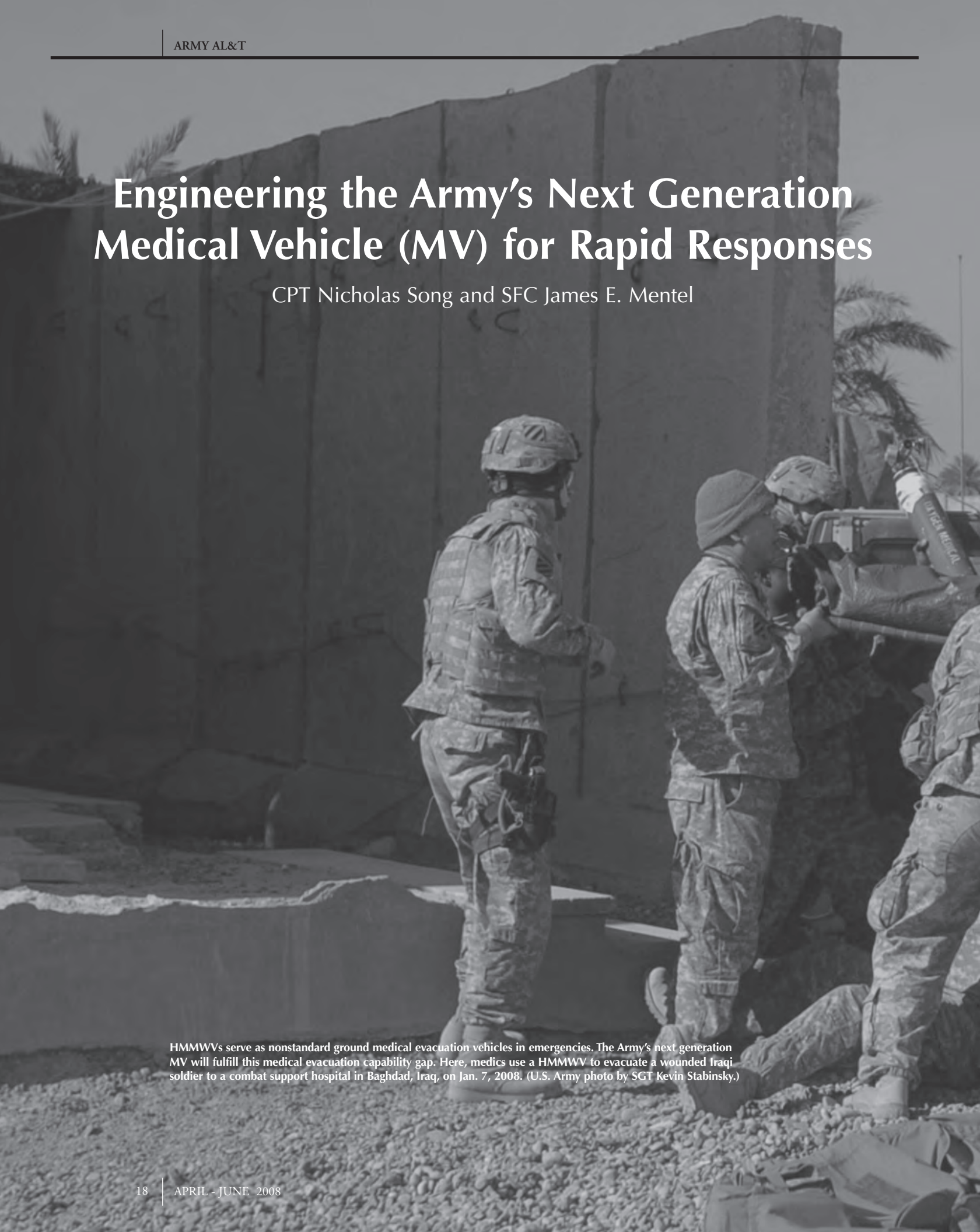


Engineering the Army's Next Generation Medical Vehicle (MV) for Rapid Responses

CPT Nicholas Song and SFC James E. Mentel




HMMWVs serve as nonstandard ground medical evacuation vehicles in emergencies. The Army's next generation MV will fulfill this medical evacuation capability gap. Here, medics use a HMMWV to evacuate a wounded Iraqi soldier to a combat support hospital in Baghdad, Iraq, on Jan. 7, 2008. (U.S. Army photo by SGT Kevin Stabinsky.)

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A medical platoon leader for the 1st Battalion, 504th Parachute Infantry Regiment, deployed in support of *Operation Iraqi Freedom (OIF)*, returned from his battalion's daily Battle Update Brief. He was dismayed by the information he learned from the battalion staff and battalion commander. He discussed the information with his platoon sergeant before disseminating it to his squad leaders.



A 1st Brigade, 3rd Infantry Division Soldier in an M113 armored medical evacuation vehicle transports mock wounded Soldiers during a mission readiness exercise at Fort Stewart, GA, in preparation for deployment to Iraq. (U.S. Army photo by MSG Johancharles Van Boers.)

fills a capability gap desperately needed by the Current Force. The ongoing conflicts in Iraq and Afghanistan have proven that the Army is facing an adaptive and resilient enemy. The enemy has exposed and exploited vulner-

FCS MV

The FCS MV is one of 14 MGVs, unmanned ground vehicles and unmanned aerial vehicles. The MVs are designed on a common chassis with common parts to greatly reduce the FCS logistical footprint and to ensure MVs have mobility, survivability and sustainability equivalent to other FCS (Brigade Combat Team) (BCT) vehicles. Therefore, the new MVs will be able to keep pace with the Infantry Combat Vehicles and Mounted Combat Systems they support.

The FCS MV has two separate variants: MV-Evacuation (MV-E) and MV-Treatment (MV-T). MV-E has

the capability to evacuate up to four litter patients, six ambulatory patients or a combination of three litter and three ambulatory patients. Some key MV design characteristics and capabilities include:

The FCS LLHS can be reconfigured from litter to ambulatory configuration with no tools or removable parts in less than 2 minutes.

- 3-person crew.
- Medic workstation.
- Reconfigured Litter Lift Handling System (LLHS) with no tools.
- Oxygen concentrators.
- Vital signs monitors.
- Rapid Automated Medical Processing Systems (RAMPS).
- Medical Equipment Sets (MES) for ground ambulance.

The MV-T will replace the current Battalion Aid Station and provide Advanced Trauma Life Support anywhere on the battlefield. Some key MV-T design characteristics include:

- 4-person crew
- Treatment table with full body access
- Blood refrigerator
- Oxygen concentrators

“Sergeant, per the Iraqi Theater Policy, and due to the increasing threat of improvised explosive devices [IEDs] and enemy tactics, techniques and procedures [TTPs], soft-skinned vehicles are no longer allowed off the Forward Operating Base [FOB]. This means we cannot use our ambulances for ground medical evacuation,” the lieutenant explained. “How are we going to support the battalion?”

“Relax sir,” the sergeant replied. “Looks like we need to coordinate with battalion for armored HMMWVs [High-Mobility Multipurpose Wheeled Vehicles] to be used as nonstandard evacuation. They only hold one litter, but it is a short-term fix for now. For a long-term solution, we need to talk with the AMEDD C&S [U.S. Army Medical Department Center and Schools]. The Army desperately needs to modernize its ground medical evacuation capability. What we need is a highly mobile, survivable, networked MV with a Soldier-centric design incorporating input from medics and providers so these problems now can be mitigated for the Future Force.”

Future Combat Systems (FCS) has developed the next generation MV that

abilities in U.S. and coalition forces’ equipment, particularly manned ground vehicles (MGVs). Depending on the situation, Iraq theater policies sometimes limit or even prohibit nonarmored vehicles from operating outside of FOBs because of inadequate survivability against IEDs and anti-tank mines. These limitations and/or prohibitions directly impact combat medics and their ability to provide ground medical evacuation on the battlefield with currently fielded U.S. Army MVs: the M113 Tracked Ambulance and M996/M997 Field Litter Ambulance. Medics supporting combat operations must resort to using nonstandard vehicles with the appropriate level of armor protection needed to operate outside of FOBs. The FCS MV has a Soldier-centric design that incorporates input and continual feedback from the user. This involvement early in the systems engineering process optimizes the MV’s capabilities and design, and ensures it meets critical functionality and survivability requirements.

- Medical lighting
- Vital signs monitor
- Quick deployable shelter
- Medic workstation
- MES for trauma and sick call

User Involvement

What separates the FCS MV from its predecessors is that the MV is the first mobile, survivable, networked combat medical evacuation and treatment vehicle being developed around the combat medic and medical providers. This Soldier-centric design ensures that the medical community influences the MV's design early in the development process. Every MV aspect is developed around the medical community, for the combat medics and doctors. Because of the FCS MV's importance to the AMEDD, key billets within the FCS program are filled by medical Military Occupational Specialty (MOS) personnel, who ensure that AMEDD is represented during the development process. Within the Product Management Office (PMO), a branch-qualified field medical assistant serves as the Assistant Product Manager (APM) for MV. Collocated with the PMO, a U.S. Army Training and Doctrine Command Capabilities Manager (TCM) medical noncommissioned officer (NCO) serves as the user representative and requirements lead. Together, the PM and TCM medical personnel work to ensure that appropriate coordination takes place and that the medics/providers — the targeted audience — are delivered a vehicle that allows them to do their job more effectively and efficiently.

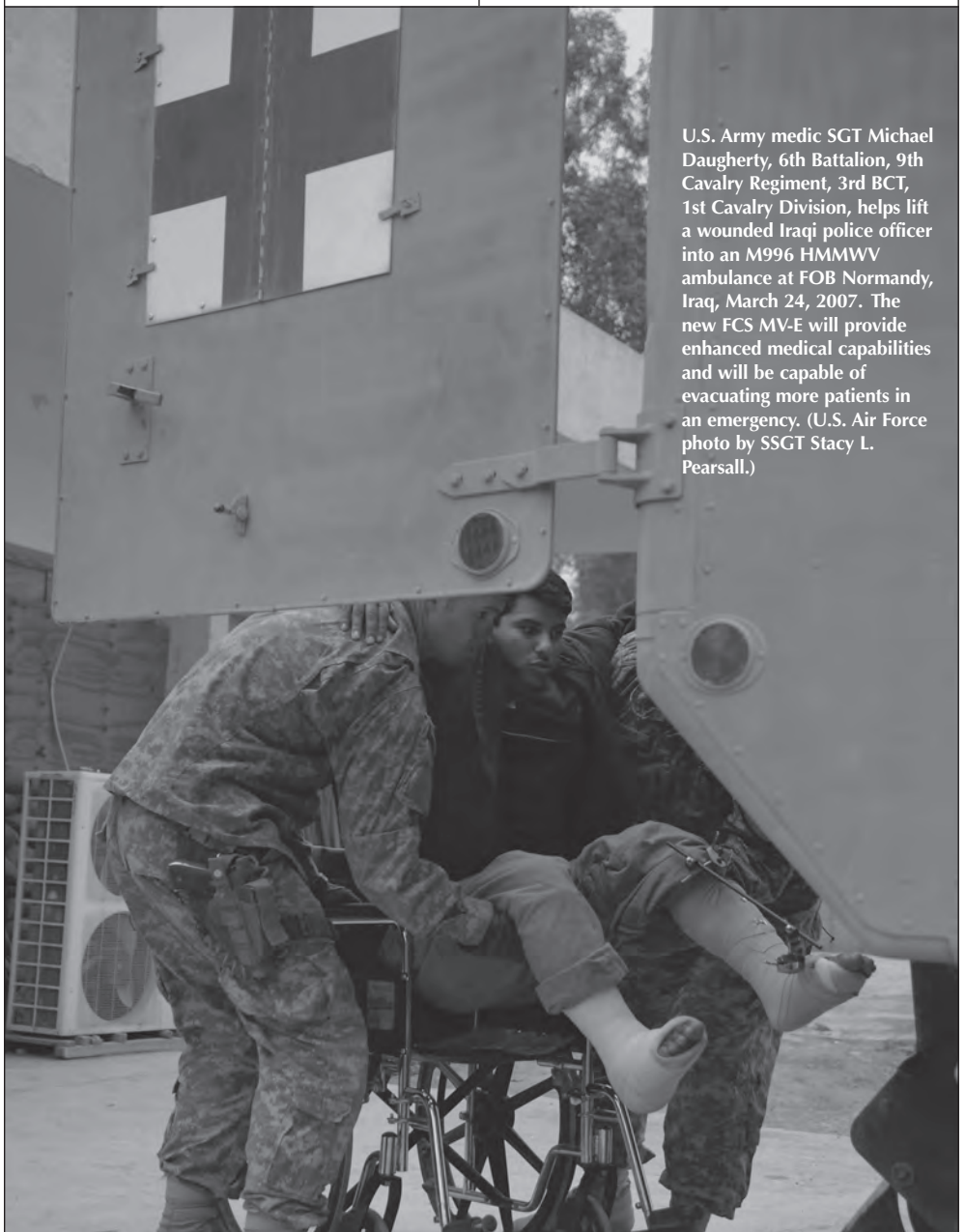
To capitalize on lessons learned, the MV development integrated product team regularly interacts with operational units returning from combat deployments to discuss and receive updates on evolving friendly and enemy TTPs. The first step is identifying the

problems and issues faced by Current Force medics and medical providers. The next step is to use their input on how to improve or fill the needed capability. Interaction with Current Force medical units has been vital in identifying capability gaps and in developing the MV's design concept and functionality. In September 2007, the PM and TCM coordinated to interview several combat medics, medical NCOs and medical providers from the 4th Infantry Division (4ID), Fort Hood, TX, who recently redeployed in support of *OIF*. The interviews helped identify problems that medics, BCT providers

and lower echelons of health care face when capturing medical information digitally. A follow-up coordination session with 4ID providers was then conducted in November 2007 to gain more detailed information on how to resolve current issues. It is through these routine interactions with medical units that two critical pieces of equipment have been developed under the FCS MV: the LLHS and RAMPS.

FCS LLHS

The FCS LLHS resides on the MV-E and is a motorized litter system with the capability to transport up to four



U.S. Army medic SGT Michael Daugherty, 6th Battalion, 9th Cavalry Regiment, 3rd BCT, 1st Cavalry Division, helps lift a wounded Iraqi police officer into an M996 HMMWV ambulance at FOB Normandy, Iraq, March 24, 2007. The new FCS MV-E will provide enhanced medical capabilities and will be capable of evacuating more patients in an emergency. (U.S. Air Force photo by SSGT Stacy L. Pearsall.)

litter patients, six ambulatory patients or a combination of three litter and three ambulatory patients. The FCS LLHS is designed with 3 litter births stacked vertically, with 22 inches between each birth, and a fourth litter on the MV-E's sponson that allows for full body access of patients. It is powered by a single motor that allows raising and lowering of the top litter and minimizes physical strain on the litter bearers during the loading and unloading process. The single motor allows for a synchronized raising and lowering of the entire litter birth, reducing any mechanical jams as found with previous litter lift systems. There is also a manual function incorporated into the design so that, in the event the motor fails, the litter can be raised and lowered manually.

The FCS LLHS can be reconfigured from litter to ambulatory configuration with no tools or removable parts in less than 2 minutes. The FCS LLHS contains a moveable litter tray that pulls out to the vehicle's center aisle allowing the litter to be loaded from the ramp or door, in the event of a ramp failure, and allowing the litter bearers to load the litter without having to enter the vehicle, thereby saving critical time. The litter is supported and secured by the litter stirrups, providing maximum security and overall safety for the patient. Placement of the medic's workstation and patient movement items (PMIs) inside the MV-E maximizes space, functionality and patient care. The LLHS design improves on many currently fielded systems' shortcomings. FCS LLHS design improvements are a direct result of user input and include: how patient litters are secured to the platform; the ability to reconfigure the LLHS from litter

to ambulatory with no tools; the ability to load and unload the LLHS from the ramp door without having to enter the vehicle; and the storage of PMIs for immediate accessibility.

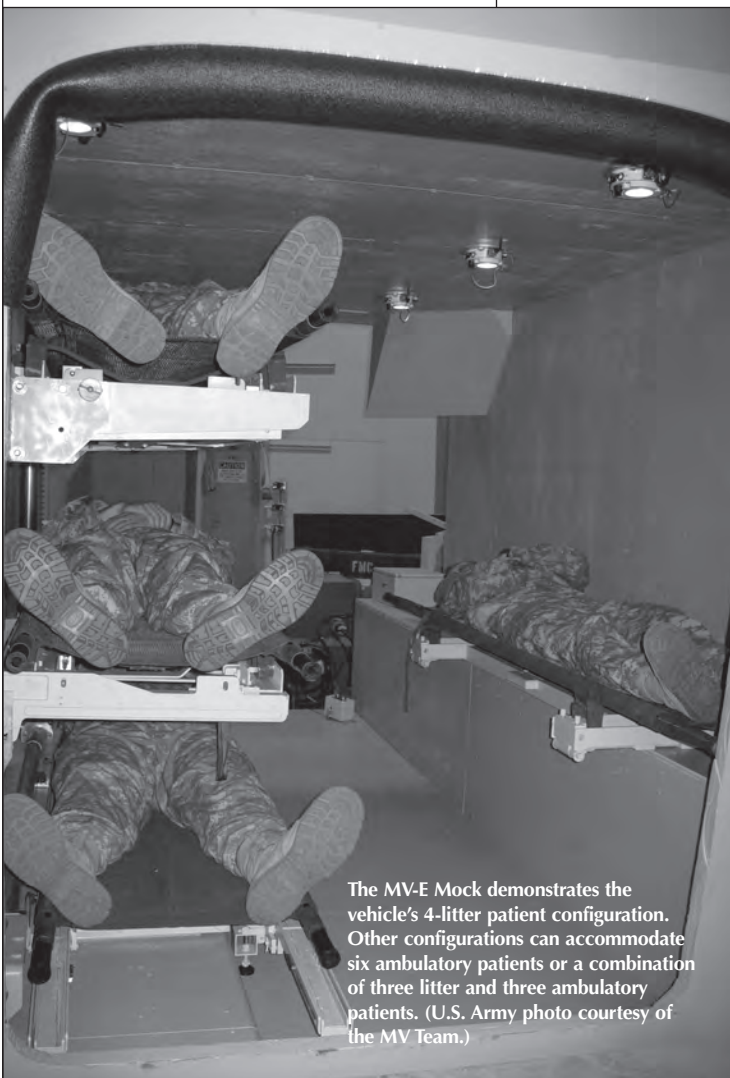
RAMPS stores information on a local database that resides on the MV and possesses the capability to send the information through the FCS network to higher echelons of medical care for their situational awareness on number of casualties, status and location.

RAMPS

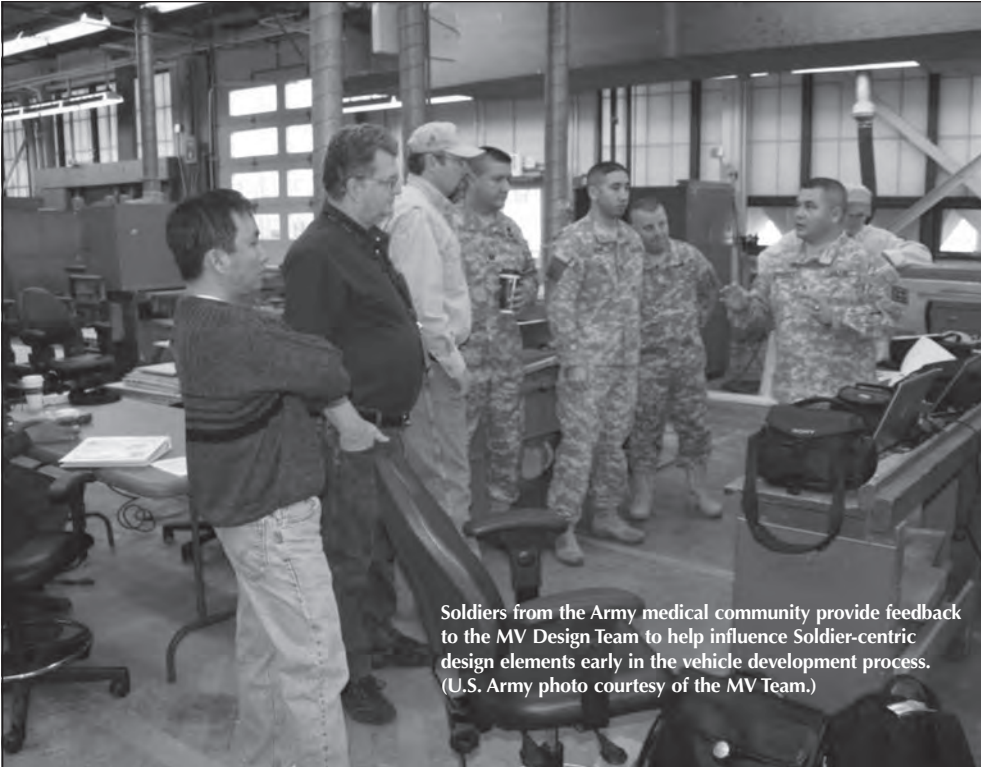
RAMPS provides the medic with the capability to digitally capture medical treatment data performed on the patient and medical status of an injured Soldier.

RAMPS also stores the information on a local database that resides on the MV and possesses the capability to send the information through the FCS network to higher echelons of medical care for their situational awareness on number of casualties, status and location. The ability to capture this information on the MV and send the information prior to the MV's arrival at the medical treatment facility will enable medical providers to proactively prepare for and receive critically wounded Soldiers. In combat, where the cause of death and loss of limbs routinely involves severe trauma and major blood loss, every second counts. Passing this accurate information empowers the medical providers and leaders, allowing them to be proactive rather than reactive in their decision making.

RAMPS also sends the medical information via the FCS network to the Theater Medical Information Program to be stored in a patient's medical record. RAMPS can send and receive critical patient information. Significant effort is being made to provide medics with a user-friendly interface for inputting and recording patient information. User



The MV-E Mock demonstrates the vehicle's 4-litter patient configuration. Other configurations can accommodate six ambulatory patients or a combination of three litter and three ambulatory patients. (U.S. Army photo courtesy of the MV Team.)



Soldiers from the Army medical community provide feedback to the MV Design Team to help influence Soldier-centric design elements early in the vehicle development process. (U.S. Army photo courtesy of the MV Team.)

within the FCS LLHS and RAMPS design and development. Maintaining open communication with our customers has been vital in FCS's success to date and is the key in delivering equipment that makes Soldiers more combat effective and survivable.

CPT NICHOLAS SONG is a Medical Service Corps Officer assigned to Program Manager FCS(BCT) as an APM for PM FCS MV. Prior to that, he served as a Brigade Support Medical Co. (BSMC) Commander with 3rd BCT, 101st Airborne Division (AbnDiv) Air Assault. He has deployed in support of *OIF* (twice) and *Operation Enduring Freedom* as a Medical Platoon Leader and as a BSMC Company Commander. Song holds a B.S. in exercise science and sport studies from Rutgers, The State University of New Jersey. He is Level I certified in acquisition.

SFC JAMES E. MENTEL is an Army Combat Medic assigned as the TCM lead user representative for the FCS MV-E and MV-T variants. Prior to that, he served in various positions including Medical Evacuation NCO, Treatment NCO, Emergency Room NCO, Clinic NCO in charge, Medical Platoon Sergeant and as a Pathfinder Medic with the 101st AbnDiv (Air Assault). Mentel is certified as an Emergency Medical Technician, Advanced Combat Life Support Provider and has earned the coveted Expert Field Medical Badge.

juries of physicians and physician assistants have helped validate and incorporate critical medical functionality into the RAMPS user interface. Medics' and medical providers' input provides software engineers with insight on how to best design the man-machine interface. This strong interaction between the PM and medical community has resulted in a system with a Soldier-friendly interface for capturing/entering medical data, maximizing patient treatment care and minimizing medic information input. RAMPS incorporates touch-screen technology, voice recognition software and PMIs, including a vital signs monitor, oxygen generator, intravenous pump and ultrasound. RAMPS also interfaces with an Electronic Information Carrier, a memory card issued to each Soldier

that will contain a digital copy of his or her deployment medical record.

The ability to capture this information on the MV and send the information prior to the MV's arrival at the medical treatment facility will enable medical providers to proactively prepare for and receive critically wounded Soldiers.

The FCS MV, LLHS and RAMPS are first-hand examples of technology developed with a medical community focus. From FCS program inception, AMEDD C&S has ensured proper representation, via medical MOS billets, within the PMO and TCMs. AMEDD representation embedded through the entire systems engineering process has been vital in ensuring that the operational requirements and needed functionality are incorporated into the MV's preliminary design to fill capability gaps desperately needed by the Current Force. Direct input and feedback from medics and medical providers within operational units has paid dividends during the design and early build phases as documented