Review basic wound closure options (e.g., steri-strips) and application procedures to Lab • Review wound packing procedures • Review signs and symptoms of hemorrhagic shock Provide student instructions (below) •In groups of two, complete all stations related to wound care and bleeding control. Students must be in appropriate PPE at all times. •Complete the following stations: wound irrigation and sharps wound Instructions debridement, wound packing, and basic wound closure • Students can opt out of wound packing for religious or ethical reasons. If students opt out of wound packing, they will spend more time at the other stations

using wound closure strips, and wound packing. The focus of the wound packing station was to provide students with experience in controlling acute hemorrhage and packing a wound for stabilization (Figure 1). Before beginning the lab, the wound packing activity was thoroughly described to students, and students were aware the wound they were packing was a pork shoulder. Students were safe to opt out of packing the wound for any reason, such as religious or ethical reasons. Students who opted out could use a hemorrhage control trauma trainer (eg, Simulaids,¹⁵ NAR Wound management simulator¹⁶) to gain experience packing wounds (Figure 2).

STRATEGIES FOR IMPLEMENTATION

Materials Needed

While students need to learn and practice packing a wound, educators cannot inflict injuries on students to make a realistic

learning experience. Using a pork shoulder is a good replacement, as pork shoulders are easily found in the meat section of a local grocery store, ranging from \$9 to \$12 depending on size, approximately 1.13-1.36 kg (2.5-3 pounds). A bone-in pork shoulder with the skin on 1 side makes the model appear more realistic. If institutions are unable to procure pork shoulders or the Institutional Animal Care and Use Committee determine the use of pork models is not permitted, other options can be used. For example, Simulaids (Z-Medica)¹⁵ and North American Rescue¹⁶ have each developed hemorrhage control trauma trainers for approximately \$350 that can be used for wound packing. However, often, commercial wound packing simulators do not have active bleeding. Therefore, these wound simulators do not create the stressful or time sensitive environment as options with higher fidelity. A budget friendly option to replicate a wound is to use a pool noodle with a dowel rod in the middle to simulate soft tissue surrounding the bone. A small foam roller could also be used. Educators can even use

Figure 2. Placing simulated skin over foam roller or pool Figure 3. Wound packing supplies. noodle.



simulated skin (eg, rubber shelf liner, rubberized replacement skin from Simulaids, elastic resistance band) to make the limb more realistic (Figure 2). Additionally, an intravenous (IV) bag with simulated blood can still be placed inside the pool noodle to increase fidelity.

Simulated blood is another item needed for this laboratory activity. We used Simulaid Simulation Blood Packet, which costs approximately \$15-\$20 for a packet that makes approximately 3.79 L (1 gallon).¹⁷ We have found that 1 pack of blood is sufficient for 1 lab because we typically use a little over 1.89 L (0.5 gallon) of simulated blood with 2 pork shoulder stations with 25 students. Blood is made using the blood packet and hot and cold water. The blood is then placed in IV bags with the tubing clamped shut. Simulated blood can also be prepared using items found in the local grocery store, such as corn syrup, food coloring, and cocoa mix or dissolved gelatin for thicker blood. Additional items for this activity are outlined in Table 1 and Figure 3.

Lab Preparation

Environment. This activity can be very messy because of the simulated blood, so the lab space should be prepared by lining the table or floor with plastic tablecloths or trash bags.

Simulated Blood and IV Tubing. Simulated blood is prepared as instructed by the packet or recipe. The simulated blood is then placed in an IV bag with tubing and a clamp. The IV tubing will serve as the "vessel"; therefore, before threading the tubing through, make a 1.27-cm (0.5-inch) slit



into the tube to allow students to feel the ruptured vessel. This should be done immediately before inserting the IV vessel into the pork shoulder so the blood does not leak out of the IV tube.

Pork Shoulder. Once the blood is prepared, the pork shoulder should be placed on the desired surface (eg, table or floor). To make cleanup easier, a disposable roasting pan is a good option to contain most of the blood; however, it decreases the fidelity.

The pork shoulder should be placed skin side up, and a scalpel is used to make deep lacerations (approximately 5–7.5 cm [2–3 inches] deep; approximately 7.5 cm [3 inches] long) into the tissue (Figure 4). Make an additional cut on the side of the pork shoulder and thread the IV tubing through the side cut through to the large laceration (Figure 5). This may require multiple cuts. The ruptured vessel of the IV tube will be placed under the laceration in the pork shoulder. This will provide students with the ability to feel the bleeding decrease when good direct pressure is applied, which increases realism. Once the IV tube is in the large laceration, unclamp the tubing and squeeze the IV bag to saturate the wound with blood. Once saturated, close the clamp on the IV tube until ready to use.

Instruction and Teaching the Skill

As a part of the wound care section in this course, students learned how to manage hemorrhage and wounds. Before beginning this laboratory, the steps for managing hemorrhage were reviewed (Table 2). In pairs, students were instructed to go through the steps of managing hemorrhage on the pork shoulder (Figures 6–9).

Table 1. Supplies Needed for Wound Packing Lab Activity

Pork shoulder (approximately 1–1.8 kg [2–4 pounds], preferably with skin and bone) Scalpel Simulated blood or other red colored fluids (1.89 L [0.5 gallon]) Intravenous (IV) bags with large bore IV administration sets that include slide clamp (1 per station) Gloves (all sizes to ensure students use the correct size) Sterile or nonsterile packing roll gauze (eg, Kerlix or z-pak) Hemostatic dressing (eg, QuikClot, Wound stat, HemCon) for reference Pressure dressings (eg, ace wrap, elastic wrap) Biohazard bags Large disposable roasting pan Plastic tablecloths or tarps Trash bags Tape (nonelastic athletic tape to attach trash bag to table; secondary tape for elastic wrap)

Figure 4. Pork shoulder with laceration.



Before students begin the wound packing station, the IV tube is unclamped, and IV bag is squeezed by the instructor to saturate the wound with fresh blood as students prepare to pack the wound. Throughout the activity, the instructor should continuously saturate the pork shoulder with blood until the students are able to find the bleeding vessel and apply compression directly to the vessel. Once the vessel is compressed, the instructor lightens the squeezing of the IV bag to simulate the decreased bleeding associated with quality direct pressure. This was evaluated based on the location and depth of the fingers. If students did not maintain good, focused pressure during wound packing, the instructor continued squeezing the IV bag, and bleeding continued. Focused pressure was evaluated by observing the students' perceived depth of the fingers and the ability to reduce the Figure 5. Intravenous "vessel" threaded through the pork shoulder with cut tubing to simulate a damaged and bleeding vessel.



blood in the wound. If the students removed their fingers from the wound, the wound continued to bleed. Once the hemorrhage was controlled, the wound was packed and secured and the students' ability to complete the steps from Table 2 was checked by the instructor. Once checked, the students unpacked the wound, cleaned up all material, and placed materials in a biohazard bag. The instructor then prepared the station for the next group of students by squeezing fresh blood into the wound.

This activity can also be advanced by changing the environment because most patients will not have a wound

Table 2. Instructions Given to Students for Wound Packing Station^{9,13,19}

- 1. Initiate appropriate body substance isolation procedures.
- 2. Expose the wound (clear clothing, spread the wound as needed).
- 3. Remove excess pooled blood.
- 4. Locate the source of active bleeding.
- 5. Apply focused direct pressure using thumb or 2 fingers directly on the vessel (Figure 6).
- 6. Continue applying focused direct pressure while obtaining wound packing supplies.
- 7. Pack the wound tightly using sterile packing gauze or hemostatic dressing if available (eg, QuikClot, Wound stat, HemCon). (Figure 7)
 - a. Do not release pressure except to apply gauze under the initial pressure point.
 - b. Pack by swapping fingers or climbing on the added gauze.
 - c. If using a hemostatic dressing, place 1 full package into the wound and continue packing the remaining space with traditional packing gauze (only 1 hemostatic necessary as more layers will not chemically react).
 - d. After filling the entire wound, apply direct pressure and maintain for 3–5 minutes (Figure 8).
 - e. Overpack the wound with sterile gauze over the hemostatic dressing.
 - f. Hemostatic dressing may be repacked if it fails to provide hemostasis.
- 8. Reassess for proper and effective placement.
- 9. Apply a pressure dressing (eg, elastic wrap, ace wrap) over the wound packing (Figure 9).
- 10. Continually monitor for rebleeding.
- 11. Continuously monitor for shock until patient is transported.
- 12. Clean up.

Figure 6. Focused direct pressure on the vessel.



contained on a treatment table in a well-lit area. Examples of

changing environments to challenge students include changing the amount of light or noise, positioning the pork shoulder as

if a patient was trapped under a table or another limitedaccess area, moving the activity outside, or positioning the

pork shoulder next to a real patient and draping to simulate a

patient with a deep wound (Figure 10). Figure 11 provides

One consideration for this activity is the use of hemostatic

agents, which are recommended when packing a wound.

Hemostatic agents can be used in this activity to provide

students the opportunity to practice with these products;

Figure 7. Initial wound packing using rolled gauze while

example scenarios that can be used with this activity.

maintaining pressure.

Figure 8. Secondary direct pressure, holding pressure for 3–5 minutes.



however, the hemostatic agents will not react with simulated blood and will not be as beneficial for demonstration purposes. If hemostatic agents are used during this activity, students should understand how these agents will react differently in an actual wound with real blood.

OUTCOMES AND LESSONS LEARNED

Overwhelmingly, students responded favorably to this laboratory activity. This course activity did not include any formal assessments; however, students commonly reported this laboratory activity was their favorite part of the course, and many students stated that they felt more prepared to manage external hemorrhage. After the activity, students were asked to provide informal feedback directly to the instructor. Students also provided formal feedback on their course evaluations. For direct quotes, students provided their consent to have their comments included in this article. Students commented on many benefits of this activity, such as helping them practice their wound packing skills, remembering various aspects of managing hemorrhage (eg, wearing gloves, compressing the bleeding vessel), and learning how to manage a stressful injury in a low-stress environment. One student stated:



Figure 9. Application of pressure dressing.



Figure 10. Advancing the skill by changing environment.



The wound packing lab we completed in the emergency care class was extremely beneficial for me in that it provided me with a semirealistic scenario of packing a wound. The pork shoulder we used continuously bled until we could find the source of the bleeding and pack the wound with gauze. It demonstrated how it would physically feel to pack a wound as well as taught me how much pressure to use and how to quickly and efficiently pack a deep wound.

Another student commented:

The wound packing lab we did in our emergency care class allowed me to learn how to properly pack a wound while also having fun with it. I believe that having hands-on time in a lab is important in helping learn the skill, and the wound packing lab with the pork shoulder allowed for a good learning experience on how to pack a wound.

Another student stated:

This wound packing lab showed me just how much packing you need to do to stop a wound of this severity. This lab really displayed the intensity of these situations, and you quickly realize that, as you go along, you need to do more than you imagined to get the bleeding under control. As far as labs go, I couldn't think of a better way to simulate such an emergent situation.

Another student commented:

The wound packing lab was fun. I honestly thought it would be easy to find the "vessel" and stop the bleeding, but I was wrong. It was tough to find and stop the bleeding when you couldn't fully see what you were touching. I could only hope I was in the right area by looking for signs that the bleeding had minimized or stopped. Thanks for an awesome and informational lab!

While these are anecdotal outcomes, future research should further explore confidence levels before and after the activity with wound packing as well as further exploring perceptions of the activity.

This activity was used to develop skills in packing wounds; however, the steps and skills required could be assessed to

ensure competence. Instructors could assess student learning of the skill by using a checklist (Table 2) to ensure students successfully complete each step of the activity. Additionally, a hybrid standardized patient experience could be used, which would require the student to complete the technical skill of packing the wound while also ensuring he or she is taking care of the patient holistically (eg, monitoring vitals). This could be done as a learning experience or as a practical examination.

This activity has been successfully implemented for both classes and conferences, and lessons have been learned along the way. This activity can be messy; therefore, adequate time (ie, 30–60 minutes) must be allotted before the activity to prepare the area, blood, and pork shoulder. During cleanup, triple bagging the pork shoulder before disposal helps keep the blood contained. We have found students are more successful with packing the wound when reviewing all the steps of wound packing before the activity. Additionally, it is necessary to have alternative activities, as described previously, for individuals who are uncomfortable or unable to use the pork shoulder. Ways to further enhance this activity include assessing the skill, developing interprofessional education experiences, and using a hybrid standardized patient experience.

CLINICAL ADVANTAGE

Despite the importance of being able to manage severe external hemorrhage efficiently and effectively, students do not often engage in this type of wound management during clinical education experiences. Severe external hemorrhage is not limited to active shooter or mass casualty events and can occur as an isolated event during regular athletic activities, such as lacerations and incisions from ice skates, metal, or glass. Therefore, athletic training educators need to simulate this experience to ensure students can manage external hemorrhage if necessary. Using a pork shoulder with simulated blood can provide a valuable and worthwhile experience for students on a skill not often seen during clinical education. Faculty may consider using this educational technique to ensure CAATE standards⁶ are met related to this topic.

While this activity was done in an athletic training laboratory setting, there are ways to expand this activity through collaborations with emergency medical care students or nursing students. Some nursing programs have implemented the Stop the Bleed campaign¹⁴ into nursing curricula to teach emergency preparedness for mass casualty events.¹⁸ An interprofessional simulation experience in which athletic training students pack the wound and then nursing students act as emergency department nurses to treat the wound could be a valuable learning experience for both athletic training and nursing students. Athletic training faculty are encouraged to seek out additional ways in which this activity could be used interprofessionally.

CONCLUSIONS

Athletic training programs must prepare students to manage wounds and external hemorrhage.⁶ Athletic trainers are on the frontlines and may be perfectly poised to respond in a mass casualty and other life-threatening situations and therefore should be trained in hemostatic agents, proper wound packing, and pressure application techniques to enhance patient outcomes.¹ Students perceived a wound packing

Scenario 1

• You are the athletic trainer providing patient care to the high school hockey team. Prior to practice, the hockey team was warming up without all their pads and decided to test their jumping abilities on their skates. One player squatted down to have others jump over him. Another player mistimed his jump and his skate slashed the upper thigh of the other player. Two of his teammates drag him over to the edge of the rink while another teammate rushes to the Athletic Training Clinic to alert you. You rush to the patient and note significant external hemorrhage coming from his upper thigh.

Scenario 2

• You are the athletic trainer providing patient care to the university baseball team in Ohio. The team is on their way to Spring Training in Florida on a bus. The athletic training staff and managers are in a van following the bus. The team has just is about one hour into the journey when freezing rain begins. The bus skids on some black ice on a bridge and drives off the overpass, landing on the highway below. The van is able to quickly maneuver to the other highway to reach the team. You have completed a quick assessment of the scene and you notice on of your patients has an open wound that is bleeding profusely in his groin. Manage the wound appropriately.

Scenario

• You are working as an athletic trainer at a track meet. As you are making your rounds, you see an athlete from another team who is not paying attention and walked through the javelin field as another athlete was throwing. Despite everyone's best attempts to get the athlete's attention, the javelin pierced them in the shoulder. After crying out, they removed the javelin and collapsed to the ground. You rush to the area and note significant bleeding from the axillary region. Manage the wound appropriately.

laboratory activity as a valuable learning opportunity to provide experience with a vital skill that is not often seen in clinical education. This activity is a simple but effective way to enhance skills in managing external hemorrhage.

REFERENCES

1. Bulger EM, Snyder D, Schoelles K, et al. An evidence-based prehospital guideline for external hemorrhage control: American

College of Surgeons Committee on Trauma. *Prehosp Emerg Care*. 2014;18(2):163–173. doi:10.3109/10903127.2014.896962.

- 2. Zwislewski A, Nanassy AD, Meyer LK, et al. Practice makes perfect: the impact of Stop the Bleed training on hemorrhage control knowledge, wound packing, and tourniquet application in the workplace. *Int J Care Injured*. 2019;50(4):864–868. doi:10. 1016/j.injury. 2019.03.025.
- 3. Limper L, Lee S. Planning for injuries from an active shooter emergency—part 2. Board of Certification for the Athletic

Trainer Web site. Published September 26, 2019. Accessed September 3, 2021. https://www.bocatc.org/blog/planning-for-injuries-from-an-active-shooter-incident-part-two

- Holcomb JB, Butler FK, Rhee P. Hemorrhage control devices: tourniquets and hemostatic dressings. *Bull Am Coll Surg.* 2015;100(1 Suppl):66–70.
- Kheirbek T, Monaghan SF, Benoit E, Lueckel SN, Adams CA Jr. Advances in the management of bleeding trauma patients. *R I Med J.* 2019;102(8):30–33.
- 6. 2020 standards for accreditation of professional athletic training programs. Commission on Accreditation of Athletic Training Education Web site. Published 2018. Accessed September 3, 2021. https://caate.net/wp-content/uploads/2018/09/2020-Standards-for-Professional-Programs-copyedited-clean.pdf
- Brinsfield KH, Mitchell E Jr. The Department of Homeland Security's role in enhancing and implementing the response to active shooter and intentional mass casualty events. *Bull Am Coll Surg.* 2015;100(1 Suppl):24–26.
- Jacobs LM, McSwain N, Rotondo M, et al. Improving survival from active shooter events: the Hartford Consensus. *Bull Am Coll Surg.* 2015;100(1 Suppl):32–34.
- Bolleter S, Heightman AJ, Taillac PP. Wound packing essentials for EMTs and paramedics. Updated April 1, 2017. Accessed date September 3, 2021. https://www.jems.com/patient-care/trauma/ wound-packing-essentials-for-emts-and-paramedics/
- Drew B, Bennett BL, Littlejohn L. Application of current hemorrhage control techniques for backcountry care: part one, tourniquets and hemorrhage control adjuncts. *Wilderness Environ Med.* 2015;26(2):236–245. doi:10.1016/j.wem. 2014.08.016.

- Granville-Chapman J, Jacobs N, Midwinter MJ. Pre-hospital hemostatic dressings: a systematic review. *Injury*. 2011;42(5):447– 459. doi:10.1016/j.injury. 2010.09.037.
- 12. Payne EK, Berry DC, Seitz SR. Educating the educator: use of advanced bleeding control mechanisms in athletic training: a shift in the thought process of prehospital care—part 2: hemostatic agents. *Athl Train Educ J.* 2014;9(4):193–201.
- Littlejohn L, Bennett BL, Drew B. Application of current hemorrhage control techniques for backcountry care: part 2, hemostatic dressings and other adjuncts. *Wilderness Environ Med.* 2015;26(2):246–254. doi:10.1016/j.wem.2014.08.018.
- 14. Stop the Bleed. U.S. Department of Defense, Defense Health Agency Web site. Accessed September 3, 2021. https://www. stopthebleed.org/
- Simulaids Z-Medica QuikClot Trauma Trainer. AED Superstore Web site. Accessed September 3, 2021. https://www. aedsuperstore.com/simulaids-100851-zmedica-quikclot-traumatrainer.html
- NAR Wound Management Simulator. North American Rescue Web site. Accessed September 3, 2021. https://www.narescue. com/nar-wound-management-simulator.html.
- Simulaid Simulation Blood Powder. School Health Web site. Accessed September 3, 2021. https://www.schoolhealth.com/ simulaids-simulated-blood-powder.
- Varanelli V, Basilio M, Breda K. Teaching nursing students to Stop the Bleed emergency preparedness education for mass casualty events. *Teach Learn Nurs.* 2019;14(4):288–290.
- Strapp E. Beyond direct pressure: evidence-based practice for shock and advanced wound care. Lecture presented at Mid-Atlantic Athletic Trainers' Association Annual Symposium. May 18, 2018; Ocean City, MD.