Using Civilian Simulation Centers for Reserve Component Medical Unit Training

John C. Morey and Vinette Langford
Dynamics Research Corporation
Andover, MA 01810
JMorey@drc.com, VLangford@drc.com

ABSTRACT

This paper reports the results of three studies of a five year project that examined the logistics, training events, and outcomes associated with using civilian medical simulation centers as training venues for Reserve Component (RC) medical units. The studies were based on the need for clinical skills, and especially team-based skills, to be sustained through periodic training. In the absence of resources to support unit-level patient simulators and the distances involved for using the Army's Medical Simulation Training Centers, RC units might meet this training need by using civilian simulation centers close to their locations. The studies showed that in terms of logistics, units could readily access a regional center and engage in one-day training events. A variety of training strategies were examined, but the model that emerged was that the focus should be on team-based care of combat casualties presenting to level II/III health care facilities. Outcomes were examined in terms of the clinical task and teamwork performances of the care provider teams, the roles of unit trainers, and factors affecting the quality of the after-action reviews (AARs). The results of the three studies are summarized, and key observations and recommendations for using civilian medical simulation centers for RC medical unit training are provided.

ABOUT THE AUTHORS

Dr. John C. Morey is the senior research psychologist at Dynamics Research Corporation. He has over 32 years of experience in training evaluation and was a researcher on teamwork training programs in aviation, ground systems, and healthcare. Prior to joining DRC, Dr. Morey was a research psychologist with the Army Research Institute at Ft. Benning, GA. He holds a Ph.D. in experimental psychology from the University of Georgia, an M.S. in general-experimental psychology from the University of North Texas, and a B. S. in psychology from Union College (NY).

Ms. Vinette Langford, RN, MSN is the Director for MedTeams® and Healthcare Programs for the Force Health Readiness Business Unit of Dynamics Research Corporation, Andover, MA. In this capacity Ms. Langford provides expert consultation and program management services for all of DRC's MedTeams® customers and other healthcare contracts related to high performance team training or medical skills training. Possessing over 30 years of experience in emergency nursing covering both clinical and management roles, Ms. Langford also maintains extensive experience in educational program planning relative to both individual offerings and multiple-day programs. She holds a M.S.N. as a Clinical Nurse Specialist in emergency nursing from the University of Texas Health Science Center at Houston, Texas and a B.S.N. in nursing from Northwestern State University, Natchitoches, LA. Ms. Langford was also certified as an Adult Nurse Practitioner in Primary Care from the Massachusetts General Hospital Institute of Health Professions.

Using Civilian Simulation Centers For Reserve Component Medical Unit Training

John C. Morey and Vinette Langford
Dynamics Research Corporation
Andover, MA 01810
JMorey@drc.com, VLangford@drc.com

For the last two decades, the Reserve Component (RC) of the U. S. armed forces has experienced a significantly expanded role in providing combat and combat service support for major military operations, first in Operation Desert Storm and more recently Operation Iraqi Freedom and Operation Enduring Freedom. In 2008 Army National Guard and Army Reserve units provided 21.9% of the combat assets in the Afghanistan theater of war (CRS, 2008). No longer regarded a strategic reserve, the Army National Guard and Army Reserve (together with RC components from the other services) are now considered an operational force. As described by LTG James Lovelace, "the confluence of the substantially decreased size of the active component combined with the increased global demands of this long war, require the reserve components to fill a much larger and more active part of the operational force pool" (Lovelace, 2007).

A significant part of this role in generating combat power is training, which has a long history of limited time and constrained resources for the RC (GAO, 1992, 2009; Morrison, Metzko, & Hawkins, 2002). Recently, improvements to the Army's cycle of training preparation for RC deployment has been instituted, under the rubric Army Force Generation (ARFORGEN), that now place increased drill time and resources in the two year period prior to availability for deployment. This plan increases individual and collective training during the preparatory years before deployment to reduce the requirement for extensive training at the time of deployment (McHugh & Casey, 2010). This approach places increased responsibility on local commanders to develop mission-relevant training to ensure their units' readiness to deploy. In the case of medical units of the Army National Guard and Army Reserves, the requirement for clinically relevant training is hampered by the lack of patient simulation assets and trainer/operator capabilities at the unit level (Morey, Langford, Jones, Carrera, & Cupfer, 2010). The Army has established 18 Medical Simulation Training Centers (MSTC) at major installations across the U.S. that are available as training resources for RC medical units. But an analysis by Morey, Langford, Jones, et. al (2010) showed that the average distance between RC medical unit battle drill locations and Army MSTCs is 278.3 miles (range: 53 to 877 miles). As a practical matter, these distances preclude most RC units from using the MSTCs as a resource for short weekend battle drill training sessions.

On the other hand, this analysis also showed that the average distance from these units to the closest suitable civilian medical simulation center is 32.3 miles (range: 1 to 181 miles). Civilian centers generally are available on weekends, have two or more high end patient simulators to enable running multiple exercises (either in succession or simultaneously), offer part-task trainers and debriefing/classroom space, and have staff experienced in providing trauma training to students, hospital staffs, and first responders.

In a series of three studies, we examined the feasibility of using civilian medical simulation centers as a training resource for RC medical units with respect to logistics, planning and executing training events, and performance outcomes of various configurations of simulator-based training. The studies were case studies using selected civilian sites and types of medical units to examine feasibility issues. Experimental manipulations enabled the examination of research hypotheses that addressed issues of order of training events, after-action review (AAR) processes, and the use of video as a supplement for the AARs conducted after each clinical scenario. The key research hypotheses were:

1. Teams would demonstrate improvement in clinical performance and teamwork behaviors across the case scenarios.

2. Teams receiving skill station training prior to executing case scenarios would show performance superior to teams receiving the skill stations after the case scenarios.

3. AARs conducted after the case scenarios would be improved with the use of cognitive aids and video recordings of the cases being debriefed.

METHOD

Participants

The studies were conducted with three RC Forward Surgical Teams (FST) at the Rhode Island Hospital Medical Simulation Center (Providence, RI) in 2006, seven Ohio Army National Guard (OHARNG) area support medical companies and six Ohio Air National Guard (OHANG) medical detachments at the Riverside Methodist Hospital Center for Medical Education + Innovation (Columbus, OH) in 2009, and two companies of an RC combat support hospital (CSH) at the Mt. Sinai Skills and Simulation Center (Cleveland, OH) in 2011. The number of trainees from the FSTs was 39, the National Guard units 74, and the combat support hospital 78. Units detailed nine non-commissioned officers (NCOs) and a flight surgeon to serve as trainer-facilitators for the OHARNG and OHANG units respectively, and five officers and enlisted members were detailed to serve as the trainer-facilitators for the CSH teams.

Materials

Table 1 shows various design features of the three studies. A common set of six case scenarios were used as training and performance evaluation exercises. Scenarios focused on team-based Level II/ III combat casualty care (i.e., resuscitative treatment provided by a FST, a battalion aid station, or a CSH emergency treatment section). The scenarios were a traumatic leg amputation, a motor vehicle accident victim with fractures and internal injuries, a rocket-propelled grenade blast injury with pneumothorax, a closed head injury, a thoracic injury with pneumothorax, a gunshot wound to neck, and a pediatric burn victim. Scenarios were designed by a combat-experienced trauma surgeon, three emergency physicians, and a trauma nurse. Modifications were made to the basic scenarios based on unit mission profiles and unit trainer inputs. All three studies used the patient simulators at the civilian simulation centers with programming, moulage, and simulator operation provided by the centers' simulation technicians. Except as noted for the FST group, medical instruments and equipment (e.g., IVs, chest tubes, laryngoscopes, EKG monitors) appropriate for the Level II/III treatment site were provided. Skill stations using part-task trainers provided individual instruction in two studies.

Augmented case AAR materials consisted of a set of preprinted easel-mounted sheets, displaying clinical trigger events, learning objectives, and key teamwork behaviors for each scenario; and a binder with scenario summary sheets, debriefing guidelines and teamwork behavior listings. Standard AAR materials consisted of the scenario summary sheets and blank easel sheets. For an end-of-day trainer-facilitator AAR, an Access database run-time program (the TOLogger) hosted on a laptop computer presented a series of data input pages on a projection screen. The pages displayed clinical task areas (e.g., vascular access), teamwork tasks (e.g., prioritize tasks), and general comments and training recommendations sections for filling in text that describes performance deficiencies, observations, and recommendations. Unit identifying information and training event descriptions were entered also. The software created print files of the recorded information.

Procedure

Common procedures followed in all three studies consisted of (a) an in-briefing to the trainees on the purpose of the training events and research components of the study, (b) an informed consent process, (c) an orientation to the simulators to include safety procedures, (d) training events consisting of a series of case scenarios and AARs (debriefings) after each case, and (e) data collection events at the various points during the training day for both trainees and trainer-facilitators from their units. To conduct the case scenarios, two teams of four to six trainees were formed each day with an appropriate mix of care providers to create comparable teams in terms of officer-enlisted status and duty positions (e.g., medic, OR tech). Teams task organized themselves with respect to leader and clinical roles. All case scenarios and AARs were video recorded. In addition, each study employed some procedural details that were specific to the participating units or experimental hypotheses. Teams were randomly assigned to experimental groups.

Forward Surgical Teams. Two trainee teams consisting of physicians, nurses, and medics were formed for each FST. After skill station refresher training on basic resuscitative tasks, each team participated in one single patient scenario and observed the other team perform in another scenario. The two teams returned about three months later to participate in a four-patient mass casualty scenario. The team not participating in the scenario took concurrent training either before or after the scenario. Skill station trainers, scenario trainer-facilitators, and case debriefers were simulation center faculty physicians. This study involved erecting a tent liner in the exercise space to simulate a field treatment facility setting in addition to the unit setting up major components of its field medical equipment for each exercise.

OHARNG/OHANG Units. On a given training day trainees were either Army medics or Air Force medical technicians. Once two teams were formed, one team participated in a half-day of skill station training while the other team participated in four, single-patient scenarios with bedside AARs (see Figure 1) after each case. For the second half of the day, teams switched training modality to complete either skill stations or case scenarios. Unit trainers facilitated the scenarios and AARs. As an experimental manipulation, on half the training days the trainer-facilitators used an aug-

Table 1. Study features.

Design Feature	Training Sites		
	Rhode Island Hospital Medical Simulation Center	Riverside Methodist Hospital Center for Medical Education + Innovation	Mt. Sinai Skills and Simulation Center
Units	3 Forward Surgical Teams	7 Army National Guard Medical Area Support Companies and 6 Air National Guard Medical Detachments	2 Companies from a Combat Support Hospital
Trainees[a]	Physicians, nurses, medics (n = 39)	Medics (n = 74)	Nurses, medics, physician assistant (n = 78)
Number of training days	6	9	8
Teams trained per day	2	2	2
Team size	4-6	4-5	4-5
Scenarios	2 single patient cases[1,2] 4 patient mass casualty[3,4,5,6]	4 single patient cases[1,4,5,6]	6 single patient cases[2-7]
Skill Stations	Patient simulator assessments, IV access, airway management	Airway management, IV insertion, basic suturing, chest tube insertion	None
Trainer-facilitators	Site faculty physicians (case scenarios, skill stations, and AARs)	Unit NCO trainers (case scenarios and AARs) Site faculty (skill stations)	Unit nurses and NCOs (case scenarios and AARs)
Video-supported AAR	Yes	No	Yes
Unit-supplied equipment	Litters, Reed Bags with supplies, O^2 concentrator, ventilator, pharmacy box, defibrillator	Combat Application Tourniquets, pressure wrap dressings	None
Patient simulators	Laerdal SimMan®	Medical Education Technologies, Inc. Human Patient Simulator	Laerdal SimMan®, SimBaby®, Medical Education Technologies, Inc. iSTAN
Data collection instruments (n)	7	9	5

[a] Medics refers to Army 68W Health Care Specialists and Air Force Independent Duty Medical Technicians
[1] Traumatic leg amputation [2] Motor vehicle accident with fractures and internal injuries [3] Rocket-propelled grenade blast with pneumothorax
[4] Closed head injury [5] Thoracic injury with pneumothorax [6] Gunshot wound to neck [7] Pediatric trauma

Figure 1. Bedside AAR.

mented set of debriefing materials and on the other half the standard materials. Trainer-facilitators were given a refresher briefing on Army doctrinal AAR techniques and were introduced to the augmented debriefing materials. Video playback of team performance was not used. Teams participated in only one day of training.

Combat Support Hospital. Researchers developed and presented a four-hour class on Army AAR doctrine and guidelines for clinical debriefings to trainer-facilitators prior to unit training events. On unit training days two teams were formed with a mix of nurses and medics (with one instance of a physician's assistant as a team member). Teams participated in six case scenarios during the training day. The scenarios featured a primary and secondary mechanism of injury to increase the complexity of the cases compared to the prior studies. Order of scenarios and video support for AARs was counterbalanced. Cases and AARs were facilitated by unit trainers. As an experimental manipulation, a video recording of the team's clinical performance was available as a debriefing tool for half the AARs and not for the other half. AARs were conducted in classrooms. Augmented briefing materials were used in all AARs. Trainer-facilitators engaged in an end-of-day AAR using the TOLogger to capture their subjective performance observations and training recommendations. Teams participated in only one day of training.

Performance Measures

A clinician rated team clinical performance in executing resuscitative tasks for all three studies using an instrument developed by Holcomb, Dunmire, Cromett et al. (2002). A research psychologist rated teamwork behaviors using a scale modified from Morey, et al. (2002). The AAR performance of the trainer-facilitators for the OHARNG/OHANG study were evaluated for the quality of the AARs using two different instruments. One set of ratings examined the adherence to doctrinal AAR guidelines and AAR organization, and the other set of ratings examined AAR behaviors and the effectiveness of the AAR using a methodology developed by Cuper, Jones, Drucker, and Morey (2009). AAR performance for the CSH AARs examined use of doctrinal AAR guidelines and AAR organization. The performance evaluations were conducted using video recordings.

All study participants completed a demographic survey. Trainees completed a training evaluation survey, and in the first two studies completed a self-efficacy scale reflecting confidence in performing selected clinical tasks. Trainer-facilitators completed a survey to rate the quality of the AAR support materials and features of the training events, and in the CSH study they evaluated also the contribution of video playback to the AAR process.

RESULTS

Experimental Hypotheses

Table 2 summarizes data that reflect the first experimental hypothesis of expected improvements in clinical performance and teamwork behaviors over the case scenarios. Mean clinical performance for the three study groups representing different professional mixes of team members were in the mid-range of the score scale. Variations in clinical proficiency were found for the OHARNG/OHANG teams across their four cases ($F\ (3,42) = 10.61$, $p < .0001$) and across the six cases for the CSH teams ($F\ (5,70) = 11.84$, $p < .0001$). Improvement over practice could not be statistically evaluated for the OHARNG/OHANG teams because the order of cases was not varied to mitigate the effect of scenario differences. However, the order of cases was varied for the CSH teams allowing an examination of clinical performance over time. The CSH teams showed a progressive increase and plateau in performance, followed by a drop and final recovery as reflected in a statistically significant curvilinear trend ($F\ (1,15) = 23.98$, $p = < .0001$). These data indicate that the deliberate mix of various mechanisms of injuries presented performance challenges and elicited different levels of proficiency. Very similar cases, or a training to mastery approach, might have yielded a definitive trend of improved proficiency.

Mean teamwork performance for the three study groups revealed variations in the mid-range of scores. The OHARNG/OHANG teams showed a statistically significant linear improvement in teamwork skills ($F\ (1,10)= 43.65$, $p < .0001$) while the CSH teams showed no significant differences in teamwork across the cases, $F < 1$. These results may be attributable to the em-

Table 2. Performance and Change Scores

Single Patient Case Measures	Study		
	FST	OHARNG/ OHANG	CSH
Number of teams	6	16	16
Number of cases	1	4	6
Clinical performance			
M	65	62	52
SD	9.0	12.0	9.7
% change over cases	na	12.7	17.7
Teamwork performance			
M	73	48	64
SD	19.0	9.3	14.3
% change over cases	na	17.6	12.6

Note: Mean scores on a 0-100 scale. na = not applicable

phasis on teamwork skills in the OHARNG/OHANG AARs and clinical skills in the CSH AARs.

The second experimental hypothesis was that skill stations presented before the case scenarios would yield better team clinical performance than with the order of cases and skill stations reversed. This hypothesis, examined in the OHARNG/OHANG study, was not supported. Mean clinical task performance across the four cases (measured on a scale of 1-100, skill stations first $M = 64.0$, skill stations second $M = 63.2$) was not significantly different for the two orders of training modality ($F < 1$). In addition to the order of training modalities not being shown to be a performance factor, trainee and trainer comments indicated advantages to each order but no clear preference for either. Therefore, training events using these two modalities can use either order without a detriment to team clinical performance if logistical constraints permit only one order.

The third experimental hypothesis was that AARs conducted with a set of cognitive aids would show outcomes superior to those without. The OHARNG/ OHANG study examined the effect of a set of augmented trainer-facilitator materials (e.g., structured easel sheets, teamwork behaviors listing) and found no clinical or teamwork performance advantages to the augmented materials (mean measures yielded F values <1). However, the augmented materials yielded a marginally significant improvement in the quality of AAR facilitation skills, $F(1,14) = 4.44$, $p = .054$.

CSH study facilitators used video review for 66.7% of the AARs supported by this capability. However, for only 4 of the 16 teams was video playback used for the entire block of 3 AARs for which it was available. Adding video playback to the AAR tool set in the CSH study did not result in statistically different team clinical or teamwork performance related to either the number of times video was used (1, 2, or 3 times in a block of 3 AARs) or performance trends over time.

AARs

The 64 AARs examined in the OHARNG/OHANG study led to the finding that in the augmented materials condition the AAR doctrinal elements of "What Happened" and "What Went Well (Sustain)" were addressed consistently only 50% of the time, and the elements "What Didn't Go Well" and "What to Do Better the Next Time (Improve)" only 12.5% and 25% of the time respectively. The standard AAR condition showed even less consistent use of AAR doctrine. In addition, the clinically relevant organizing frameworks of (a) chronological order of events, (b) airway, breathing, and circulation (the ABCs) assessment steps, and (c) the steps of rapid trauma assessment completed were absent between 62.5% and 87.5% of the time. Twelve other organizing themes (e.g., discussion of team member roles) were identified in this set of AARs. A common debriefing theme was the individual tasks performed, but without a temporal, case management, or team strategic framework to organize the discussion. No trainer-facilitator used a consistent doctrinal or clinical approach for the AARs.

An examination of the 96 AARs conducted in the CSH study revealed that 40.0% of the officer's AAR discussions, and 100% of the NCO's AARs, were consistently organized (i.e., at least five of the six AARs) with respect to the features of the preprinted easel sheet specific to each scenario. The sheets listed the learning objectives for the scenario case; key clinical tasks or indicators associated with initial assessment, secondary assessment, and patient disposition; and common teamwork behaviors (see Figure 2). Blank areas labeled Sustain and Improve allowed the recording of discussion points related to the doctrinal pillars of What Went Well and What to Do Better Next Time respectively.

The third pillar of the doctrinal AAR format, asking What Happened to lead off the AAR, was consistently used 83.3% of the time by NCO facilitators and 60% of the time for officer facilitators. The fourth pillar of the AAR format, What Didn't Go Well, was inconsistently used (i.e., four or less of the six AARs) in 60% of the officer AARs and 16.7% of the NCO AARs.

None of the five CSH trainer-facilitators reported having received any prior formal training on conducting Army AARs. The trainer-facilitators primarily depended on the organizing features of the preprinted easel sheet to conduct their AARs, with some adherence to the AAR principle of having the team describe what happened as a lead off to a detailed examination of the team's performance. Therefore, the short course

Case 1: Rocket-Propelled Grenade Shrapnel Thoracic Injury

Learning Objectives

1. Demonstrate the primary and secondary survey of an injured patient
2. Identify and manage the major injuries to include:
    a. hemopneumothorax
3. Demonstrate the use of appropriate teamwork skills

ACTIONS	SUSTAIN	IMPROVE
Initial Assessment - Assess ABC's - Vital signs		
Secondary Assessment - Reassess ABC's - 2nd IV - Fluids or blood product - Recognition of change in status - Advanced Airway/Breathing/ Circulation support		
Disposition - Stabilization in the OR - Rapid Evac		

Teamwork:

- Organize as a Team - <>
- Communicate Clearly - <>
- Maintain Situational Awareness- <>
- Manage Workload - <>

Figure 2. Example of an AAR easel sheet.

on clinical AAR techniques and the debriefing materials at the beginning of this study appears to have influenced their adherence to most of the Army doctrinal tenets for conducting AARs.

Trainee Satisfaction

The trainee mean (*SD*) overall evaluation (on a 1 to 7 scale where 7 is excellent) of the experience at the simulation center was 6.4 (.74) , 6.8 (.47) , and 6.5 (.83) for the FST, OHARNG/OHANG, and CSH groups respectively. Relevance of the training to duty positions was likewise highly rated 6.2 (.87), 6.7 (.57) , and 6.3 (.98) by the three groups of trainees. These high ratings of trainee satisfaction were in line with written comments that the simulator sessions provided clinical training and teamwork practice that are not provided at the unit level.

Observations on Operational Features of the Training

Across the three studies, we were able to make some general observations on the training events at a civilian medical simulation center. These are described in the following.

1. Using their own field medical equipment provides units familiarity with available clinical instruments and improves work flow, but imposes a burden on units in transporting the equipment to the training site. Our use of a tent liner for the FST study did not materially affect perceptions of realism. Trainees favorably rated the task content and cognitive challenges of the scenarios in all three studies. Mean (*SD*) responses to the training evaluation survey item "Realism of the clinical scenarios" were 5.9 (.75), 6.3 (.79) and 6.1 (.95) for the FST, OHARNG/OHANG, and CSH groups respectively (where 7 equals strongly agree).

2. As compared to simulation center faculty, unit trainer-facilitators are more effective as instructors because of their familiarity with unit standard operating procedures and trainee experience. However, some trainer-facilitators had never been trained in Army AAR techniques, which required a half-day class to introduce them to the Army's debriefing methods and techniques focused on the unique requirements for clinical procedures. An end-of-day AAR is beneficial in capturing the trainer-facilitators' subjective observations of performance and recommendations for further sustainment training.

3. Patient simulator scenarios focusing on team-based Level II/III combat casualty care are not readily available from Army sources. We used the same basic set of scenarios for consistency across the studies, and modified them to reflect the echelon of care and care provider skill levels. However, Army standard scenarios of sufficient complexity for Level II/III team-based training would have been an attractive alternative.

4. The simulator technician operating the patient simulator may not have the necessary medical knowledge to modify the clinical script (i.e., the progression of simulator physiological states) in response to team performance that deviates from the expected actions. A second person, a controller with sufficient medical knowledge, is necessary to observe the team's clinical performance and instruct the technician the make the appropriate changes to the script. Where the technology is available, a radio link between the medical controller and the care team trainer-facilitator wearing an ear-bud would be helpful in coordinating script changes in real time.

5. A second trainer-facilitator is helpful to assist the primary unit trainer-facilitator in managing the case scenario (e.g., assisting in finding instruments) and providing observations during the AARs.

6. None of the units reported providing specific training to prepare their trainees for the training day at the simulation center.

DISCUSSION

The three studies of this project provided the opportunity to gather information about the planning and execution of training events for medical RC units hosted by a civilian medical simulation center, and to examine experimentally some features central to clinical training using simulation. The case study and experimental aspects of these studies were interwoven and provided a number of lessons-learned that may be helpful to RC units and simulation centers seeking to partner to provide training events relevant to the units' missions.

After Action Reviews

A skillfully conducted debriefing after a clinical case scenario is fundamental to achieving a satisfactory learning outcome for trainees (Dismukes, Gaba, & Howard, 2006; Flanagan, 2008). One of our goals was to examine how Army trainer-facilitators, familiar with Army AAR techniques, would fare in conducting the clinical case AARs. To explore this issue, in the OHARNG/OHANG study for half the AARs we provided a set of enriched debriefing materials to include an easel sheet listing learning objectives, clinical case event triggers specific to the case being debriefed, and teamwork behavior topic cues. For the other half of the AARs the debriefers used only a blank easel sheet and a scenario summary as their resource materials. Since the OHARNG/OHANG non-commissioned officers had experience in conducting AARs, we offered them only a short refresher briefing on Army doctrinal AAR techniques. As it turned out, our not providing more AAR training provided the opportunity to assess the native ability of these trainer-facilitators to conduct their clinical AARs. In the end, the AARs yielded highly variable thematic approaches. Not only were the doctrinal AAR elements of "What happened", "Why", "What to sustain", and "What to improve" addressed at most 50% of the time, but also standardized resuscitation strategies such as assessing airway, breathing, and circulation (the ABCs) were used infrequently or inconsistently to organize the discussions. Facilitation skills showed a trend towards improvement when the augmented set of debriefing materials was used, but not when these cognitive aids were unavailable. The structure provided by the enriched materials appeared to be beneficial.

Based on these findings, for the third study with the CSH companies we developed a four-hour block of instruction that included a didactic portion that covered the Army AAR doctrine and incorporated some clinical debriefing guidelines developed by Rudolph (2006, 2008). The AAR instruction also included video review and critique of clinical AARs conducted by Army personnel and practice on the training scenarios and debriefing materials used later for unit training. Fortuitously, this training addressed a skill deficit for the trainer-facilitators detailed by the CSH, since none of the five non-commissioned and commissioned officers had completed any formal training in Army AAR techniques.

The performance of the CSH facilitators was closer to Army doctrinal guidelines than the OHARNG/ OHANG facilitators who were given only a refresher briefing on AAR techniques. The flow of the CSH AAR discussions was in most instances channeled by the topic areas of the easel sheet which addressed two important take-away lessons from the case under discussion—what to sustain (repeat) and what to improve in the next case. Implicit in the lessons for improvement was a discussion of what didn't go well in the current case. Leading off with asking the team what happened is a natural start point of discussions, and this feature of AAR doctrine was closely followed.

Use of Video Review

Video playback is commonly used as a tool to enable clinical teams to review critical segments of their performance. The video allows the team to see successful interventions, lapses in performance, avoidance or commission of errors, or features such as the time interval between critical performance events or decision points. However, no consensus exists about the contribution of video to successful clinical debriefing (Dismukes, Gaba, & Howard, 2006; Byrne, Sellen, Jones, et al., 2002; Savoldelli, Naik, Park, et al., 2006; Scherer, Chang, Meredith, et al., 2003). We deliberately excluded the use of video in the OHARNG/OHANG study to allow an unconfounded evaluation of the augmented AAR materials. Perhaps more importantly, debriefers avoided the negative impact of unfamiliarity with integrating video into their AARs since we were not able to train them in video playback as a debriefing aid.

When video was introduced into the AARs in the CSH study, we found no compelling evidence that the video improved the quality of the AARs. The video playback was used for all three AARs only 25% of the time it was available for a block of AARs, precluding an examination of its impact on clinical performance. While it was used in some instances to examine some feature of task performance that had already been discussed, in many instances it was simply played for the team without any teaching points raised about the team's performance.

The Simulation Center as Assessment Center

In the planning stage for these studies the participating units indicated that they wanted scenarios with a mix of presenting problems related to mechanisms of injury being reported from current combat operations. The scenarios also required a common set of individual skills and a challenging mix of presenting problems. As we have described, the mix did not result in a definitive improvement in performance, but overall acceptable levels of performance nevertheless. However, the scenario package did offer the trainer-facilitators from the units an opportunity to develop a picture of clinical skill strengths and weaknesses of the participating teams. In the final study we enabled these observations to be systematically elicited, organized, and documented with the TOLogger (for Training Observations Logger). Because the units did not express an interest in using the exercises at the simulation center for any kind of formal skill evaluation, the role of the simulation center emerged as that of an assessment center. That is, the scenarios served as a diagnostic tool for observing individual skill strengths and deficiencies in addition to providing a platform for assessing teamwork behaviors.

Use of Project Materials for Simulation Training

Units with mid- to high-level patient simulators and trained operators as a training resource can use the materials developed in these studies to conduct simulation exercises at a unit training site. Each scenario was created using a modified template based on the Society of Academic Emergency Medicine Simulation Interest Group Scenario Template (Long Form) which provided the following:

1. Title
2. Author
3. Target Audience
4. Learning Objectives
5. Competencies Assessed
6. Environment and Props (supporting equipment)
7. Actors (collaborators or adjuncts to the scenario)
8. Case Narrative (describes what the learner will experience)
    a. Scenario Background
    b. Scenario Conditions Initially
    c. Scenario Branch Points
9. Instructor Notes (what the instructor must do to create the experience)
10. Debriefing Plan
11. Simulator States
12. Transitions
13. References
14. Addendums of Scenario Set-up Checklist, Lab Values, X-rays, and a completed Field Medical Card (DA FORM 7656)

Additionally, a Scenario Script was developed for use during the simulation scenario which consolidated the information into a usable format for the trainer-facilitator starting with the case narrative, background information, and history of the patient. It gave the clinical information not available from the patient simulator and reinforced when to "check the patient" for the information the mannequin would provide.

Recommendations for Using a Civilian Simulation Center

The units in this study reported that they do not have the materiel or personnel resources necessary to deliver simulation-based training as that provided by our civilian centers. For units to effectively use a civilian medical simulation center, these planning factors are recommended:

- The medical simulation center should be used primarily for team-based training and assessment, and secondarily for those individual tasks that cannot be adequately trained at the unit level. Unit trainers need to develop training objectives which focus on both clinical skills and teamwork skills for the scenario-based exercises.
- Unit trainers need to be engaged with simulation center clinical training experts and technicians to develop scenarios relevant to the training objectives, if these scenarios are not available from Army sources.
- Individual task training (e.g., inserting airways) needs to occur at the units before the simulation center experience. Units are generally adequately resourced for individual task training with training devices, curriculum materials, and performance evaluation instruments.
- Unit personnel who serve as scenario trainer-facilitators need to be trained on debriefing skills, practice the scenarios themselves before facilitating the cases with trainees, and report their assessments of skill proficiencies to the unit training officer and commander after each day of training.
- The unit needs to assign an experienced clinician to serve as medical controller to monitor a team's clinical interventions and instruct the simulator technician to maintain or change the patient simulator physiological states (scenario script). A medical controller can support only one patient simulator or case at a time.
- Unit trainers, scenario trainer-facilitators, and medical controllers need to have a clear understanding of the learning objectives, clinical presentations, and acceptable team performance deviations of each scenario.
- Trainees need to review standards and practices for combat casualty care prior to training at the simulation center. For cross-professional teams of nurses and medics, review of team members' scope of practice and skill sets is recommended.
- Unit planning needs to be started at approximately nine months prior to anticipated training to obtain

or develop scenarios, prepare trainer-facilitators, organize and schedule the simulation center events, train individual skills in the unit prior to training events at the simulation center, and complete a contract with the simulation center.

CONCLUSIONS

Discussions with Army RC medical units participating in this research revealed that units that have patient simulators do not use them to conduct either individual or team training. Distances to MSTCs that provide training using patient simulators are prohibitively high to accomplish weekend training for most units. On the other hand, training on individual medic skills is routinely accomplished by the RC units using part-task trainers, point-of-injury training protocols, and standardized instruments to conduct required training. This project demonstrated that RC medical units with a need to train trauma teams have a resource in local civilian medical simulation centers that can provide mission-relevant training for combat casualty care provider teams.

While civilian simulation centers have the resources for training individual tasks, these centers are best suited for presenting human patient simulator scenarios for team-based care. RC units need to support training events at these centers with their own trainers who are skilled in clinical debriefing and can serve as clinical experts to manage the clinical events enabled with the patient simulators. Trainees need to be prepared for the simulator scenarios through unit-level refresher training of basic individual skills, mission-based care provider roles, and trauma resuscitation principles.

The research-focused findings of these studies reveal that unit trainer-facilitator AAR skills need to be trained or refreshed, and that AAR facilitator performance is improved by following a structure that parallels the flow of resuscitation events. We focused on using key clinical events or triggers that were built into the scenario, but alternative structures could be the ABCs or trauma assessment protocol steps. In addition, we found no evidence that video playback is an essential requirement for an effective AAR. The bedside AAR keeps the AAR in the simulation space and provides the opportunity for the trainer-facilitator to demonstrate use of clinical tools or tasks on the mannequin.

The bedside AAR, the use of this project's augmented AAR briefing materials, and the marginal importance of video playback suggest that patient simulations conducted in the field is an option for RC units. All three of the medical simulation centers participating in this study provide on-site simulation support using portable patient simulators for groups such as first responders. This support option would bring the essential resources of medical simulation—patient simulators and experienced operators—to a field setting that could be configured to represent important physical and operational features of a field treatment facility.

Units can avail themselves of the trauma scenarios and training materials developed in our studies (Morey, Williams, Kobayashi, Counihan, Norman, Holland, & Langford, 2006; Morey, Langford, Jones, Carrera, & Cupfer, 2010; Morey & Langford, 2011). These reports and supporting materials are available from the authors or the Telemedicine and Advanced Technology Research Center (TATRC) at Ft. Detrick, Maryland.

DISCLAIMER

This work was supported by the US Army Medical Research and Material Command under Contract No. W81XWH-10-C-0293, W81XWH-08-C-0061, and W81XWH-06-C-0060. The views, opinions and/or findings contained in this paper are those of the authors and should not be construed as an official Department of the Army position, policy or decision unless so designated by other documentation. In the conduct of this research, the investigators adhered to the policies regarding the protection of human subjects as prescribed by Code of Federal Regulations (CFR) Title 45, Volume 1, Part 46; Title 32, Chapter 1, Part 219; and Title 21, Chapter 1, Part 50 (Protection of Human Subjects).

REFERENCES

Byrne, A. J., Sellen, A. J., Jones, J. G., Aitkenhead, A. R., Hussain, S., Gilder, F., Smith, H. L., & Ribes, P. (2002). Effect of videotape feedback on anaesthetists' performance while managing simulated anaesthetic crises: A multicenter study. *Anaesthesia, 57*, 169-182.

Congressional Research Service. (2008). *CRS report for congress: U.S. Forces in Afghanistan*. (Order Code RS22633). Washington, DC: Congressional Research Service-The Library of Congress.

Cuper, T., Jones, P., Drucker, D., & Morey, J. (December, 2009). Evaluation and outcomes of a novel AAR scoring methodology. Orlando, FL: *Interservice/Industry Training, Simulation, and Education Conference (I/ITSEC)*.

Dismukes, R. K., Gaba, D. M., & Howard, S. K. (2006). So many roads: Facilitated debriefing in healthcare. *Simulation in Healthcare, 1* (1), 23-25.

Flanagan, B. (2008). Debriefing: Theory and techniques. In R. H. Riley (Ed.), *Manual of simulation* *in healthcare*, pp. 155-170. New York: Oxford University Press.

Government Accountability Office. (1992). *Operation Desert Storm: Full Army medical capability not achieved.* (GAO Report NSIAD-92-175). Washington, DC: U. S. General Accounting Office.

Government Accountability Office. (2009). *Reserve Forces: Army needs to reevaluate its approach to training and mobilizing Reserve Component forces.* (GAO-09-720). Washington, DC: Author.

Holcomb, J. B., Dunmire, R. D., Cromett, J. W., et. al. (2002). Evaluation of trauma team performance using an advanced human patient simulator for resuscitation training. *Journal of Trauma, 52 (*6), 1078-1086.

Lovelace, J. J. (April, 2007). *Statement By Lieutenant General James J. Lovelace, Jr., Deputy Chief of Staff, G3, United States Army, Before The Commission On National Guard And Reserves.* Washington, DC: The Commission On National Guard And Reserves.

McHugh, J. M., & Casey, G. W. (February, 2010). *A Statement on the Posture of the United States Army 2010*. Washington, DC. Department of the Army. Accessed May 2, 2011 https://secureweb2.hqda.pentagon.mil/vdas_armyposturestatement/2010/addenda/Addendum_F-Army Force Generation (ARFORGEN).asp.

Morey, J. C., & Langford, V. (2011). *Improving unit trainer AAR facilitation skills and training event assessments during combat casualty case simulations.* Andover, MA: Dynamics Research Corporation.

Morey, J. C., Langford, V., Jones, P., Carrera, M., & Cupfer, T. (2010). *Performance diagnostics and assessment using a civilian medical simulation center for reserve component medical units.* Andover, MA: Dynamics Research Corporation.

Morey, J. C., Simon, R. S., Jay, G. D., Wears, R. L., Salisbury, M. L., Dukes, K., & Berns, S. (2002). Error reduction and performance improvement in the emergency department through formal teamwork training: Evaluation results of the MedTeams project. *HSR: Health Services Research, 37* (6), 1553-1581.

Morey, J. C., Williams, K. A., Kobayashi, L., Counihan, T., Norman, B., Holland, J. B., & Langford, V. (2006). *Skill sustainment for national guard and reserve component medical personnel through web-based training and human patient simulation.* Andover, MA: Dynamics Research Corporation.

Morrison, J. E., Metzko, J., & Hawkins, C. (2002). *Planning and preparing for training in reserve component units* (IDA Document D-2700). Alexandria, VA: Institute for Defense Analysis.

Rudolph, J. W., Simon, R., Dufresne, R. L., & Raemer, D. B. (2006). There's no such thing as "non-judgmental" debriefing: A theory and method for debriefing with good judgment. *Simulation in Healthcare, 1* (1), 49-55.

Rudolph, J. W., Simon, R., Raemer, D. B., & Eppich, W. J. (2008). Debriefing as formative assessment: Closing performance gaps in medical education. *Academic Emergency Medicine, 15* (11), 1010-1016.

Savoldelli, G. L., Naik, V. N., Park, J., Joo, H. S., Chow, R., & Harnstra, S. J. (2006). Value of debriefing during simulated crisis management. *Anesthesiology, 105,* 279-285.

Scherer, L. A., Chang, M. C., Meredith, J. W. et al. (2003). Videotape review leads to rapid and sustained learning. *American Journal of Surgery, 185,* 516-520.