Training Effects for First-responder Competency in Cholinergic Crisis Management

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ABSTRACT

Background: Military and civilian first-responders must be able to recognize and effectively manage mass disaster casualties. Clinical management of injuries resulting from nerve agents provides different challenges for first responders than those of conventional weapons. We evaluated the impact of a mixed-methods training program on competency acquisition in cholinergic crisis clinical management. **Methods:** We developed a multimedia and simulation-based training program based on the more comprehensive USAMRICD courses. The training program was designed to provide first-responders with the necessary abilities to recognize and manage a mass casualty cholinergic crisis event. Training included a learner controlled multimedia iPad app and hands-on instruction using SimMan3G™ mannequin simulators. We evaluated the impact of the training through a purposively selected sample of 204 civilian and military first responders who had not previously completed either of the referenced USAMRICD courses. We assessed knowledge, performance, affect, and self-efficacy measures pre- and post-training using previously validated assessment instruments. We calculated results using analysis of variance with repeated measures, and with statistical significance set at $p < .05$. **Results:** Analyses demonstrated a significant improvement ($p = .000$) across all domains (knowledge, performance, self-efficacy, and affect). Knowledge scores increased from 60% to 81% correct. Performance scores increased from 16% to 68% correct. Self-efficacy scores increased from 51% to 87% confidence in ability to effectively manage a cholinergic crisis event. Affect scores increased from 75% to 81% personal comfort during procedures. **Conclusions:** These findings could aid in the selection of instructional methodologies available to a broad community of first-responder personnel in military and civilian service. Although less comprehensive than the USAMRICD courses, training outcomes associated with this easily distributed instruction set demonstrated its value in increasing the competency of first responders in recognizing and managing a mass casualty cholinergic event. Retention outcomes are in process.

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INTRODUCTION

Global conflict and the war on terrorism requires both military and civilian medical personnel to be able to rapidly and effectively respond to mass disaster casualties associated with unconventional weapons, including chemical weapons such as nerve agents (Brennan, Waeckerle, Sharp, & Lillibridge, 1999; Cannard, 2006; DeYoung, 2014; Human Rights Watch, 2014; Kadivar & Adams, 1991; Khan, Morse, & Lillibridge, 2000; Macilwain, 1993; Morita et al., 1995; Murray, 2006; Ohbu et al., 1997; Okumura et al., 1996; Rodgers, 1998; Sidell, 1997; Waeckerle, 2000). Although these types of events are relatively rare, timely and accurate care for casualties, along with appropriate self-protection for clinician responders, can limit mortality and provide the best chance for full recovery after exposure. The challenge for clinical providers is that the opportunity to train for a mass casualty event associated with nerve agents is extremely limited.

Simulation technologies may provide sufficient fidelity to adequately facilitate clinical interactions with human patients because they are designed to reproduce human anatomy and physiological responses, as well as support experiential learning. The opportunity for experiential learning is extremely important because knowledge-based training alone may miss the vital mastery of associated skills and affective elements embedded in clinical contexts. Especially in a mass casualty environment, dissonance resulting from cognitive and affective overload can interfere with the application of knowledge and skills (Arad et al., 1993; Berkenstadt, Arad, Nahtomi, & Atsmon, 1999; Fine & Kobrick, 1987; Hendler et al., 2000; Humara, 1999; King & Frelin, 1984; Mandler, 1979; Smith & Nye, 1989; Smolander, Louhevaara, & Korhonen, 1985; VanGemmert & VanGalen, 1997). Experiential learning theory prescribes direct engagement in a contextually relevant environment to help learners create mental representations such as attitudes, mental models, scripts, and schemas, which correspondingly lead to the desired behavioral outcomes (Bruner, 1990; Dewey, 1933/1998; Harnad, 1982; Vygotsky, 1978). This theoretical framework serves crisis and emergency medical training well because the training environment supports the relevant factors that might otherwise lead to dissonance in the performance context (Andreatta et al., 2010; Dandoy & Goldstein, 1990; Filner, 2009; Inzana, Driskell, Salas, & Johnston, 1996).

Experiential learning may also be supported through the use of well-designed multimedia applications that engage learners in a virtual experience (Holzer & Andruet, 2000). Learners navigate through interactive layers of content to develop understanding that leads to the desired performance outcomes. Multimedia applications have advantages for instructional control because they are consistent, user controlled, repeatable, and accommodate multimodal presentations that facilitate multiple learning preferences (Cairncross & Mannion, 2001; Kolb & Kolb, 2005).

A training environment that makes use of multimedia and hands-on engagement with mannequin simulators may provide a feasible solution for training medical personnel to rapidly and effectively respond to the type of mass casualties that would result from a chemical weapon. The purpose of this study was to capture the impact of a training program comprised of a multimedia application and hands-on engagement with mannequin simulators on the ability of trainees to clinically manage patients (actors) during a simulated mass casualty cholinergic event.

METHODS

Institutional review and approvals were secured from the University of Michigan, University of Minnesota, and U.S. Army Medical Research and Materiel Command (HRPO). All study related activities took place at the University of

Michigan and the University of Minnesota. The study involved clinical activities and therefore a purposive sample of clinicians with varying levels of expertise was recruited. All subjects completed written informed consent prior to participating in study related activities.

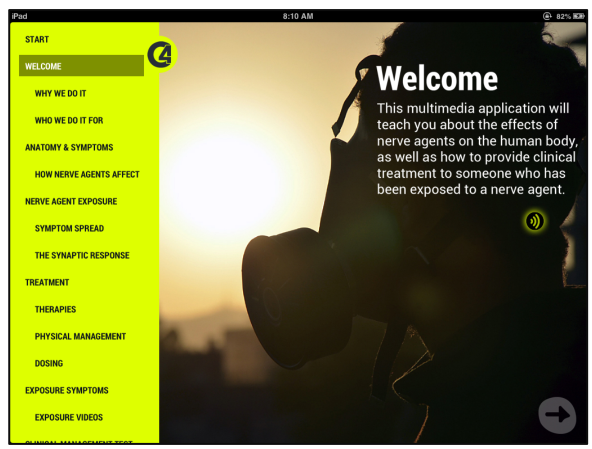
Study Design

We implemented a quasi-experimental research design, using a purposively selected sample of first-responder clinicians. The sample (N=204) was comprised of nurses (N=21), paramedics (N=137), and clerkship-level medical students (N=46). Subjects had not previously completed the United States Army Medical Research Institute of Chemical Defense (USAMRICD) courses "Medical Management of Chemical and Biological Casualties" or "Field Management of Chemical and Biological Casualties".

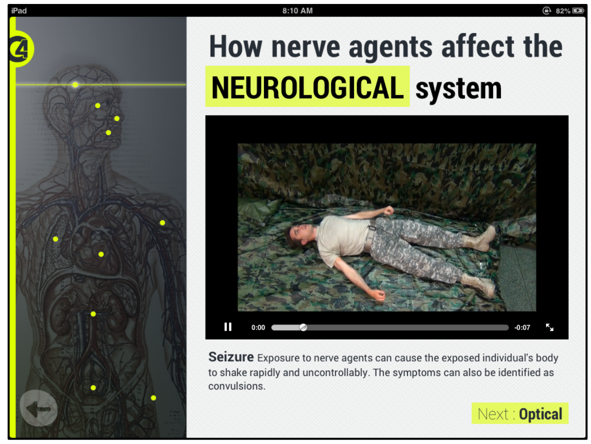
The study was designed to examine the impact of first-responder training in the management of a cholinergic event as measured by changes in knowledge, performance, self-efficacy and affective behaviors of the participants. Instructional content was informed by the USAMRICD course materials for "Medical Management of Chemical and Biological Casualties" and "Field Management of Chemical and Biological Casualties". The training took place over a 4-hour period and was comprised of four components: 1) orientation, 2) content, 3) hands-on practice, and 4) hands-on performance. We grouped participants into cohorts of 6-8 people during training, however each participant independently completed all activities. All instruction followed the same sequencing of content and activities.

First, we provided an orientation in a classroom to present information about the training context and a brief introduction to casualties resulting from chemical weapons. Next, participants interacted with the foundational content of the training using a multimedia application. The multimedia application necessitated a high level of interactivity and provided formative feedback throughout to engage and inform the participants about their progress. The multimedia application includes a total of 9 interactive sections, illustrated and described below.

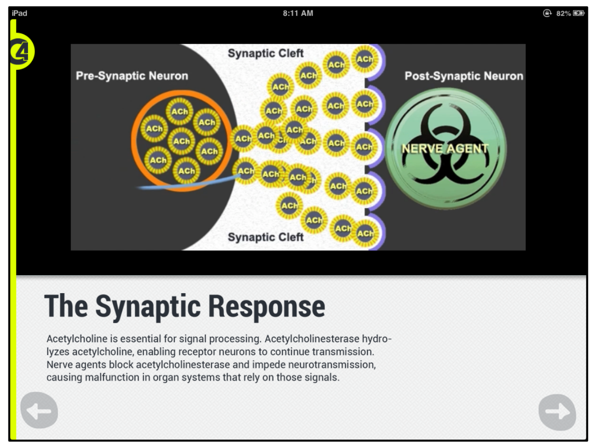
1. **Introduction to Nerve Agent Casualties**: Provides contextual purpose for the training.



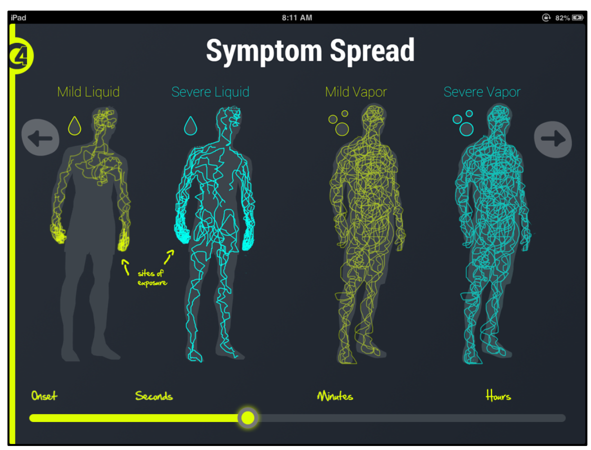
2. **Anatomy & Physiological Response**: Overview of relevant anatomy, physiological responses, and symptomology of human response to nerve agent exposure. Interactive "hotspots" on the patient plays the associated symptom video.



3. **Nerve Agent Exposure:** Physiological response to nerve agent and antidote effects. A video shows the step-by-step synaptic responses inside the body.

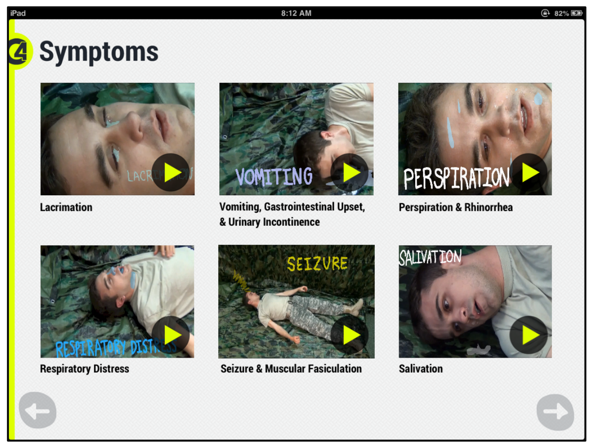


4. **Liquid & Vapor Nerve Agents:** In-depth information on the differences between liquid and vapor nerve agents in severity of response and onset of symptoms. Interactive animations illustrating the difference between vapor and liquid nerve agents in terms of the speed and severity of symptom onset, and progression of symptoms over time.

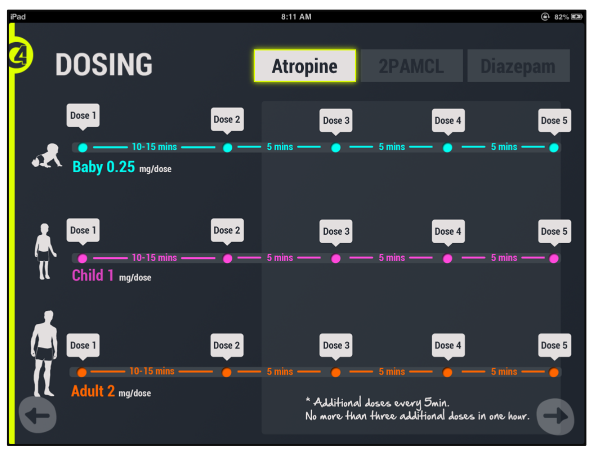


5. **Liquid & Vapor Nerve Agents**: In-depth information on the differences between liquid and vapor nerve agents in severity of response and onset of symptoms. Interactive animations illustrating the difference between vapor and liquid nerve agents in terms of the speed and severity of symptom onset, and progression of symptoms over time.

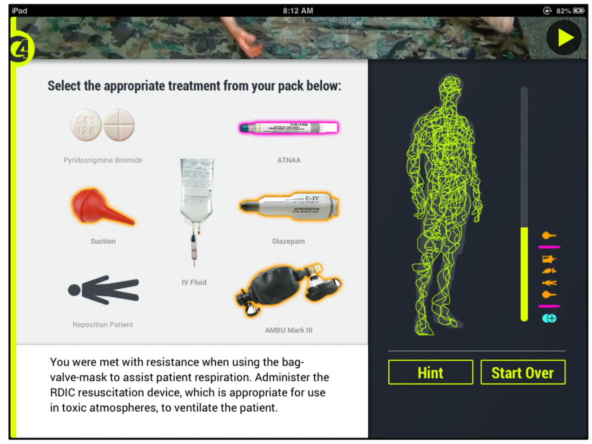
6. **Treatment Effects:** A human model serves to highlight symptom "hotspots" that facilitates discovery of treatment options for each symptom.



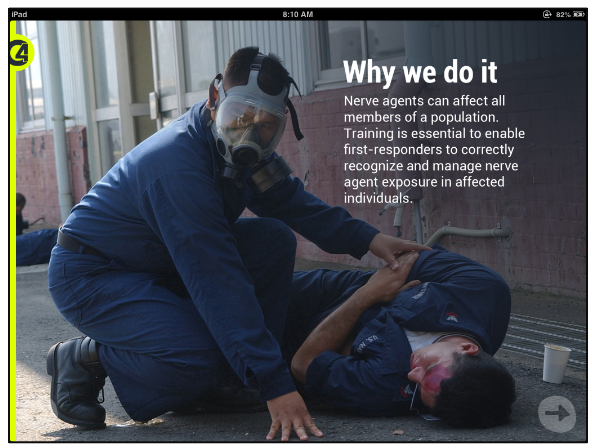
7. **Medications:** Interactive guide for determining the dose and time sequence for each medication, categorized for adult, child, and infant patients. Interactive quiz about medication dosing and time sequence for different patients.



8. **Assessment & Treatment Quiz:** Interactive test to assess ability to respond to a specific nerve agent exposure case. Requires learner to diagnose exposure and administer the appropriate medications, doses, and time sequences per the treatment protocol.



9. **Summative Discussion:** Summary of need and value of training in clinical management of nerve agent casualties.



After completing the multimedia component, participants reviewed the clinical protocols for diagnosing and managing a patient experiencing cholinergic crisis, and practiced associated clinical tasks using SimMan3G™ mannequin simulators (Laerdal Medical Corporation, Stavanger, Norway). Because nerve agent mass casualties require medical personnel to wear protective gear that simultaneously overtaxes and limits their perceptual capacities, we taught participants how to prepare themselves using Mission-Oriented Protective Posture (MOPP) Level IV to align the fidelity of the performance component of the training (Arad et al., 1993; Berkenstadt et al., 1999; Fine & Kobrick, 1987; Hendler et al., 2000; King & Frelin, 1984; Smolander et al., 1985). Finally, participants interacted with patients (actors) who behaved as if they had been exposed to a chemical weapon as part of a simulated mass casualty event.

Actors were trained to display symptoms associated with a moderate exposure to Sarin gas (nerve agent), as well as to a mustard gas (vesicant). Those with mustard gas exposure were used as distractors to assess the abilities of the participants to correctly diagnose patients with nerve agent exposure. A professional special-effects make-up artist provided the formulas for creating the visual representations of symptoms for both exposure types. All training events were conducted at the City of Plymouth Fire Department (Plymouth, MN); a two story facility with classrooms, common areas, and a large bay for housing trucks and equipment. The large bay was used to create a mass casualty of 24 people; half of which exhibited symptoms associated with exposure to a nerve agent, the other half to mustard gas. Participants donned protective gear and entered the casualty area where they were instructed to select and treat the patients with nerve agent exposure. Actors were instructed to monitor any treatment provided to them by the participants in order to respond appropriately to any medications and physical interventions.
To examine the relative effects of training on the abilities of subjects to identify and manage a patient experiencing cholinergic crisis in a mass casualty situation, we used four validated assessment instruments: 1) knowledge, 2) performance, 3) self-efficacy, and 4) affective state. Subjects completed pre-training assessments prior to participating in any of the instructional activities, and post-training assessments immediately following the instructional activities.

We used validated assessment instruments to assess multiple performance dimensions associated with managing a nerve agent casualty. We assessed knowledge through 23 multiple choice and short-answer questions, with a maximum score of 39 total points. Construct validity (p = .003), test-retest reliability (r = .97) and internal consistency (alpha = .69) were previously established for the knowledge assessment (Andreatta, Klotz, Madsen, Hurst, & Talbot, in press). Two pairs of trained raters used a performance assessment instrument to score trainees on their ability to clinically manage nerve agent casualties (actors) at multiple points, and in aggregate with a maximum total score of 45 points. Raters were trained until they achieved and maintained inter-rater agreement above .90. Construct validity (p = .000), test-retest reliability (r = .98) and internal consistency (alpha = .90) were previously established for the knowledge assessment (Andreatta et al., in press). To capture self-efficacy, we asked the subjects to self-report the extent to which they would be comfortable helping or independently managing patients in a nerve agent related mass casualty. A 7-item, 6-point Likert scale (strongly disagree to strongly agree) was used for self-efficacy, for a total of 42 points. We measured state related affect using a 19-item adaption of the State-Trait Anxiety Inventory (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). All items were scored using a 6-point Likert scale (strongly disagree to strongly agree), for a total of 114 points. We inverse coded scores so that lower scores reflected greater anxiety. There is considerable evidence of construct and concurrent validity for the scale, reported internal consistency ranges between .86 and .95, with test-retest reliability coefficients between .65 and .75 (Spielberger et al., 1983).

All data were analyzed using SPSS-Statistics v21 (IBM, Armonk, New York, USA). We conducted analysis of variance with repeated measures and statistical significance set at $p < .05$.

RESULTS

There were significant increases in knowledge scores after training ($F(1,203) = 1046.47$, $p = .000$). Performance scores were also significantly higher after training ($F(1,203) = 1805.23$, $p = .000$), as were scores for self-efficacy ($F(1,203) = 933.22$, $p = .000$) and affect ($F(1,203) = 78.97$, $p = .000$). Scores associated with training outcomes are presented in Table 2 for each type of assessment.

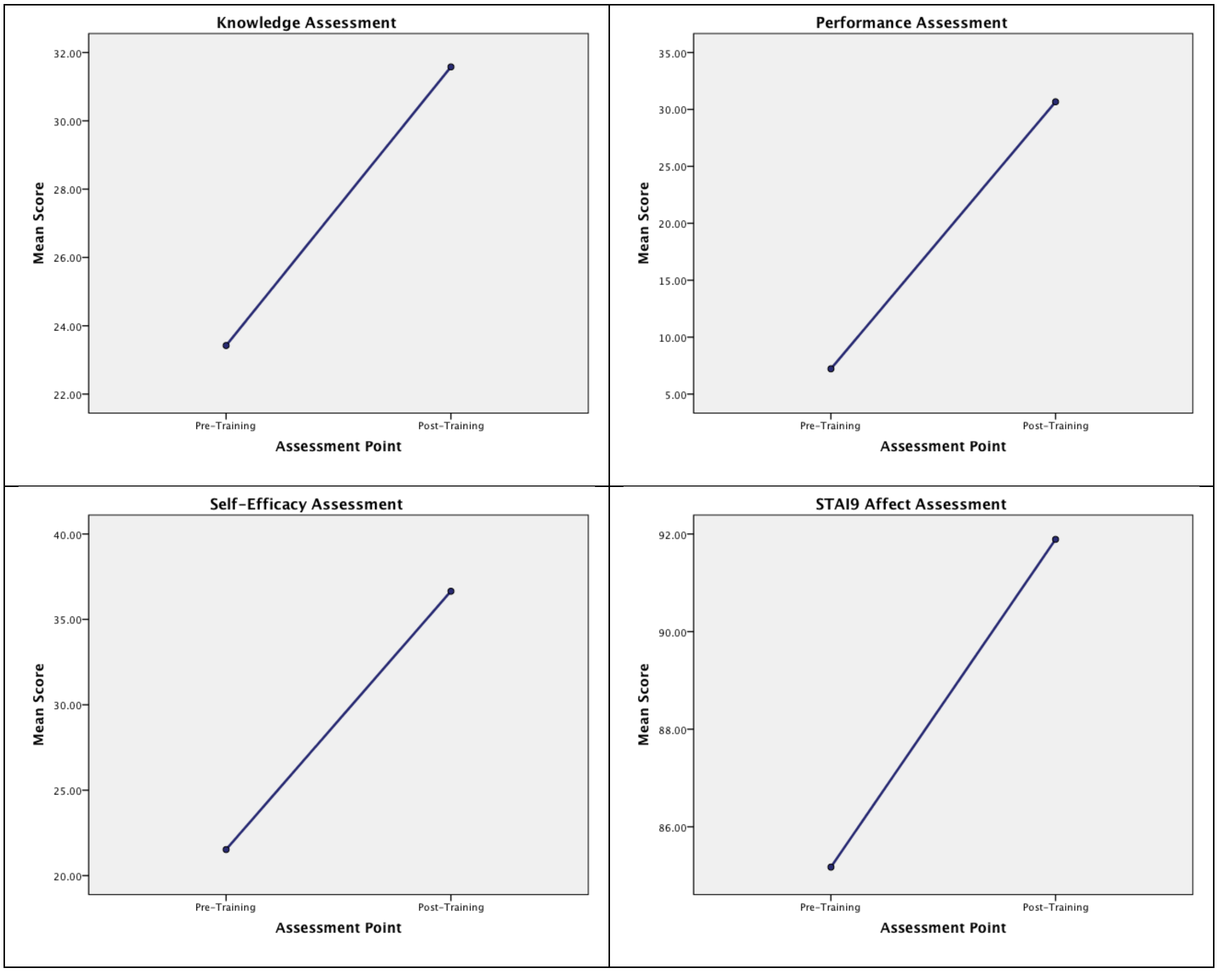
Table 2: Pre/Post Training Scores

Assessment (Total Score)	Pre-Training Score*	Post-Training Score*
Knowledge (39)	23.42 (3.50); 60%	31.58 (3.12); 81%
Performance (45)	7.22 (5.58); 16%	30.67 (6.62); 68%
Self-Efficacy (42)	21.52 (7.58); 51%	36.65 (3.31); 87%
Affect (114)	85.28 (12.11); 75%	91.89 (11.03); 81%

Note: * Mean (Standard Deviation); Percent of Total Score

Differential outcomes for each assessment are illustrated in Table 3. There were significant correlations between self-efficacy scores and those for knowledge ($p < .01$), performance ($p < .01$), and affect ($p < .001$). There was also a significant correlation between knowledge and performance scores ($p < .05$).

Table 3: Pre/Post Training Outcomes



DISCUSSION

There are limited opportunities for medical personnel to practice skills associated with the management of mass disaster and rare event casualties, which makes it difficult to acquire and maintain these critical competencies. The use of chemical weapons on civilian and military targets has heightened awareness of the need for first responder clinicians to be trained to manage nerve agent casualties. The results of this study demonstrate the effectiveness of a 4-hour training intervention on first responder trainees' abilities to identify and clinically manage patients experiencing cholinergic crisis.

The data suggest several key considerations for training of first-responder medical personnel. The substantial 52% increase in post-training performance scores exceeded the differential scores for cognitive, self-efficacy and affective domains. This underscores the value of performance-based assessment, but also the opportunity to practice skills in a simulated context. Although there was no significant correlation between pre-training knowledge and performance scores, the post-training knowledge and performance scores correlated significantly. This is especially notable because knowledge scores also increased by 21%. This demonstrates importance of hands-on applied practice for both initial and refresher training. A passing rate of 70% is typical for demonstrating competency as a civilian first-responder (National Registry of Emergency Medical Technicians, 2014), and the 68% post-training performance score was just beneath that. This is likely due to limitations on the extent of time allotted to deliberate practice during the training and with increased time these scores would likely improve further.

Implications

This training provides an alternative for military medical personnel who are unable to attend more comprehensive training at USAMRICD, as well as for civilian first responder personnel who may be tasked with responding to a terrorist attack on the general population. The design of the training makes it easily portable to multiple locations, which is advantageous for initial instruction, but also for refresher training as needed. The multimedia module is suitable for on-demand training, and the simulation-based modules could be facilitated with any mannequin simulator, standardized patients (actors), or even between peers acting as patient and provider. Additionally, the content could be modified or adapted for casualties resulting from exposure to other types of chemical or biological agents. The combination of multimedia content and hands-on simulation-based training methods provides versatility for prescribed and standardized instruction that facilitates the deliberate practice clinicians need to develop and improve their performance abilities. Improvements to the tissue fidelity and physiological functioning of mannequin simulators would likely lead to additional training benefits (Klotz, Dooley-Hash, House, & Andreatta, in press).

Limitations and Next Steps

A limitation of this study is that we did not evaluate retention after training. A study examining retention after training at 6-weeks, 18-weeks, and 52-weeks is in process. Another limitation of this study is that we did not attempt to evaluate performance during applied clinical care, so the extent to which performance in the simulated context transfers to competent performance managing actual patients in crisis remains to be quantified. Theoretically the mental models created from a relevant training environment will transfer to a clinical care setting, however future work to characterize the extent of transfer in different clinical contexts is merited.

CONCLUSIONS

The findings from this study could aid in the selection of instructional methodologies available to a broad community of first-responder personnel in military and civilian service. Although less comprehensive than the USAMRICD courses, the combination of multimedia and simulation-based methods created an experiential learning environment that yielded significant improvements in knowledge, performance, self-efficacy and affect. These outcomes demonstrate the value of this easily distributed program to increase competency of first responders in recognizing and managing a mass casualty cholinergic event. Retention outcomes are in process.

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REFERENCES

Andreatta, P. B., Maslowski, E., Petty, S., Shim, W., Marsh, M., Hall, T., … Frankel, J. (2010). Virtual reality triage training provides a viable solution for disaster-preparedness. *Academic Emergency Medicine*, *17*(8), 870-876. http://dx.doi.org/10.1111/j.1553-2712.2010.00728.x

Andreatta, P., Klotz, J., Madsen, J. M., Hurst, C. G., & Talbot, J. B. Assessment instrument validation for critical clinical competencies: Pediatric-neonatal intubation and cholinergic crisis management. *Interservice/Industry, Training, Simulation and Education Conference Newsletter*, in press.

Arad, M., Berkenstadt, H., Zehlinger, J., Laor, A., Shemer, J., & Atsmon, J. (1993). The effects of continuous operation in a chemical protective ensemble on the performance of medical tasks in trauma management.

Journal of Trauma and Acute Care Surgery, 35(5), 800-804. http://dx.doi.org/10.1097/00005373-199311000-00025

Berkenstadt, H., Arad, M., Nahtomi, O., & Atsmon, J. (1999). The effect of a chemical protective ensemble on intravenous line insertion by emergency medical technicians. *Military Medicine, 164*(10), 737-739.

Brennan, R. J., Waeckerle, J. F., Sharp, T. W., & Lillibridge, S. R. (1999). Chemical warfare agents: Emergency medical and emergency public health issues. *Annals of Emergency Medicine*, *34*(2), 191-204. http://dx.doi.org/10.1016/S0196-0644(99)70229-5

Bruner, J. (1990). *Acts of meaning*. Cambridge, MA: Harvard University Press.

Cairncross, S., & Mannion, M. (2001). Interactive multimedia and learning: Realizing the benefits. *Innovations in Education and Teaching International*, *38*(2), 156-164. http://dx.doi.org/10.1080/14703290110035428

Cannard, K. (2006). The acute treatment of nerve agent exposure. *Journal of the Neurological Sciences*, *249*(1), 86-94. http://dx.doi.org/10.1016/j.jns.2006.06.008

Dandoy, A. C., & Goldstein, A. G. (1990). The use of cognitive appraisal to reduce stress reactions: A replication. *Journal of Social Behavior and Personality*, *5*, 275-285.

Dewey, J. (1933/1998). *How we think* (rev. ed.). Boston, MA: Houghton Mifflin Company.

DeYoung, Karen. (2014, May 15) Kerry says 'raw data' indicate recent use of chemical weapons by Syrian government. *Washington Post*. Retrieved from http://www.washingtonpost.com/world/middle_east/kerry-says-raw-data-indicate-recent-use-of-chemical-weapons-by-syrian-government/2014/05/15/7ca7d3fa-dc50-11e3-a837-8835df6c12c4_story.html

Filner, B. [CA-51] (introduced 2009, December 10) H.R. 4269: Battlefield Excellence through Superior Training Practices Act. Retrieved from http://www.thomas.gov/cgi-bin/bdquery/z?d111:h.r.04269

Fine, B. J., & Kobrick, J. L. (1987). Effect of heat and chemical protective clothing on cognitive performance. *Aviation, Space, and Environmental Medicine*, *58*(2), 149-54.

Harnad, S. (1982). Neoconstructivism: A unifying theme for the cognitive sciences. In T. Simon & R. Scholes (Eds.), *Language, mind and brain* (pp. 1-11). Hillsdale, NJ: Erlbaum.

Hendler, I., Nahtomi, O., Segal, E., Perel, A., Wiener, M., & Meyerovitch, J. (2000). The effect of full protective gear on intubation performance by hospital medical personnel. *Military Medicine*, *165*(4), 272-274.

Holzer, S. M., & Andruet, R. H. (2000). Experiential learning in mechanics with multimedia. *International Journal of Engineering Education*, *16*(5), 372-384.

Human Rights Watch (2014, May 13). Syria: Strong Evidence Government Used Chemicals as a Weapon. Retrieved from http://www.hrw.org/news/2014/05/13/syria-strong-evidence-government-used-chemicals-weapon.

Humara, M. (1999). The relationship between anxiety and performance: A cognitive-behavioral perspective. *Athletic Insight*, *11*(2), 1-14.

Inzana, C. M., Driskell, J. E., Salas, E., & Johnston, J. H. (1996). Effects of preparatory information on enhancing performance under stress. *Journal of Applied Psychology*, *81*(4), 429-435. http://dx.doi.org/10.1037/0021-9010.81.4.429

Kadivar, H., & Adams, S. C. (1991). Treatment of chemical and biological warfare injuries: Insights derived from the 1984 Iraqi attack on Majnoon Island. *Military Medicine*, *156*(4), 171-177.

Khan, A. S., Morse, S., & Lillibridge, S. (2000). Public-health preparedness for biological terrorism in the USA. *Lancet*, *356*(9236), 1179-1182. http://dx.doi.org/10.1016/S0140-6736(00)02769-0

King, J. M., & Frelin, A. J. (1984). Impact of the chemical protective ensemble on the performance of basic medical tasks. *Military Medicine*, *149*(9), 496-501.

Klotz, J. J., Dooley-Hash, S. L., House, J. B., & Andreatta, P. B. Pediatric and neonatal intubation training gap analysis: instruction, assessment, and technology. *Simulation in Healthcare* (in press).

Kolb, A. Y., & Kolb, D. A. (2005). Learning styles and learning spaces: Enhancing experiential learning in higher education. *Academy of Management Learning and Education*, *4*(2), 193-212. http://dx.doi.org/10.5465/AMLE.2005.17268566

Macilwain, C. (1993). Study proves Iraq used nerve gas. *Nature*, *363*(6424), 3. http://dx.doi.org/10.1038/363003b0

Mandler, G. (1979). Thought processes, consciousness, and stress In V. Hamilton & D. M. Warburton (Eds.), *Human stress and cognition: An information processing approach* (pp. 179-201). New York, NY: John Wiley & Sons.

Morita, H., Yanagisawa, N., Nakajima, T., Shimizu, M., Hirabayashi, H., Okudera, H., … Mimura, S. (1995). Sarin poisoning in Matsumoto, Japan. *Lancet*, *346*(8970), 290-293. http://dx.doi.org/10.1016/S0140-6736(95)92170-2

Murray, C. K. (2006). Development of a deployment course for graduating military internal medicine residents. *Military Medicine*, *171*(10), 933-936.

National Registry of Emergency Medical Technicians. (Accessed 2014, May 18) About NREMT examinations. Retrieved from http://www.nremt.org/nremt/about/about_exams.asp

Ohbu, S., Yamashina, A., Takasu, N., Yamaguchi, T., Murai, T., Nakano, K., … Hinohara, S. (1997). Sarin poisoning on Tokyo subway. *Southern Medical Journal*, *90*(6), 587-593. http://dx.doi.org/10.1097/00007611-199706000-00002

Okumura, T., Takasu, N., Ishimatsu, S., Miyanoki, S., Mitsuhashi, A., Kumada, K., … Hinohara, S. (1996). Report on 640 victims of the Tokyo subway sarin attack. *Annals of Emergency Medicine*, *28*(2), 129-135. http://dx.doi.org/10.1016/S0196-0644(96)70052-5

Rodgers, J. C. (1998). Chemical incident planning: A review of the literature. *Accident and Emergency Nursing*, *6*(3), 155-159. http://dx.doi.org/10.1016/S0965-2302(98)90031-5

Sidell, F. R. (1997). Nerve agents. In F.R. Sidell, E. T. Takafuji, & D. R. Franz (Eds.), Medical Aspects of Chemical and Biological Warfare, (pp. 129-180) *Textbook of Military Medicine, Part 1. Warfare, Weaponry, and the Casualty, Vol. 3.* Washington, DC: Walter Reed Army Medical Center Borden Institute; Falls Church, VA: U.S. Army Office of The Surgeon General; Fort Sam Houston, TX: U.S. Army Medical Department Center and School; Fort Detrick Frederick, MD: U.S. Army Medical Research and Materiel Command; & Bethesda, MD: Uniformed Services University of the Health Sciences.

Smith, R., & Nye, S. (1989). Comparison of induced affect and covert rehearsal in the acquisition of stress management coping skills. *Journal of Counseling Psychology*, *36*(1), 17-23. http://dx.doi.org/10.1037/0022-0167.36.1.17

Smolander, J., Louhevaara, V., & Korhonen, O. (1985). Physiological strain in work with gas protective clothing at low ambient temperatures. *American Industrial Hygiene Association Journal*, *46*(12), 720-723. http://dx.doi.org/10.1080/15298668591395625

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press.

VanGemmert, A., & VanGalen, G. (1997). Stress, neuromotor noise, and human performance: A theoretical perspective. *Journal of Experimental Psychology: Human Perception and Performance*, *23*(5), 1299-1313. http://dx.doi.org/10.1037/0096-1523.23.5.1299

Vygotsky, L. (1978). *Mind in society*. Cambridge, MA: Harvard University Press.

Waeckerle, J. F. (2000). Domestic preparedness for events involving weapons of mass destruction. *Journal of the American Medical Association*, *283*(2), 252-254. http://dx.doi.org/10.1001/jama.283.2.252