Evaluation of a Combat Medic Skills Validation Test

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The purpose of this study was to describe validity and reliability of a skills-based test (the Semi-Annual Combat Medic Skills-Validation Test) used by the Army to determine combat medic competency. An instrumentation design was used in which a panel of experts completed a content validity index on all skills. Simulation testing was used to determine criterion validity, intrarater, interrater, and test-retest reliability. Findings revealed that needle chest decompression, Combitube insertion, and automatic external defibrillator were the only skills with low validity (content validity index ≤0.75). Splinting was recommended as an addition to the skill test. The validity criterion of a modified postcourse Emergency Medical Technician-Basic examination score was significantly related to the Semi-Annual Combat Medic Skills-Validation Test scores (r = 0.409, p = 0.006, two tailed). There was high intra- and interrater agreement on performance steps and skills. Higher subject scores were seen on the medical skills than on the trauma skills. When retested, there was significant improvement (t = 3.268, df = 7, p < 0.014, two tailed).

Introduction

In war, approximately 90% of all combat deaths occur on the battlefield, forward of any type of medical aid station.[1,2] Because of these grave statistics, the first responders become the individuals whose competence determines the cost in life, limb, or death for the sons and daughters of America.[3] Combat medics initiate the trauma chain of care and are responsible for providing initial aid to the wounded. Today with the war in Iraq, the first responder is vital because the battlefield is dispersed and casualties can occur at anytime or place. Medics must be proficient and ready to render care at a moment's notice. Throughout history, Army combat medics, who form the core of the Army Medical Department, have been the Army's first responders. They have performed with pride, honor, and distinction.

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As with every military occupation, the requirements and expectations for combat medic performance continue to change at a pace dictated primarily by changing strategies of waging war and Army requirements. For a long time, supervisors and military commanders acknowledged concern about the competency level of their combat medics and, at times, there were calls for improved training followed by brief initiatives. It was not until after Operations Desert Storm and Desert Shield that it became visibly evident that initial medic training was not at the level required for first responder combat casualty care[4]; sustainment programs were not focused on these critical skills and unit sustainment training lacked command focus.[5]

On October 1, 2002, a major re-engineering initiative reclassified all combat medics into a medical occupational specialty called the 91W Health Care Specialist. Their basic 91W Training Course at the U.S. Army Medical Department Center and School was improved to meet National Emergency Medical Technician (EMT) Standards. A Training Circular (TC) (8-800)[6] was published in June 2002 to provide official guidance on sustainment training and, for the first time, to provide a validation testing instrument.[7] However, since the structure of training remained unchanged, the ability to sustain these perishable skills may be problematic. Unit-level noncommissioned officer (NCO) trainers with variable skills, resources, and conflicts of interest continue to be responsible to both train and test their medics. Skill decay is a pressing issue. Numerous studies have shown that, even with frequent use, up to 50% of a medic's core skills can be lost within the first 6 months and continuing education does little to slow down the process.[8–11] Medic experience compounds the problem.[12] Unlike their civilian EMT counterparts, Army combat medics may not work everyday in their occupational specialty. Medics are assigned to units wherever the Army needs them. Medics may be assigned to units without medical missions where essential operations such as vehicle maintenance may take priority over medic sustainment training.[13]

With the publication of TC-800, Semi-Annual Combat Medic Skills-Validation Test (SACMS-VT) became the instrument for determining combat medic competency.[6] It consists of four different scenarios (Fig. 1) under which 19 skills are clustered. Each skill has multiple performance steps, some of which are designated as critical. To pass, the medic must score at least 70% and not miss any performance step designated as critical. The historical construction of SACMS-VT is based on the National Registry task sheets with the addition of military unique requirements. There has been an extensive practice analysis to ensure the domain of entry-level first responder tasks was captured in the registry examination.[14] No formal research, however, on the reliability and validity of the validation skills instrument was found.

Just as clinicians must use current best evidence for their practice, so too must educators. Only when educational out-

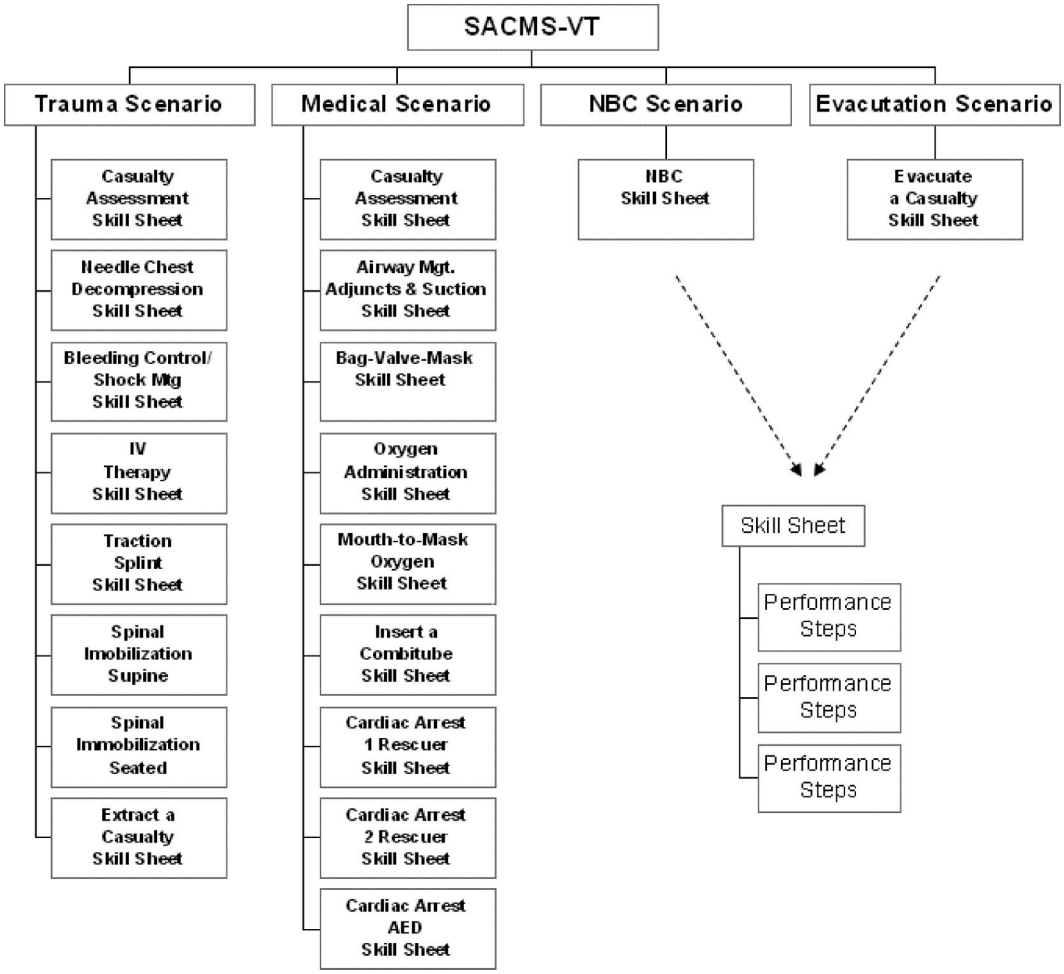

Fig. 1. SACMS-VT framework.

comes are measured using valid and reliable measurements can credible information be available on which to make decisions. In the haste to develop educational outcome measurements, the development of valid and relevant instruments to gain current information may be omitted. If meaningful and useful information on educational outcomes can be obtained using a reliable and valid test of combat medic competence, then policy development, program design, and interventional educational strategy selection can be improved. Therefore, this study's aim was to provide evidence on which the quality of the SACMS-VT could be assessed. It does not begin to address the structure of the training system, the processes involved in command support, nor the available resources. It simply addresses whether these are the right skills being evaluated for combat medic competency and if the validation test is consistent or dependable in measuring this attribute.

The first phase of the study involved developing an instrument to quantify content validity and selecting subject matter experts to complete the content validity surveys. The second phase of this study consisted of developing and operationalizing simulation scenarios and then testing 50 subjects, to develop evidence on criterion validity, interrater, intrarater, and test-retest reliability. Subject testing data are also provided.

Methods

Validity

A content validity index (CVI) instrument using Lynn's method[15] was developed to guide the process by which content validity could be determined and quantified. According to her method, content validity can be examined using a two-step process. Step one involved developing a CVI instrument using the skill sheets and performance steps in TC 8-800 and selecting a panel of experts to rate each item. Step two involved asking the experts to identify areas of omission and suggest areas of improvement or modification.

According to Waltz and Bausell,[16] two limitations in the CVI procedure for assessing content validity are the possibility of chance inflation in the agreement of experts using the CVI and the dependence of the CVI on the number of categories used in the rating. These two limitations were addressed by providing a sufficient level of control for chance agreement based on the number of subject matter experts (SMEs) and by using the four-option rating scale: (1 indicated a nonrelevant item and 4 indicated the item was very relevant). The 1 to 4 scale is preferable because it does not include the ambivalent middle rating.

Using Lynn's method, the number of expert evaluators who might agree was calculated over the total number planned for

evaluations, which sets the standard error of the proportion and established the cutoff for chance versus significance. This study used eight SMEs, therefore six or more (>75%) had to agree and endorse an item as content valid to be beyond the 0.05 significance level in order for the instrument, the skills, and the performance items to be assessed as content valid (Table I). SMEs were selected for their availability, position, credentials, experience, and discipline. At the time of the study, all SMEs were located in the surrounding community, had military experience in teaching or supervising combat medics, and experience in deployed settings. Five were active duty Army (three officer and two enlisted) and three were civilian paramedics. Of the active duty Army, three were officers (two registered nurses (RNs) and one physician). One of the RNs worked in a large Army medical center emergency room and had recently returned from Afghanistan. The other RN was a combat medic instructor at the 91WM6 (licensed practical nurse) course with extensive deployment experience in Iraq and other forward surgical hospitals. The physician was a battalion surgeon for the Corps who also had deployment experience and supervised and trained combat medics on a daily basis. Of the enlisted panel members, one was a National Registry for Emergency Medical Technicians (NREMT) instructor at the Joint Medical Training Center, training combat medics, and the other was an instructor at the 91WM6 Course. Both had deployment experience and had been in their military occupational specialty for years. Of the civilian paramedics, all had previous military background as combat medics, were currently teaching EMT-Basic (EMT-B) classes to combat medics and Special Forces medics, and were active paramedics on city ambulances in a local community of 195,000 people.

The CVI used in this study was divided in four parts: in part I, skills were rated for their relevance with regard to the SACMS-VT; in part II, performance steps were rated for their relevance to skills; in part III, critical item designation was rated for appropriateness; and in part IV, numerical values and cut scores were rated for appropriateness.

Another common way to define validity is criterion validity, in which other accepted measures are correlated with the SACMS-VT to see how well one set of variables predicts an outcome based on information from other variables. In this study, criterion validity was evaluated by correlating the SACMS-VT scores with the only other available measures of combat medic competence. These measures were the self-reported NREMT examination scores and a modified EMT-B Certification Course post-test. The modified EMT-B post-test consisted of standard examination questions used by the Joint Medical Training Center. Because of the length of the test, only the scenario-based questions that related to skill testing were selected.

Reliability

TC 8-800 provided sample scenarios which were contingent on the grouping of skills by casualty and the context in which the casualties were treated, and recommended systematic grouping of these skills based on available resources and manpower.[6] A multidisciplinary panel was used to agree on the grouping of skills by casualty and the circumstances or environment in which the medic would be working. This panel consisted of combat medics, paramedics, RNs, and physicians who were actively involved in testing and training 91Ws. A standardized orientation script, provided by TC 8-800, and use of a simulation environment enabled control over cues presented as well as provided the ability to compare performance across subjects.[17] The Andersen Simulation Center located on Fort Lewis, Washington was used for testing (Table I).

TABLE I

PROPORTION OF EXPERTS REQUIRED TO ESTABLISH CONTENT VALIDITY BEYOND THE 0.05 LEVEL OF SIGNIFICANCE

	No. Endorsing Item as Content Valid						
No. Used	2	3	4	5	6	7	8
8	0.25	0.38	0.50	0.63	0.75	0.88	1.00

TABLE II

INTERRATER AND INTRARATER ASSESSMENTS

	Rater A	Rater B
Rater A[a]	5	
Rater B[b]	16	5
Rater C[c]	5	4

[a] Rater A: 91W, EMT instructor, graduate of the Daniel Freeman Paramedic School (UCLA), current deployment Iraq.
[b] Rater B: 91W, EMT instructor, simulation expertise, current deployment Iraq.
[c] Rater C: 91W, EMT instructor, simulation expertise, NCOIC, noncommissioned officers in charge EMT training.

Three primary raters (subject to availability) were used (Table II). Twenty-five interrater assessments and 10 intrarater assessments were completed. Whenever possible, a second rater was placed in the testing room. At the end of the testing sessions, both the primary evaluator and the second rater independently rated subject performance. When this was not possible and to increase the number of interrater evaluations, a third rater was used. In addition, interrater and intrarater reliability were achieved through random selection of the taped testing sessions for rater viewing at a later time. Raters were instructed to grade the medic performance based on the observed performance of each performance step. If it was not observed and could not be elicited using auditory or visual casualty cues, the step was graded "no go." If the performance step was done incorrectly, it was graded "no go." All performance steps were graded similarly regardless of whether it was designated as critical or not critical. For test-retest reliability, all available subjects who indicated on the informed consent that they agreed to be retested were contacted.

Testing Procedures

Testing was organized into three scenarios and the subjects moved from room to room as they were tested on the different scenarios. Medical skills were aggregated into a medical scenario in the first room (Fig. 2), which was designated as a battalion aid station. The room was draped with camouflage netting and props. One Laerdal Sim Man was placed on a litter and stand in the center of the room. The equipment to support the scenario was visible and within easy reach of the test subject on another litter. Subjects had additional equipment in the room: an automated external defibrillator (AED), a field suction, Combitubes, BVM (bag-valve mask), various sizes of airway adjunct equipment (mouth-to-mask, naso-

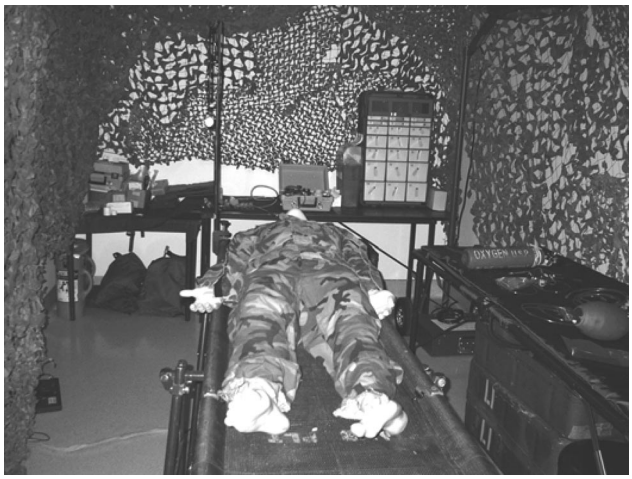

Fig. 2. Medical scenario testing room for SACMS-VT.

pharyngeal airway, oral pharyngeal airway), and an oxygen tank (2000 pounds per square inch). The lighting was dimmed to simulate battlefield conditions. The computer was concealed under camouflage netting. This room was equipped with Pelco cameras (one wide angle and one pan-tilt-zoom camera), from which all aspects of the student testing could be visualized. Once the subject demonstrated the last skill, shouts of "Medic!" and simulated explosions moved him to the second room.

The second room was designated as the trauma room (Fig. 3), in which trauma and evacuation skills were aggregated. This room had two Sim Man and one static manikin. The static manikin was used for the head injury. Unlike the Sim Man, it was not connected to computer cables and air compressors, therefore it was easily repositioned from a sitting position to a backboard. This room was designed to look like a tactical operations center, in which an explosion had occurred. The visual battle scene was achieved through the use of overturned cots, sand bags, flashing strobes to simulated fires, a smoke machine that intermittently expelled fog into the room, and camouflage netting draped on the walls and the ceilings. The lights were dimmed to create an evening/night time simulation. To achieve realistic battle scenes and sounds, a sheet was hung on one wall as a screen. A video tape of battle scenes and sounds was projected in a constant loop on the wall showing soldiers returning enemy fire, explosions occurring, gunfire being returned, helicopters incoming, and cries of "Medic!" with soldiers dying. The entire scene was so realistic, it looked like a hole had been blown in the wall of the mess tent and actual combat was occurring outside. Equipment in the room consisted of one litter, one Kendrick extraction device, one hare traction splint, two cervical collars in different sizes, two backboards, and several litter straps. This room was equipped with three cameras. A salvaged PRC77 radio was placed on a sandbag inside the room as the mechanism for subjects to call a nine-line MEDEVAC evacuation request. Once the subject completed the triage and treatment of the three simulated casualties and called in the evacuation request, he was rapidly moved to the final room.

Fig. 3. Trauma scenario testing room for SACMS-VT.

The final testing scenario took place back in the medical room, which required a rapid turnover to support testing of nuclear, biological, and chemical (NBC) skills (Fig. 4). The scene was the same as before, however, this time the Sim Man was in chemical overprotective garments (mission-oriented protective-posture level 4) gear. A decontamination line was taped on the floor. Atropine and 2-pyridine aldoxime methochloride chloride training auto injectors and a decontamination red-colored bucket were available in the room.

The control room was separate from the testing rooms (Fig. 5). It was equipped with a digital imagery system from March Networks (Ottawa, Ontario, Canada), which included an integrated soundboard. One central processing unit controlled the network of laptops for each Sim Man. Three screens were in the room. One provided visual images from the fixed and pan-tilt-zoom

Fig. 4. NBC scenario testing room for SACMS-VT.

Fig. 5. Control room for SACMS-VT.

cameras, which could be positioned and zoomed for different views. One provided the visual image of the simulation software and the last was a backup. This enabled the controller/evaluator (C/E) to visualize the subject's testing behavior and change the physiological parameters of the Sim Man in response to the subject's actions. All rooms had microphones in the ceiling, which enabled the sounds in the room to be heard in the control room. Since it was very important to record the spoken words of the test subjects, a portable, wireless microphone (Shure Wireless Microphone System (Northern Sounds & Lights, Pittsburgh, Pennsylvania) with a Countryman Lavalier omni directional microphone) was clipped to the subject's collar. The C/E sat at the center of this technological hub and "ran" the scenario. A microphone was positioned in front of the C/E, which was connected through the computer to each Sim Man. This permitted the C/E to be the actual voice of the Sim Man casualties and to communicate with the testing subject, as a casualty would respond in the given scenario. An additional member of the research team sat beside the C/E and directed the cameras and managed the recording and sound equipment. At the end of the test, subjects received an after-action review of the trauma room followed by a complete debriefing in a private room. Subjects were given a copy of their recorded test session.

Results

Content Validity

All CVI surveys were returned. Responses were aggregated and analyzed by calculating the percentage of items receiving a rating of 3 or 4 by the SMEs. SPSS was used to calculate the valid percent agreement. If there was less than 75% agreement on the validity, the item was determined to be not valid. Frequency of ratings and textual comments were summarized and analyzed with the assistance of a psychometric consultant.

In the initial survey, five skills were deemed nonrelevant and two additional skills were recommended for addition to the SACMS-VT. A modified CVI survey was constructed of items with <75% agreement and resent to the panel members. The final recommendations deemed only three skills (needle chest decompression, inserting a Combitube, and AED) (Table III) and one of the recommended additions, blood management, as not valid. The panel recommend splinting be added to the SACMS-VT. The performance steps rated not valid were clustered under concepts related to the medics' assessment abilities. There was agreement on the 70% as a cut point for passing, although several comments indicated a desire for a higher score. Overall, the experts wanted to increase the number of critical items.

TABLE III

SACMS-VT PERCENT AGREEMENT FOR SKILL RELEVANCE

CVI Rating (%)		
Round 1	Round 2	Individual Skills
75	62.5	Needle chest decompression
75	75	Insert a Combitube
75	75	Cardiac arrest management (AED)
75	87.5	Cardiac arrest management (1 rescuer)
75	87.5	Cardiac arrest management (2 rescuer)
100		Trauma casualty assessment/management-
100		bleeding control/shock management
100		Intravenous therapy
100		Traction splint
100		Spinal immobilization-seated
100		Spinal immobilization-supine
100		Extract a casualty
100		Medical casualty assessment/management
100		Airway management-upper airway adjuncts and suction
100		BVM
100		NBC
100		Evacuate a casualty
100		Oxygen administration
100		Mouth-to-mask supplemental oxygen

Interrater, Intrarater, and Test-Retest Reliability

The study's target population was 91Ws (combat medics) from Fort Lewis units scheduled to deploy to Iraq or Afghanistan within 1 year. All combat medics available for testing were scheduled through their unit-training NCOs. Of the 54 medics recruited over a 4-month period for testing, only one declined to participate in the study (n = 53).

Subjects were males in the rank of E4 (specialist) or below with an average age of 22 years and had been in the military for <1.5 years (only males are assigned to combat units). All had a high school education, four had an associate's degree, and one had a master's degree. Ninety-four percent had never been deployed. Only three had previously taken the SACMS-VT. The average self-reported score on the NREMT was 76%.

The average SACMS-VT test score was 58% with 66 (SD = 20) critical items missed. Table IV lists the skill scores in descending value. The skill scores are aggregated by scenario and skills (Figs. 6–8). Lower scores were found in the assessment skills, Combitube insertion, and needle decompression. High scores were observed in the skills requiring routine certification (cardiopulmonary resuscitation (CPR) and AED) or performed frequently by medics at their troop medical clinics (intravenous initiation). The mouth-to-mask was a virtually nondemonstrated skill, with the subjects preferring mouth-to-mouth or to move directly to a BVM.

All subjects who indicated on the informed consent that they agreed to be retested were contacted (N = 52). Only eight sol-

TABLE IV

SACMS-VT AVERAGE TEST SCORES

	Mean	(SD)
IV	90	(14)
AED	81	(17)
BVM	80	(23)
Cardiac arrest (one man)	79	(27)
Evacuation	79	(27)
Oxygen management	73	(18)
Med assessment	72	(13)
Bleeding and shock	66	(22)
Airway management	66	(32)
Spinal immobilization (supine)	64	(29)
NBC	58	(19)
Extraction	58	(29)
Spinal immobilization (seated)	56	(32)
Combitube	55	(22)
Traction	52	(28)
Needle decompression	50	(21)
Trauma assessment	29	(16)
Mouth-to-mask	16	(22)

diers were available for retesting within 4 months. Their SACMS-VT retest scores were significantly higher ($t = 3.268$, $df = 7$, $p < 0.014$, two tailed). No significant differences in characteristics were found between the initial group tested and the ones that were retested. There was high interrater and intrarater agreement on the skills (Table V) with the exceptions of three skills: bleed/shock management, spinal (supine), and extraction.

Criterion Validity

The National EMT Registry certification examination scores reported by the subjects were not significantly correlated with the SACMS-VT scores ($r = 0.041$, $p = 0.798$, two tailed) using a Spearman's correlation. The modified postcourse EMT examination scores, however, were significantly related to the SACMS-VT scores ($r = 0.409$, $p = 0.006$, two tailed).

Discussion

Competence has been defined as the ability to apply knowledge, make decisions, and use psychomotor skills expected for the practice of one's profession within the context of public health, welfare, and safety.[18] Competence, however, is a phenomenon that is very difficult to measure because of its dynamic nature and varying levels of expertise. The SACMS-VT is an instrument designed to measure combat medic competence, and its quality should be explored to determine its reliability and validity. A limitation of this study is that the content validity of

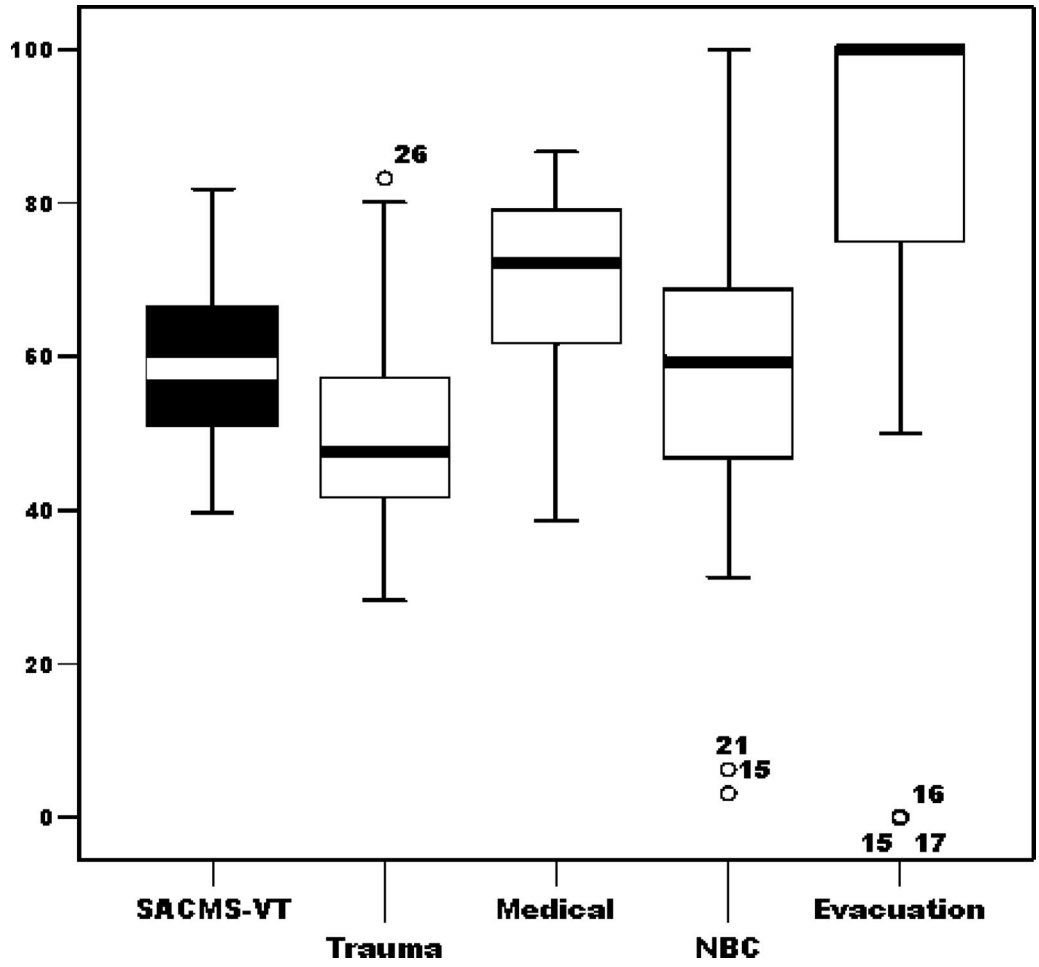

Fig. 6. SACMS-VT scores by scenario.

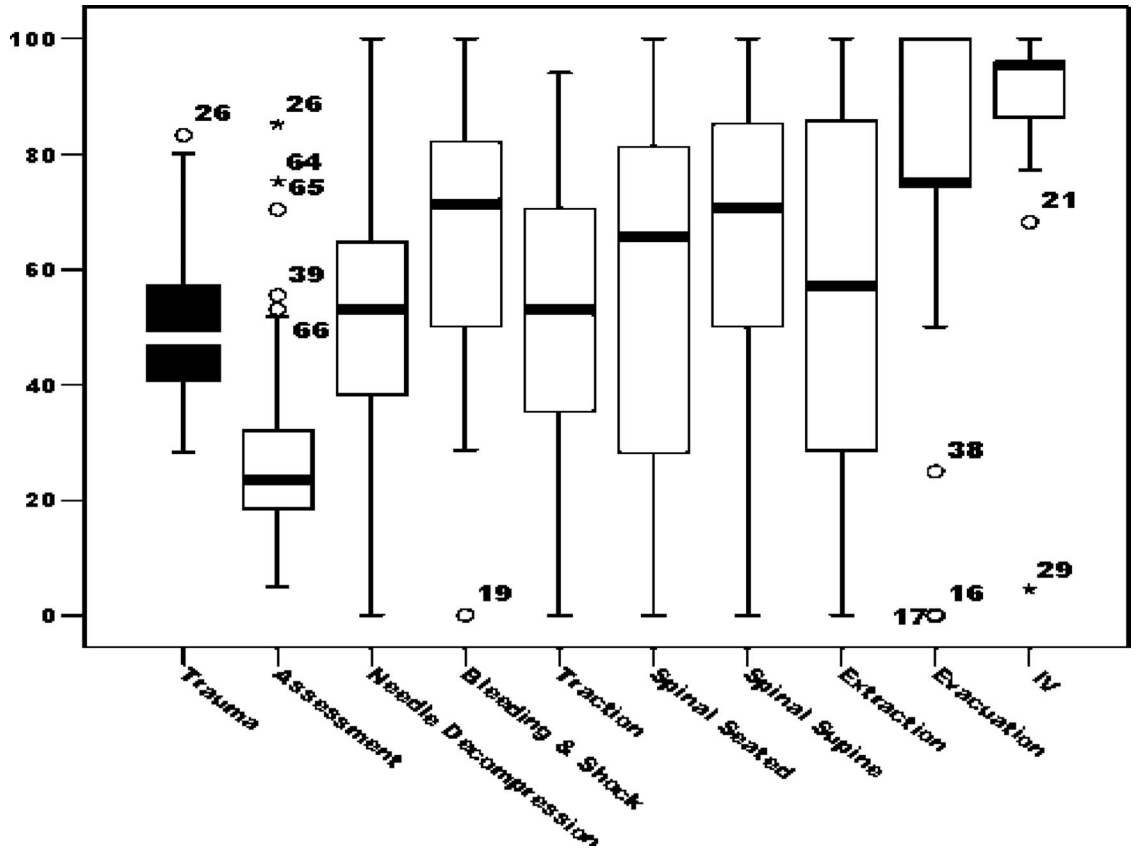

Fig. 7. Trauma scenario skill scores.

the SACMS-VT is subject to the experiences, perceptions, training, and knowledge of the experts rating the relevance of the performance steps and skills. Two of the three skills deemed not valid (needle chest decompression, inserting a Combitube,) were definitely influenced by the experts' personal experiences and observations. The written comments reflected that the skills were deemed valid as an abstract concept for 91W competence; however, because of the panel's personal observations of combat medics incorrectly performing these two high-risk skills, their decision was that the risk did not outweigh the benefit to keep the skill in the domain of beginning level combat medic. Maybe after feedback to training systems and intense retraining efforts, the content validity rating of these two skills may change. The third skill deemed not valid was the AED. The panel supported their nonvalid ratings with statements such as, "AEDs are not on the battlefield" or "this is not a trauma skill." These statements, again, were a reflection of the changing focus of competency (from medical to trauma care) required by the combat medic dictated by a time of war, and not a time of peace.

The performance steps rated as not valid were clustered in a category reflecting the medic's medical assessment ability. Assessment performance steps require a grasp of an advanced concept, an ability to retrieve it from long-term memory and then be able to demonstrate the appropriate behavior. For example, few medics could define concepts such as priapism, hyper-resonance, or subcutaneous emphysema let alone link it to the physical trauma in the scenario and demonstrate the appropriate actions. Perhaps the training system needs to devise innovative and simplified methods of instruction for these advanced concepts.

There was high rater (intra and inter) agreement with the exception of three skills (bleeding, spinal immobilization–supine, and extraction). The lower agreement may be due to the limitations of the camera angles. These skills typically require increased activity by the medic and fine psychomotor movements. Often times the medic had his back to the camera and what could be seen in the room might not have been detectable on video tape when reviewed later. In this instance, the discrepancy in ratings may increase. In addition, the performance steps that were not demonstrated were rated as no go's. This decision was based on the fact that the simulation scenarios provided the equipment and casualty cues on which a reasonable medic would demonstrate the performance step.

The scores of these medics on the SACMS-VT must be addressed within the structure and process of the Army's personnel and training systems. Combat medics scheduled to deploy to Iraq or Afghanistan within the year were the target population for this study. The Corps surgeon provided points of contact for the unit and encouraged unit participation. Units electing to participate scheduled their medics through the unit training NCO based on availability. The sample was 100% male (since females are not assigned to front line units), 76% Caucasian with an average age of 22 (SD = 3.78), and 89% had high school as the highest level of education completed. Subjects were relatively young and new to the military. Eighty-three percent were

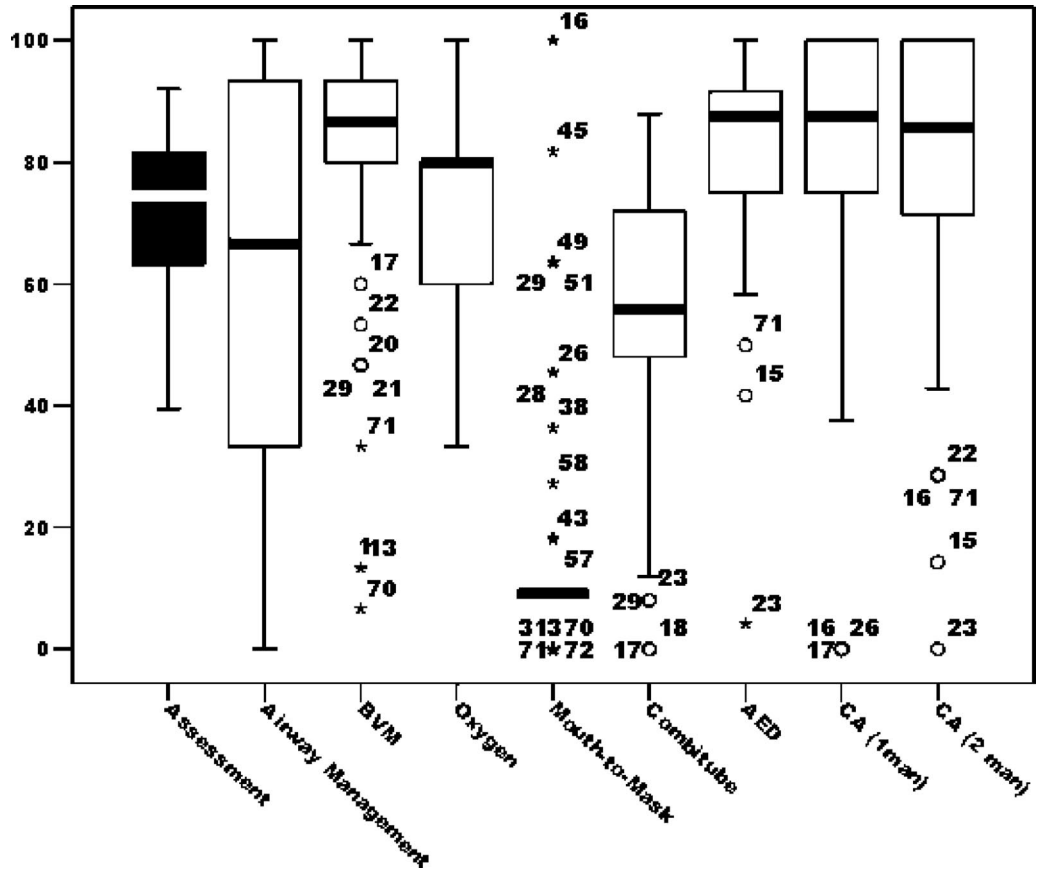

Fig. 8. Medical scenario skill scores.

TABLE V

INTERRATER AND INTRARATER AGREEMENT

Scenario and Skill	Interrater (%)	Intrarater (%)
Trauma scenario	100	100
Assessment	100	100
Decompression	84	100
Bleeding	52	60
Intravenous	100	100
Traction	76	80
Spinal immobilization-seated	72	80
Spinal immobilization-supine	48	70
Extraction	66.67	100
Evacuation	87.5	89
Medical scenario	95.83	100
Assessment	88	80
Airway	100	90
BVM	96	100
Oxygen	88	90
Mouth-to-mask	87.5	90
Combitube	75	90
AED	93.75	100
CPR one person	96	100
CPR two person	91.67	100
NBC scenario	72	86
SACMS-VT	84	100

E4 (specialist) and below, had been in the Army on an average of 1.69 years (SD = 2.33), and had been out of their basic EMT certification program for 0.62 years (SD = 1.83).

Another limitation of this study was the threat to internal validity from history and maturation. This study occurred during rapid transition for war. Subjects were assigned to new rapidly forming units, which initially lacked sufficient training equipment and training NCOs. Since their window of deployment was projected to be within the year, their commanders' priorities were focused on getting soldiers and equipment ready for war. As manpower and resources infused, the unit's focus turned to intensified medical training. This could account for the significant improvement in the retest scores. The high operation tempo of the units and accelerated deployments, however, accounted for a very high attrition rate within the 4-month subject retesting window.

The highest scores were seen on the skills that require annual certification for all health care personnel such as CPR, AED, and BVM. Unlike the SACMS-VT, these skills have training systems structures that are resourced with certified personnel to train, test, and track outcomes. Not passing has consequences for the medic and his organization, ultimately determining the ability of medics to practice in their specialty. Another skill in which medics scored high was intravenous initiation, which medics have opportunities to perform on a daily basis at their unit treatment medical centers. The lowest scores were seen on the skills that medics rarely performed such as the Combitube. See Figures 6 to 8. This again supports the importance of repetitive

training and testing on these perishable psychomotor skills, if daily performance opportunities are not available. The significant improvement of performance when the subjects were retested also lends support to the fact that periodic training and validation of performance skills can help to consistently improve combat medic competence if there are ramifications for the medic and his organization for not meeting minimum competency requirements.

The lack of correlation between the NREMT and the SACMS-VT scores and the significance seen between the SACMS-VT and the EMT-B post-test may be related to several factors. First, there is a potential bias involved in the self-reporting of NREMT score; it was, however, impossible to obtain the individual NREMT scores. Medics were requested in writing and were asked repeatedly to bring copies of their registry examinations to no avail. The second factor is supported by the literature, which reports that skills rapidly degrade within 3 to 6 months of the initial training, especially if not practiced daily.[8–12] Lastly, the difference in the types of tests may also account for this finding. The NREMT is a cognitive knowledge-based pen-and-pencil test, the EMT-B course post-test was based on scenario decision making in which cognitive knowledge-based questions were removed, and the SACMS-VT is an observation of demonstrated psychomotor skills.

Based on the findings of this study, it is highly recommended that the passing criteria of the SACMS-VT be revised. Currently to pass, medics must achieve a 70% and not miss one of the 184 critical items. It is not humanly possible for anyone to attain the latter standard during integrated, problem-based testing that involves critical thinking and decision making. It is highly recommended that the critical item designation be used for training only and for testing purposes be replaced with a nonpass if the medic (1) increases a casualty's injuries during treatment or (2) death of the casualty results through inaction or wrong action.

Lastly, simulation testing relies on the ability of the evaluator to create, manipulate, and control conditions forcing the student to demonstrate skills and performance steps appropriate to casualty management. This skill requires not only knowledge and experience, but is an art rather than a science. Evaluators must be carefully chosen to ensure reliability of testing standards and outcomes. A difference in the skill level of the evaluators may decrease the reliability of the SACMS-VT, however, further research is needed in this area. Validation testing is resource and manpower intensive. The average length of the medical scenario was 39 minutes (SD = 9), the trauma scenario 38 minutes (SD = 11), and the NBC 21 minutes (SD = 7). Although training should continue at the unit level, it is recommended that centralized testing centers with trained staff using simulation-testing methods be used to improve efficiency and accuracy of the training system. Medics should be tested on arrival to a command for a baseline, given an individual training plan, and retested yearly. Central databases for competency benchmarking should be developed, maintained, tracked, and reported. Ramifications for not meeting minimum standards should be entertained. Only when objective educational outcomes can be collected using reliable and valid tests can combat medic training be improved, combat medical readiness monitored, and educational interventions evaluated.

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