



# Archived Content

In an effort to keep DHS.gov current, this document has been archived and contains outdated information that may not reflect current policy or programs.

**Operational Field Assessment  
Post Assessment Report:**

**Emergency Medical Services Board Armor Backboard Cover**

Prepared in Support of the  
First Responder Technologies (R-Tech) Program  
Science and Technology Directorate  
US Department of Homeland Security

Prepared under  
Contract GS-23-F-0048K  
Delivery Order HSHQDC-10-Q-00187

By  
DDL OMNI Engineering LLC  
11301-ENG

8 November 2011

Enclosure (1)

## **Executive Summary**

This document contains results from an Operational Field Assessment of the Board Armor Backboard Cover designed by Advanced EMS Designs (Orlando, FL) to prevent contamination between a victim and a backboard while also protecting Emergency Medical Service (EMS) providers. The First Responder Technologies (R-Tech) Program, Science and Technology Directorate of the United States (US) Department of Homeland Security (DHS) identified this need of the EMS community and supported the development of an EMS backboard cover.

The Board Armor Backboard Cover Operational Field Assessment was conducted for the R-Tech Program by DDL OMNI Engineering LLC (DDL OMNI) on August 1, 2011 at the Prince George's County Fire Service Building grounds. Prince George's County Fire/Emergency Medical Services (EMS) personnel played the roles of victims and end users. The backboard cover was evaluated against a full range of EMS emergency scenarios selected based on results of an EMS Focus Group Survey. The scenarios included utilization of the covered backboard for extraction of a victim from an automobile, exposing the cover to a victim covered in simulated blood, application of the cover when the backboard was dry, and application of the cover when the backboard was wetted by both simulated blood and water prior to covering the backboard. The victim was secured to the covered backboard and transported over flat and inclined terrain, through brush and up and down a stairwell. All testing was performed using qualified EMS end-users following standard emergency medical services protocols. Among the features of the performance of the backboard cover evaluated were the following:

- The ability of the Board Armor Backboard Cover to be rapidly and effectively deployed.
- The ability of the Board Armor Backboard Cover to securely and comfortably hold the victim on the backboard when transported over a full range of terrain.
- The ability of the Board Armor Backboard Cover to prevent contamination from the backboard onto the victim and the EMS personnel.
- The ability of the Board Armor Backboard Cover to limit contamination from the victim onto the backboard.
- The ruggedness of the Board Armor Backboard Cover during transport up and down inclines, through brush, and up and down stairwells.

Upon completion of each operational scenario, the EMS participants were surveyed regarding the performance of the cover in terms of ease of application, ability to securely and comfortably hold the victim in place and effectiveness in preventing contamination. It should be noted that the EMS test staff complied with all Department of Homeland Security privacy and human subject testing regulations.

The following summarizes the findings from this Operational Field Assessment of the Board Armor Backboard Cover:

- The Board Armor Backboard Cover was easy to deploy, and robust enough to deal with a full range of environments and the elements.
  - There was one minor tear in the Board Armor Backboard Cover near the elastic cuff, but the tear was local and did not affect the covers performance.

- The Board Armor Backboard Cover is designed to be a one-time use item, and the minor tear that occurred by the elastic cuff did not compromise the integrity of the barrier device.
- The victim was maintained in a stable condition, and there was no slippage between the victim and the Board Armor Backboard Cover.
- As expected, there was some minor contamination at the edges and handles of the backboard from the blood-covered victim and from EMS participants placing the victim on the covered backboard and during transport and handling.
- The Board Armor Backboard Cover was effective in protecting the victim from contamination by blood on the backboard.
- The backboard was much cleaner after usage than it would be without the Board Armor Backboard Cover.
- The Board Armor Backboard Cover adhered well to the backboard even in wet conditions.
- The Board Armor Backboard Cover protected the EMS participants from simulated blood on the backboard.
- The Board Armor Backboard Cover adhesive came off the backboard easily after removal.

In summary, the Board Armor Backboard Cover performed per the stated requirements as identified by the EMS community.

Based on the results of the assessment and feedback from test participants, a suggested area for improvement to the Board Armor Backboard Cover that might be considered is the packaging. The package could be more compact (e.g. re-sealable with zipper) and the Cervical Immobilization Device (CID), backboard cover and head straps could all be placed in one package for easier deployment and disposal. Also, the addition of disposable secure straps would add to the overall usefulness of the backboard cover.

## Contents

	Page
Executive Summary .....	1
Introduction.....	4
Mission Description .....	4
Threat Description .....	4
System Description .....	4
System Usage.....	8
Operational Assessment Outline.....	9
Assessment Objective .....	9
Pre-Assessment Activities .....	9
Testing Area.....	11
Description of Scenarios .....	15
Operational Field Assessment Survey .....	16
Operational Field Assessment Performance Criteria.....	17
Deployment.....	17
Transport.....	17
Cleanup .....	17
Operational Field Assessment Scenarios.....	18
Scenario 1 – Extraction of a victim from a vehicle. ....	18
Scenario 2a – Carrying the victim over flat grass terrain on a covered backboard. ....	22
Scenario 2b – Carrying the victim through brush on a covered backboard.....	25
Scenario 2c – Carrying the victim up/down an embankment on a covered backboard.....	27
Scenario 3a – Carrying a blood covered victim over flat grass terrain on a covered backboard.....	29
Scenario 3b – Carrying a blood covered victim through brush on a covered backboard .....	32
Scenario 3c – Carrying a blood covered victim up/down an embankment on a covered backboard .....	34
Scenario 4aa – Carrying the victim over flat grass terrain on a blood covered backboard .....	37
Scenario 4ab – Carrying the victim over flat grass terrain on a blood covered backboard .....	39
Scenario 4ac – Carrying the victim through brush on a blood covered backboard .....	42
Scenario 4b – Carrying the victim up/down an embankment on a blood covered backboard.....	45
Scenario 5a – Carrying the victim over flat grass terrain on a wet backboard .....	48
Scenario 5b – Carrying the victim up/down an embankment on a wet backboard.....	51
Scenario 6 – Carrying the victim up/down an interior stairwell on a covered backboard.....	54
Results and Discussion .....	57
Pre-Assessment Survey Results.....	57
Operational Field Assessment Survey Results .....	57
Average Scores from the Board Armor Backboard Cover Operational Field Assessment .....	58
Average Score vs. Scenario for Unpackaging and Applying the Board Armor Backboard Cover .....	59
Findings and Recommendations .....	60
Appendix	
List of Figures .....	61

## **Introduction**

The DHS First Responder Technologies Program (R-Tech) rapidly assesses technology solutions for maturation and application in critical DHS programs and applications. Several technologies which have direct application to the first responder and emergency preparedness and response technology gaps have been identified by the DHS R-Tech Program. These gaps are bridged by technology development projects selected and funded by R-Tech in partnership with the Center for Commercialization of Advanced Technologies (CCAT). To ensure the quality of the solutions generated through this activity, independent third-party testing in real-world scenarios is necessary.

The technology evaluated herein is a proposed solution for covering a backboard used by Emergency Medical Service (EMS) participants to simultaneously provide secure transportation of victims in a full range of emergency scenarios and prevent contamination from the backboard to the victim and minimize contamination of the backboard from bodily fluids on the victim. The system, requirements, preparation, facilities, materials, personnel, scenarios, and testing results are presented and discussed.

## **Mission Description**

The purpose of the technology developed is to prevent patient contamination to and from backboards, to reduce cleaning times, and prevent infection.

## **Threat Description**

When emergency medical personnel need to stabilize and transport a victim at the scene of an incident, a backboard is used to align the victim's spine and provide full-body support so they can be carried. The victim may discharge bodily fluids such as blood, urine, vomit, and feces at the scene and during transport. Once the victim is removed from the backboard it is superficially cleaned and put back into service. Often backboards are stacked in a location adjacent to the emergency room without being cleaned and an emergency medical technician must take one of these backboards to use on their next call. These backboards are stored in compartments that are often hard to reach and therefore difficult to keep clean. In the case of ladder trucks, backboards are often transported on the outside of the truck and collect soot and road debris. When the emergency medical personnel get back to their station, the backboards are commonly bleached and hosed down. This does not fully disinfect the backboards which have many small crevices due to wear from use, and large crevices that are used for hand holds. Victims, first responder vehicles, and hospital facilities are then unnecessarily exposed to contamination from these body fluids and road debris.

## **System Description**

The project for the development of a backboard cover system that was selected for funding by DHS and CCAT was submitted by Advanced EMS Designs, a start-up company based in Orlando, Florida. The Backboard product they developed is comprised of tyvek material with an integrated cervical immobilization device. The backboard cover is affixed to a backboard through an elastic cuff located at the top and bottom of the cover and adhesive strips contained on the back of the cover. The system is for one-time use only and should be disposed of and not reused. The current design is presented below in Figures 1 and 2.



Figure 1. The Board Armor Backboard Cover with the integrated Cervical Immobilization Device (CID).



Figure 2. The Board Armor Backboard Cover from below.



The material used to construct the backboard cover is Tyvek Tychem QC which is impermeable to fluids and has passed ASTM F1670 Synthetic blood penetration and ASTM F1671 Bacteriophage penetration tests. The material is white and will show staining in a way that may allow an emergency medical technician to distinguish the types of body fluid that are present. Three adhesive strips each measuring 6 inches by 13 inches are used to fix the cover to the backboard. The adhesive backing tabs are arranged such that they can be removed after the backboard cover has been attached to the backboard by using the elastic contained at the head and foot of the cover. The cover has a head and foot orientation and must be arranged correctly on the backboard. The foot of the cover is slightly tapered and the cervical immobilization device (CID) base is pre-attached at the head.

The CID is constructed from two triangular high-density foam blocks fixed to the cushion with Velcro. This design is familiar to emergency medical service providers as similar products are available from other vendors. To provide a base for the CID, a loop Velcro pad is fixed to the cover. The foam blocks of the CID are fixed to the pad with Velcro. The head is kept within the CID by two nylon straps affixed with Velcro to the head blocks. One strap is placed across the forehead. The second strap is used to secure the chin. Alternatively, an end user can use a reusable CID of their own rather than the CID that is packaged with the backboard cover. The cover, head block, and Velcro straps are folded and packaged in a sealed pouch.

## System Usage

The backboard cover is packaged in a small plastic pouch that can be easily stored in an emergency medical services vehicle. After un-packaging, the backboard cover is placed on the backboard using the elastic located at the end of the cover, and then secured to the backboard with the adhesive tabs located on the back of the cover. This is achieved by pulling on tabs which extend out from the sides of the cover. Next, the emergency medical service providers place the victim on the backboard as they normally would and then apply the CID. Once the victim is secured and strapped to the backboard, the emergency medical service provider can transport the victim. Once the victim has been transferred from the backboard to a gurney, hospital bed, or other surface, the cover is removed from the backboard for disposal. When removing the cover from the backboard, it may be folded into its center from the outside edges to prevent spillage of accumulated bodily fluids and other matter. The cover and the integrated CID are disposed of in biohazard disposal containers at the location where the victim is transported. Figure below outlines the procedure for using the Board Armor Backboard Cover.

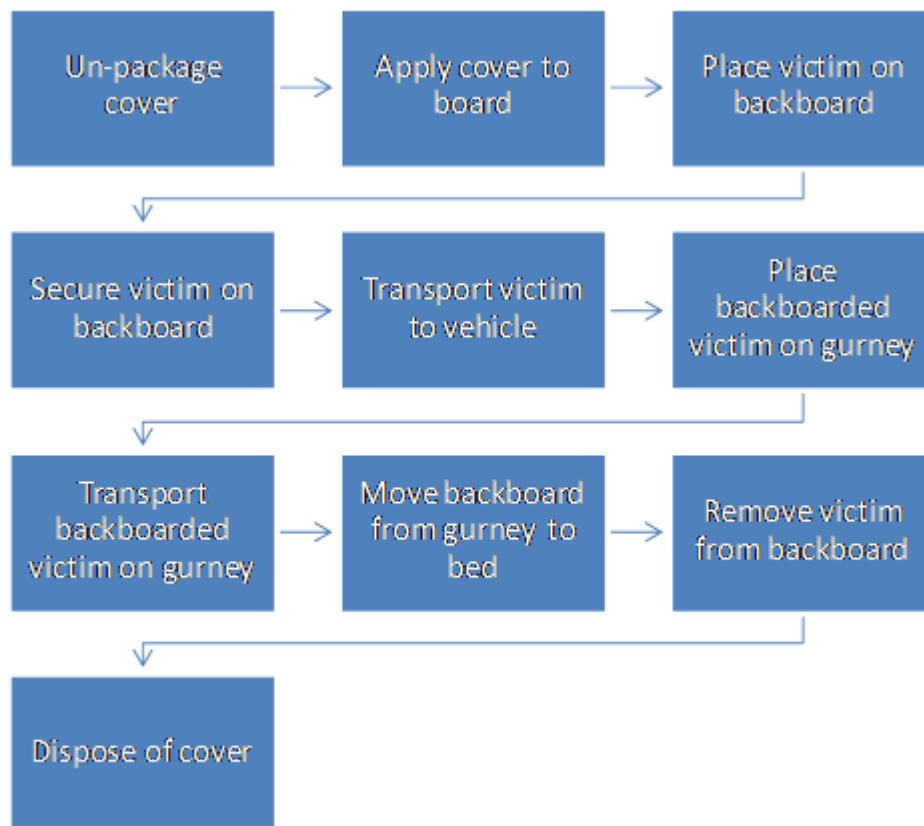


Figure 3. Diagram of the Board Armor Backboard Cover system usage.

## **Operational Assessment Outline**

### **Assessment Objective**

The objective of the operational field assessment was to evaluate the backboard cover's ability to operate in real-world scenarios. These include the ability to be placed on a backboard under a variety of environmental conditions, allow for safe transport of a victim, reduce contamination between the backboard and victims, and be compatible with an emergency medical unit's standard operating procedure.

### **Pre-Assessment Activities**

Prior to testing, third-party first responders from the Prince Georges County Fire/EMS Service were introduced to the best practices for using the Board Armor Backboard Cover by Advanced EMS Designs personnel. In addition, participating EMS personnel were requested to fill out a Pre-Operational Field Assessment Survey Form, Figure 4. The form was used to identify the most important functions of the cover, as viewed by the participating EMS personnel. After completing the form, the first responders were directed to perform testing scenarios with DHS and Advanced EMS Designs personnel observing. DDL OMNI personnel collected relevant data during the testing through videos, photos, and surveys.

It should be noted that DDL OMNI conducted a privacy threshold analysis and that all parties adhered to the Privacy Act, Title 5 of the US Code, Section 552(a) and applicable agency rules for the field test.

### Pre-Operational Field Assessment Survey Form

**Fill in a score (1=Least, 10=Most Important) for importance of each event in the backboard cover's performance. Use each number ONCE.**

Phase	Event	Importance (1-10)
Deployment	Store backboard cover with EMS equipment	
Deployment	Unpackage the backboard cover quickly	
Deployment	Cover board quickly and thoroughly	
Transport	Log Roll or Place victim on covered backboard	
Transport	Securely transport victim on backboard	
Transport	Remove the victim from the backboard cover	
Transport	Reduce contamination of victim by backboard	
Cleanup	Remove the cover from the backboard	
Cleanup	Dispose backboard cover	
Cleanup	Reduce contamination of backboard by bodily fluids	

**Please use this space to make any other comments:**

**Circle one for each:**

**Organization:**                      End User              Test Management              Sponsor              Facility Staff

Figure 4. Sample of a blank Pre-Operational Field Assessment Survey Form.

## Testing Area

Testing was conducted on the grounds of the Fire Services Building in Prince George's County located at 6820 Webster Street, Landover Hills, MD. The site is pictured below in Figure 5. The test area for scenarios included a Parking lot, areas of flat grass and brush cover, and a grass embankment.



Figure 5. Image of the Prince George's County Fire Services Building from above. The boundary of the grounds and prospective testing area is outlined in red. State Route 450 is at the bottom right of the frame.



Figure 6. View of parking lot north of the Fire Services Building. This area was used to simulate the “extraction of a victim from a vehicle” scenario.



Figure 7. View of the flat grass ground next to the Fire Service Building. This area was used to simulate the scenarios in the flat grass ground. The yellow dotted arrows indicate the route where the victim was transported.





Figure 8. View of the brush cover next to the Fire Service Building. This area was used to simulate the scenarios through brush cover. The yellow dotted arrows indicate the route where the victim was transported.



Figure 9. View of the grass embankment next to the Fire Service Building. This area was used to simulate scenarios up and down the grass embankment. The yellow dotted arrows indicate the route where the victim was transported.



Figure 10. Image of Volunteer Fire/EMS #830 facility with advanced emergency medical services trucks parked in front of the building.



## Description of Scenarios

The six scenarios outlined below were executed during the Operational Field Assessment:

Scenario 1 – Extraction of a victim from a vehicle.

Scenario 2 – Carrying a victim over various terrain on a covered backboard.

Scenario 3 – Carrying a blood covered victim over various terrains on a covered backboard.

Scenario 4 – Carrying the victim over various terrains on a blood covered backboard.

Scenario 5 – Carrying the victim over various terrains on a wet backboard.

Scenario 6 – Carrying the victim up/down an interior stairwell on a covered backboard.

For consistent results throughout testing, one volunteer first responder was used as the victim during all the tests. Depending upon the scenario, the victim was outfitted in standard poly/cotton white coveralls and/or a Tyvek chemical suit. In Scenario 3 and Scenario 5 evaluations, the victim had 0.3 to 0.5 ounces of simulated blood applied to the victim's back at the shoulders and hips before being log rolled and secured onto the covered backboard. When simulated blood was applied to the victim, the distribution of the simulated blood was visually checked and documented before and after conducting the tests. The simulated blood was non-toxic, safe for exposure to humans and is commonly used in emergency medical services training and activities. No other makeup was applied to the volunteer victim to simulate the appearance of injuries. Images of the backboard, backboard cover, and victim were taken before and after each scenario and iteration.

# Operational Field Assessment Survey

After each Scenario, an Operational Field Assessment Survey form (see example in Figure 11) was completed by each of the eleven (11) EMS test participants. The forms were used to score the backboard cover's performance on a scale from 10 (good) to 1 (bad).

**Typical Operational Field Assessment Survey Form**

**Scenario:**  
**Victim:**  
**Environment:**  
**Terrain:**

Scenario 1 – Extraction of a victim from a vehicle.  
 Dry  
 Dry  
 Flat

Objective: Determine whether the cover has durability to avoid being damaged when deployed in a confined vehicle space with potentially sharp edges during the extraction of the victim from a vehicle

The conditions during the test are summarized below:

- One backboard was used
- One cover was used
- One CID was used
- One set of victim clothing was used
- The victim did not have any simulated bodily fluids applied to the victim's body
- The covered backboard was wedged into the space between the victim and the car seat and the emergency medical services participants followed their standard operating procedure to extract the victim and secure the victim to the backboard on a gurney.
- The covered backboard was inspected after the victim was removed

**Fill in a score (1=Bad, 10=Good Performance) for the backboard cover's performance during each event and any notes you feel should be made.**

Phase	Event	Performance (1-10)	Notes
Deployment	Store		
Deployment	Unpackage		
Deployment	Cover Board		
Transport	Log Roll Victim		
Transport	Transport Victim		
Transport	Remove Victim		
Cleanup	Remove Cover		
Cleanup	Dispose Cover		
Cleanup	Inspect Backboard	X	

**Please use this space to make any other comments:**

**Circle one for each:**  
**Role in testing:**

Victim
EMS Provider
Observer

Figure 11. Sample of a blank Operational Field Assessment Survey Form

## Operational Field Assessment Performance Criteria

The following performance criteria were used to assess the Board Armor Backboard Cover. The functions considered important for successful performance were categorized into three areas: deployment; transport; and cleanup. The categories were based on the results of an EMS Focus Group Survey conducted by DDL OMNI.

### Deployment

**Packaging/Un-packaging** – The ability to remove a cover from its packaging material in a field scenario. Potential failures include a complete inability to open the package or taking too long to open the package.

**Cover Backboard** – The ability to cover the backboard was measured by the ease of applying the cover to the backboard from the time the cover was removed from the package until a victim was placed on the backboard.

### Transport

**Log Roll Victim** – In log rolling, a victim is rolled to their side while the backboard is slid beneath them. The ability to place a victim on the covered backboard by log rolling is important. This is a primary method used by emergency medical personnel to place a victim on a backboard. If the emergency medical personnel cannot achieve the successful log rolling of the victim without diminishing the cover's effectiveness, this is considered a failure of the product. During the log roll procedure, the cover must not be damaged or shift in a way that contaminates the backboard. The victim must be secured with the integrated CID without undue effort.

**Transport Victim** – The ability to transport the victim without significant sliding or shifting of the victim on the covered backboard is important. As noted, the victim was transported over flat land, brush, and inclines in a wet environment and up and down on the indoor stairwell. The backboard cover should not shift in a way that affects or contaminates the victim or the backboard.

**Remove Victim** – The ability to remove the victim from the backboard after transport to an offloading location is important because the backboard cover must not shift in a way that contaminates either the victim or the backboard. Extra effort to remove the victim should not be necessary.

### Cleanup

**Remove Cover** – The backboard cover must be removed in a way that does not contaminate the backboard with a victim's bodily fluids. It must not require significant effort to remove the cover from the backboard.

**Dispose Cover** – After removal from the backboard, the backboard cover and integrated CID must be readily disposable using existing disposal methods and materials.

**Inspect Backboard** – Depending upon the specific scenario, the victim and the backboard were inspected to identify any visible contamination by simulated blood.

## Operational Field Assessment Scenarios

This section describes each Operational Field Assessment Scenario. These scenarios were designed with feedback from EMS subject matter experts. The scenarios were executed to fully evaluate the performance of the Board Armor Backboard Cover in a full range of simulated emergency environments (dry/wet conditions), different victim conditions (dry/wetted with simulated blood) and the ability to securely transport the victim over various terrains, including up and down the stairs.

### Scenario 1 – Extraction of a victim from a vehicle.

**Victim:** Dry  
**Environment:** Dry  
**Terrain:** Flat

Objective: Determine whether the cover has durability to avoid being damaged when deployed in a confined vehicle space with potentially sharp edges during the extraction of the victim from a vehicle

The conditions during the test are summarized below:

- One backboard was used
- One cover was used
- One CID was used
- One set of poly/cotton clothing was used
- No simulated bodily fluids were applied to the victim
- The covered backboard was wedged into the space between the victim and the car seat and the emergency medical services participants followed their standard operating procedure to extract the victim and secure the victim to the backboard on a gurney.
- The covered backboard was inspected after the victim was removed



Figure 12. A backboard and a new packaged cover on the parking lot ready to be deployed. (Scenario 1)



Figure 13. The victim wearing poly/cotton clothing seated in the vehicle. (Scenario 1)





Figure 14. Extraction of the victim from a vehicle onto the covered backboard. (Scenario 1)



Figure 15. The victim secured to a covered backboard on a gurney after removal from the vehicle. (Scenario 1)

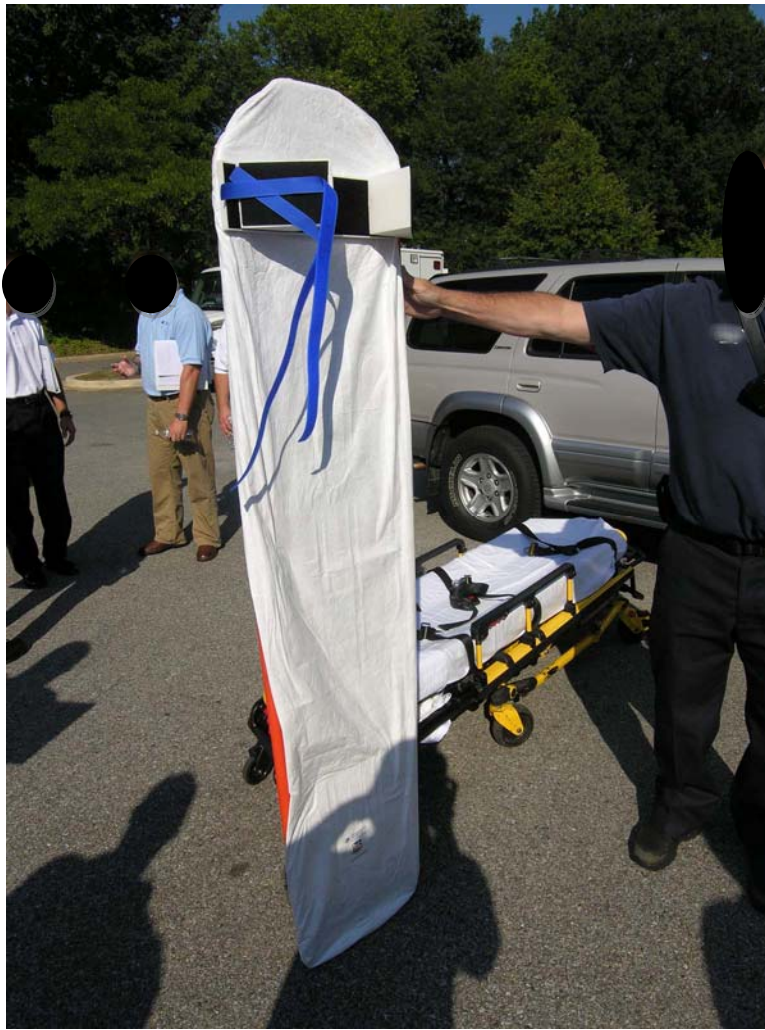


Figure 16. Inspection of the covered backboard after completion of Scenario 1. No damage was observed.

Comments from EMS participants:

- The package was difficult to open
- A lot of plastic/paper trash would be left behind the scene after un-packaging
- Recommended storing the CID straps and CID blocks in the same package
- The victim felt very secure, could not tell the difference from a standard uncovered backboard

## Scenario 2a – Carrying the victim over flat grass terrain on a covered backboard.

**Victim:** Dry  
**Environment:** Dry  
**Terrain:** Flat Grass

Objective: Determine whether the emergency medical services participants can apply the cover in a dry environment while transporting a dry victim over flat grass terrain in a dry environment without any adverse events such as the cover coming off of the backboard or the victim sliding off the backboard

The conditions during the test are summarized below:

- One backboard was used
- One cover was used
- One CID was used
- One set of poly/cotton clothing was used
- No simulated bodily fluids were applied to the victim
- The victim was log rolled onto the covered backboard, secured with spider straps, and carried over flat grass terrain in a dry environment
- The covered backboard was inspected after the victim was removed



Figure 17. The victim wearing Poly/Cotton clothing was log rolled onto the covered backboard. (Scenario 2a)





Figure 18. The victim wearing Poly/Cotton clothing secured with spider straps and ready to be transported across flat grass terrain. (Scenario 2a)



Figure 19. Inspection of the covered backboard after completion of Scenario 2a. No damage was observed.

Comments from EMS participants:

- Some contents unexpectedly came out of the package when the packaging was opened and the backboard cover was removed
- It was easy to learn how to apply the cover to the backboard
- There was no slippage while transporting the victim, the backboard cover worked really well
- After removing the cover from the backboard, some adhesive tape remained on the backboard, but it was easily removed
- The victim could not tell the difference from a standard uncovered backboard and the covered backboard while being transported

## Scenario 2b – Carrying the victim through brush on a covered backboard.

**Victim:** Dry  
**Environment:** Dry  
**Terrain:** Through Brush

Objective: Determine whether the emergency medical services participants can apply the cover in dry environment conditions and transport the victim through brush without any adverse events such as the cover coming off of the backboard or the victim sliding off the backboard

The conditions during the test are summarized below:

- One backboard was used
- One cover was used
- One CID was used
- One set of poly/cotton clothing was used
- No simulated bodily fluids were applied to the victim
- The victim was log rolled onto the covered backboard, secured with spider straps, and carried through brush in a dry environment
- The covered backboard was inspected after the victim was removed



Figure 20. The victim being transported through brush. (Scenario 2b)





Figure 21. Inspection of the covered backboard after completion of Scenario 2b. No damage was found

Comments from EMS participants:

- There was no problem removing the cover from the package
- The application of the cover was easy
- There was some litter from the packaging and tape after removing the cover from the backboard, but that should not be an issue during emergency operations
- The victim felt secure, and did not move on the backboard while being transported

## Scenario 2c – Carrying the victim up/down an embankment on a covered backboard.

**Victim:** Dry  
**Environment:** Dry  
**Terrain:** Up/Down Embankment

Objective: Determine whether the emergency medical services participants can apply the cover in dry environment conditions and transport the victim up and/or down an embankment in a dry environment without any adverse events occurring such as the cover coming off the backboard or the victim sliding off the backboard

The conditions during the test are summarized below:

- One backboard was used
- One cover was used
- One CID was used
- One set of poly/cotton clothing was used
- No simulated bodily fluids were applied to the victim
- The victim was log rolled onto the covered backboard, secured with spider straps, and carried up and down an embankment in a dry environment
- The covered backboard was inspected after the victim was removed



Figure 22. The victim being transported up the embankment. (Scenario 2c)



Figure 23. Inspection of the covered backboard after completion of Scenario 2c. No damage was observed.

Comments from EMS participants:

- Opening the package and applying the cover are simple
- It was easy to deploy and apply the cover to the backboard
- There was no slippage while transporting the victim
- The victim could not tell the difference from a standard uncovered backboard and a covered backboard while being transported



### Scenario 3a – Carrying a blood covered victim over flat grass terrain on a covered backboard.

**Victim:** Wet  
**Environment:** Dry  
**Terrain:** Flat Grass

Objective: Determine whether the presence of bodily fluids on the victim affects cover performance while EMS participants are transporting the victim over flat grass terrain in a dry environment.

The conditions during the test are summarized below:

- One backboard was used
- One cover was used
- One CID was used
- One set of Tyvek clothing was used
- Simulated blood was sprayed onto victim's shoulders and hips
- The victim was log rolled onto the covered backboard, secured with spider straps, and carried over flat grass terrain in a dry environment
- The backboard was inspected after the victim and the cover were removed

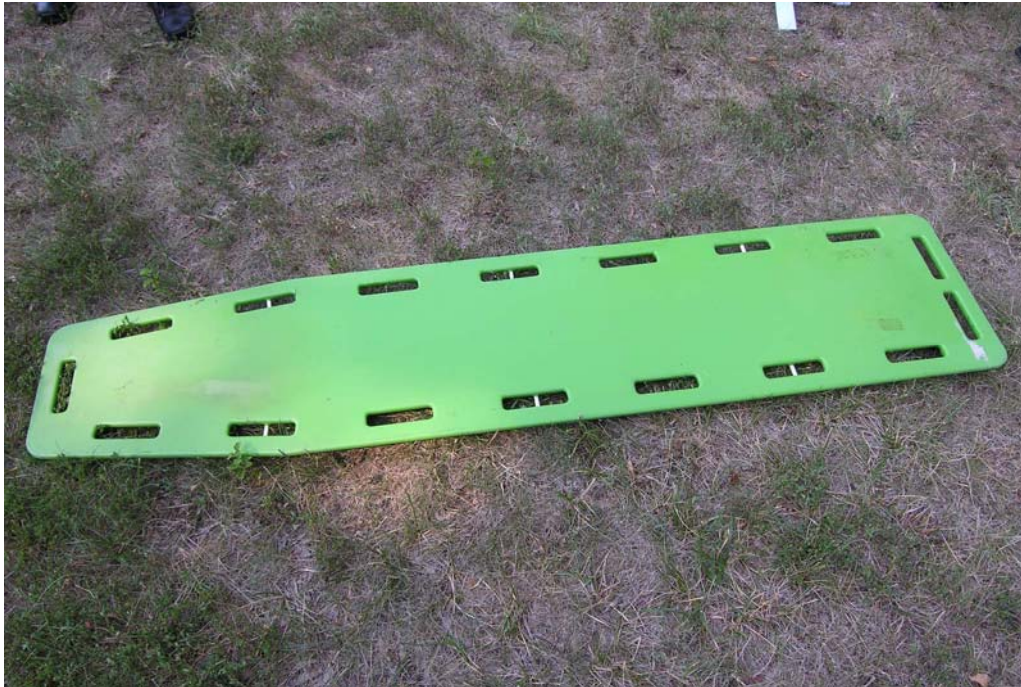


Figure 24. Inspection of the backboard before execution of Scenario 3a.



Figure 25. Simulated blood was sprayed on the victim. (Scenario 3a)



Figure 26. Blood covered victim wearing Tyvek, being secured to the backboard by spider straps in preparation for transport. (Scenario 3a)



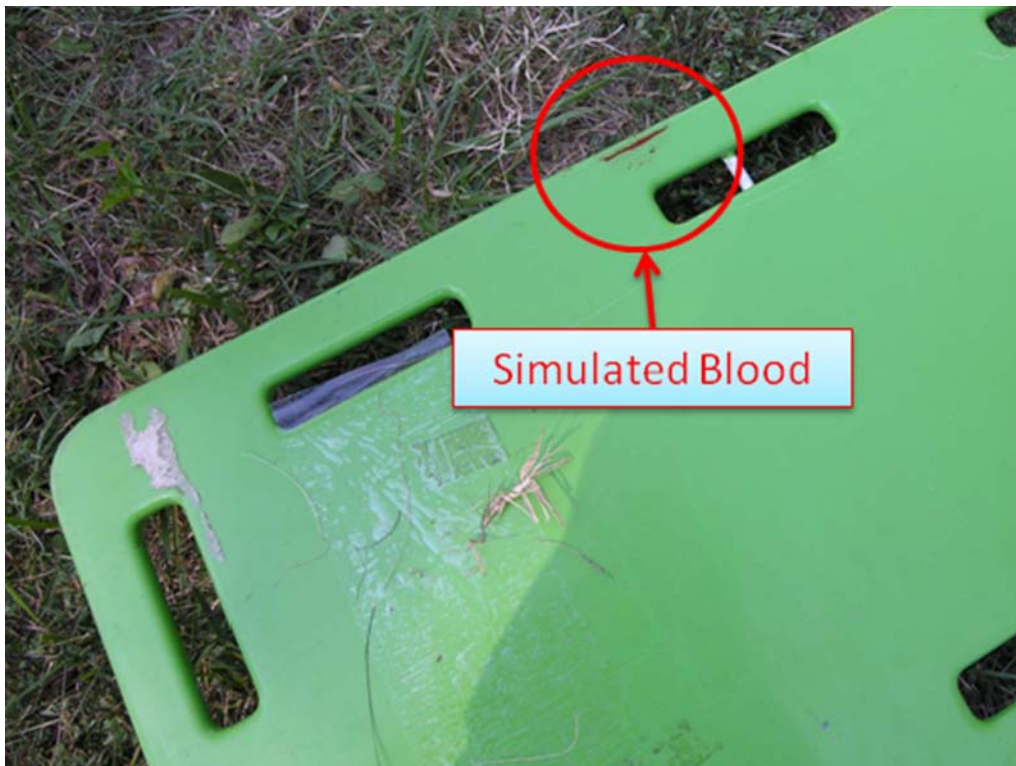


Figure 27. Inspection of the backboard after completion of Scenario 3a. A small amount of simulated blood was found on the edge of the backboard.

Comments from EMS participants:

- The victim could not tell the difference from a standard uncovered backboard and a backboard covered with Board Armor while being transported
- There was a small amount of simulated blood on the handle at the edge of the backboard after Scenario 3a, where the blood covered victim contacted the backboard during the log roll procedure

### Scenario 3b – Carrying a blood covered victim through brush on a covered backboard.

**Victim:** Wet  
**Environment:** Dry  
**Terrain:** Through Brush

Objective: Determine whether the presence of bodily fluids on the victim affects cover performance while EMS participants transporting the victim through brush in a dry environment.

The conditions during the test are summarized below:

- One backboard was used
- One cover was used
- One CID was used
- One set of Tyvek clothing was used
- Simulated blood was sprayed onto victim's shoulders and hips
- The victim was log rolled onto the covered backboard, secured with spider straps, and carried through brush in a dry environment
- The backboard was inspected after the victim and the cover were removed



Figure 28. Log rolling the blood covered victim onto the covered backboard. (Scenario 3b)

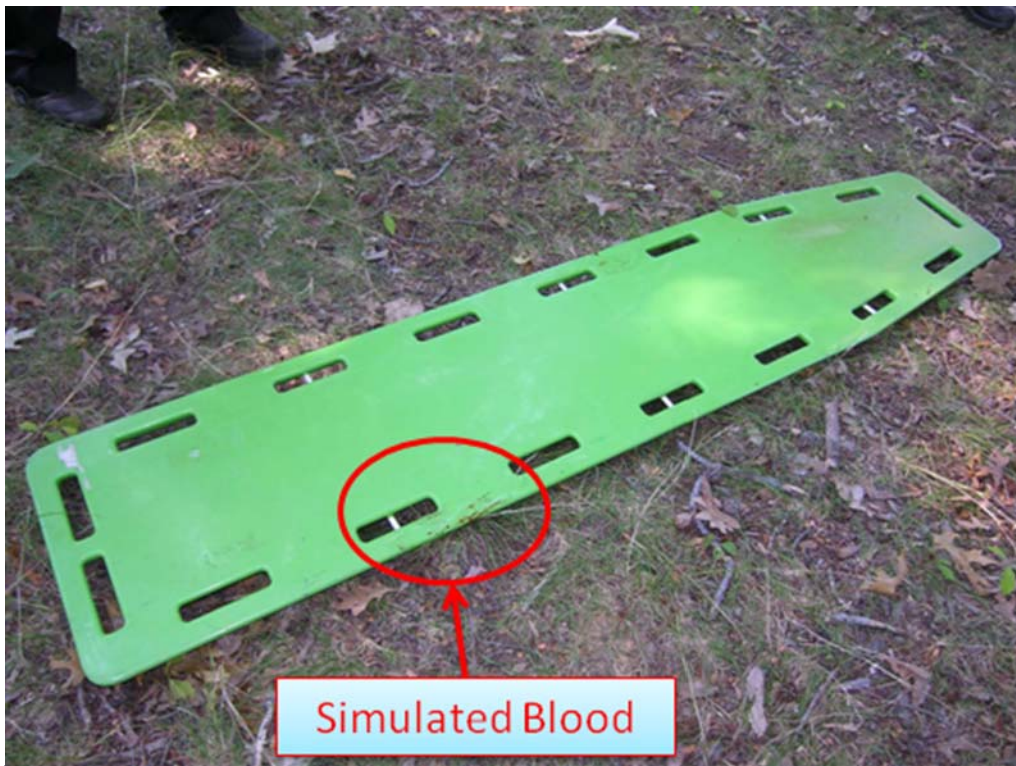


Figure 29. Inspection of backboard after completion of Scenario 3b. A small amount of simulated blood was found on the edge of the backboard.

Comments from EMS participants:

- The covered backboard was ready for log rolling the victim in 60 seconds or less
- The victim felt secure even without using C-Collar to secure the neck/head
- There was a small amount of blood on the handle at the edge of the backboard after scenario 3b, where the blood covered victim contacted the backboard during the log roll procedure



### Scenario 3c – Carrying a blood covered victim up/down an embankment on a covered backboard.

**Victim:** Wet  
**Environment:** Dry  
**Terrain:** Up/Down Embankment

Objective: Determine whether the presence of bodily fluids on the victim affects cover performance while EMS participants transport the victim up and/or down an embankment in a dry environment.

The conditions during the test are summarized below:

- One backboard was used
- One cover was used
- One CID was used
- One set of inside out Tyvek victim clothing was used
- Simulated blood was sprayed onto victim's shoulder and hips
- The victim was log rolled onto the covered backboard, secured with spider straps and carried up and down an embankment in a dry environment
- The backboard was inspected after the victim and the cover were removed



Figure 30. Simulated blood was sprayed on the victim's shoulders and hips. (Scenario 3c)



Figure 31. Transporting the blood covered victim down the embankment. (Scenario 3c)



Figure 32. View of the covered backboard after the victim was removed. (Scenario 3c)



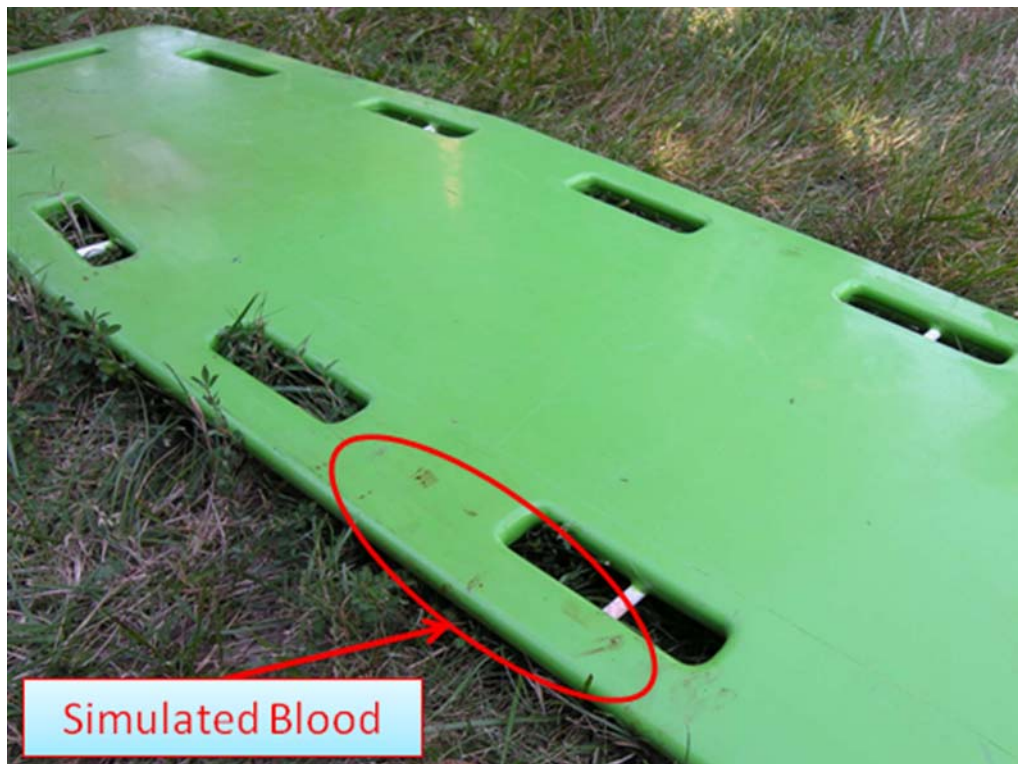


Figure 33. Inspection of the backboard after completion of Scenario 3c. A small amount of simulated blood was found on the edge of the backboard.

Comments from EMS participants:

- The victim felt he was sliding a bit back and forth on the backboard while being transported. The amount of movement was the same as being transported on the backboard without a cover
- There was some minor amount of simulated blood found on the front edge of the backboard

#### Scenario 4aa – Carrying the victim over flat grass terrain on a blood covered backboard.

**Victim:** Dry  
**Environment:** Dry  
**Terrain:** Flat Grass

Objective: Determine whether the presence of dried and rehydrated bodily fluids on the backboard affects cover performance while EMS participants transport the victim on in a dry environment.

The conditions during the test are summarized below:

- One backboard was used
- One cover was used
- One CID was used
- One set of poly/cotton victim clothing was used
- Simulated blood was sprayed onto flat uncovered backboard and allowed to dry
- Simulated blood was rehydrated with a water spray bottle before cover was applied The backboard cover was applied to the backboard
- The victim was log rolled onto the covered backboard, secured with spider straps, and carried over flat grass terrain in a dry environment
- The victim and the covered backboard were inspected after the scenario



Figure 34. Rehydrated simulated blood applied on the backboard prior to applying the cover. (Scenario 4aa)

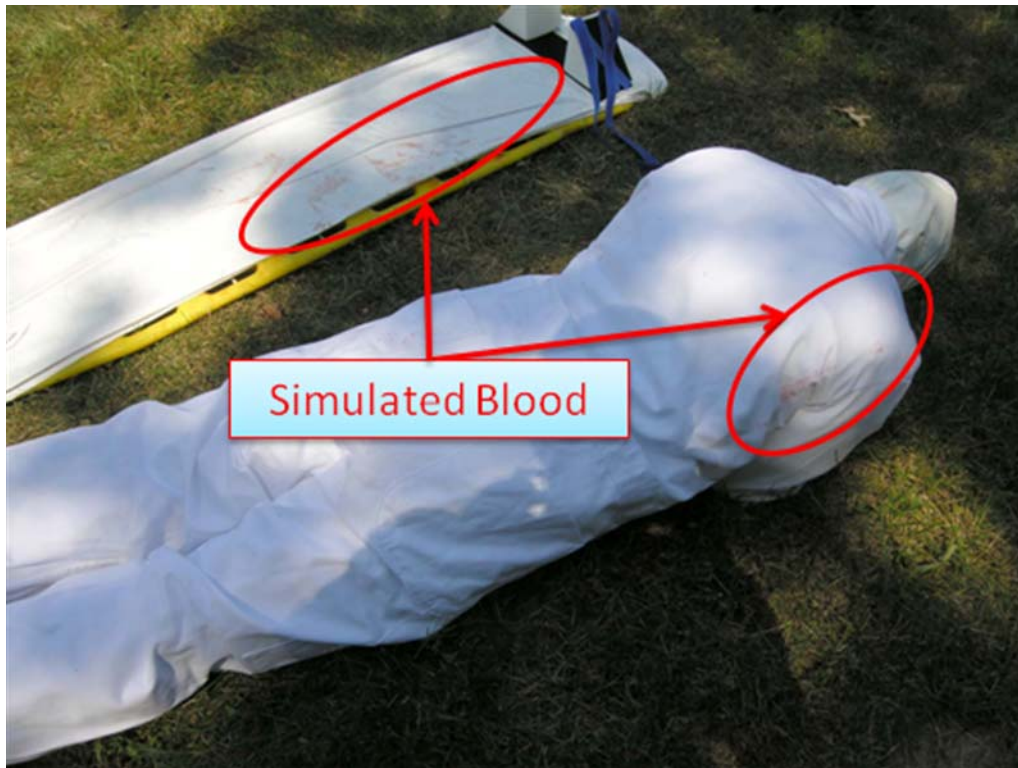


Figure 35. Inspection of the victim's back and the covered backboard after completion of Scenario 4aa. A small amount of simulated blood was found on the cover and the victim's shoulder.

Comments from EMS participants:

- The victim could not tell the difference from a standard uncovered backboard and a covered backboard while being transported
- There was small amount of simulated blood on the backboard cover side (not in contact with the backboard) and the back of the victim



#### **Scenario 4ab – Carrying the victim over flat grass terrain on a blood covered backboard.**

**Victim:** Dry  
**Environment:** Dry  
**Terrain:** Flat Grass

Objective: Determine whether the presence of dried and rehydrated blood on the backboard affects cover performance while EMS participants transport the victim on a covered backboard secured with medical tape over flat grass terrain in a dry environment.

The conditions during the test are summarized below:

- One backboard was used
- One cover was used
- One CID was used
- One set of poly/cotton victim clothing was used
- Simulated blood sprayed onto flat uncovered backboard and allowed to dry
- Simulated blood was rehydrated with a water spray bottle before the cover was applied The backboard cover was applied to the backboard
- Tape was used to secure the cover during this scenario (suggested by EMS participants) to test the compatibility with the cover
- The victim was log rolled onto the covered backboard, secured with spider straps and carried over flat grass terrain in a dry environment
- The victim and the covered backboard were inspected after the test



Figure 36. Rehydrated blood applied on the backboard prior to applying the cover. (Scenario 4ab)

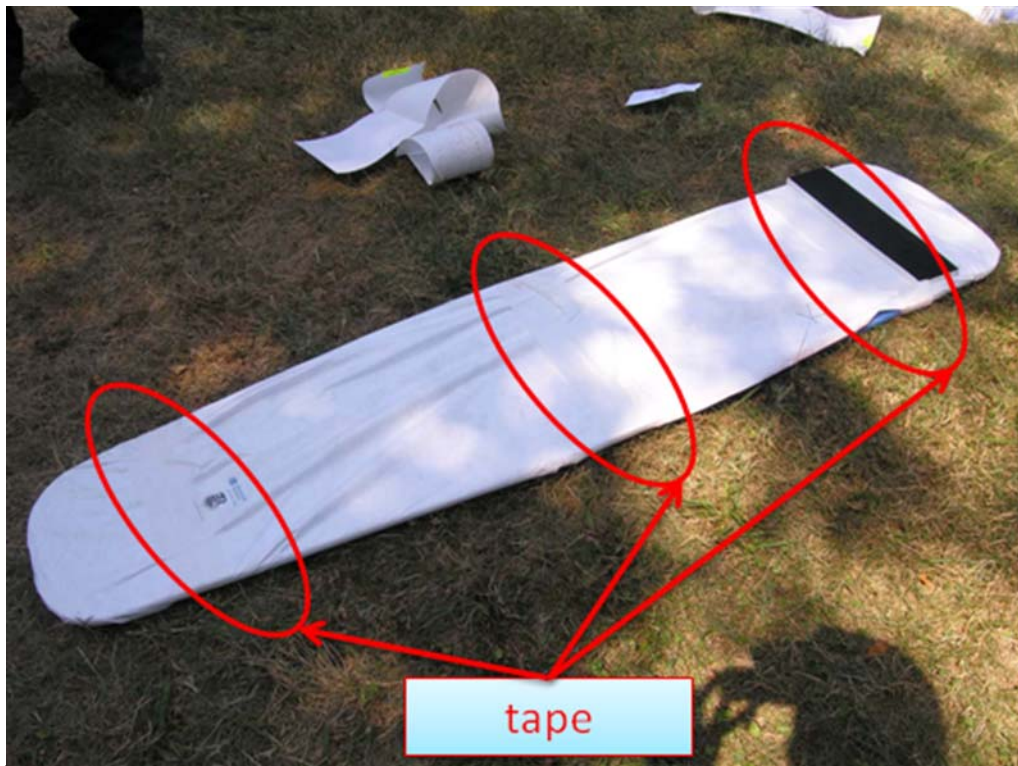


Figure 37. The covered backboard was taped before transporting the victim. The cover worked well with the tape. (Scenario 4ab)



Figure 38. Inspection of the covered backboard after Scenario 4ab. A small tear was observed on the cover.



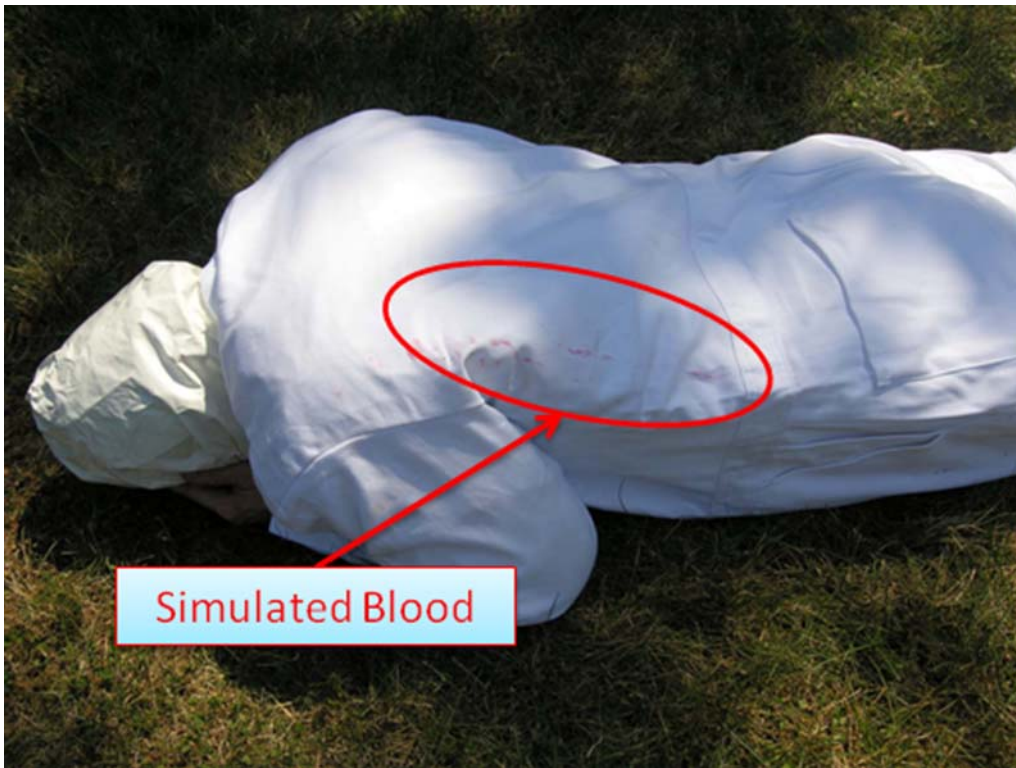


Figure 39. Inspection of the victim's back after Scenario 4ab. A small amount of simulated blood was found on the victim's back.

Comments from EMS participants:

- The victim could not tell the difference from a standard uncovered backboard and a covered backboard while being transported
- There was small amount of simulated blood found on the victim's back
- There was a small tear found near the head area of the cover

#### **Scenario 4ac – Carrying the victim through brush on a blood covered backboard.**

**Victim:** Dry  
**Environment:** Dry  
**Terrain:** Through Brush

Objective: Determine whether the presence of dried and rehydrated bodily fluids on the backboard affects cover performance while EMS participants transport the victim on a taped backboard through brush in a dry environment.

The conditions during the test are summarized below:

- One backboard was used
- One cover was used
- One CID was used
- One set of poly/cotton victim clothing was used
- Simulated blood was sprayed onto flat uncovered backboard and allowed to dry
- Simulated blood was rehydrated with water spray bottle before cover was applied
- The backboard cover was applied to the backboard
- Medical Tape was used to secure the cover during this scenario
- The victim was log rolled onto the covered backboard, secured with spider straps, and carried through brush in a dry environment
- The victim and the covered backboard were inspected after the test



Figure 40. View of the cover taped to the backboard which was covered with rehydrated simulated blood.  
(Scenario 4ac)

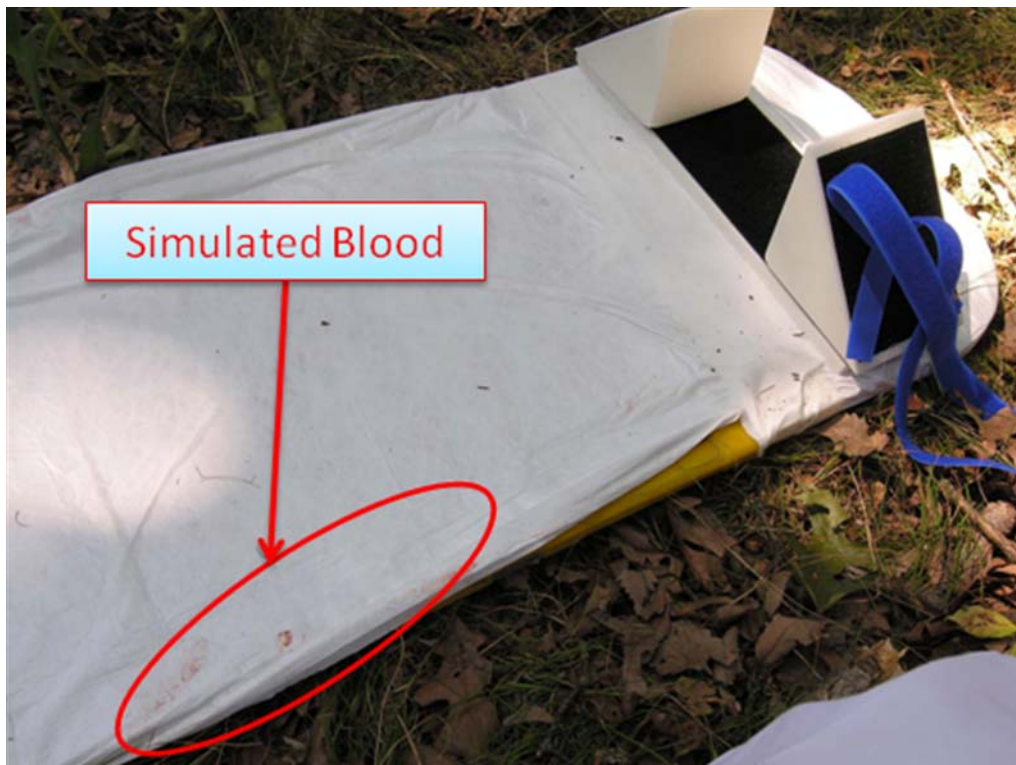


Figure 41. Inspection of the covered backboard after completion of Scenario 4ac. Minor simulated blood was found.

Comments from EMS participants:

- The tape appeared to work well during the scenario 4ac
- There was small amount of simulated blood on the edge of the covered backboard



## Scenario 4b – Carrying the victim up/down an embankment on a blood covered backboard.

**Victim:** Dry  
**Environment:** Dry  
**Terrain:** Up/Down Embankment

Objective: Determine whether the presence of dried and rehydrated bodily fluids affects cover performance while EMS participants transport the victim on the blood covered backboard up and/or down an embankment in a dry environment

The conditions during the test are summarized below:

- One new model backboard was used
- One cover was used
- One CID was used
- One set of poly/cotton victim clothing was used
- Simulated blood was sprayed onto flat uncovered backboard
- The backboard cover was applied to the blood covered backboard
- The victim was log rolled onto the covered backboard, secured with spider straps, and carried up and down an embankment in a dry environment
- The victim and the covered backboard were inspected after the scenario



Figure 42. Applying the cover to the simulated blood covered backboard. (Scenario 4b)



Figure 43. Transporting the victim down the embankment. (Scenario 4b)

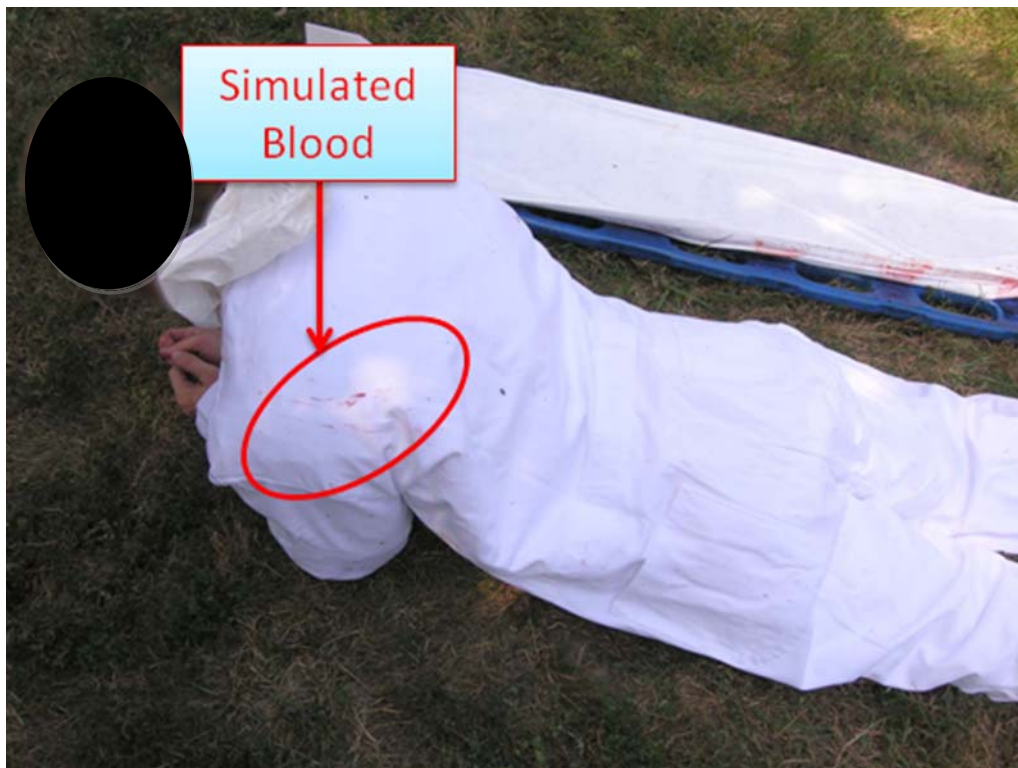


Figure 44. Inspection of the covered backboard and the victim's back after the completion of Scenario 4b. Minor simulated blood spot were found on the victim's shoulder.

Comments from EMS participants:

- The adhesive was not as sticky, but it still held and worked well during the test
- There were no differences in applying the backboard cover to the new model backboard used during this test from the procedures used for the previous backboards
- The victim could not tell the difference from a standard uncovered backboard and a covered backboard while being transported.
- There was a small amount of simulated blood found on the victim's shoulder



### Scenario 5a – Carrying the victim over flat grass terrain on a wet backboard.

**Victim:** Wet  
**Environment:** Wet  
**Terrain:** Flat Grass

Objective: Determine whether the presence water on the backboard affects cover performance while EMS participants are transporting a blood covered victim over flat grass in a wet environment.

The conditions during the test are summarized below:

- One backboard was used
- One cover was used
- One CID was used
- One set of Tyvek clothing was used
- Simulated rain from a garden hose was sprayed onto the backboard and the victim to simulate a wet environment
- Simulated blood was sprayed onto the prone victim
- The backboard cover was applied to the wet backboard (simulated rain)
- The victim was log rolled onto the covered backboard, secured with spider straps, and carried over flat grass terrain in a wet environment
- The backboard was inspected after the test after the cover and the victim were removed



Figure 45. View of the blood covered victim and the covered backboard (Scenario 5a).



Figure 46. View of the victim's back and the covered backboard after Scenario 5a.

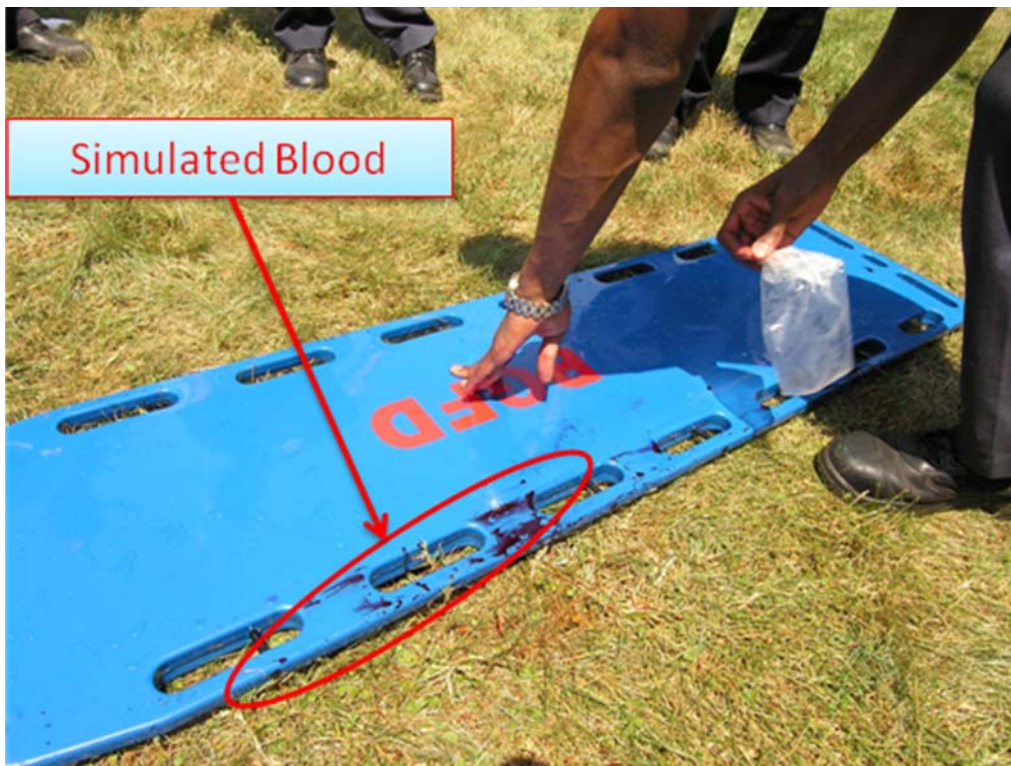


Figure 47. Inspection of the backboard after completion of Scenario 5a. A small amount of simulated blood was found at the edge of the backboard.



Comments from EMS participants:

- There was no slippage while the victim was being transported
- There was a small amount of simulated blood found on the edge of the backboard

## Scenario 5b – Carrying the victim up/down an embankment on a wet backboard.

**Victim:** Wet  
**Environment:** Wet  
**Terrain:** Up/Down Embankment

Objective: Determine whether an excess amount of water on the backboard affects cover performance while EMS participants are transporting a blood covered victim on a covered backboard up and down an embankment in a wet environment.

The conditions during the test are summarized below:

- One backboard was used
- One cover was used
- One CID was used
- One set of Tyvek clothing was used
- Simulated rain from a garden hose was sprayed onto the backboard and the victim to simulate a wet environment
- Simulated blood was sprayed onto the prone victim
- The backboard cover was applied to the wet backboard (simulated rain)
- The victim was log rolled onto the covered backboard, secured with spider straps, and carried up and down an embankment in a wet environment
- The backboard was inspected after the victim and the cover were removed



Figure 48. View of the wet backboard (simulated rain) and the cover in an unopened package. (Scenario 5b)



Figure 49. View of the covered backboard and the victim after completion of Scenario 5b

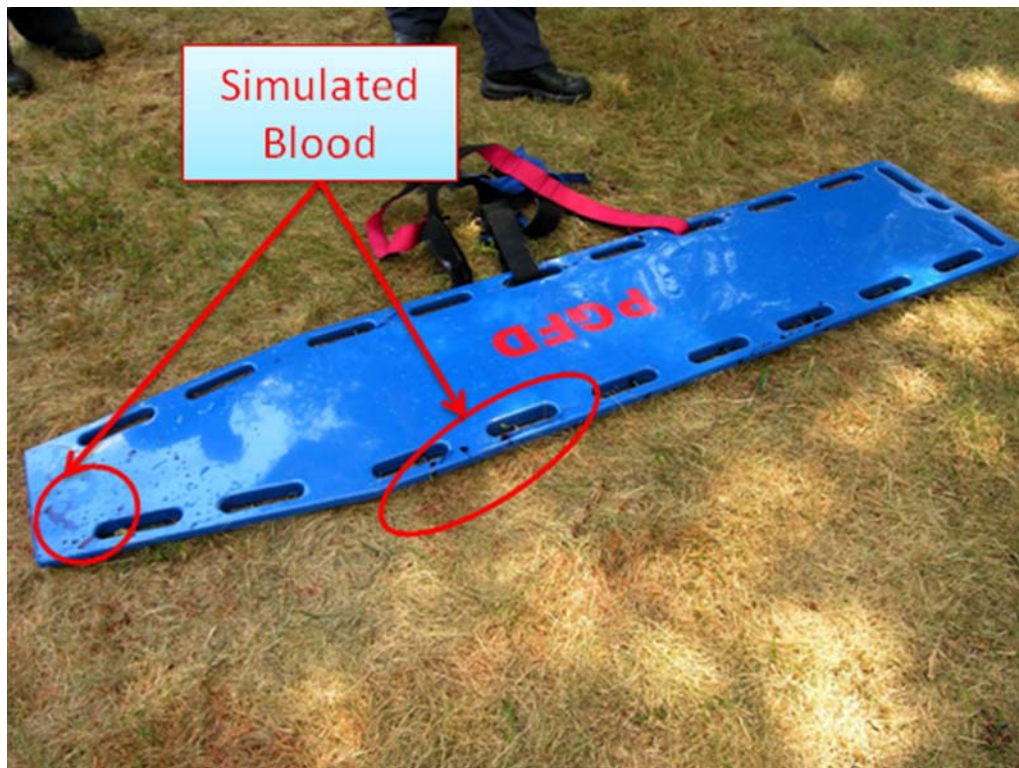


Figure 50. Inspection of the backboard after completion of Scenario 5b. A small amount of simulated blood was found on the edge of the backboard.

Comments from EMS participants:

- There was no slippage while transporting the victim
- There was some simulated blood found at the edge of the backboard



## Scenario 6 – Carrying the victim up/down an interior stairwell on a covered backboard.

**Victim:** Wet  
**Environment:** Dry  
**Terrain:** NA

Objective: Determine the performance of the cover while transporting the victim up and/or down an interior stairwell

The conditions during the test are summarized below:

- One backboard was used
- One cover was used
- One CID was used
- No special clothing was used on the victim
- The victim was log rolled onto the covered backboard, secured with spider straps and carried up and down a stairwell
- The transportation path through Building #830 started at the backdoor, proceeded up the stairwell, and continued through a hall to the engine room. The path was then reversed.
- The covered backboard was inspected after the victim was removed



Figure 51. The victim being secured on the backboard. (Scenario 6)



Figure 52. Transporting the victim down a stairwell. (Scenario 6)



Figure 53. View of the backboard after the completion of Scenario 6. No damage was observed.

Comments from EMS participants:

- EMS participants typically use a flexible stretcher for this type of transport.

## **Results and Discussion**

This section presents the results and findings from the Operational Field Assessment of the Board Armor Backboard Cover. The results are based upon the responses from the Prince George County Fire/EMS test participants before and after conducting the Operational Field Assessments.

### **Pre-Assessment Survey Results**

As indicated earlier, using the Pre-Assessment Survey forms, the Prince George County Fire/EMS test participants were requested to determine which function(s) of the Board Armor Backboard Cover were considered the most important. The following performance functions of the Board Armor Backboard Cover were considered to be the most important:

- The ability to cover the backboard quickly and thoroughly.
- The ability to reduce contamination of the backboard by bodily fluid from the victim and contamination of the victim by fluid on the backboard.
- The ability to securely transport the victim.

### **Operational Field Assessment Survey Results**

Eleven EMS personnel participated in the Operational Field Assessment and utilized field assessment survey forms (see Figure 11) to numerically evaluate the performance of the Board Armor Backboard Cover. Each EMS participant applied a score ranging from 10 (good performance) to 1 (bad performance) to each test scenario executed. The EMS participants average score for each scenario executed is presented in Table 1 below. As indicated in the table, most of the average scores are above 9.0, indicating that the Board Armor Backboard Cover performed well in all scenarios. The function of un-packaging and applying the Board Armor Backboard Cover received relatively low scores during the initial scenarios. However, as illustrated in Figure 54, the scores given to this function improved significantly as EMS participants became more familiar with the product. This indicates that after gaining some experience with the product (e.g. training), the un-packaging and applying the cover improved. In summary, the EMS participants were all very satisfied with the performance of the Board Armor Backboard Cover in conjunction with their standard operation procedures.



Table 1. Average Scores from the Board Armor Backboard Cover Operational Field Assessment Survey

Function	Scenario																
	Scenario 1: Extraction of a victim from a vehicle	Scenario 2a: Carrying the victim over flat grass terrain on a covered backboard	Scenario 2b: Carrying the victim through brush on a covered backboard	Scenario 2c: Carrying the victim through brush on a embankment on a covered backboard	Scenario 3a: Carrying a blood covered victim up/down an grass terrain on a covered backboard	Scenario 3b: Carrying a blood covered victim over flat brush on a covered backboard	Scenario 3c: Carrying a blood covered victim through an embankment on a covered backboard	Scenario 4aa: Carrying a blood covered victim up/down on a blood covered backboard	Scenario 4ab: Carrying the victim over flat grass terrain on a blood covered backboard	Scenario 4ac: Carrying the victim over flat grass terrain blood covered backboard	Scenario 4b: Carrying the victim through brush on a embankment on a blood covered backboard	Scenario 5a: Carrying the victim up/down an on a wet backboard	Scenario 5b: Carrying the victim over flat grass terrain embankment on a wet backboard	Scenario 6: Carrying the victim up/down an stairwell on a covered backboard			
Store backboard cover with EMS equipment	9.30	9.10	9.50	9.38	9.38	9.00	9.50	9.25	9.38	9.38	9.38	9.43	9.43	8.88			
Unpackage the backboard cover quickly	6.64	8.27	8.20	8.13	8.25	8.25	9.25	8.75	8.88	9.25	9.00	8.86	8.86	8.25			
Cover board quickly and thoroughly	8.82	9.09	9.70	9.63	9.38	9.50	9.50	8.50	9.00	9.50	9.25	9.43	9.57	8.75			
Log Roll or Place victim on covered backboard	9.20	9.10	9.60	9.71	9.57	9.38	9.38	9.13	9.25	9.50	9.50	9.38	9.50	8.89			
Securely transport victim on backboard	9.78	9.00	9.73	9.00	9.38	9.13	8.63	9.13	9.25	9.38	9.50	9.13	9.38	8.67			
Remove the victim from the backboard cover	8.55	8.82	9.40	9.25	9.38	9.38	9.63	9.25	9.25	9.25	9.25	9.25	9.38	8.78			
Remove the cover from the backboard	8.70	8.82	9.56	8.38	9.13	9.50	9.38	8.88	9.38	9.50	9.13	9.25	9.50	8.89			
Dispose backboard cover	9.00	8.64	9.33	9.50	9.50	9.50	9.13	8.75	9.13	9.38	9.00	9.25	9.50	8.89			
Inspect backboard/victim					8.89	9.33	8.80	9.11	8.78	9.44	9.22	9.20	9.40	8.89			

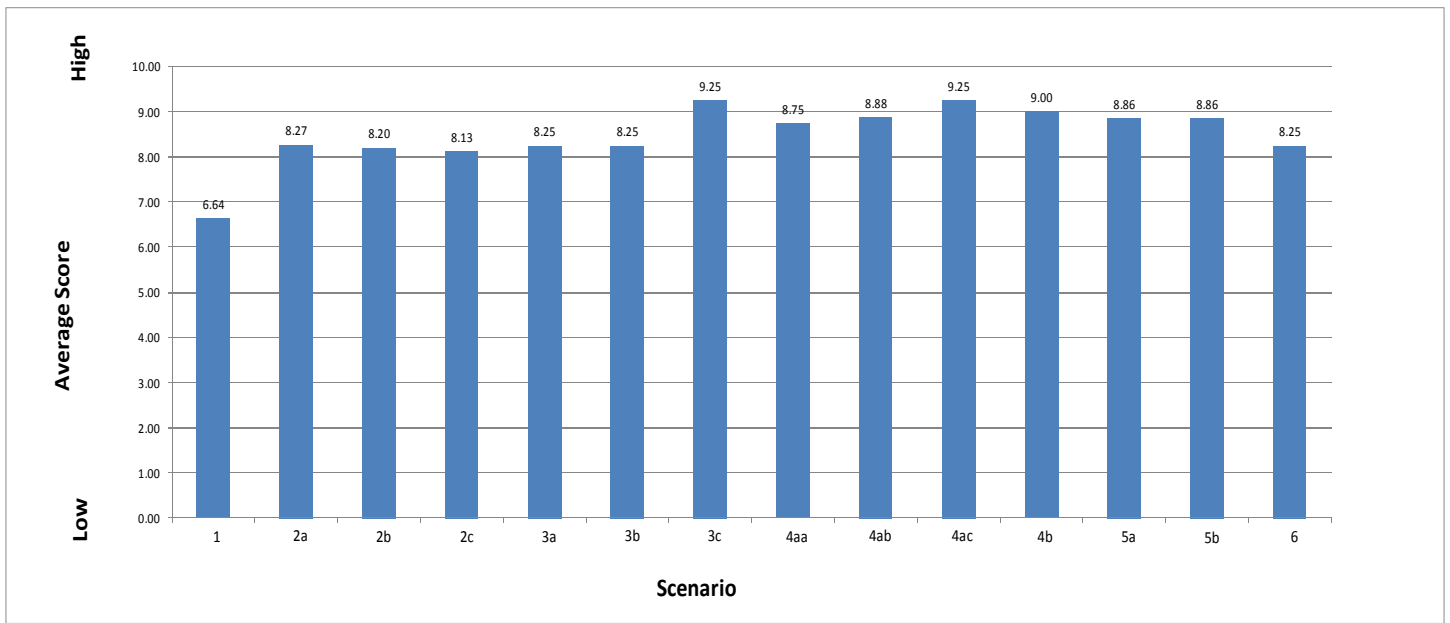


Figure 54. Average Score vs. Scenario Chart for the Function: Un-packaging and applying the backboard cover.

## **Findings and Recommendations**

This Operational Field Assessment evaluated the performance of the Board Armor Backboard Cover in a full range of scenarios developed by EMS first responders. Based on the evaluations performed and reported herein, including comments from EMS test participants, the following findings appear warranted:

- The Board Armor Backboard Cover was easy to deploy, and robust enough to deal with a full range of environments and the elements.
  - There was one minor tear in the Board Armor Backboard Cover, but the tear was local and did not affect the overall performance of the cover.
  - The Board Armor Backboard Cover was designed to be a one-time use item, and the minor tear that occurred by the elastic strip did not compromise the integrity of the barrier device.
- The victim was maintained in a stable condition, and there was no slippage between the victim and the Board Armor Backboard Cover.
- There was some minor contamination at the edges and handles of the backboard from the blood covered victim and EMS participants handling the backboard during transport.
- The Board Armor Backboard Cover was effective in protecting the victim from contamination.
- The backboard was much cleaner after usage than it would be without the Board Armor Backboard Cover.
- The Board Armor Backboard Cover adhered well to the backboard even in wet conditions.
- The Board Armor Backboard Cover protected the EMS participants from simulated blood on the backboard.
- It was easy to remove the Board Armor Backboard Cover from the backboard.

In summary, the EMS participants were very satisfied with the performance of the Board Armor Backboard Cover. Their overall impression was that the product is easy to deploy, sufficiently robust, performed per the stated requirements as identified by the EMS community.  
a full range of representative emergency operation scenarios.

Based on the results of the assessment and feedback from test participants, a suggested area for improvement to the Board Armor Backboard Cover that might be considered is the packaging. The package could be more compact (e.g. re-sealable with zipper) and the Cervical Immobilization Device (CID), backboard cover and head straps could all be placed in one package for easier deployment and disposal. Also, the addition of disposable secure straps would add to the overall usefulness of the backboard cover.

## Appendix

### List of Figures

Number	Title	Page
1.	The Board Armor Backboard Cover with the integrated Cervical Immobilization Device (CID).....	5
2.	The Board Armor Backboard Cover from below. ....	6
3.	Diagram of the Board Armor Backboard Cover system usage.....	8
4.	Sample of a blank Pre-Operational Field Assessment Survey Form.....	10
5.	Image of the Prince George’s County Fire Services Building from above. The boundary of the grounds and prospective testing area is outlined in red. State Route 450 is at the bottom right of the frame.....	11
6.	View of parking lot north of the Fire Services Building. This area was used to simulate the “extraction of a victim from a vehicle” scenario. ....	12
7.	View of the flat grass ground next to the Fire Service Building. This area was used to simulate the scenarios in the flat grass ground. The yellow dotted arrows indicate the route where the victim was transported.....	12
8.	View of the brush cover next to the Fire Service Building. This area was used to simulate the scenarios through brush cover. The yellow dotted arrows indicate the route where the victim was transported. ....	13
9.	View of the grass embankment next to the Fire Service Building. This area was used to simulate scenarios up and down the grass embankment. The yellow dotted arrows indicate the route where the victim was transported.....	13
10.	Image of Volunteer Fire/EMS #830 facility with advanced emergency medical services trucks parked in front of the building.. ....	14
11.	Sample of a blank Operational Field Assessment Survey Form.....	16
12.	A backboard and a new packaged cover on the parking lot ready to be deployed. (Scenario 1) .....	19
13.	The victim wearing poly/cotton clothing seated in the vehicle. (Scenario 1).....	19
14.	Extraction of the victim from a vehicle onto the covered backboard. (Scenario 1) .....	20
15.	The victim was secured to the covered backboard on a gurney after removal from the vehicle and ready to be transported. (Scenario 1) .....	20
16.	Inspection of the covered backboard after completion of Scenario 1. No damage was observed.....	21
17.	The victim wearing Poly/Cotton clothing was log rolled onto the covered backboard. (Scenario 2a) .....	22
18.	The victim wearing Poly/Cotton clothing was secured with spider straps and ready to be transported across flat grass terrain. (Scenario 2a) .....	23
19.	Inspection of the covered backboard after the completion of Scenario 2a. No damage was observed. ....	23
20.	The victim being transported through brush. (Scenario 2b) .....	25
21.	Inspection of the covered backboard after completion of Scenario 2b. No damage was found.....	26
22.	The victim being transported up the embankment. (Scenario 2c) .....	27
23.	Inspection of the covered backboard after the Scenario 2c. No damage was observed. ....	28
24.	Inspection of the backboard before execution of Scenario 3a. ....	29
25.	Simulated blood was sprayed on the victim. (Scenario 3a) .....	30
26.	The blood covered victim wearing inside out Tyvek, being secured to the backboard by spider straps in preparation for transport. (Scenario 3a) .....	30
27.	Inspection of the backboard after completion of Scenario 3a. A small amount of simulated blood was found on the edge of the backboard. ....	31
28.	Log rolling the blood covered victim onto the covered backboard. (Scenario 3b).....	32
29.	Inspection of backboard after completion of Scenario 3b. A small amount of simulated blood was found on the edge of the backboard. ....	33



## List of Figures (Cont'd)

Number	Title	Page
30.	Simulated blood was sprayed on the victim's shoulder and hips. (Scenario 3c).....	34
31.	Transporting the blood covered victim down the embankment. (Scenario 3c) .....	35
32.	View of the covered backboard after the victim was removed. (Scenario 3c) .....	35
33.	Inspection of the backboard after completion of Scenario 3c. A small amount of simulated blood was found on the edge of the backboard. ....	36
34.	Rehydrated simulated blood applied on the backboard prior to applying the cover. (Scenario 4aa) .....	37
35.	Inspection of the victim's back and the covered backboard after completion of Scenario 4aa. A small amount of simulated blood was found on the cover and the victim's shoulder.....	38
36.	Rehydrated blood applied on the backboard prior to applying the cover. (Scenario 4ab).....	39
37.	The covered backboard was taped before transporting the victim. The cover worked well with the tape. (Scenario 4ab) .....	40
38.	Inspection of the covered backboard after Scenario 4ab. A small tear was found on the cover. ....	40
39.	Inspection of the victim's back after Scenario 4ab. A small amount of simulated blood was found on the victim's back.....	41
40.	View of the cover taped to the backboard which was covered with rehydrated simulated blood. (Scenario 4ac).....	43
41.	Inspection of the covered backboard after completion of Scenario 4ac. Minor simulated blood was found. ....	43
42.	Applying the cover to the simulated blood covered backboard. (Scenario 4b) .....	45
43.	Transporting the victim down the embankment. (Scenario 4b).....	46
44.	Inspection of the covered backboard and the victim's back after the completion of Scenario 4b. Minor simulated blood spot were found on the victim's shoulder. ....	46
45.	View of the blood covered victim and the covered backboard (Scenario 5a). ....	48
46.	View of the victim's back and the covered backboard after Scenario 5a. ....	49
47.	Inspection of the backboard after completion of Scenario 5a. A small amount of simulated blood was found at the edge of the backboard. ....	49
48.	View of the wet backboard (simulated rain) and the cover in an unopened package. (Scenario 5b) .....	51
49.	View of the covered backboard and the victim after completion of Scenario 5b.....	52
50.	Inspection of the backboard after completion of Scenario 5b. A small amount of simulated blood was found on the edge of the backboard. ....	52
51.	The victim was ready to be secured on the backboard. (Scenario 6).....	54
52.	Transporting the victim down a stairwell. (Scenario 6).....	55
53.	View of the backboard after the completion of Scenario 6. No damage was observed. ....	55
54.	Average Score vs. Scenario Chart for the Function: Un-packaging and applying the backboard cover.....	59