Study of Tourniquet Use in Simulated First Aid

User Judgment

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ABSTRACT

Background: The purpose of this study was to survey the judgments of tourniquet users in simulation to discern opportunities for further study. **Methods:** The study design constituted two parts: questions posed to four tourniquet users and then their tourniquet use was surveyed in simulated first aid, where the users had to decide how to perform among five different cases. The questions addressed judged confidence, blood volumes, a reason bleeding resumes, regret of preventable death, hemorrhage assessment, need for side-by-side use of tourniquets, shock severity, predicting reliability, and difference in blood losses. The mechanical performance was tested on a manikin. Case 1 had no bleeding. Case 2 had limb-wound bleeding that indicated tourniquet use in first aid. Case 3 was like case 2, except the patient was a child. Case 4 was like case 2, except caregiving was under gunfire. Case 5 was like case 4, but two tourniquets were to be used side by side. Each user made tests of the five cases to constitute a block. Each user had three blocks. Case order was randomized within blocks. The study had 60 tests. **Results:** In answering questions relevant to first-aid use of limb tourniquets, judgments were in line with previous studies of judgment science, and thus were plausibly applicable. Mechanical performance results on the manikin were as follows: 38 satisfactory, 10 unsatisfactory (a loose tourniquet and nine incorrect tourniquet placements), and 12 not applicable (case 1 needed no mechanical intervention). For cases 1 to 5, satisfactory results were: 100%, 83%, 100%, 75%, and 58%, respectively. For blocks 1 to 3, satisfactory results were 50%, 83%, and 83%, respectively. **Conclusion:** For tourniquet use in simulated first aid, the results are plausibly applicable because user judgments were coherent with those in previous studies of judgment science. However, the opportunities for further studies were noted.

KEYWORDS: *psychomotor performance; practice-based learning; choice behavior; motivation; readiness*

Introduction

Judgment guides how people make choices, and judgment science has been highlighted since 2002 by several Nobel prizes. For example, Daniel Kahneman shared one for groundbreaking work that showed just how unreliable intuitive judgment could be or, as the awarders put it, "for having integrated insights from psychological research into economic science, especially concerning human judgment and decision-making under uncertainty."[1] Readers from the operational health community may recall that Kahneman had worked in a psychology unit within the Israeli military services.[2,3] Kahneman later explained an example of judgment in commenting on Michael Lewis's bestselling book *Moneyball*, a story about inefficient predictions made by professional scouts of the Oakland Athletics baseball team.[3] The scouts judged traditionally by forecasting the potential performance of ballplayers by including how their build and behavior looked like those of stereotypically good players.[3,4] Although this way of predicting is common, it is also flawed.[2,3,5] Billy Beane was the team's general manager and had previously worked as a player and a scout, but he disagreed with his scouts by choosing players by statistics of their previous performance.[4] Because the scouts of other teams continued to make inefficient predictions by the traditional way, Oakland got specific players cheaply by undertaking its new way, because other teams had undervalued those players.[3] With such change in judgments, Oakland soon improved. Eventually, many teams, sports, and organizations adopted similar methods, such as through extensive use of analytics, to improve judgments.[2]

Awareness in medicine of such judgment science is increasing,[6–9] but so far it is infrequently derived from first-aid data.[10] When we discuss judgment science within the operational health community, we find that little awareness of such science persists, in part because few health studies deal directly with both judgment and the community. In prior works, we noted how caregiver judgments affected clinical outcomes in caregiving and in its simulation.[11–14] As investigators, we thought that judgment science may be relevant to first aid, so we took an initial look to generate hypotheses for further study. As educators, we thought that by studying judgments, awareness of such science may be improved within the community. The purpose of the present study was to compare judgments of tourniquet users in simulation to discern opportunities for additional study.

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Methods

This study was conducted within protocol guidelines at the Institute of Surgical Research (ISR) in 2017. The study design consisted of two parts: questions posed to tourniquet users and then a survey of their performance in simulated first aid, where they made clinical judgments.

All tourniquet users were at the ISR and participated individually in the following order: two military cadets, a fellow investigator, and a clinician-scientist. Among them, the cadets had recently finished another tourniquet research project; the fellow was in another department and had trained with tourniquets. The clinician-scientist was a tourniquet expert. The extent of experience in handling tourniquets varied for cadets, the fellow, and the clinician-scientist and can be categorized as least, moderate, and most, respectively. The clinician-scientist designed the study and oriented others to its procedures. All users were familiar with the tourniquet model.

The questions were answered before performances were surveyed. Readers can answer the questions now in the Appendix to see if the results are surprising.

Item 1 had users assess their confidence in successful tourniquet use in caregiving. Item 2 questioned judgment of a blood-loss volume. Item 3 questioned the most likely reason bleeding may resume after tourniquet use had controlled bleeding. Regarding a preventable death, item 4 questioned preference about regret—a pertinent point about motivation to intervene. Item 5 was a question about bleeding assessment. Item 6 questioned which factor is most associated with a need for tourniquets used side by side. Item 7 was a question of hemorrhagic shock severity. Item 8 had users predict when their performance would become reliable. We wanted to see if National Baseball Hall of Fame member Yogi Berra was right: it's tough to make predictions, especially about the future. Item 9 was like item 8 except users judged when they would remain reliable. Item 10 had users judge the minimal important difference for blood loss. Afterward, users and the clinician-scientist discussed the answers.

Performance of tourniquet use was tested as reported previously[15] with exceptions below. Briefly, a HapMed Leg Tourniquet Trainer (CHI Systems; www.chisystems.com) simulated a limb amputation. The model of tourniquet was the Combat Application Tourniquet (generation 7; C-A-T Resources, www.combattourniquet.com).

Tests were grouped for users in two ways: cases and blocks. Each user made tests of the five clinical cases. This set of five constituted a block. Each user had three blocks, and case order was randomized within blocks. Each user had 15 tests; the study comprised 60.

There were five clinical cases (Table 1). Case 1 was a negative control: no bleeding. Case 2 was a positive control: a bleeding wound, one tourniquet indicated, and a casualty with a large build. Case 3 was like case 2, but the patient had a small build and was a child. Case 4 was like case 2, except care was under gunfire. Case 5 was like case 4, but two tourniquets were indicated in side-by-side use.

The user was encouraged to think aloud and troubleshoot problems. After "start" was called, the user turned toward the manikin. While turning, users were told of the case as scripted. The user walked to the table, judged how to act, picked up a tourniquet next to the manikin, unrouted the band by removing it from its course through the buckle, and applied the tourniquet to the manikin. After the user judged the test to be satisfactorily completed, the user said, "Done."

TABLE 1 *Case Information*

Case No.	No. of Devices Needed	Care Context	Patient Build	Script Read to the User
1	0	Regular first aid	Large	You see an injured adult.
2	1	Regular first aid	Large	You see an injured adult.
3	1	Regular first aid	Small	You see an injured child who appears to be about 12 years old.
4	1	First aid under fire	Large	You see an injured adult and hear what sounds like gunshots.
5	2	First aid under fire	Large	You see an injured adult and hear what sounds like gunshots.

The descriptive statistics were used to portray results. The data collected for different groups were compared and analyses were conducted by using Excel 2003 (Microsoft; www.microsoft.com).

Results

Questions and Answers

In item 1, users assessed self-confidence in successful tourniquet use in caregiving, and a cadet and the fellow were confident (4 on a 1–5 ladder [i.e., Likert] scale), whereas another cadet and the clinician-scientist were very confident (5). No one was very unconfident (1), unconfident (2), or neutral (3).

In item 2, users answered a question about judging blood-loss volume, and this question was modified from one in the Cognitive Reflection Test (CRT), a test of people's tendency to answer questions with the first idea that comes to their mind, without checking it.[3,16] The original CRT question was of the cost of a bat and ball adding up to $1.10. The fellow and the clinician-scientist correctly gave an answer of 5mL to the modified question about blood loss, whereas both cadets answered 10mL incorrectly. The cadets spontaneously answered with the first idea that came to their mind without checking it, but the doctors calculated deliberately and answered slowly.

In item 3, a cadet and the clinician-scientist answered correctly that the compressed portion of the limb loses pressure under a static tourniquet over time, risking that blood vessels reopen and blood flows again. However, another cadet and the fellow answered incorrectly. Recent studies established how tourniquet compression affects soft tissue over time with such reflow in normal humans,[17–23] and those who answered correctly noted that the question resembled closely a prior discussion they had of such effects. Both users recalled the previously discussed knowledge that helped them answer, whereas the others never discussed such knowledge, so it was inaccessible to recall. This mechanical phenomenon appears to occur more commonly in care situations when initial tourniquet pressure is marginally acceptable or tourniquet use is lengthy.

Item 4 was if someone in need of tourniquet use has bled to death, would the respondent regret it more if they were the only person available to apply a tourniquet or someone else was instead. All users noted that regret loomed large over judgment, as found in prior works.[3,24–26]

In item 5, the fellow and the clinician-scientist answered correctly that the flow in a half-closed artery was normal.[27] To the contrary, the cadets answered incorrectly that it was half the normal flow. This item addressed a fluid mechanics phenomenon, the Venturi effect, which is relevant to the assessment of bleeding in first aid. The question was framed to allow the respondent to adjust their prediction by using two relevant values as maximum and minimum bounds, normal and no flow, respectively. All users assumed that the use of the word "flow" meant volumetric flow rate and not simply the velocity of that flow.

Item 6 questioned which factor is most associated with a need for side-by-side use of tourniquets, and the responses by three users were all different but incorrect. The clinician-scientist answered correctly, mentioning the limb girth. At the site of tourniquet use, greater limb girth increases the need for a second tourniquet used side by side with the first.[11] The frequency of girth causing such increase is greater than any other factor. The greater girth commonly occurs in adult patients, especially with tourniquet use on the proximal thigh,[11] the limb region of greatest girth.[28,29]

Item 7 dealt with the blood-loss volume, which was associated with the severest degree (class IV) of hemorrhagic shock.[30] Three users answered "true" that such volume had caused that degree for an individual patient, and the clinician-scientist answered "false," because causation was indeterminable in such a way. The three users conflated association with causation,[31] and the coherent story of the item was written to allow readers to jump to the conclusion of the storyline being about causality as opposed to sampling.[3,4] The clinician-scientist knew that the association between blood loss and shock severity was well established on average, but interpatient variability in that association has long been shown to be large, thereby making causation impossible to determine from a single occurrence.[29] The clinician-scientist was aware (1) that the shock information[30,32] was based on a 70kg man (the item allowed users to discount unspecified possibilities, because neither mass nor sex was noted),[6] (2) the relevant ranges of body weight were known,[28,29] (3) that compelling stories are likely to have us think of potential causes to potential effects,[3,26] and (4) that it takes effort to abstain from the favorite sport of humans: jumping to conclusions.[3] As a counterexample, a gunshot wound through abdominal blood vessels and the spinal cord result in shock associated with both lesions, but the cause of one (blood loss) differs from the other (neurogenic dysfunction). Sports announcers can retrospectively pick the turning point of a ballgame with ease (as if an audience demands that the story has to have something that must be the cause of the outcome), but it is hard to predict such.

In item 8, users predicted when their performance would begin to be reliable with a specific definition of reliability. The first cadet answered test 1 incorrectly, although she had previously aced all 80 tests in a prior study. But she was not reliable in the present study and peaked with 73% at test 14. The second cadet answered test 13 incorrectly despite having satisfactorily completed 76 of 80 tests in the prior study. But he was not reliable in the present study, peaking at 75% at test 15. The fellow answered test 12 incorrectly and test 13 correctly. The clinician-scientist answered test 1 correctly (all good results). The clinician-scientist created item 8 to check for a pattern that was revealed as follows: users with more skills and experience were noted to be more accurate in assessing their own skills and experience.[33]

Item 9 was like item 8 except the user judged when he or she would remain reliable. The first and second cadet answered test 1 and 13, respectively. Both were incorrect and never became reliable. The fellow answered test 13 correctly. The clinician-scientist answered test 1 correctly. The sought pattern was again seen: Users with more skills and experience in assessing their own skills and experience were more accurate in assessing their own skills and experience. Although the finding sounds circular, it is not.[33] It is spiral.

Item 10 defined minimal important difference for blood loss, and three users judged 100mL, and the clinician-scientist answered 177mL, a value noted by educators.[34] Users answers were within the mid-range of others we have polled over the years.

Tourniquet Use Testing

Overall results among 60 tests were as follows: 38 were satisfactory ("go" status); 12 were not applicable because there was no bleeding, so users judged not to intervene; and 10 were unsatisfactory ("no go"). Unsatisfactory results were due to one test with a loose tourniquet and nine tests with 10 incorrect tourniquet placements (i.e., not at the right location). Results are shown in Table 2.

Each case resulted in a different pattern. Case 1 was uniformly (100%) passed; users identified an absence of bleeding in each of its 12 tests; the manikin was not turned on, and no lights on meant no bleeding. Case 1 was to be procedurally easy, but we also wanted to see if users could reliably decide not to intervene. Case 2 had 83% (10 of 12) satisfactory results. The two unsatisfactory tests resulted from an incorrect tourniquet placement and a loose tourniquet, but neither ended in a bleeding status. Case 2 was to be mechanically easy, but we also wanted to see if the uncertainty from randomization

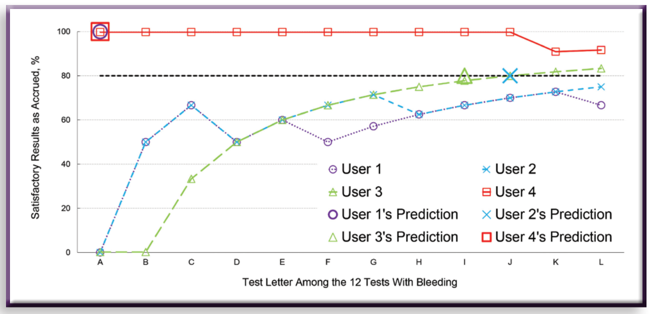
TABLE 2 *Results for All 48 Tests Requiring Mechanical Intervention*

Parameter	Mean	Minimum	Maximum	Median	Range
Time to determination of bleeding control, seconds	44	16	217	32	201
Total trial time, seconds	67	24	248	54	224
Blood loss volume, mL	268	99	1069	225	970
Pressure, mmHg	411	256	572	391	316
Ease of use (1, very difficult; 2, difficult; 3, neutral; 4, easy; 5, very easy)	4.6	3	5	5	2

of case order might affect performance. Case 3 had uniformly satisfactory results, although a cadet and the fellow paused a couple of seconds in their first test at the moment the word "child" was heard. Case 3 was to be mechanically easy but psychologically surprising, and the two users slowed their movements briefly as they mentally figured out that there was nothing extra to do. Case 4 had 75% (nine of 12) satisfactory results; the three unsatisfactory tests resulted from an incorrect tourniquet placement, but none ended in a bleeding status. Case 4 was to be moderately difficult because it simulated care under gunfire, but such was a common way users had learned and practiced previously. Case 5 had 58% (seven of 12) satisfactory results; five unsatisfactory tests were from an incorrect second tourniquet placement (one of which also had a first tourniquet incorrectly placed), and three of these five tests ended in a bleeding status. Case 5 was designed to be most challenging due to its extra steps and decisions.

User performance varied. Users 1, 2, 3, and 4 had unsatisfactory test counts of four, three, two, and one, respectively. Plots showed two patterns of learning (Figure 1). By block, satisfactory results were 50% (six of 12) for block 1 and 83% (10 of 12) for blocks 2 and 3. As a group, users learned quickly from the first to second block but then plateaued.

FIGURE 1 *Performance and prediction results by user.*

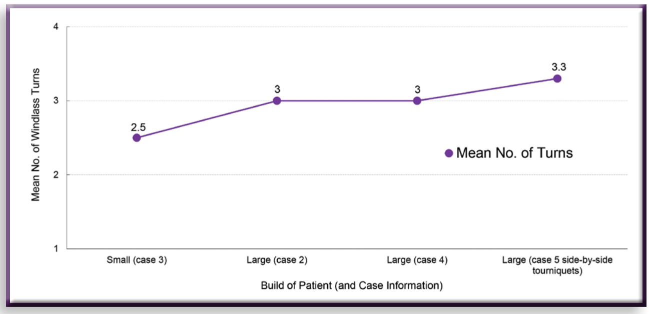


The graph depicts performance results from the manikin for the four users. There are 12 tests per user because the three tests without bleeding dropped out of this analysis; we lettered the 12 to differentiate these results from those of all 15 tests per user. These results were accrued test by test so that the y-axis is a percentage (number of satisfactory tests divided by number of accrued tests). The reliability threshold is drawn at 80% (black dashed line), and two users (users 3 and 4, green line and triangle and red line and square, respectively) attained it. By user, their self-predicted point of becoming reliable is overlaid by an oversized marker. The three users (users 1 through 3) with less experience started with an unsatisfactory result. The two users (users 1 and 2, violet line and circle and blue line and cross, respectively) with least experience had similar results throughout as most (75%; nine of 12) of their data points were identical, and these two were the only users who did not attain reliability. These plots are a type of learning curve, and the expert, user 4 (red line and square), shows a nearly flat performance, an effect commonly seen after prelearning. The other three users showed a typical pattern. The metric here starts (at the left) as a binary measure (either 0% or 100%), because the first try is either satisfactory or unsatisfactory. Such small numbers in the numerator and denominator greatly affect the percentage. At the end, the percentages tend to change little, and in the middle, changes from test to test are moderate. The area under these curves distorts the amount of success for each user, but the curves show trajectories of reliability by user.

When ease of use was parsed by results among 48 tests with bleeding, satisfactory results averaged 4.74 (very easy was 5) and unsatisfactory results averaged 4.05 (easy was 4).

When turn number of windlass use was parsed by cases among 48 tests with bleeding, case 2 averaged 3, whereas cases 3, 4, and 5 averaged 2.5, 3, and 3.3, respectively. Turn number appeared to be associated with patient build, because turn number was increased with greater limb girth (Figure 2). The lowest average was for the patient with a small build, and the highest average was for the patient with a large build and the need for use of a second tourniquet side by side with the first.

FIGURE 2 *Results of windlass turn number by build of patient.*



The chart shows the mean number of windlass turns by build of patient with case information. On average, turn number appeared to be associated with limb girth.

Discussion

Our key finding in this study was that the judgment results have plausible applicability to first aid. This finding served our purpose because we apply tourniquet science to medical readiness. Our preliminary look at how users of limb tourniquets made judgments was in line with our expectations. The results of the answers and the performances were analogously similar to those seen in previous studies of judgment science. Such plausibility may indicate that development of feasible techniques and methods may eventually lead to developing valid tools for first-aid caregivers in the operational health community. Several topics may be worthy of research hypotheses (Table 3). We usually have studied simulated caregiving, but in this study, we specifically changed our view to simulate the simulation of caregiving. By simulating the training of caregivers with different clinical cases, we took a direct look at how tourniquet users actually perform when the situation has a moderate degree of uncertainty. In the past, we had repeatedly tested only one case to look at topics other than judgment. There is not much uncertainty in test numbers 2–140 if the user remembered the case information test to test. The within-block randomization led to a moderate degree of uncertainty for the first block; and the second block had less uncertainty than the first, because all five cases were repeated; and the third block had the least uncertainty, because the user became more familiar with the cases as experience was accrued. We do not recommend testing user judgment in this way for novice users, because the skills required are multiple and complex, but we found that the advanced beginners here (two cadets) and the competent user (the fellow) realized the testing to be worthwhile and hard. The expert found the testing to be a good drill. It also changed how he thought about matching types of testing to the skill levels of users. Furthermore, the change by block in performance for the group of users may indicate a learning curve, because performance improved quickly then flattened.

The first minor finding was a surprise knuckleball, because we had designed a new challenge of judging when and how to use two tourniquets side by side, but we chose a setting of care under gunfire. However, after we started collecting data, such

TABLE 3 *Developed Topics for Hypothesis Testing*

Does an emergency room nurse assess a 500mL blood loss differently if the nurse witnessed it or the nurse received a verbal report of it?
Would the assessment in the story differ if the loss was witnessed before the patient arrived and the latter was the one verbally reported? To what degree do people feel blood-loss volumes are substitutable or additively interchangeable?
Is 500mL of blood loss seen on a computed tomography image mentally accounted the same as 500mL seen on the floor?
Do users show a learning curve when taught in blocks, as in the present study?
How strongly are subjects' memories of pain during tourniquet application associated with real-time measurements of peak pain, duration of pain, or end-of-procedure pain?
A degree to which users think of training to give care as caregiving itself would be interesting to delimit. Do they conflate meanings or just choose words poorly?
Reliable performance in testing with random cases may aid in determining when a user is to be graduated from advanced beginner to a competent user.
How often do users try to turn the windlass more before adding a second tourniquet?
Does knowledge of the result, like pass or fail, affect the users' ease-of-use perception?
Does the experience of a person seeing, hearing, or smelling the blood loss itself affect its perceived severity? If so, how?
To what extent does the stress of time pressure impair judgment?
Do medics use perceived resemblance to predict answers to case studies?
Decision-making studies may aid in developing caregiver readiness to use tourniquets.
Block-randomized cases may aid in promoting a user from one skill level to the next.

use seemed too risky to be doing all those steps in tourniquet use while being shot at. We felt that checking pulses and placing the second tourniquet were unsafe. Before we started the study, our preparatory checks of this case all went well and appeared to offer a suitable challenge to the judgment of the user. This challenge proved to be as hard as we hoped, because the result of failures (42%) was highest but not ridiculous. Previously, we had not tried any case during care under fire that was as complex as this one, and we did not see any problem during our checks.

Furthermore, the first test of this case had a performance so messed up that it was distracting. We were into its second test before we realized that the manikin settings we had entered required performance that risked the lives of both the patient and caregiver. The clinician-scientist explained (1) his misjudgment of these settings to each user and (2) that the user would get an unsatisfactory result from the manikin if the second tourniquet was not used before the test ended. However, we collected the data as planned. From this misjudgment, we learned a lot about assessing and performing from a try and a mistake, like hitters can learn a lot about pitching and hitting from a swing and a miss. We also later consulted with various stewards of training and of doctrine, and we confirmed that the performance indicated by the manikin settings was risky. Also, we confirmed that such risky actions were neither trained nor advised. However, the stewards agreed that tourniquet guidelines, like instructions for use, algorithms, handbooks, manuals, and lesson plans, were sufficiently unclear to need revision for clarity. This surprise seemed to come out of left field, but it was in front of us all the while. In hindsight, we should have had users get themselves and their casualty to safety before assessing the function of the first tourniquet.

In tourniquet use, we have observed that people make similar types of judgments frequently and consistently enough for us to occasionally recognize their patterns as they happen. If we allow ourselves to expect such patterns, we can more readily look for and see them, especially when they are not in line with the needs of the moment. One way of aiding a snap judgment when things are uncertain is called a heuristic, a simplifying aid (roughly, a rule of thumb) used in the process of making a judgment.[3] A heuristic is easy and usually effective, but it can lead to systematic and predictable errors. We reported an error in this study's introduction where, for scouts, predicting by resemblance was easy but inefficient. For tourniquet users, an example of a heuristic has already been reported; Aberle and coauthors[10] described a heuristic in their analysis of a 2012 online survey of law enforcement officers who responded about their tourniquet experience. These authors described that prior experience or knowledge affected how the officers perceived tourniquet use. For that effect, these authors described the mechanism as an affect heuristic, a type of heuristic where affect (an emotion or a feeling) is used as a cue. The officers who viewed tourniquets positively tended to perceive that tourniquet use risked less potential harm than officers who viewed tourniquets differently.[10] Thus it is conceivable that a better understanding of such a heuristic as well as the biases to which it leads could improve judgments and decisions.[3] The behavioral insights can potentially aid in improving the quality of caregiving. Our current readiness should guide decision-making about improvements like ensuring that people, whether in the military or in the civilian community, are ready in emergencies to use tourniquets and save lives.

The limitations of this study are rooted in its design as a preliminary experiment aimed to generate, not confirm, hypotheses. The few data studied, the newness of the techniques, and the narrow scope of the things studied all were purposefully restricted in to their depth and breadth. That the clinician-scientist collected the data was a limitation in that he designed the study and so would be expected to perform well, but such would also aid in validating items if they were neither too easy nor too hard.

Future directions for scholarly work include feasibility studies and validation of items such as questions or methods. Surveying more persons may gather enough data for statistical analyses. Studying how people may mentally determine[35,36] the volumes of blood loss may help inform the development of the skill in assessing hemorrhage. In this context, the studies on the effects of stress on judgment in first aid may be informative to best-practice development in caregiving and in education. Other common tasks may be integrated into tourniquet research, such as transporting a casualty to safety before applying the second tourniquet, as in case 5.

Conclusion

In simulated tourniquet use, the results of user judgment have plausible applicability, because they were in the ballpark with those seen in previous studies of judgment science. These investigations contribute to developing readiness of the fighting force, with applicability to public health.

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Author Contributions
JFK, JKA, and MAD conceived and designed the study; JFK resourced, managed, and oversaw the study, and led production; JFK, ART, and NJN collected data; JFK and JKA analyzed data; and all participated in writing the manuscript. All authors approved the final version of the manuscript.

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Appendix: Pretest Data Collection Sheet

User_______ (number as coded)

Date (DD/MM/YY, e.g., 29/07/17)   ____ /____ /____

Before the first test:

1. Assess your confidence (5-point scale) now in successful tourniquet use in care: 1   2   3   4   5
2. Two pools of spilled blood sum to 110 milliliters (mL) in total volume. The first pool is 100 mL more than the second. How many milliliters is the second? ________ mL
3. After tourniquet use had controlled bleeding, what is the most likely reason bleeding may resume later?

   ____

4. If someone in need of tourniquet use has bled to death, would you regret it more if you were the only potential user available or instead someone else was the only potential user available?

   Myself   Someone else

5. A fully open artery has normal flow. When fully closed, there is no flow. When half-closed, how much does it flow?

   None   Half   Normal

6. What is the major factor that increases the likelihood of need for the use of a second tourniquet side-by-side of the first? ________
7. Shock from bleeding in its most severe degree, Class IV, has four traits: heart rate of >140 beats per minute, decreased systolic blood pressure, negligible urine output, and blood loss of either a) greater than 2 liters (>2,000 milliliters) or b) >40% total blood volume. For this individual patient, blood loss of that amount has caused those effects.

   True   False

8. Reliability is when good ('Go') results occur among ≥80% of tests as experience is gained. Experience accrues by test number: test 1 through test 15. When do you think you will first become reliable (circle a test number from 1 to 15)?

   Test # 1   2   3   4   5   6   7   8   9   10   11   12   13   14   15

9. At which test number do you think you will both become reliable and remain so thereafter?

   Test # 1   2   3   4   5   6   7   8   9   10   11   12   13   14   15

10. Minimal important difference (MID) is the smallest change in a treatment outcome that a patient would identify as important and which would mandate a change in the patient's management. What is MID for blood loss volume in milliliters (mL)? ________ mL