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ABSTRACT

The U.S. Navy currently employs two types of trauma care training for Navy corpsmen: highly realistic training and live tissue training. Highly realistic training is a scenario-based training method uniquely crafted to replicate real-life combat settings. Live tissue training involves the use of live specimens (typically pigs or goats) to practice specific medical procedures. The objective of this study was to obtain subjective information regarding the perceived effectiveness and the strengths and weaknesses of highly realistic training and live tissue training. The sample consisted of 25 Navy service members assigned to the Independent Duty Corpsman (IDC) School, Surface Warfare Medical Institute, in San Diego, California. Participants completed brief surveys and semi-structured interviews. Results showed that participants perceived both types of training as equally effective on most dimensions. However, unique strengths and weaknesses were reported for each training type. While live tissue training may be better for practicing specific medical skills, highly realistic training may be better for preparing corpsmen for stressful operational settings. The Department of Defense has been tasked with phasing out the use of live tissue in military medical training; thus, additional research is needed to improve highly realistic training and extend its use to other military medical populations.

INTRODUCTION

Over the past decade, military trauma care training for medical professionals, infantry personnel, and special warfare operators has gravitated toward the use of realistic and immersive training methods, referred to as "highly realistic training." Highly realistic training is typically scenario-based, with the training environment uniquely crafted by subject matter experts to mimic the sights, sounds, and situations encountered during combat. The training includes pyrotechnics, battlefield special effects, combat wound effects, and professional actors. In addition, most actors wear a device called a "cut suit," which consists of a false torso worn over the actor's real torso. The cut suit technology permits attending corpsmen to practice a variety of trauma care skills such as hemorrhagic control and needle thoracentesis, adding greater realism to the training.

In highly realistic training, participants demonstrate their mastery of training and learning objectives during fast-paced scenarios that include multiple decision points and are executed under conditions designed to generate stress, confusion, and concern for safety. Participants can be trained repeatedly over the course of multiple scenarios until they demonstrate required proficiencies in both the provision of medical care and infantry tactics. Furthermore, instructors can evaluate participants based on their individual-level or team-based performance. This type of training has the potential to improve participants' medical skills, their performance in operational environments, and their ability to provide medical care under pressure.

Based on the success of the Infantry Immersion Trainer with Marine infantry personnel,[1–3] highly realistic training has been used to train Navy corpsmen as part of a Naval Health Research Center (NHRC) project.[4] Preliminary results for this project and anecdotal evidence suggest that this type of training is an effective way to prepare corpsmen to provide trauma care. Highly realistic training is also consistent with the overall trend in both civilian and military sectors (including medical schools) to rely more heavily on simulation as a method for delivering medical training rather than on other means such as the use of live tissue.[5–7]

Live tissue training is another type of trauma care training used by the military. In live tissue training, specimens (typically pigs or goats) are anesthetized, monitored, and finally euthanized by a qualified technician. Using a living specimen offers training participants an opportunity to practice specific hands-on emergency skills, such as hemorrhage control and airway intubation, and provides immediate feedback about the quality of their care through their specimens' vital signs and other physical reactions.

Anecdotal evidence along with several news reports have suggested that live tissue training is positively regarded by many corpsmen, corpsmen instructors, and other medical providers. In fact, some service members and providers familiar with the training have stated that the use of live tissue is one of the best methods for training corpsmen.[8] Additionally, numerous individuals who have received or taught live tissue training have supported its ability to effectively train corpsmen in lifesaving medical procedures.[8,9]

Despite the positive reviews by users of live tissue training methods, in recent years, this method has become highly controversial due to the ethical questions and concerns it raises about the proper use and care of animals.[10–12] For three decades, activists have tried to end the practice of

using live animals for medical training. Although live tissue training continues to be widely used in the training of military medical providers, the Department of Defense (DoD) has been tasked with phasing out the use of live tissue medical training.[13]

One recent study compared live tissue training with simulation training that used a sophisticated medical mannequin called TraumaMan.[14] In this study, no statistically significant differences were found in overall student confidence or performance outcomes (e.g., chest tube placement) when the two types of training were compared. It was concluded that "modern simulation is reaching parity with live animal training models."[14] Similarly, Hall and colleagues found that both live tissue training and simulation training using TraumaMan equally improved self-efficacy among airmen who were training to become medics.[15] However, the authors noted that participants expressed a preference for live tissue training versus simulation training. Finally, a study conducted in the Israeli Defense Forces assessed perceived confidence of military medical providers (physicians and paramedics) in relation to different types of training they had received in the past.[16] The study found that mannequin simulation training and clinical training had a significant positive impact on confidence levels for the three medical procedures that were assessed, whereas live tissue training did not result in increased confidence.

Although this is an important and timely issue, we are not aware of any published research that has compared highly realistic training and live tissue training for Navy corpsmen. The objective of this study was to obtain subjective information on the perceived effectiveness and on the strengths and weaknesses of highly realistic training and live tissue training for corpsmen.

METHODS

Subjects

The sample consisted of 25 active duty Navy service members (23 corpsmen, 1 medical doctor, and 1 physician's assistant) assigned to the Independent Duty Corpsman (IDC) School, Surface Warfare Medical Institute, in San Diego, California. Most participants (19/25, 76%) were current instructors of Navy corpsmen or were staff at the IDC School. The other participants were all Navy corpsmen students at the IDC School (6/25, 24%). All study participants had participated in both types of training as students and/or training instructors for other military personnel, including corpsmen, infantry, and Special Warfare Operators.

Most of the participants were male (80%), 23 of the participants were enlisted service members, and 2 were officers (both O-3, Lieutenant). Enlisted paygrades ranged from E-3 to E-8, but most of the participants (76%) were between E-5 and E-7. Tenure in the Navy ranged from 6 years to 25 years (mean = 15.2 years). Number of completed deployments ranged from 0 to 10 (mean = 4.3 deployments). In terms of race/ethnicity, the sample was predominantly either white/Caucasian (48%) or Hispanic (20%). There were smaller proportions of black (12%), Asian (8%), and mixed or multiple race (12%) participants. For education, all participants had completed some college (68%), a bachelor's degree (24%), or a postgraduate degree (8%).

Procedures

Data collection instruments for this study consisted of an interview and a survey. The interview and survey were developed specifically for this study, in consultation with corpsmen instructors at the IDC School. Each participant was interviewed by two civilian researchers in a private office; one researcher conducted the interview and the other researcher recorded the participant's responses. The interviews were not audiotaped or videotaped. Following the interview, each participant completed a brief survey. The entire data collection session took about 60 minutes.

Participation in the study was voluntary. Data collection was anonymous, except that participants wrote their names on an informed consent form. Names were not collected on the data collection instruments; subject identification numbers were used to link interviews and surveys. All research procedures were approved by the NHRC institutional review board.

Measures

Interview

The semi-structured interviews began with questions about the participants' demographic characteristics and military career. Participants then described their experiences with highly realistic and live tissue training as students and/or as training instructors. They also discussed their perceptions of the advantages and disadvantages of both training types. Questions included "What do you view as some of the main strengths or advantages of live tissue training?," "What do you view as some of the main drawbacks of live tissue training?," and "Are there any specific skills or qualities that you think highly realistic training especially helps corpsmen to develop?" Parallel questions were asked about the two training types. Participants answered a variety of questions, including open-ended and multiple-choice questions. They also used a 10-point scale, ranging from 1 (*not at all effective*) to 10 (*extremely effective*), to rate a number of training-related topics.

Survey

The survey assessed participants' perceptions of highly realistic and live tissue training. Sample questions included: "Overall, how beneficial is highly realistic training (or live tissue training)?" and "Which type of training (highly realistic or live tissue training) has a more positive impact on a corpsman's trauma care skills?" and "How challenging is highly realistic training (or live tissue training)?" Parallel questions were asked about the two types of training.

Four scales, constructed for this study, assessed participants' perceptions of the degree to which each type of training prepares corpsmen to perform basic and advanced corpsmen skills. For both highly realistic and live tissue training, participants rated the degree to which the training prepares corpsmen to perform a set of basic (8 items) and advanced (7 items) corpsmen skills.

Items on the skills scales were prefaced with the phrase: "Please rate how well highly realistic (or live tissue) training prepares corpsmen to do the following." This was followed by a list of

specific skills such as “perform airway management” and “perform or manage hemorrhage control” (for the Basic Corpsmen Skills Scale) and “function well as the only medical provider in a unit” and “stay focused on patient care in chaotic operational setting” (for the Advanced Corpsmen Skills Scale). Item responses ranged from 1 (*not at all*) to 5 (*extremely*). For highly realistic training, internal consistencies (Cronbach’s alpha) were 0.91 for Basic Corpsmen Skills and 0.85 for Advanced Corpsmen Skills. For live tissue training, Cronbach’s alphas were 0.87 for Basic Corpsmen Skills and 0.95 for Advanced Corpsmen Skills. The survey also assessed demographic characteristics and military career information.

Content Analysis of Interview Data

Analysis of the qualitative data from the semi-structured interviews focused on identifying positive and negative comments about the two types of training. The goal of the content analysis was to identify interview responses that related to the following four topics: (1) strengths or advantages of highly realistic training, (2) weaknesses or disadvantages of highly realistic training, (3) strengths or advantages of live tissue training, and (4) weaknesses or disadvantages of live tissue training. Although all relevant interview responses were used in the content analysis, the majority of the relevant data occurred in response to the following interview questions: (1) What do you view as some of the main strengths or advantages of highly realistic training (live tissue training)? (2) What do you view as some of the main drawbacks or weaknesses of highly realistic training (live tissue training)? (3) Are there any special skills or qualities that you think highly realistic training (live tissue training) especially helps corpsmen to develop? (4) Are there any other key differences between live tissue training and highly realistic training that you would like to mention?

To conduct the content analysis, two reviewers independently developed a preliminary list of themes for each of these four topics, after reading through all of the interview responses. Uncertainties regarding the list of themes were resolved through consultation with a third reviewer. Once the list of themes was established, two other reviewers independently tallied the participants’ comments into content categories; discrepancies were resolved by a third reviewer.

RESULTS

Quantitative Analysis

During the interview, participants were asked to rate (1) the overall effectiveness of both types of training, (2) the degree to which each type of training “boosts a corpsman’s confidence to provide trauma care,” and (3) the degree to which each type of training “strengthens the development of corpsmen skills overall.” These results are shown in Table 1. Paired *t* tests were used to compare the mean responses for the two types of training. None of the *t* tests were significant (all *p*’s > 0.10), which suggests that participants viewed the two types of training as equally effective.

Another set of survey questions directly assessed participants’ perceptions of the benefits of highly realistic and live tissue training. Participants were asked (1) Overall, how beneficial is

highly realistic training (or live tissue training) for the participants? (2) Overall, to what degree does highly realistic or (live tissue training) have a positive impact on a corpsman's readiness for deployment?, and (3) How challenging is highly realistic training (or live tissue training) for the participants? Mean responses to this set of questions are shown in Table 2. Again, results of paired *t* tests revealed no significant differences in ratings for highly realistic versus live tissue training (all p's > 0.10).

Participants were asked to indicate which type of training has a more positive impact on a corpsman's: (1) confidence to provide trauma care in a field setting, (2) readiness for deployment, and (3) trauma care skills. As shown in Table 3, participants viewed highly realistic training as having a more positive impact than live tissue training for all three of these dimensions, but none of the differences were statistically significant ($p > 0.10$). On the question that asked "Which type of training has a more positive impact on a corpsman's trauma care skills?" the most common response (52%) was "about the same."

Participants rated both types of training on the Basic Corpsmen Skills Scale and the Advanced Corpsmen Skills Scale (see Table 4). Paired *t* tests comparing the mean scale responses revealed no difference on the Basic Corpsmen Skills Scale. On the Advanced Corpsmen Skills Scale, highly realistic training was rated significantly higher than live tissue training ($p < 0.01$).

Content Analysis

The content analysis focused on determining the perceived strengths and weaknesses of highly realistic training and live tissue training for corpsmen. These results are presented in Tables 5 and 6.

For highly realistic training, the most frequently mentioned strengths and weaknesses are shown in Table 5. The most frequently mentioned strength was that highly realistic training "prepares students for high stress, operational settings"—this was mentioned by 84% of the participants. One participant made this comment: "This training provides students a taste of complete chaos in a scene." Another commonly mentioned strength of highly realistic training was "the use of actors; the ability to practice procedures on live actors" (76%). Other frequently mentioned strengths of this type of training included "the realistic, combat-like environment (chaos, special effects, etc.)" (52%), and the fact that the training "boosts students' confidence for trauma care" (48%).

The most frequently mentioned weaknesses of highly realistic training were "deficiencies of the cut suits" (32%), "insufficient medical supplies" (24%), and "poor acting or actors do not always act like real patients" (20%). The specific deficiencies of the cut suits that were mentioned included comments that the cut suits were too big and bulky, that they lacked sufficient sturdiness, or that they were not anatomically correct.

The perceived strengths and weaknesses of live tissue training are shown in Table 6. By far, the most commonly mentioned strength of live tissue training was "the ability to work on a live animal/patient"—this idea was expressed by the majority (88%) of participants. One participant made the following comment: "Live tissue training gives you a feel for what working on a

human is like." Another participant said, "Live tissue training is as close to working on a human as possible." Other frequently mentioned strengths of live tissue training were that it is "helpful for learning specific medical procedures" (52%), it "allows students to see the impact of their interventions" (40%), and it "boosts students' confidence for trauma care" (32%).

The most frequently mentioned weaknesses of live tissue training were that "the student to specimen ratio is too high, so hands-on practice is limited" (36%), and "the setting of the training is too controlled, clean, or clinical" (36%). Other weaknesses of this type of training were "ethical concerns (animals are sacrificed for the training)" (28%), "a pig's anatomy is not the same as a human's anatomy" (28%), and "the logistics may be difficult (planning, scheduling, resources)" (28%).

DISCUSSION

To our knowledge, this is the first study to examine the perceived strengths and weaknesses of highly realistic training and live tissue training. In a sample of corpsmen and IDC School staff who had experience with both types of training, we found that highly realistic training and live tissue training were perceived as about equally effective. However, we also found that each type of training was viewed as having fairly distinct strengths and weaknesses.

Analysis of the quantitative data revealed that highly realistic training and live tissue training were rated similarly on a number of dimensions, including overall effectiveness and the degree to which it strengthens corpsmen skills overall. For the majority of survey and interview items, ratings of the two types of training were not significantly different. The only significant difference between the two types of training was on the scale that assessed Advanced Corpsmen Skills. Highly realistic training was rated as more beneficial than live tissue training for the development of advanced corpsman skills.

The qualitative data revealed some interesting results regarding the perceived strengths and weaknesses of the two types of training. For highly realistic training, the most commonly mentioned strengths were that it prepares corpsmen for high-stress, operational settings, and also the use of live actors. The weaknesses of highly realistic training that were mentioned most often concerned deficiencies of the cut suits and insufficient medical supplies. For live tissue training, the two strengths that were mentioned most often were the ability to practice and learn on a live patient and the usefulness of the training for learning hands-on medical procedures. The most commonly mentioned weakness of live tissue training was that the student to specimen ratio is too high, which limits chances for hands-on practice. The comments about the number of students-per-specimen ratio were due to the fact that live tissue training in the Navy typically involves between 4 and 8 students per specimen. Consequently, each student receives only a limited amount of hands-on practice during the training. Another commonly mentioned weakness of live tissue training was the fact that the setting is too controlled and clinical.

Results of the present study are consistent with other research that compared simulation training using mannequins with live tissue training.[14,15] These studies have generally found that simulation training and live tissue training were about equally effective for improving medical

skills and for increasing confidence and self-efficacy among military medical providers.

Although live tissue training has been an important component of corpsmen training for many decades, the U.S. military has been advised by Congress to phase out the use of this training.[13] Also, simulation methods for delivering medical training have become more sophisticated in recent years and much more widely used. In light of the military's goal of finding effective alternatives to live tissue training, it is reassuring that the present study found few differences in the perceived effectiveness of live tissue training and highly realistic training.

The Navy has only recently begun to implement highly realistic training for corpsmen. This type of training has potential for use with other military medical populations, such as physicians, nurses, and Navy Fleet Surgical Teams. This training could be adapted and used to help newly formed military medical teams (e.g., made up of physicians, nurses, and corpsmen or medics) learn to function smoothly and cohesively. Research suggests that functioning well as a medical team is a skill that must be trained and fine-tuned.[17] This is a valuable area to explore because even small improvements in team functioning could lead to reductions in medical errors.

The strengths of the study include the use of both quantitative and qualitative data, and the use of participants who were familiar with both highly realistic and live tissue training for corpsmen. Limitations of the study include the small sample size with its attendant lack of power, and the lack of objective measures assessing the effectiveness of the two types of training.

In summary, this study showed that participants who had experience with both highly realistic and live tissue training generally viewed the two types of training as equally effective. However, the two types of training were perceived as having distinct strengths and weaknesses. While live tissue training may be better for practicing specific hands-on medical skills, highly realistic training may be better for preparing corpsmen to function well in stressful operational settings.

Future research should seek to improve highly realistic training to ensure that no essential skills or experiences are lost in the transition away from live tissue training. Furthermore, since a small portion of military medical personnel currently receive highly realistic training, future efforts should adapt and deliver this training to additional military populations (such as other corpsmen, physicians, and nurses) and also to military medical teams. It is recommended that future research assess the impact of highly realistic training on medical performance and on important psychosocial outcomes, such as resilience. The impact of highly realistic training should also be examined using prospective study designs so that the intermediate and long-term impact of the training can be determined.

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Table 1. Interview Ratings of the Effectiveness of Highly Realistic and Live Tissue Training

	Highly Realistic Training *M* (*SD*)	Live Tissue Training *M* (*SD*)	Paired *t* Test	*P*
Overall effectiveness of training	8.44 (1.19)	8.60 (1.19)	0.58	0.57
Degree to which training boosts a corpsman's confidence to provide trauma care	8.24 (1.20)	8.64 (1.22)	1.29	0.21
Degree to which training strengthens the development of corpsmen skills overall	8.16 (1.34)	8.24 (1.62)	0.19	0.85

Responses are from the interview (*N* = 25). Responses were made on a scale ranging from 1 *(not at all*) to 10 (*extremely*).

Table 2. Survey Ratings of the Effectiveness of Highly Realistic and Live Tissue Training

	Highly Realistic Training *M* (*SD*)	Live Tissue Training *M* (*SD*)	Paired *t* Test	*P*
Degree to which training is beneficial overall	8.64 (1.58)	8.96 (1.21)	0.79	0.43
Degree to which training has a positive impact on corpsmen's readiness for deployment	8.88 (1.27)	8.68 (1.34)	-0.58	0.57
Degree to which the training is challenging	8.16 (1.21)	7.84 (2.17)	-0.63	0.53

Responses are from the survey (*N* = 25). Responses were made on a scale ranging from 1 (*not at all*) to 10 (*extremely*).

Table 3. Forced Choice Comparisons of Highly Realistic and Live Tissue Training

Question	Percentage
Which type of training has a more positive impact on a corpsman's confidence to provide trauma care in a field setting?	
Highly realistic training	48%
Live tissue training	36%
About the same	16%
$p = 0.228$	
Which type of training has a more positive impact on a corpsman's readiness for deployment?	
Highly realistic training	48%
Live tissue training	20%
About the same	32%
$p = 0.125$	
Which type of training has a more positive impact on a corpsman's trauma care skills?	
Highly realistic training	28%
Live tissue training	20%
About the same	52%
$p = 0.141$	

Responses are from the survey ($N = 25$). One-sample chi-square tests were used.

Table 4. Mean Ratings on Basic and Advanced Corpsmen Skills Scales for Highly Realistic and Live Tissue Training

	Highly Realistic Training *M* (*SD*)	Live Tissue Training *M* (*SD*)	Paired *t* Test	*P*
Basic Corpsmen Skills Scale	32.60 (5.28)	33.96 (5.24)	0.84	0.41
Advanced Corpsmen Skills Scale	30.40 (4.22)	18.68 (9.44)	-5.31	<0.01

Responses are from the survey (*N* = 25). Basic corpsmen skills were measured using an 8-item scale. Advanced corpsmen skills were measured using a 7-item scale. Responses were made on a scale ranging from 1 (*not at all*) to 5 (*extremely*).

Table 5. Content Analysis Results: Perceived Strengths and Weaknesses of Highly Realistic Training for Corpsmen

	n	%
Prepares students for high stress, operational settings	21	84
The use of actors; the ability to practice procedures on live actors	19	76
The realistic, combat-like environment (e.g., chaos, special effects)	13	52
Boosts students' confidence for trauma care	12	48
Prepares students for trauma and mass casualty management	9	36
Cut suits	6	24
Deficiencies of the cuts suits	8	32
Insufficient medical supplies	6	24
Poor acting or actors do not always act like real patients	5	20
Lack of realism	4	16
Not great for practicing all hands-on medical skills	4	16

Responses are from the interview (N = 25). Percentages do not sum to 100 because multiple responses were allowed. Responses given by 3 or fewer participants are not shown.

Table 6. Content Analysis Results: Perceived Strengths and Weaknesses of Live Tissue Training for Corpsmen

	n	%
The ability to work on a live animal/patient	22	88
Helpful for learning specific medical procedures (e.g., chest tubes, suturing)	13	52
Allows students to see the impact of their interventions	10	40
Boosts students' confidence for trauma care	8	32
The student to specimen ratio is too high, so hands-on practice is limited	9	36
The setting of the training is too controlled, clean, or clinical	9	36
Ethical concerns (animals are sacrificed for the training)	7	28
A pig's anatomy is not the same as a human's anatomy	7	28
The logistics may be difficult (planning, scheduling, resources)	7	28

Responses are from the interview (N = 25). Percentages do not sum to 100 because multiple responses were allowed. Responses given by 3 or fewer participants are not shown.

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14. ABSTRACT

The U.S. Navy currently employs two types of trauma care training for Navy corpsmen: highly realistic training and live tissue training. Highly realistic training is a scenario-based training method that is uniquely crafted to replicate real-life combat settings. Live tissue training involves the use of live specimens (typically pigs or goats) to practice specific hands-on medical skills. The objective of this study was to obtain subjective information regarding the perceived effectiveness and the strengths and weaknesses of highly realistic training and live tissue training. The sample consisted of 25 Navy service members assigned to the Independent Duty Corpsman School, Surface Warfare Medical Institute in San Diego, CA. Participants completed brief surveys and semi-structured interviews. Results showed that participants perceived both types of training as equally effective on most dimensions. However, some unique strengths and weakness were reported for each type of training. While live tissue training may be better for practicing specific medical skills, highly realistic training may be better for preparing corpsmen for high stress, operational settings. Additional research is needed to improve highly realistic training and to extend its use to other military medical provider populations.

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