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Report Documentation Page

Form Approved
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE 2010	2. REPORT TYPE	3. DATES COVERED 00-00-2010 to 00-00-2010			
4. TITLE AND SUBTITLE New Equipping Strategies for Combat Support Hospitals		5a. CONTRACT NUMBER			
		5b. GRANT NUMBER			
		5c. PROGRAM ELEMENT NUMBER			
6. AUTHOR(S)		5d. PROJECT NUMBER			
		5e. TASK NUMBER			
		5f. WORK UNIT NUMBER			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) RAND Corporation, 1776 Main Street, PO Box 2138, Santa Monica, CA, 90407-2138		8. PERFORMING ORGANIZATION REPORT NUMBER			
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S)			
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)			
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 132	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

This product is part of the RAND Corporation monograph series. RAND monographs present major research findings that address the challenges facing the public and private sectors. All RAND monographs undergo rigorous peer review to ensure high standards for research quality and objectivity.

New Equipping Strategies for Combat Support Hospitals

Matthew W. Lewis, Aimee Bower, Mishaw T. Cuyler, Rick Eden,
Ronald E. Harper, Kristy Gonzalez Morganti, Adam C. Resnick,
Elizabeth D. Steiner, Rupa S. Valdez

Prepared for the United States Army
Approved for public release, distribution unlimited



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Center for Military Health Policy Research

The research described in this report was sponsored by the United States Army under Contract No. W74V8H-06-C-0001.

Library of Congress Cataloging-in-Publication Data

New equipping strategies for combat support hospitals / Matthew W. Lewis ... [et al].
p. cm.

Includes bibliographical references.

ISBN 978-0-8330-4996-4 (pbk. : alk. paper)

1. Military hospitals—United States—Equipment and supplies. 2. Military hospitals—United States—Planning. 3. Military hospitals—United States—Management.
4. United States. Army—Medical supplies. I. Lewis, Matthew W.

UH473.N38 2010

355.3'45—dc22

2010019796

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Published 2010 by the RAND Corporation

1776 Main Street, P.O. Box 2138, Santa Monica, CA 90407-2138

1200 South Hayes Street, Arlington, VA 22202-5050

4570 Fifth Avenue, Suite 600, Pittsburgh, PA 15213-2665

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Preface

This monograph documents findings and recommendations from the RAND Arroyo Center project “AMEDD’s [Army Medical Department’s] Equipping and Maintenance Solution to ARFORGEN [Army Force Generation].” The objective of the project was to develop and evaluate alternative strategies for equipping the Army’s Combat Support Hospitals (CSHs) that would meet their equipment needs in each of the readiness pools of the ARFORGEN cycle.

The study identified a new equipping and maintenance strategy that has the potential to enable the Army to reduce the cost of equipping and maintaining its CSHs at fully modernized levels, providing them with equipment that is newer and in better condition on average than what they have now. Because the proposed strategy represents radical change in several respects, the study recommends a phased implementation, beginning with the fielding of new equipment set designs to several active and reserve CSHs at home station. Evaluation of the performance and effects of these sets will permit fine tuning of the proposed strategy.

This research was sponsored by the Commanding General, U.S. Army Medical Command/The Surgeon General. It was conducted within RAND Arroyo Center. The research was managed jointly by RAND Arroyo Center’s Military Logistics Program, directed by Ken Girardini, and the RAND Center for Military Health Policy Research, co-directed by Sue Hosek and Terri Tanielian. RAND Arroyo Center, part of the RAND Corporation, is the United States Army’s federally funded research and development center for policy studies and analyses. The RAND Center for Military Health Policy Research is a joint endeavor of RAND Arroyo Center and RAND Health.

The Project Unique Identification Code (PUIC) for the project that produced this document is MCCSG08834.

For more information on RAND Arroyo Center, contact the Director of Operations (telephone 310-393-0411, extension 6419; fax 310-451-6952; email Marcy_Agmon@rand.org), or visit Arroyo's web site at <http://www.rand.org/ard/>.

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Summary

Combat Support Hospitals

The U.S. Army uses Combat Support Hospitals (CSHs)—mobile, deployable hospitals housed in tents and expandable containers—to provide surgical and trauma care close to combat action. A CSH is a 248-bed hospital staffed by approximately 500 personnel. Modular in design, it can also operate as two geographically separated hospitals (“split-based operations”), one with 164 beds and the other with 84 beds. CSHs provide the highest level of in-theater medical care available to American military personnel serving in active, deployed operations, including stabilization and surgical capabilities comparable to those in the trauma centers of major hospitals in the United States. Currently the Army has 29 CSHs, soon to be reduced to 26: 10 in the active component (8 in the continental United States and 2 forward stationed in South Korea and Germany) and 16 in the U.S. Army Reserve.

Equipping and Maintenance Challenges

A CSH’s ability to deliver high-quality medical care depends in large part on its possessing well-maintained, state-of-the-art medical equipment. However, a CSH’s need for medical equipment is not stable but rather varies widely depending on whether it is preparing to deploy, deployed, available to be deployed, or returning from a deployment.

- CSHs typically only operate as hospitals when they are deployed, and deployments are infrequent: for an active component CSH, no more often than one year out of three; for a reserve CSH, no more often than one year out of five.
- Even if deployed, a CSH often does not deploy with its own medical equipment. Instead, its personnel often fall in on equipment downloaded from Army Prepositioned Stocks (APS) or Theater Provided Equipment (TPE).
- When not deployed, the CSH’s primary need for equipment is to support training activities that rarely require a full-scale 248-bed hospital, so a large portion of its equipment is stored at the Sierra Army Depot (SIAD) and not accessed.

In addition, like all hospitals, CSHs must keep their medical equipment state of the art. Since much CSH equipment is not in continual use, items can become outdated while receiving limited or even zero use. Thus, questions arise regarding when equipment should be upgraded and whether it is worthwhile for the Army to keep equipment used for training or stored at SIAD upgraded to the same degree as the equipment being used by deployed CSHs.

Research Objective and Approach

The Surgeon General of the U.S. Army sponsored the research reported here to develop and evaluate alternative strategies for equipping the Army's CSHs that would meet their equipment needs in all phases of the deployment and redeployment cycle (the ARFORGEN [Army Force Generation] cycle). We employed a number of methods to execute the research. To gain an understanding of the perspectives of AMEDD (Army Medical Department) personnel on the current state of equipping and maintenance, we conducted focus groups, surveys, and interviews. We attended AMEDD conferences and visited key sites and organizations to conduct interviews. To understand costs and obsolescence risk, we analyzed data on CSH medical equipment maintenance, procurement, requirements, useful life, and obsolescence rates. To understand the prospective value and feasibility of alternative procurement strategies, we reviewed commercial and academic literature on leasing and conducted interviews with medical equipment procurement experts from hospitals, equipment manufacturers, and consulting organizations. To understand how alternative equipping strategies would perform over time, we used spreadsheet modeling and discrete event simulation.

Findings

Our analyses showed that the current CSH equipping and maintenance strategy has resulted in the Army owning more CSH medical equipment than it appears to need to support units throughout the ARFORGEN cycle, more than it seems to have the maintenance resources to keep in good condition, and more than it has had the budgetary resources to keep technologically current.

CSH medical equipment resides in four large pools:

- **Home station equipment sets.** These consist of the portion of a CSH's 248-bed hospital it retains at home station, with the remainder being stored at SIAD.
- **Centralized assets.** These are of two types, both stored at SIAD. First, there are almost two dozen 164-bed hospital modules, which are owned (i.e., on the property books) by CSHs and represent the portion or "balance" of their medi-

cal equipment that units are storing while retaining the 84-bed modules at home station. Second, there are also four full 248-bed hospital equipment sets in the U.S. Army Medical Materiel Agency's (USAMMA's) Medical Materiel Readiness Program (MMRP), which are ready for immediate deployment with any CSH that might require them.

- **Training site equipment.** The Army has three Regional Training Sites-Medical (RTS-Med) with full 248-bed CSH equipment sets plus a training facility with a partial CSH equipment set at Fort Polk (associated with the Joint Readiness Training Center) that can be used by CSHs to conduct training activities.
- **Army Prepositioned Stocks.** The Army has six 248-bed hospitals and one 44-bed Early Entry Hospital Element (EEHE) module in APS.

The current equipping and maintenance strategy has left the equipment in some of these four pools in better condition than others, in terms of both maintenance and technological currency. Currently, most CSH units do not own and train on the most up-to-date equipment except when they are deployed to Afghanistan and Iraq, where they fall in on modernized-generation equipment sets established in those theaters. The sets in APS, consisting of six full CSH sets and one 44-bed EEHE, are also technologically current, as are the two full CSH sets in the MMRP. By contrast, other CSH sets—including those at home station, those at the RTS-Med, and those stored at SIAD—have not been modernized in at least five years. Moreover, none of the equipment stored at SIAD is utilized either for training or missions—or at least has not been in a very long time.

Recommendations

Because the CSH equipment in APS and MMRP is technologically current and in good condition, we focused our efforts to develop an equipping and maintenance strategy to improve the situation in the other pools of equipment. For home station equipment sets, we recommend that the Army move to new designs that are better aligned with training needs, with different designs for active and reserve component CSHs.

- If the Army decides that active component CSHs should have the capability to train for split-based operations at home station, it should adopt a design termed the Split-Based Operations (SBO) set. The SBO set would provide similar equipment and medical capability in both the Alpha and Bravo medical companies, providing two 32-bed hospitals, each with 12 ICU (intensive care unit) beds and 20 ICW (intermediate care ward) beds. Though the SBO design has fewer total beds than the current design, its adoption would double the surgical and trauma capability at home station.

- If active component CSHs can train for split-based operations elsewhere than at home station, such as at an RTS-Med, then they should adopt a set termed the Enhanced Capability, Single Base (ECSB). The ECSB design would provide a CSH with a single 32-bed hospital at home station on which it could train and execute all hospital functions (except for dental).
- We recommend that reserve component CSHs adopt a very lean equipment set at home station, termed the Training Equipment Only (TEO) set. The TEO design would not provide a CSH with a full hospital or any real capacity to provide medical care locally; rather, it would provide a very limited set of equipment sufficient to allow the CSH personnel to train to conduct certain core hospital functions.

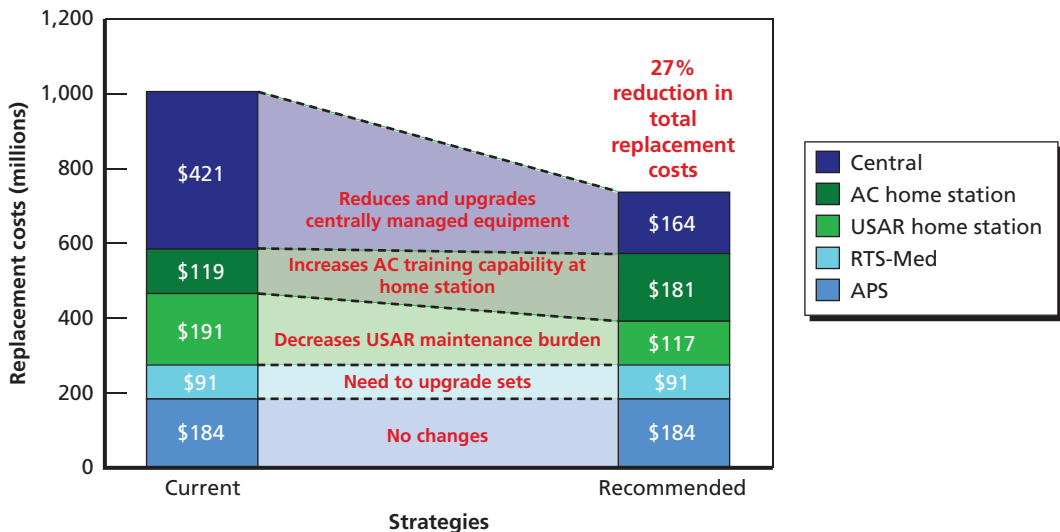
We recommend that the Army regularly upgrade these sets during the Reset phase of the ARFORGEN cycle (i.e., every three years for active CSHs and every five years for reserve CSHs).

For training sites, we recommend that the Army improve the currency of the equipment sets. We also recommend that it improve the flexibility of the sites to tailor the equipment configurations for training exercises to the needs of specific CSHs. Flexibility might be enhanced by leasing some medical equipment. For example, some of the medical equipment stored in APS or MMRP, which might not be used at all before being superseded in the Army's inventory by newer models, might be considered for lease.

For centralized assets at SIAD (other than MMRP), we recommend that the Army permit CSHs to share these assets rather than have a one-to-one correspondence between home station equipment sets and these partial "balance" sets at SIAD. Balance sets provide CSHs with the option of deploying with their home station equipment. To implement this aspect of the recommendation, the Army would need to address how CSHs would report their readiness when some of their MTOE (Modified Table of Equipment) is represented by shared equipment residing in a centralized asset pool. In conjunction, the Army should then reduce the number of balance sets, improving the condition and currency of the remaining sets, and change what equipment is in each set in accordance with the associated recommended changes in home station sets.

Overall, we recommend an equipping and maintenance strategy that would result in fewer, but regularly modernized, full hospital sets systemwide, resulting in less total medical equipment: the total equipment replacement cost at today's prices would decrease from approximately \$1 billion to about \$740 million, more than a one-quarter reduction (see Figure S.1). A reduced inventory of medical equipment would reduce maintenance and upgrade costs, making it easier for the Army to ensure that CSH equipment is well maintained and state of the art. Nevertheless, the overarching intent of the recommended strategy is to improve training and deployed capabilities, not reduce costs.

Figure S.1
The Recommended Equipping and Maintenance Strategy Would Result in a Leaner Total Inventory of CSH Medical Equipment That Is Less Expensive to Maintain and Keep Current



SOURCE: USAMMA POM data, current replacement prices.

RAND MG887-S.1

Implementing the New Equipping and Maintenance Strategy

Because the recommended equipping and maintenance strategy would represent a radical departure from the current strategy in many respects, it needs to be vetted with stakeholders in the operations, maintenance, clinical, and training communities, and they should be included in efforts to refine and test the strategy. Thus, it would be prudent for the Army to begin moving toward the new strategy by fielding the new home station equipment designs at a few active and reserve CSHs, and then evaluating their performance in terms of the mission, maintenance, training, and manning effects of the designs. In conjunction, the Army should begin to reduce the number of balances in the Hospital Optimization and Standardization Program (HOSP) and Reserve Component Hospital Decrement (RCHD) programs at SIAD.

The Army should survey CSH commanders to gain a detailed and updated understanding of what training products and services they would like to be able to obtain from the RTS-Med. Under the new strategy, the reserve CSHs may have a need to expand their reliance on RTS-Med and MTTs (Mobile Training Teams). The Army should address the desire of CSH commanders, expressed in focus groups, to have the medical equipment in the training base upgraded to current generation, and it should

anticipate a call for increased flexibility to tailor the training sites to mirror the equipment and facilities that deploying CSHs will encounter in deployed operations.

To improve its flexibility to configure training sites, the Army should explore leasing as a means of permitting the RTS-Med to acquire equipment temporarily for training when the item is not part of the MTOE but is being used by CSHs in theater. The Army should further investigate leasing high-cost medical equipment with a short technological lifespan for centralized training and in pools that have a lower chance of deployment.

The recommended equipping and maintenance strategy would substantially reduce the cost of equipping and maintaining the Army's CSHs, while providing them with equipment that is newer and in better condition on average than what they have now. Additionally, further exploring into how RTS-Med, MTTs, and leasing could be leveraged could offer further opportunities.

Acknowledgments

Many individuals in the U.S. Army and at RAND contributed to the design and execution of the research reported here.

This research benefited greatly from the participation of many Army Medical Department staff members. Without their honest, frank input and commitments of time to provide background information on many AMEDD issues, this research would have been significantly more difficult and not as effective. The authors would like to thank the participants in the survey and focus groups that provided invaluable input to the design of equipping and maintenance solutions. Their time, suggestions, and feedback greatly influenced the course of the project.

LTC Charles H. Strite Jr., Deputy Commander for Operations, USAMMA, Fort Detrick, MD, and LTC James Tuten, Director of Force Sustainment, USAMMA, provided a great deal of insight and guidance throughout the project and helped to sharpen the design of the equipping options we explored. Mr. Jack Rosarius of the Medical Maintenance Operations Division provided information on maintenance practices, cost, and performance. Mr. John Lapham of USAMMA provided invaluable introductions to many aspects of USAMMA funding and equipping practices. Dr. James Kirkpatrick of AMEDD's Directorate of Combat and Doctrine Development and COL Timothy Lamb, supported by MAJ Gary Cooper, included members of our team in visits to Sierra Army Depot and Hill Air Force Base. Our project team was generously hosted by LTC Keith Kizzie of FORSCOM at the 2008 CSH commanders conference, where we were able to collect data and conduct focus group sessions.

Mr. Ed Arominski of the USARC Surgeon's Office was also extremely helpful in providing guidance to this work and access to U.S. Army Reserve CSH staff to collect data. His knowledge of reserve CSH operations and the history of reserve CSH equipment sets provided valuable insights and context for our research.

Finally, we are indebted to COL Jim Signiago (U.S. Army, ret.), who provided much initial guidance and entree to the AMEDD community, and to COL Edmund Haraguchi, who as Director of Logistics on the Surgeon General's staff oversaw the execution of the project, for providing open access to all elements of AMEDD's resources and supporting a steady stream of interim project reviews (IPRs) at which the team gained valuable feedback.

At RAND, we benefited from the guidance and support of two research managers: Eric Peltz, then director of RAND Arroyo Center's Military Logistics Program, and Sue Hosek, co-director of the RAND Health Center for Military Health Policy Research.

We thank Donna White for her expert assistance in correcting, improving, and managing our text and graphics files through many iterations.

Glossary of Acronyms

AC	Active Component
AFB	Air Force Base
AHA	American Hospital Association
AMC	Army Materiel Command
AMEDD	Army Medical Department
APS	Army Prepositioned Stocks
ARFORGEN	Army Force Generation [Process]
ARMT	Army Reset Management Tool
ARTEP	Army Training and Evaluation Program
ASIOE	Associated Support Items of Equipment
AUQE	Authorized Equipment
CEF	Contingency Expeditionary Force
CHS	Community Health Systems
CMAP	Centrally Managed Asset Pool
CO	Company
CONUS	Continental United States
CSH	Combat Support Hospital
CSM	Command Sergeant Major
CT	Computed Tomography
CTC	Combat Training Centers
DCDD	Directorate of Combat and Doctrine Development
DEF	Deployed Expeditionary Force
DEPMEDS	Deployable Medical Systems
DLA	Defense Logistics Agency
DMRTI	Defense Medical Readiness Training Institute

DoD	Department of Defense
DSCP	Defense Supply Center, Philadelphia
DSO	Domestic Support Operation
ECSB	Enhanced Capability, Single Base
EEHE	Early Entry Hospital Element
ELFA	Equipment Leasing and Financing Association
EMEDS	Expeditionary Medical Support
EMT	Emergency Medical Treatment
ERC	Equipment Readiness Code
FM	Field Manual
FORSCOM	Forces Command
FST	Forward Surgical Team
FTX	Field Training Exercise
FY	Fiscal Year
GE	General Electric
GPO	Group Purchasing Organization
HAE	Hospital Augmentation Element
HHD	Headquarters and Headquarters Detachment
HOSP	Hospital Optimization Standardization Program
HQ	Headquarters
ICU	Intensive Care Unit
ICW	Intermediate Care Ward
IDT	Inactive Duty Training
ISO	International Organization for Standardization
JRTC	Joint Readiness Training Center
LBE	Left Behind Equipment
LICC	Lease in Case of Contingency
LIN	Line Item Number
LTG	Lieutenant General
MASH	Mobile Army Surgical Hospital
MCO	Major Combat Operations
MEDCOM	U.S. Army Medical Command

MEDSILS	Medical Services Information Logistics System
MEET	Minimum Essential Equipment for Training
MES	Medical Equipment Set
MFH	Mobile Field Hospital
MMRP	Medical Materiel Readiness Program
MMS	Medical Materiel Set
MRC	Major Regional Contingency
MRI	Medical Reengineering Initiative
MRTC	Medical Readiness and Training Command
MTF	Medical Treatment Facility
MTOE	Modified Table of Organization and Equipment
MTP	Medical Treatment Plan
MTT	Mobile Training Team
NIIN	National Item Identification Number
NPC	National Product Council
NV	Nevada
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
OMA	Operations and Maintenance, Army
ONS	Operational Needs Statement
OPA	Other Procurement, Army
OTSG	Office of the Surgeon General
Ps&Ds	Potency [Items] and Dated [Items]
POM	Program Objective Memorandum
PROFIS	Professional Filler System
PUIC	Project Unique Identification Code
PUAEQ	Parent Unit Authorized Equipment
PUREQ	Parent Unit Required Equipment
RCHD	Reserve Component Hospital Decrement
REQEQ	Required Equipment
RFF	Request for Forces
RTS-Med	Regional Training Site-Medical

Rx	Pharmacy
S-3	Staff 3 [Operations Officer]
SBE	Stay Behind Equipment
SBO	Split-Based Operations
SIAD	Sierra Army Depot
SKO	Sets, Kits, and Outfits
SRC	Special Requirements Code
TAC-SiMM	Tactical Simulator for Military Medicine
TDY	Temporary Duty
TEO	Training Equipment Only
TOE	Table of Organization and Equipment
TPE	Theater Provided Equipment
TSG	The Surgeon General
UA	Unit Assemblage
UCLA	University of California, Los Angeles
USAF	U.S. Air Force
USAFMSA	U.S. Army Force Management Support Agency
USAMMA	U.S. Army Medical Materiel Agency
USAR	U.S. Army Reserve
USARC	U.S. Army Reserve Command
VMI	Vendor-Managed Inventory
XO	Executive Officer

Introduction

Thanks to the popularity of the *M*A*S*H* film and television series, even many Americans without military experience are familiar with the basic concept of an Army field hospital: a mobile, deployable hospital housed in tents and expandable containers quite unlike the permanent, fixed facilities that we think of as standard for hospitals but quite capable of caring for critically wounded soldiers. The U.S. Army continues to rely on such field hospitals to provide surgical and trauma care close to combat action; the successor to the Mobile Army Surgical Hospital (MASH) is the current Combat Support Hospital (CSH), pictured in Figure 1.1.

Figure 1.1
A Partial Army Combat Support Hospital Set Up at Fort Lewis



RAND MG887-1.1

As delineated by its Table of Organization and Equipment (TOE), a CSH is a 248-bed hospital staffed by approximately 500 personnel. Modular in design, it can also operate in the field in a “split-based” configuration as two geographically separated hospitals, one with 164 beds and the other with 84 beds. As Figure 1.2 shows, these are organized as two companies (Alpha and Bravo, respectively) reporting to a common headquarters. Each company and modular hospital component includes a headquarters section, supply and services, nutrition care, hospital ministry, and patient administration, as well as the full range of wards and medical functions required for a trauma/surgical hospital. To further enable partial deployment and deployment in stages, the Alpha Company is further divided into two submodules: the 44-bed Early Entry Hospital Element (EEHE) and the 40-bed Hospital Augmentation Element (HAE). Currently the Army has 29 CSHs, soon to be reduced to 26: 10 in the active component (8 stationed in the continental United States and 2 forward stationed in South Korea and Germany) and 16 in the U.S. Army Reserve.

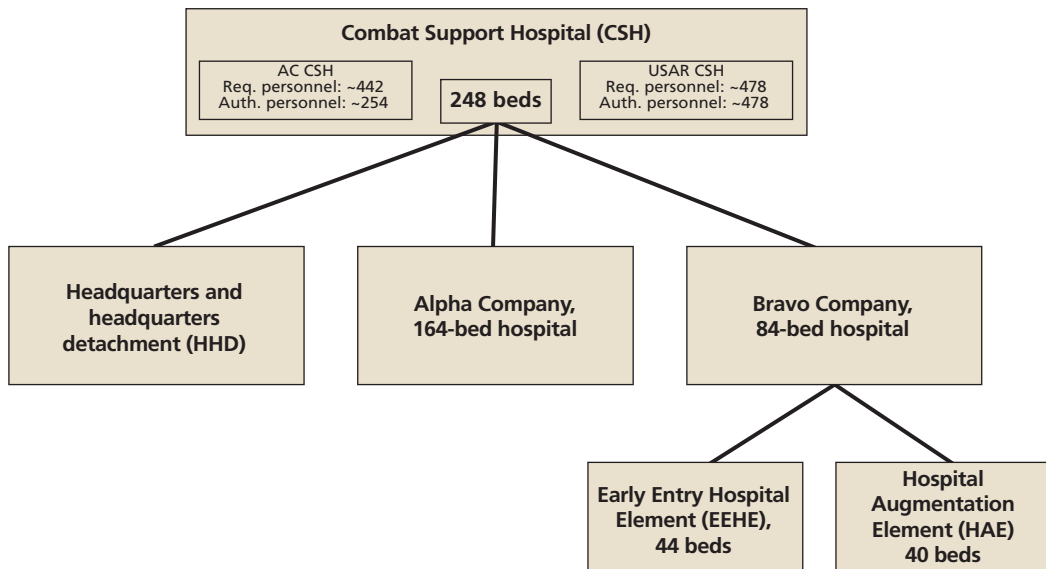
Understanding CSH Equipping and Maintenance Needs

CSHs provide the highest level of in-theater medical care available to American military personnel serving in active, deployed operations, including stabilization and surgical capabilities comparable to those in the trauma centers of major hospitals in the United States.¹ A CSH’s ability to deliver high-quality medical care depends in large part on its possessing well-maintained, state-of-the-art medical equipment. In this respect, the breadth of equipping and maintenance needs of a CSH is similar to that of major hospitals.

However, in other important respects, the CSH requirements for equipment are very different from those of a fixed-facility hospital. CSHs typically only operate as hospitals, with staff and equipment united, when they are deployed. For an active component CSH, Army planning calls for deployment to occur and last no more often than one year out of three; for a reserve component CSH, Army planning calls for one year of mobilization out of five. Like most other Army field units, CSH utilization is managed through a scheduled rotational cycle called the Army Force Generation (ARFORGEN) process. It is designed to assure that the Army sustains a steady supply of units that are available for deployment to areas of operation in response to requests

¹ CSHs represent the third of five levels of care available to a soldier wounded in combat. The first level of care is provided by the combat medic and the battalion aid station; the second, by the Forward Surgical Team (FST). The fourth and fifth levels of care are outside the area of operations: respectively, fixed-facility hospitals in countries other than the United States, such as the Landstuhl Army Regional Medical Center in Germany; and fixed-facility hospitals in the United States, such as the Walter Reed Army Medical Center. Critical functions of CSHs are to receive evacuated patients from lower levels of care and to stabilize patients and ready them for evacuation by plane outside the area of operations to higher levels of care.

Figure 1.2
The Army Combat Support Hospital (CSH) Is Modular in Design



RAND MG887-1.2

for forces (RFF) from the combatant commanders in charge of those operations while providing predictability and balance between deployed and nondeployed periods for personnel. In the ARFORGEN process, each CSH is assigned to one of three pools of forces that represent progressively higher states of readiness for deployment.

- **Available pool.** Units in the Available pool are either deployed or fully trained and ready to be deployed, if needed.
- **Train/Ready pool.** Units in the Train/Ready pool are conducting the training activities required to prepare them for the Available pool, although they are also deployable if needed to meet a surge requirement.
- **Reset pool.** After spending a year in the Available pool, whether they are deployed or not, units move into the Reset pool, where they conduct recuperative and reconstitutive activities.

After Reset, the cycle begins again, and the units enter the Ready/Train pool.

A CSH's need for medical equipment to conduct its mission and training can vary widely depending on which ARFORGEN pool it is in and, if in the Available pool, on whether or not it is deployed. When not deployed, the CSH's primary need for equipment is to support a progression of individual, collective, and unit training activities that build toward achieving complete readiness for potential deployed missions. CSH commanders have the responsibility to manage this training and achieve training objectives using a variety of methods. However, even for unit-level training,

these activities rarely require the set-up and operation of a full-scale 248-bed hospital. Tables A.1, A.2, and A.3 in Appendix A summarize the methods, which vary by type of skill (clinical versus logistics/maintenance) and by component (active versus reserve).

In addition, when not deployed, U.S.-based CSHs have a secondary though rarely exercised need for equipment to perform possible medical missions for domestic emergencies, for example, in response to a terrorist attack or natural disaster.² These missions also do not necessarily require employment of a 248-bed hospital. When deployed, a CSH often does not deploy with its own medical equipment; rather, its personnel fall in on Theater Provided Equipment (TPE), Army Prepositioned Stocks (APS), or U.S. Army Medical Materiel Agency (USAMMA) provided equipment.

CSHs are unusual among Army field units in that both their personnel and their equipment are dispersed unless the CSH is deployed. Until a CSH is deployed, the majority of its clinical staff are assigned to a Military Treatment Facility (MTF), such as the base hospital, and identified within the Professional Filler System (PROFIS) as designated to fill a deployable billet. However, many of the CSH clinical staff work in MTFs at geographically distant locations at other military bases. Because clinicians are assigned to hospitals, they do not join other personnel in the CSH until 30 days before deployment.

Moreover, a large portion of CSH equipment belonging to CSHs (primarily the Alpha Company 164-bed hospital, referred to as the “balance” of its equipment) is stored mainly in containers at the Sierra Army Depot (SIAD)³ to be used upon deployment. SIAD is located in the high desert in Herlong, California, near Reno, Nevada. The rest of a CSH’s equipment remains on hand at home station.⁴

CSH equipment storage at SIAD is handled under different agreements for active and reserve CSHs. For active component CSHs, the equipment storage is part of the Hospital Optimization Standardization Program (HOSP), and does not include any maintenance of the equipment. Active component CSH commanders have responsibility for maintaining the balance of their medical equipment stored at SIAD.⁵ Reserve component CSH commanders also store some of their CSH equipment at SIAD through a separate program called the Reserve Component Hospital Decrements (RCHD), and contract to have that materiel maintained by USAMMA.

² For example, a CSH was deployed in response to Hurricane Marilyn in 1995 (Cecchine, 2004, p. xiv).

³ SIAD offers a dry climate that is well suited to long-term storage, including open storage of containers and equipment. It has a C-5/C-17 capable airfield and has ready access to the national railway and interstate highway systems.

⁴ The equipment kept at home station for the reserve CSHs is called the Minimum Essential Equipment for Training, or “MEET” set.

⁵ The 121st CSH stationed in Korea does not store its balance at SIAD; rather, USAMMA has assigned a small group of personnel to Camp Humphreys in Korea to maintain this materiel for the CSH.

Finally, like other hospitals, CSHs must deal with the challenge and considerable expense of keeping their medical equipment well maintained and state of the art despite rapidly evolving medical technology. Since much of a CSH's medical equipment is not in continual use, as it would be in a fixed-facility hospital, equipment can become outdated after receiving limited or even zero use. Thus, questions arise over when in the ARFORGEN cycle equipment should be upgraded and whether it is worthwhile for the Army to keep equipment used for training or stored at SIAD upgraded to the same degree as the equipment being used by deployed CSHs.

In short, the Army Medical Department (AMEDD) was motivated to develop a new equipping and maintenance strategy for CSHs for two reasons. First, it was apparent that under the current strategy, a large portion of CSH medical equipment was not being kept well maintained and technologically up to date. Second, there was the challenge, shared with all types of Army units, of modifying the current strategy so that it was aligned with the equipping needs in each of the force pools defined by the recently implemented ARFORGEN cycle. The new maintenance and equipping strategy should provide mixes of equipment to active and reserve CSHs that give commanders appropriate training and operational effectiveness at each stage of the ARFORGEN cycle, while at the same time minimizing risks and both acquisition and maintenance costs.

Research Objective, Tasks, and Methods

AMEDD commissioned the study documented here to develop and evaluate alternative equipping and maintenance strategies for the Army's CSHs. These strategies would define mixes of equipment for active and reserve CSH commanders to provide appropriate training and operational effectiveness at each stage of the ARFORGEN cycle. The strategies should also minimize the risks to mission and training effectiveness and seek the most cost-effective solution for acquisition and maintenance. In addition, the evaluation pointed to a preferred strategy, so we developed and recommend an implementation approach for transitioning from the current strategy to the preferred one.

We completed three tasks to conduct the research:

1. Define CSH equipment requirements in the three force pools of the ARFORGEN cycle under alternative deployment scenarios.
2. Develop alternative equipping and maintenance strategies for meeting equipment requirements throughout the ARFORGEN cycle and across scenarios; consider leasing as well as purchasing among the equipment procurement methods.
3. Evaluate the alternative equipping and maintenance strategies, comparing their performance, cost, and risks; consider maintenance and upgrade costs in addition to equipment procurement costs.

We employed a number of methods to execute the research. To gain an understanding of the perspectives of AMEDD personnel on the current state of equipping and maintenance, we conducted focus groups, surveys, and interviews. We attended AMEDD conferences and visited key sites and organizations to conduct interviews.⁶ To understand costs and obsolescence risk, we analyzed data on CSH medical equipment maintenance, procurement, requirements, useful life, and obsolescence rates. To understand the prospective value and feasibility of leasing some medical equipment, we reviewed commercial and academic literature on leasing and conducted interviews with medical equipment procurement experts from hospitals, equipment manufacturers, and consulting organizations. To help understand how alternative equipping strategies would perform over time, we used spreadsheet modeling and discrete event simulation.

Overview of Research Results

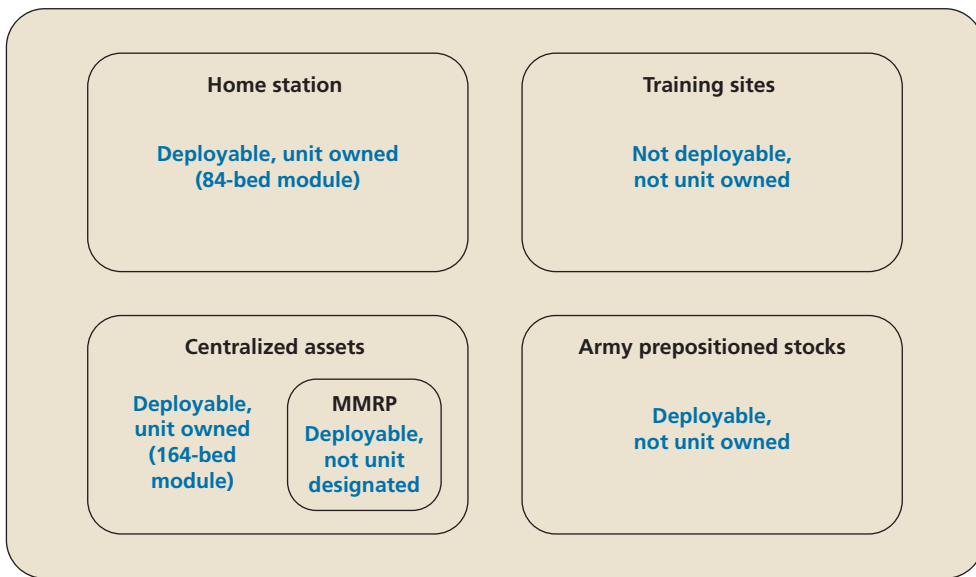
In developing and evaluating alternative equipping and maintenance strategies, we adopted a comprehensive view of the medical equipment available for use by CSHs. Conceptually, CSH medical equipment resides in four large pools (see Figure 1.3).

- **Home station equipment sets.** These consist of the portion of a CSH's 248-bed hospital it retains at home station, with the balance stored at SIAD. For active component CSHs, home station equipment sets are the 84-bed hospital modules. Reserve component CSHs utilize only a portion of their 84-bed hospital at home station; the MEET (Minimum Essential Equipment for Training) set is either containerized at home station for possible use in a Field Site Support Package/Contingency Operation Equipment Set, or maintained at SIAD as part of the RCHD.⁷
- **Centralized assets.** These are currently of two types, both stored at SIAD. First, there are almost two dozen 164-bed hospital modules, which are owned (i.e., on

⁶ These included the U.S. Army Reserve Surgeon's Office; Sierra Army Depot; the Distribution Depot and the Medical Maintenance Operations Division at Hill Air Force Base (AFB), Utah; the Defense Logistics Agency (DLA) kitting and refurbishment facility for AMEDD materiel, also located at Hill AFB; AMEDD Center and School; AMEDD Directorate of Combat and Doctrine Development; the Defense Medical Readiness Training Institute's (DMRTI) Tactical Simulator for Military Medicine (TAC-SiMM) at Camp Bullis; U.S. Air Force (USAF) Expeditionary Medical Support (EMEDS) operations in San Antonio, Texas; 228th CSH, San Antonio, Texas; the Medical Readiness and Training Command; and the Defense Medical Training Institute in San Antonio, Texas.

⁷ The MEET set is designed to sustain reserve component individual- and section-level combat critical tasks during inactive duty training (IDT). Units set up and train on one module at a time and do not use the entire MEET set at once. The MEET set is reintegrated with the larger set of MTOE equipment for operational use upon deployment of the CSH.

Figure 1.3
Combat Support Hospital Equipment Resides in Four Large Pools



MMRP: Medical Materiel Readiness Program

RAND MG887-1.3

the property books of) by CSHs and represent the portion of their medical equipment that units are storing offsite while retaining the 84-bed modules at home station.⁸ The 164-bed “balances” that belong to reserve CSHs are maintained by SIAD personnel via the RCHD program, and that maintenance is managed by USAMMA. The HOSP allows active component CSHs to store their 164-bed balances at SIAD, but the maintenance of that materiel is the responsibility of the individual CSH that owns it.

Second, there are also four full 248-bed hospital equipment sets in USAMMA’s Medical Materiel Readiness Program (MMRP), which are ready for immediate deployment with any CSH that might require them.⁹

- **Training site equipment.** The Army has three Regional Training Sites-Medical (RTS-Med) with full 248-bed CSH equipment sets plus a training facility with a partial CSH equipment set at Fort Polk (associated with the Joint Readiness

⁸ In practice, CSHs may vary in the exact equipment that they store at SIAD versus at home station; however, for purposes of discussing alternative strategies, these differences are not useful.

⁹ The MMRP sets were created by expanding and upgrading four of the reserve balances, and they remain assigned to the respective reserve CSHs even though the intention is to make them available to any deploying CSH.

Training Center (JRTC)) that can be used by CSHs to conduct training activities.¹⁰ The hospital sets at these sites are neither owned by CSHs nor deployable.

- **Army Prepositioned Stocks.** The Army has six 248-bed hospitals and one 44-bed Early Entry Hospital Element module in APS. If these are used (either deployed to an area of operations or drawn from storage for use in designated theaters such as Korea), a deploying CSH could leave its own medical equipment behind¹¹ and simply have its personnel fall in upon Theater Provided Equipment that has been drawn from APS.

We determined that the condition of the equipment in these four pools and how they are used have implications for an improved equipping and maintenance strategy.

Because medical equipment obsolesces relatively quickly due to the pace of technological change, CSH equipment must be modernized regularly to remain current. The current technological generation of CSH medical equipment is referred to as the “N series”: it is superseding the “M series” and will be superseded by the “O series.” However, under the current equipping strategy, most CSH units do not own and train on the most up-to-date equipment except when they are deployed to Afghanistan and Iraq, where they fall in on N-generation sets established in those theaters. The sets in APS, consisting of six full CSH sets and one 44-bed EEHE, are also of the N generation, as are the two full CSH sets in the MMRP. By contrast, other CSH sets—including those at home station, those at the RTS-Med,¹² and those stored at SIAD—are M generation or older.

In addition to not being technologically current, the 164-bed hospital slices in the HOSP (which is for active component CSHs only) at SIAD are generally not well maintained; moreover, none of the 164-bed hospital modules (active or reserve) stored at SIAD are utilized either for training or missions—or at least have not been in a very long time. CSHs report dissatisfaction with the ability of their home station equipment sets to support training, and there is some evidence (discussed in Chapter Five) that keeping the equipment well maintained challenges units.

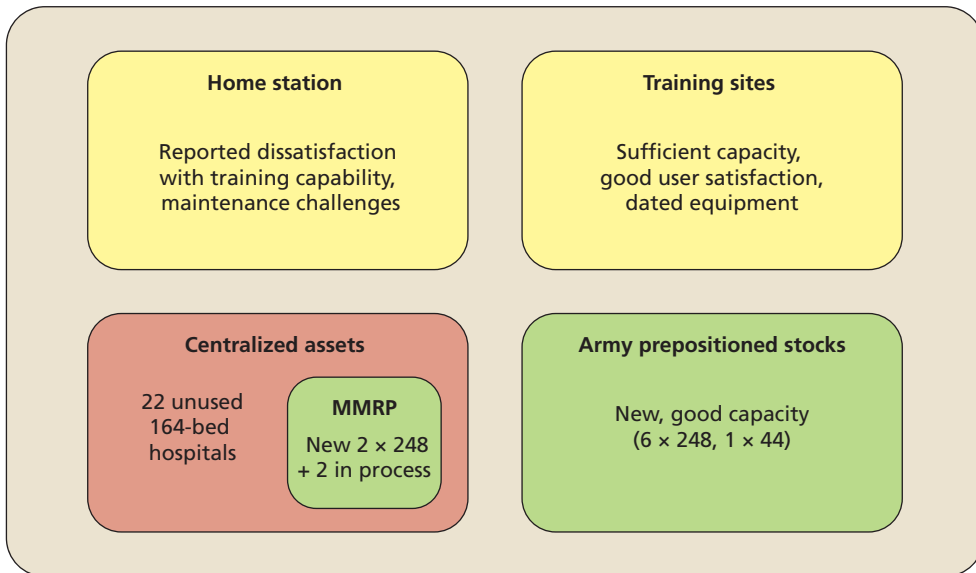
These evaluative generalizations are represented in Figure 1.4 through the standard color codes of red, yellow, and green.

¹⁰ The RTS-Med sites are at Fort Gordon, Georgia; Fort McCoy, Wisconsin; and Camp Parks, California. The set at Fort Polk is owned by RTS-Med for use by CSHs rotating through the JRTC. The AMEDD Center and School has a CSH-like equipment set established at Camp Bullis in San Antonio, Texas, that is used for training noncommissioned officers. There has sometimes been talk of making this available for training CSHs.

¹¹ A deploying CSH planning to use TPE would turn its own equipment over to the Army Materiel Command’s Left Behind Equipment (LBE) program; some of it may be transferred back to the rear detachment of the unit that remains at home station.

¹² Telephone conversation with COL Joy Ream, MRTC, and RTS-Med site managers, September 4, 2008.

Figure 1.4
Our Equipping and Maintenance Recommendations Focus on Problem Areas



MMRP: Medical Materiel Readiness Program

RAND MG887-1.4

Because the CSH equipment in APS and MMRP is technologically current and in good condition, we focused our efforts to develop alternative equipping and maintenance strategies on improving the situation in the other pools of equipment.

- For home station equipment sets, we recommend that the Army change their designs to better align them with training needs, with differences for active and reserve component CSHs, and also regularly upgrade these sets during the Reset phase of the ARFORGEN cycle (i.e., every three years for active CSHs and every five years for reserve CSHs).
- For training sites, we recommend that the Army improve the currency of the equipment sets. We also recommend that it improve the flexibility of the sites to tailor the equipment configurations for training exercises to the needs of specific CSHs. Flexibility might be enhanced by leasing some medical equipment. For example, some of the medical equipment stored in APS or MMRP, which might not be used at all before being superseded in the Army's inventory by newer models, might be considered for lease.
- For centralized assets at SIAD (other than MMRP), we recommend that the Army permit CSHs to share these assets rather than have a one-to-one correspondence between home station equipment sets and these partial "balance" sets at

SIAD. Balance sets give CSHs the option of deploying with their home station equipment. In conjunction, the Army should then reduce the number of balance sets, improve the condition and currency of the remaining sets, and change what equipment is in each set in accordance with the associated recommended changes in home station sets. We also recommend that the Army slightly expand the MMRP.

Overall, we recommend an equipping and maintenance strategy that would result in fewer, but regularly modernized, full hospital sets systemwide, resulting in less total medical equipment: the total equipment replacement cost at today's prices would decrease from approximately \$1 billion to about \$740 million, over a one-quarter reduction. A reduced inventory of medical equipment would reduce maintenance and upgrade costs, making it easier for the Army to ensure that CSH equipment is well maintained and state of the art. In our proposed strategy, the Army would be able to upgrade each CSH's partial (i.e., home station) equipment set as the unit entered the Reset pool of ARFORGEN, i.e., once each three years for an active component CSH and once each five years for a reserve component CSH, while maintaining modernized central balance and full sets. We stress that the overarching intent of this strategy is to improve training and deployed capabilities, not reduce costs. In fact, as we will show later, this strategy is designed to operate within current budget levels, primarily by reducing the amount of total medical equipment inventory.

Structure of This Document

The remainder of this document is divided into five chapters. Chapter Two describes the results of surveys and focus groups that we conducted with CSH personnel in order to gain an understanding of their perspectives on the equipping and maintenance challenges facing their units and the performance of the current equipping and maintenance strategy.

In Chapter Three we explain how we used the information and insights gained from the focus groups and surveys to devise several alternative designs for the equipment sets that CSHs have at their home stations (i.e., when they are not deployed). The design space is intentionally wide in order to explore radically different solutions to the CSHs' equipping and maintenance challenges: for example, one design would give the CSHs much more medical equipment at home station than they currently have, while another would give them very much less.

As explained above, in order to meet their mission and training needs, CSHs have access to medical equipment from sources other than what they have on hand at home station. Accordingly, in Chapter Four we examine what the alternative designs for equipment sets at home station imply for medical equipment required elsewhere in

the system, such as at regional medical training sites and in centrally managed asset pools. The result is three alternative strategies for equipping and maintaining CSHs, each anchored in a distinct design for home station equipment sets.

In Chapter Five we compare the costs and risks associated with each of the three alternative strategies, along with the current strategy. Among other risks, we consider the obsolescence risk represented by each strategy by assessing whether the Army could keep all CSH medical equipment upgraded and state of the art within current planned budgets.

In the final chapter, Chapter Six, we summarize our conclusions and recommend a preferred strategy together with an implementation approach for migrating from the current strategy to the preferred one. The preferred equipping and maintenance strategy is a mixed one that recognizes the different considerations for CSHs in the active and reserve components. The implementation approach begins with a phased roll-out of the new home station designs that is carefully evaluated in order to provide the information needed to address remaining questions about the performance, risks, and secondary effects (e.g., on training and manning) associated with the strategy our analysis showed to be preferred.

The document also has six short appendixes that will be of interest chiefly to analysts and technical experts.

- Appendix A presents summaries of the reported ways in which CSH commanders achieve training objectives for CSH staff and operations.
- Appendix B presents the survey instrument that we used.
- Appendix C is a detailed description of how we developed the alternative designs for home station equipment sets from the current CSH MTOE (Modified Table of Equipment).
- Appendix D explains issues regarding data available to estimate the procurement and upgrade costs of CSH medical equipment.
- Appendix E reports on research we conducted to assess the feasibility and desirability of having AMEDD lease some of the medical equipment available for use by CSHs, primarily to help manage obsolescence risk.
- Appendix F describes a discrete event simulation model of the movement of CSH units and equipment through the ARFORGEN cycle and explains the data that would be needed to exploit the capabilities of such a simulation.

CSH Personnel Perspectives on Equipping and Maintaining Combat Support Hospitals

In order to understand the views of CSH personnel regarding equipping and maintenance practices and to identify issues with current practices, we conducted surveys and focus groups. We also conducted individual interviews with soldiers, Army civilians, and contractors involved in CSH equipping and maintenance.¹ These interviews served to augment and inform the survey and focus group responses. In this chapter, we first review the survey process and results, followed by an analysis of the focus group results.

Surveys of CSH Personnel

Respondents and Instrument

We surveyed over 100 CSH personnel from active and reserve component units (see Table 2.1). We conducted the surveys in three waves:

1. An in-person, written survey completed by attendees at the 2008 CSH commanders conference held in Reno, Nevada, July 30, 2008. Based on the attendance at this first conference, the survey responses came primarily from active component respondents.
2. A hardcopy mailed survey of U.S. Army Reserve (USAR) commanders and staff in November–December 2008.
3. A short emailed and telephone survey of active component commanders in April 2009. This short follow-up contained 16 questions designed to gain a better understanding of the active component CSH commanders' training, maintenance, and equipping preferences.

¹ These interviews were carried out both during office visits and at conferences, meetings, and site visits.

Table 2.1
We Administered Surveys to 123 CSH Personnel

	First Wave Surveys	Second Wave Surveys	Third Wave Surveys
CSH position	Active component	Reserve component	Active component
Commander	6	18	7
Command Sergeant Major (CSM)	3	9	0
Operations	5	12	0
Logistics	9	13	0
Clinicians ^a	6	15	0
Other	4	16	0
TOTAL	33	83	7
Percent deployed with CSH in past 10 years	45.5% (15/33)	37.3% (31/83)	85.7% (6/7)

NOTE: Results include a short follow-up survey for active component CSH personnel.

^aClinicians are defined as everyone, officers and enlisted, whose primary job is direct patient care; this group included medical professions such as physicians and nurses.

The surveys were designed to gain information about equipping and maintenance issues at different stages of the ARFORGEN cycle. The instrument for the first two waves consisted of about 60 questions in the following areas:²

- Professional demographic information (6 questions related to position and deployment experience)
- Equipping and maintenance questions tied to stages in the ARFORGEN cycle³
- Training (20 questions)
- Preparation for deployment (7 questions)
- Deployment (20 questions)
- Redeployment (6 questions)
- General questions regarding CSHs and the ARFORGEN cycle (5 questions).

The follow-up survey for the active component CSH commanders consisted of 16 questions in the following areas:

- Deployment experience (1 question)
- Maintenance effectiveness (2 questions)
- Equipment used for deployment and training (3 questions)
- Training (4 questions)

² Appendix B lists the questions.

³ Recognizing that the deployment experience of some personnel predated the Army's adoption of the ARFORGEN process, we couched the questions both in terms of generic language (e.g., training for deployment) and ARFORGEN terminology (Train/Ready pool).

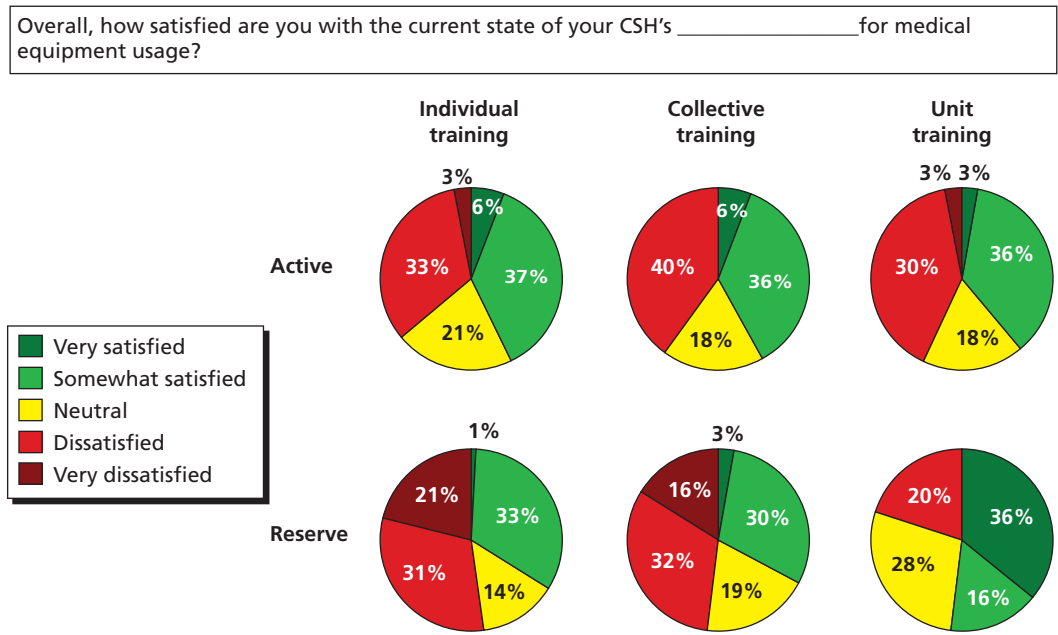
- Central management of equipment (4 questions)
- Need for split-based operations (2 questions).

Survey Findings

In this section, we focus on survey findings that provided information helpful to us in developing and evaluating alternative equipping and maintenance strategies. In particular, we learned a great deal from the survey respondents about their views on the sufficiency of their training and the contribution of training equipment to training quality.

As Figure 2.1 shows, surveyed CSH personnel reported significant dissatisfaction with clinical training. The top row shows the responses of active CSH personnel; the bottom row shows those of reserve component personnel. The three columns correspond to individual training, collective training, and unit training. Each pie chart shows the breakout of responses on a five-point scale ranging from “very satisfied” (dark green) to “very dissatisfied” (dark red). In every case, less than half of respondents reported themselves to be either somewhat satisfied or very satisfied with the clinical training afforded to the CSH. At individual and collective levels of training, dissatisfaction was higher among reserve component personnel than among active personnel.

Figure 2.1
Surveyed CSH Personnel Reported Significant Dissatisfaction with Clinical Training for Medical Equipment Usage



A number of factors affect training effectiveness, with equipping issues just one component. It was not the intent of this study or the survey to fully understand the sources of training dissatisfaction but rather to understand whether it exists, how equipping issues could be contributing to training dissatisfaction, and whether there might be ways that changes in equipping and maintenance strategies might address these issues or contribute to training effectiveness in new, potentially unanticipated ways. Additional questions and discussion focused on understanding the equipping issues and opportunities with respect to training.

We were also interested in learning about CSH personnel perspectives on the state of maintenance training. These results are shown in Figure 2.2, and the pattern differs from that for clinical training. Surveyed reserve component CSH personnel reported substantially more dissatisfaction with maintenance training than did their active counterparts; this may reflect the fact that, when not deployed, reserve CSH companies use less of their equipment at home station than do active ones, and assigned reserve full-time equipment maintainers have access to the equipment only for limited hours during weekend drills and annual training.

CSHs do not need to depend solely upon their own home station equipment for training opportunities; they can also utilize the Regional Training Sites and Mobile Training Teams. As Figure 2.3 shows, surveyed CSH commanders who had used

Figure 2.2
Reserve CSH Personnel Reported More Dissatisfaction with Maintenance Training

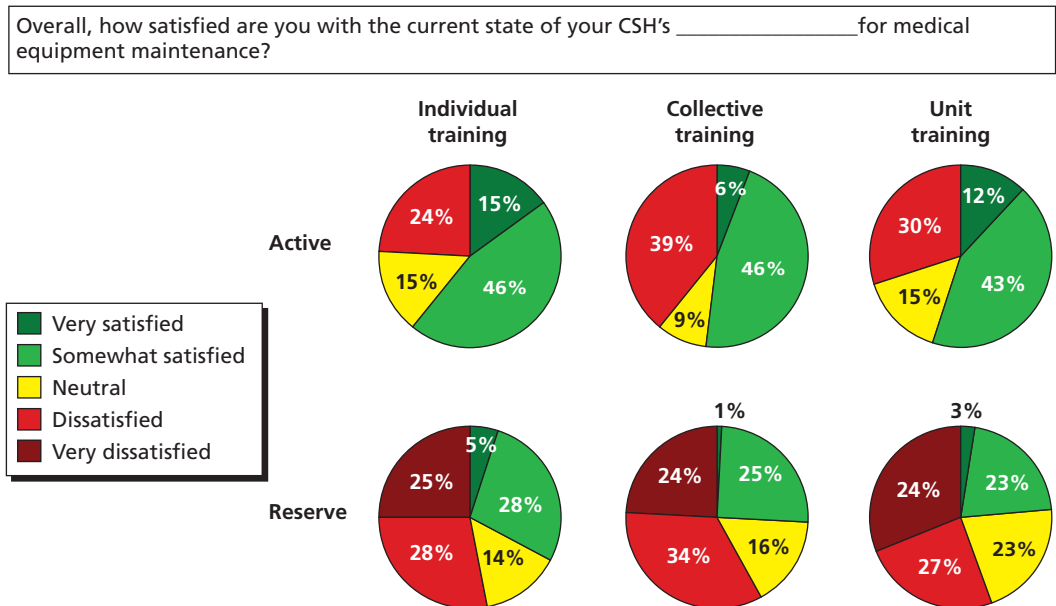
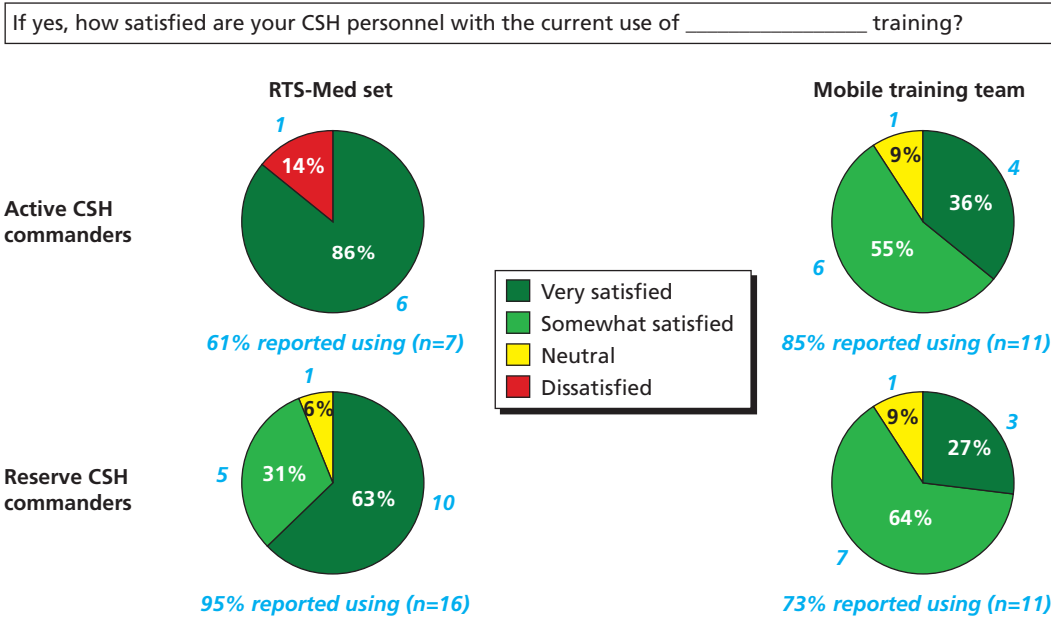


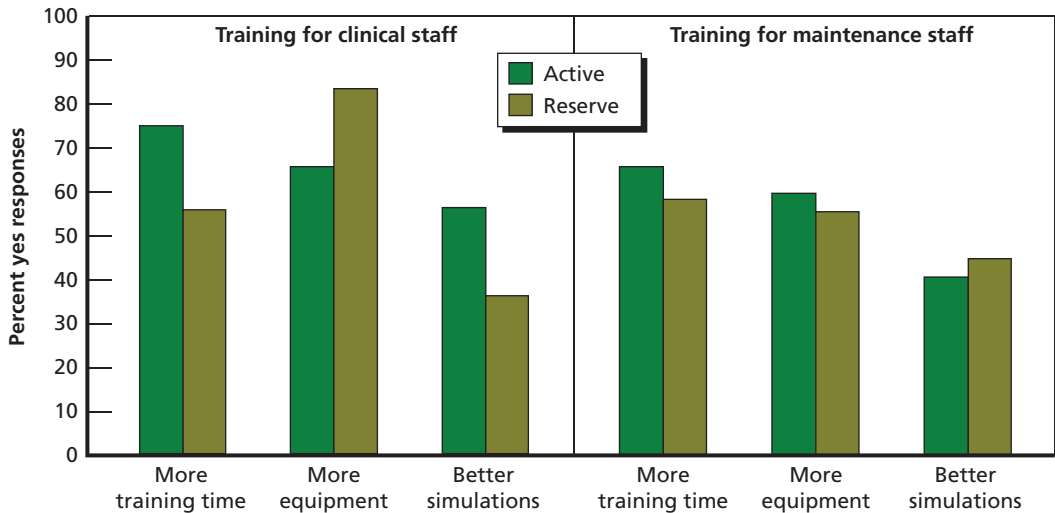
Figure 2.3
CSH Commanders Who Had Used Training Sites and Mobile Training Teams Generally Reported Good Satisfaction



Regional Training Sites and Mobile Training Teams generally reported high levels of satisfaction with these training resources. The pie charts in the top row show the responses of the active component respondents; the lower row shows the reserve component responses. The right-hand column shows results for the mobile training team with the RTS-Med sets. In all cases, although the respondents are using the same five-point scale as shown earlier in Figures 2.1 and 2.2, the pattern of response here is markedly different. The majority of respondents describe themselves as either satisfied or very satisfied with both training resources. This suggests that the high levels of dissatisfaction displayed in Figures 2.1 and 2.1 may have their roots in home station training.

What would improve satisfaction with training? Figure 2.4 shows how respondents rated the potential for improvement that might arise from more training time, more equipment, and improved simulators. The figure shows six pairs of bars; the three pairs on the left relate to training for the clinical staff, and the three pair on the right relate to the maintenance staff. Within each pair of bars, the left (bright green) bar shows the response of active component CSH personnel, while the right bar (khaki green) shows the response of their reserve counterparts. Generally, respondents judged that both more time and more equipment would improve training; improved simulations received substantially lower scores.

Figure 2.4
Respondents Indicated That Having More Time and/or Equipment Would Improve Training



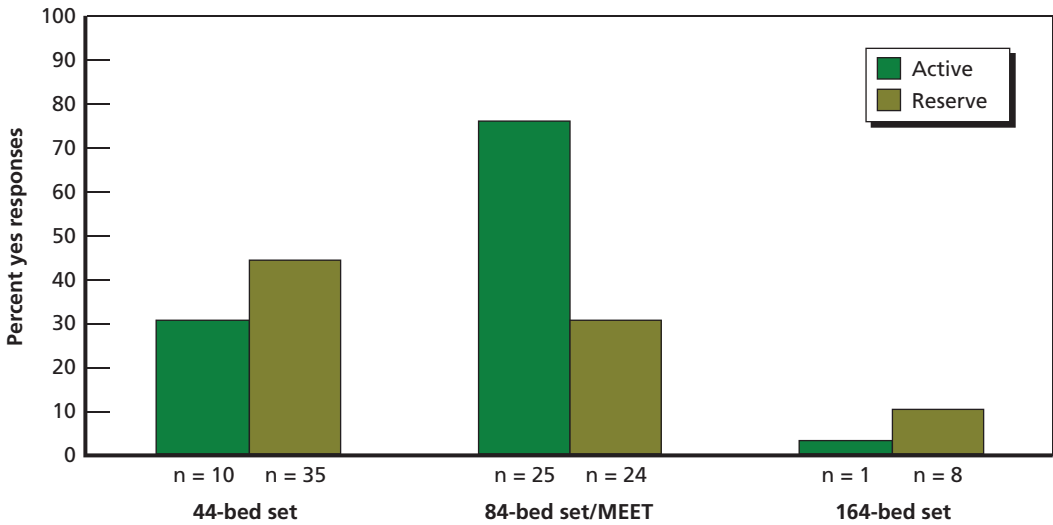
NOTES: Active n = 32; Reserve n = 36.

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Even though CSH personnel thought it would be advantageous to have access to more equipment for training, the 164-bed hospitals stored at SIAD are rarely used. Figure 2.5 shows that CSH units usually rely on their home station equipment for training. The leftmost pair of the three pairs of bars corresponds to the use of the 44-bed EEHE slice of the 84-bed hospital; the middle pair corresponds to the use of the 84-bed hospital (active) or MEET equipment set (reserve); and the rightmost pair corresponds to the use of the 164-bed hospital. It is not surprising that units rarely use their 164-bed hospitals, given the difficulty and expense that transporting them from SIAD to the unit and back again would entail.

Regardless of whether CSHs prepare for deployment by training on home station equipment or on the equipment at a training site, much of the equipment they train on will likely not be the same as what they fall in upon in theater. As Figure 2.6 shows, about three-quarters of surveyed CSH personnel reported that only 25 percent or less of the equipment they trained on matched the equipment they used in the theater of operations (which is typically newer and may include some items not on the MTOE). Moreover, as the red and dark red areas on the pie charts indicate, over half of the survey respondents believed that there were negative effects from the equipment mismatch. This was a concern that was discussed at some length in the focus groups as well (see below).

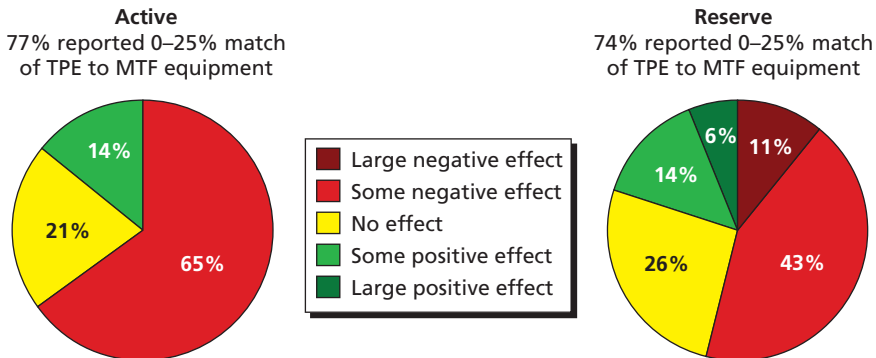
Figure 2.5
Respondents Indicated That 164-Bed Hospital Sets Were Seldom Used for Training



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Figure 2.6
Most Survey Respondents Reported Negative Effects from Training on Equipment Different from Equipment in Theater

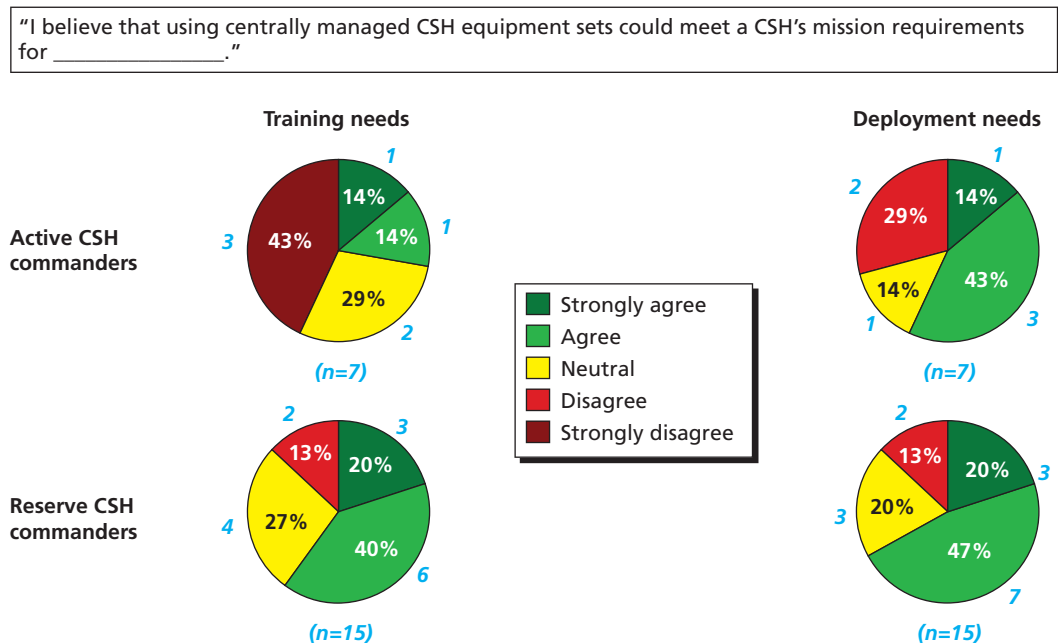
How much did the differences in medical equipment your CSH trained on, as opposed to the equipment it fell in on in theater, affect its mission capability when it arrived in theater?



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Because nondeployed CSHs retain only a portion of their full MTOE at home station, they rely on centrally managed equipment to meet at least some of their training and mission needs. In fact, under the current equipping strategy as described in Chapter One, the majority of the Army’s CSH medical equipment resides in centrally managed pools: APS, MMRP, RTS-Med, RCHD, and HOSP. As Figure 2.7 shows, in most cases CSH commanders believe that centrally managed equipment can meet their CSH’s needs both in training and during deployments. This situation appears to work satisfactorily, though reserve component commanders are more satisfied than their active counterparts, particularly with regard to using centrally managed equipment for training. As the upper left pie chart of the figure shows, 43 percent of active CSH commanders strongly disagree that centrally managed equipment could meet the training needs of their CSHs: the implication is that these active CSH commanders want sufficient home station equipment to conduct their training regimen. By contrast, no reserve CSH commanders strongly disagreed and most agreed or strongly agreed that centrally managed equipment could meet their CSH’s training needs. The responses of commanders from the two components were much more similar with respect to using centrally managed equipment during deployments (the two rightmost pie charts), though in this case as well the active commanders had more reservations than their reserve counterparts.

Figure 2.7
CSH Commanders Believed That Centrally Managed Equipment Could Meet Their Needs

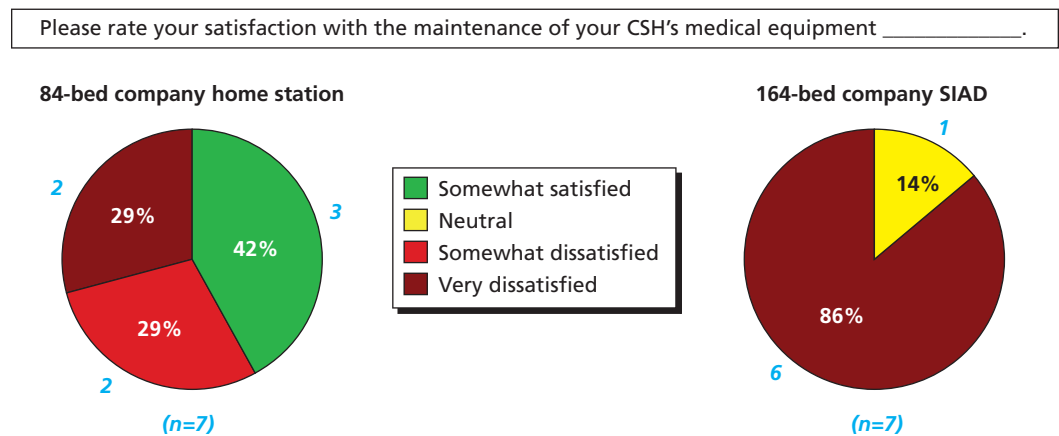


In addition to asking respondents how the current equipping strategy was meeting their training and mission needs, we asked about their satisfaction with the maintenance of medical equipment. One area where we found strong dissatisfaction was in the active component CSH commanders' assessments of their capability to keep their medical equipment in the HOSP balances at SIAD well maintained. The right pie chart of Figure 2.8 shows that they were very dissatisfied with the maintenance of this equipment. Moreover, as the pie chart on the left shows, more than half of these commanders were also dissatisfied or very dissatisfied with their CSHs' maintenance of medical equipment at home station. In focus group discussion as well as in other interviews and conversations with CSH commanders and staff members, a number of barriers were identified that hamper the ability of active CSHs to keep the Alpha Company equipment at SIAD well maintained. These barriers to maintenance include:

- The travel and TDY (temporary duty) expense to send maintenance staff to SIAD for this mission
- Conflicts with many other local taskings at home station that also require the maintenance personnel
- Staff sent for two weeks during summer have time to do some inspections, diagnoses, and ordering of parts, but they return to home station before parts for the repairs generally arrive. When they return the following summer to execute the repairs, parts are missing, inspections sometimes have to be redone, etc.

In addition, certain individuals reported that they knew USAMMA would get them new or upgraded equipment sets if they are asked to deploy, so there was not a perceived need to carry out the HOSP maintenance.

Figure 2.8
Active CSH Commanders Expressed Dissatisfaction with Maintenance of Medical Equipment at Home Station and SIAD



Unlike active component CSHs, the reserve component CSHs have their balances at SIAD maintained by USAMMA. Moreover, their balances at SIAD are packed and containerized for long-term (five-year) storage. As a result, the equipment in the balance sets in the RCHD program is in much better condition than that in the HOSP

Figure 2.9
Most Active CSH Commanders Feel Comfortable Letting USAMMA Maintain Their Equipment Stored at SIAD and Are Confident That CSH Personnel Would Keep Home Station Equipment Better Maintained

"I would feel comfortable with USAMMA maintaining the portion of our CSH's medical equipment stored at SAID."

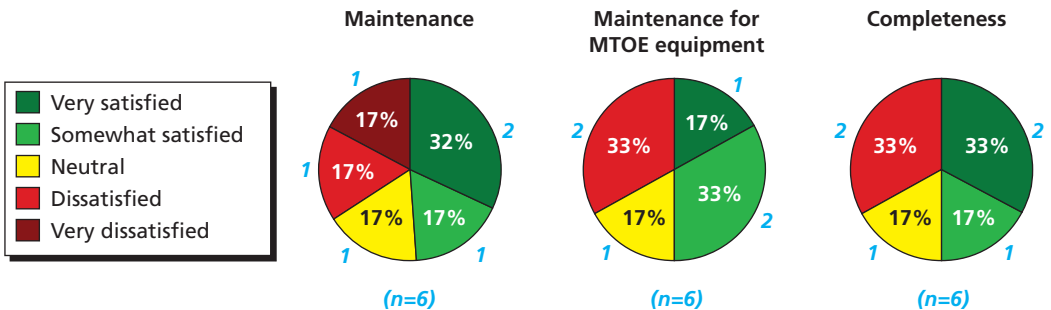
"If USAMMA has responsibility for maintaining my off-site equipment, I have confidence that my unit could maintain the equipment left at home station."



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Figure 2.10
Half of Active Component CSH Commanders Report Satisfaction Using Centrally Managed Hospital Sets

Please rate your level of satisfaction with the medical equipment items/sets provided to your CHS from TPE, APS, or USAMMA provided equipment.



NOTE: Five respondents reported medical equipment provided from TPE and one respondent reported medical equipment provided from TPE and USAMMA. This includes only CSH commanders who have deployed.

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program. As the left pie chart in Figure 2.9 shows, most of the active component commanders we surveyed would feel comfortable with having USAMMA maintain their balances at SIAD as well. Moreover, if their CSH maintainers were relieved of this off-site maintenance burden, the active component commanders felt confident that their home station equipment would be better maintained (right pie chart of Figure 2.9).

Because active component CSH commanders currently rely less on centrally managed equipment than do their reserve counterparts, we were interested in how satisfied they were in deployments where they left behind their own medical equipment and used equipment provided from TPE, APS, or USAMMA. As Figure 2.10 shows, about half of them report being satisfied or very satisfied with the maintenance condition of the equipment, its technological currency, and its completeness. About one-third reported dissatisfaction.

Focus Groups with CSH Personnel

Participants and Questions

We conducted two focus groups with CSH personnel when members of the research team attended the 2008 CSH commanders conference in Reno, Nevada, on July 30, 2008. The participants in one group were the attending CSH commanders, executive officers (XO), or operations officers (S-3) (n=9); participants in the other group were other CSH personnel, including logisticians and clinicians (n=7).

The focus groups were conducted using a loosely structured set of questions similar to those contained in the survey described above:

- **Training and preparation:**
 - Have there been issues with getting access to equipment for training your CSH clinical and maintenance personnel?
 - How useful would it have been to be able to train on the same equipment that you fell in on in theater?
 - What have been your experiences and challenges with leaving equipment behind when you deploy from home station?
- **Deployment:**
 - What have been the areas of greatest challenge with equipment during your deployment—both use and maintenance?
 - What were your experiences with the Operational Needs Statement (ONS) process for having new or nonstandard equipment procured for you during deployment?⁴

⁴ ONS is a process by which CSH personnel, usually clinicians, request that nonstandard equipment be procured.

- **Redeployment:**
 - What have been your experiences preparing to redeploy and then redeploying?
- **General question:**
 - What are your concerns regarding the possibility of your CSH not having a complete equipment set owned by your unit and available at all times prior to a deployment?

Focus Group Findings

Below we summarize and synthesize the collective responses from the two focus groups.

Have There Been Issues with Getting Access to Equipment for Training Your CSH Clinical and Maintenance Personnel?

Focus group participants indicated that in order to train both clinical and maintenance personnel, combat support hospitals require timely access to appropriate types of specific sets of equipment in sufficient quantities. Generalizations regarding equipment access for training are difficult because training is a complex area with requirements varying on many dimensions, including component (active and reserve), ARFORGEN pool (Reset, Train/Ready, Available); type of personnel needing access to the equipment (clinicians, maintainers); and level of training (individual, collective, unit). Moreover, participants stressed that the challenge of assuring access to equipment is only half of a larger training challenge for CSHs, which is to have all personnel as well as equipment available for training events.⁵

Participants agreed that for the CSH as a whole, the most valuable combination of unit, collective, and individual training opportunities prior to a deployment would involve matching the training as specifically as possible to the known deployment conditions:

- To transport, set up, and train on an equipment set that was identical to the one that the CSH would use in the theater of operations.⁶

⁵ Commanders would like to have the personnel designated to deploy with the unit available to the unit for training for the year prior to deployment. The designated personnel do not necessarily need to be present in the unit for the full year, just available to train with the unit. A barrier to such designation is the instability in the PROFIS system, which makes it difficult to identify who will deploy with a unit prior to the actual deployment and to have the actual deployers train with the unit. Clinicians are assigned to hospitals and do not join other personnel in the CSH until 30 days before deployment. Participants noted that unit training opportunities during this final month of deployment preparation are limited because of the many other activities that need to be accomplished, including turning the CSH's equipment set into the Left Behind Equipment (LBE) program operated by the Army Materiel Command (AMC).

⁶ Although a CSH might deploy with its own equipment set, the more common case would be for it to sign its own equipment set over to AMC as LBE and then fall in upon TPE, whether a set that stayed behind when the preceding CSH redeployed (Stay Behind Equipment, or SBE) or a set deployed from APS.

- To train on the exact equipment (make and model) as will be fallen in upon in theater as TPE.

Several participants suggested that to provide deploying CSHs with this ideal training, the Army could establish a fixed training site that exactly mirrored the theater medical facilities and equipment, specific down to the makes and generations of medical technologies they will use in the theater. Because CSHs are modular and the modules may not be collocated in a deployment, the training site should be designed to permit training in split-based operations.⁷

Participants indicated that field training exercises (FTXs) currently provide the best single training event for a CSH deploying with its equipment set; unfortunately, the utility of these exercises is sometimes limited by the amount of medical equipment available. Participants agreed that an 84-bed medical company lacks sufficient structure and redundant medical equipment to permit training fully in split-based operations. But they noted that the CSH may not be able to access a full, 164-bed training set: these are in storage at SIAD, and even if a CSH tried to access its stored set for training, only those sets assigned to reserve CSHs are typically maintained in a state of readiness that would permit them to be shipped promptly to a training event.

Participants suggested that at the level of individual equipment (versus complete equipment sets), access for training is less challenging for clinicians than for maintainers. Army medical clinicians typically work in fixed hospital facilities when not deployed, and they are familiar with the makes and models of the medical equipment that is used in those facilities (both for active and reserve medical staff). This equipment, though typically very modern, may not be the same as that found in the CSH's own equipment set or in the equipment sets being used in theaters of operation. Although focus group participants (a mix of clinical and nonclinical staff) reported that the possibility of having to use unfamiliar equipment creates anxiety among clinicians, their discussions strongly suggest that this concern is exaggerated: in most cases, even when clinicians find themselves working with unfamiliar makes and models of equipment when deployed, they are able to adjust very quickly (needing hours of transition training versus days or weeks).

Participants indicated that, compared to clinicians, nondeployed CSH maintainers may not have sufficient access to medical equipment on which they can train and exercise their skills. Currently that access is limited by the practice of storing most CSH equipment at SIAD in the form of 164-bed equipment sets. This practice leaves only a portion of the CSH's medical equipment available at the installation to be main-

⁷ Although access to a fixed training site mirroring hospital facilities in theater would be ideal for clinicians and maintainers, other CSH personnel need training and exercises in establishing a CSH, e.g., selecting and preparing the site, creating a perimeter, erecting the infrastructure, constructing energy and information grids, etc. Even in an established theater, the need to establish a new CSH site may arise unpredictably. An 84-bed equipment set is sufficient for this fundamental training.

tained year round.⁸ Moreover, participants noted that because the medical equipment that is locally stored is generally not used for any extended period of time, it does not typically have problems or faults to be diagnosed and repaired; because of this, most maintenance is limited to inspection and calibration. As a result, the CSH may not generate sufficient workload to assure that maintainers can keep their skills honed. Also, the makes and models of equipment in the set at the installation may not be the same as those that the maintainers will need to repair when deployed.

How Useful Would It Have Been to Have Been Able to Train on the Same Equipment That You Fell in on in Theater?

In many contingencies, including Operation Iraqi Freedom (OIF), CSH personnel do not deploy with their own equipment; rather, they fall in on TPE. Even the initial CSH deployed to a theater may fall in upon a CSH equipment set that was deployed from APS. Participants noted that, although efficient in many regards, the practice of deploying CSH personnel while leaving their equipment behind at the installation creates training challenges because both deploying medical and maintenance personnel may encounter types, makes, and models of equipment in the theater of operations with which they are not familiar (either because the items are newer or because they are not on the MTOE).⁹ The situation may be more severe for maintainers than for clinicians, because the internal mechanical differences between two models of, say, a defibrillator may be more pronounced than the differences in their operator interfaces.

Participants agreed that it would be best to train on exactly the same equipment and in exactly the same kind of facilities that they would encounter in theater. However, they also agreed that there is ample time in the early days of arriving at their deployed assignments to become familiar with the equipment, because Army practice allows for a period of time when personnel from a deploying CSH can work side by side with those of the redeploying CSH, creating “left seat/right seat” training opportunities. Again, the situation is more difficult for maintainers because, to the extent that equipment is more often serviceable than unserviceable, clinicians have more opportunities to become familiarized with equipment differences than do maintainers.

⁸ While active component CSHs have responsibility for maintaining their equipment stored at SIAD, the maintenance quality is highly variable, particularly when the CSH is deployed.

⁹ There are two potential sources of mismatch between training and deployed equipment. One source is generational: medical equipment at home station and at the regional training sites is typically of an older generation technologically than the equipment used in theater. The other source is lack of standardization: PROFIS personnel working in fixed-facility hospitals when not deployed may have access to current-generation equipment but not necessarily to the same makes and models as those used in the theater of operations.

What Have Been Your Experiences/Challenges with Leaving Equipment Behind When You Deploy from Home Station?

In current operations, CSH personnel do not deploy with their own equipment sets, but rather use TPE; therefore, they turn their own equipment sets over to the AMC LBE program. Under this program, AMC takes ownership of the LBE and assumes responsibility for its condition and maintenance. Only a few participants in the focus groups had experience with the LBE program. They noted that some of the equipment may be transferred back from AMC to the rear element of the CSH (i.e., an element that did not deploy with the rest of the CSH). This transfer can be problematic if the rear detachment does not retain adequate maintenance capability to maintain the equipment.

AMC also has the option of providing LBE equipment to other units that have a need while the CSH is deployed. Some participants expressed a concern that a CSH would not be reissued all of its original equipment upon redeployment. However, others noted that there have been few instances thus far of a redeploying CSH not receiving back all of the equipment it turned into the LBE program, for the reasons that other types of Army units have no use for most of the equipment associated with a CSH and other CSHs have their own equipment sets,

Participants expressed the opinion that the most difficult aspect of participating in the AMC LBE program for CSHs would be the timing: usually the CSH must prepare to transfer its equipment during the last 30 days before its deployment. During the same time period, it is training for its deployed mission and standing prepared for unpredictable local taskings. This training period is particularly intensive, because the CSH clinical personnel (PROFIS, professional filler staff) arrive just 30 days before deployment. Participants expressed concern that the LBE process would be very disruptive to the collective and unit training of the CSH in the final month before deployment.

Because the LBE program is relatively new, participants agreed there is insufficient experience to evaluate how readily CSHs are able to get their sets back upon redeployment or in what condition they will find their equipment.

What Have Been the Areas of Greatest Challenges with Equipment During Your Deployment (Use or Maintenance)?

Focus group participants were satisfied with the maintenance of equipment during deployment. However, they noted that maintenance was provided in the context of a reactive approach to equipment lifecycle management: that is, equipment was typically only replaced if it failed and then could not be repaired or repaired in a timely fashion. They indicated that they would prefer a proactive equipment management system that replaced equipment systematically according to indicators of age, utilization, and wear.

CSH personnel in OIF did encounter medical equipment and facilities that differed from what they trained upon: however, these differences were welcomed, as they represented improvements in the ability to provide care. For instance, as early as 2003, the CSHs deployed to OIF were working in “hospital-grade” buildings rather than tents. Also, they were provided with CT (computed tomography) scanners, a capability that other CSHs lack.

What Were Your Experiences with the ONS During Deployment?

A deployed CSH has a number of options for acquiring new medical equipment. It can order the item from USAMMA or its home station, purchase it locally or regionally (in OIF, this would mean Qatar), or work with a nonmedical Army Contracting Office. There is also an Army process for units to request that new or nonstandard equipment be procured for them to accomplish their mission. This is initiated through the submission of an Operational Needs Statement (ONS). According to focus group participants, the ONS-based procurement process has been reliable but slow in OIF. Equipment costing over \$5,000 can be requested via ONS; the requests are reviewed and approved by a board. However, it typically takes about three months for the requesting CSH to receive the equipment. In order to shorten the time it waits for the equipment, a CSH may simultaneously submit an ONS and also pursue procuring the desired equipment via another procurement channel—in effect, creating duplicate requests.

What Are Your Concerns Regarding the Possibility of Your CSH Not Having a Complete Equipment Set, Owned by Your Unit, Available at All Times Prior to a Deployment?

Active component CSH commanders participating in focus groups indicated that they needed to have more equipment than they do currently when not deployed. They indicated that both training and local taskings required them to have the capability to conduct split operations.¹⁰ The 84-bed set that they currently keep on their installations is not sufficient to meet this requirement because it lacks sufficient Level III capabilities (e.g., surgical unit, ICUs) to place each capability in each of two hospitals during split operations. On the other hand, they felt that they could do with less of some other capabilities, such as bed space. Some suggested that designing a 64-bed set with the capability to be split into two 32-bed hospitals with full Level III capabilities would be sufficient to meet their training and local tasking needs. Additionally, the commanders expressed the opinion that the 84-bed set (and by extension, the alternative configura-

¹⁰ While split-based operations for CSHs are not specified in Army Training and Evaluation Program (ARTEP) 08-855 (MRI) 2000, they are a mission requirement in the MTOE narrative for Corps Level CSHs and part of the employment doctrine found in FM 4-02.10, *Theater Hospitalization*, 2005. In the third wave of surveys, 86 percent of surveyed active component CSH commanders “strongly agreed” that it was important to have the capability at home station to train for split-based operations.

tions of 84 plus and 64) needed to be standardized across CSHs in order to support cross-leveling among them. Finally, they agreed that there should be a separate training set for potency and dated items (Ps&Ds) so that CSH personnel could have hands-on training with managing this inventory.

The same commanders were dissatisfied with the condition and availability of their CSH's 164-bed hospital sets stored at SIAD. They believed that the medical equipment in these sets could be more effectively maintained if stored at their own installations; moreover, moving the sets from SIAD to the installations would provide the CSH maintenance personnel with improved opportunities to practice their skills year round.

Key Lessons from Surveys and Focus Groups

In sum, CSH personnel reported substantial dissatisfaction with both clinical and maintenance training. They reported that having more equipment available or easily accessible for training and more time would improve training. Despite the desire for more equipment, they do not access the 164-bed hospitals stored at SIAD in order to conduct training. Those who had used the regional training sites and mobile training teams were satisfied with those training resources. This suggests that the root of their dissatisfaction is with the training afforded by current home station equipment sets. For example, commanders noted that the 84-bed hospital set does not enable them to train in a split-based configuration. They also noted that most of the equipment their CSHs train with does not match the equipment they will use in theater if they deploy, and they report negative effects from the mismatch, even though personnel from the arriving CSH can adapt to the new equipment by working alongside the personnel from the redeploying CSH. They expressed a desire to train on equipment like that in theater. Reserve component CSH commanders felt comfortable with relying on shared equipment to meet both their training and deployment needs.

These findings suggest a number of promising directions for an improved CSH equipping strategy:

- Focus on developing new home station equipment sets that will better support training needs, including split-based operations.
- Increase the ability of deploying CSHs to train on equipment that matches the equipment they will use in theater, both in terms of technological generation and the make and model.
- Continue reliance on shared equipment from centrally managed pools for use in deployments (few CSHs have deployed with their own equipment in the current contingencies).

- Reconsider the purpose of the underutilized HOSP and RCHD equipment sets and reduce their number accordingly.
- Maintain or increase the use of regional training sites and mobile training teams, which have good user satisfaction.

In the next chapter we pursue the first of these, the development of new designs for home station equipment sets.

Alternative Designs for Home Station Equipment Sets

Drawing on the information and insights gained from the focus groups and surveys, we developed alternative equipping and maintenance strategies. We focused on creating designs for new home station equipment sets that, in addition to training capabilities, took into account the CSH's need for administrative and medical capabilities at home station. The core of the design for home station training equipment is found in the MTOE for the Corps-level, split-based capable CSH,¹ which was used as representative of the objective equipment authorization for all CSHs in the Army inventory. Collaboration with the AMEDD Directorate of Combat and Doctrine Development (DCDD), USAMMA, and the Medical Readiness and Training Command (MRTC) provided understanding of the function and maintenance of the Corps CSH equipment at home station for training. The design approach was to develop capability- and requirement-driven equipment sets that balanced home station maintenance and resource requirements with ready, on-hand operational and training capability.

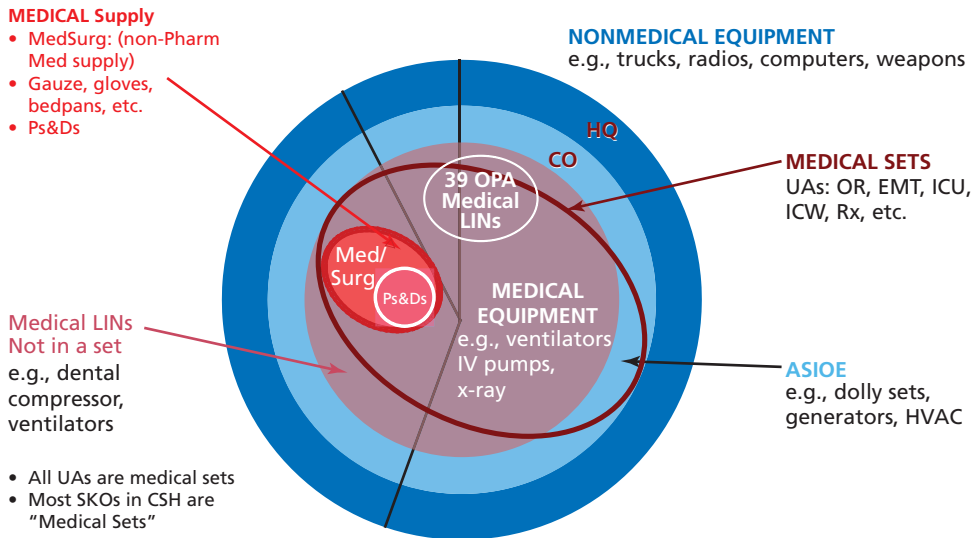
Each paragraph of the MTOE describes the medical and nonmedical equipment required to provide a distinct capability. Accordingly, we specified the capabilities of the alternative home station equipment sets in terms of the MTOE paragraphs, and we specified the equipment needed to provide each capability at the level of individual line item numbers (LINs) (treating sets, kits, and outfits as single LINs).²

The designs include both medical and nonmedical equipment. Figure 3.1 provides an overview of the equipment in a CSH, both medical and nonmedical. The diagram represents the LINs on the MTOE for a CSH. Each LIN on the MTOE is either an individual piece of authorized equipment, or one of the Sets, Kits, and Outfits (SKO) made up of component equipment and supplies. The two outer blue rings represent the nonmedical equipment. The headquarters and headquarters detachment (in dark blue) only have nonmedical LINs. These items are the administrative and support equipment for the hospital, such as trucks, radios, computers, and weapons. The Alpha and Bravo Companies have a combination of nonmedical equipment LINs,

¹ Special Requirements Code (SRC) 09845AF04, 0109.

² Appendix C provides additional detail on how those designs were developed within the context of the MTOE.

Figure 3.1
Combat Support Hospitals Have Both Medical and Nonmedical Equipment



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medical equipment LINs, and medical sets. The company headquarters for the medical companies (light blue) also have only nonmedical LINs: these comprise the administrative and support equipment for each company. The medical equipment in the medical companies (burgundy inner circle) can be individual pieces of medical equipment authorized by LIN on the MTOE, such as ventilators, IV pumps, or x-ray machines.³ Most of the medical equipment and supplies in the CSH are found in medical equipment sets. Each medical equipment set has a unit assemblage (UA) that designates what combination of medical and nonmedical LINs (known as associated support items of equipment or ASIOE) and non-LIN lines of supply are required. Each UA supports a functional area of the hospital, such as the operating room (OR), emergency medical treatment (EMT), the intensive care unit (ICU), the intermediate care ward (ICW), or the pharmacy (Rx).

In order to explore different solutions to the CSHs' equipping and maintenance challenges, we created three new designs for home station equipment that span a wide design space. One design would give CSHs about the same amount of equipment at home station as the current 84-bed hospital set while enhancing the training and medical capability; we term this the Enhanced Capability, Single Base (ECSB) design.

³ These authorized equipment LINs are funded through two different budgetary accounts, OPA (Other Procurement, Army) and OMA (Operations and Maintenance, Army). OPA LINs are the most expensive medical equipment.

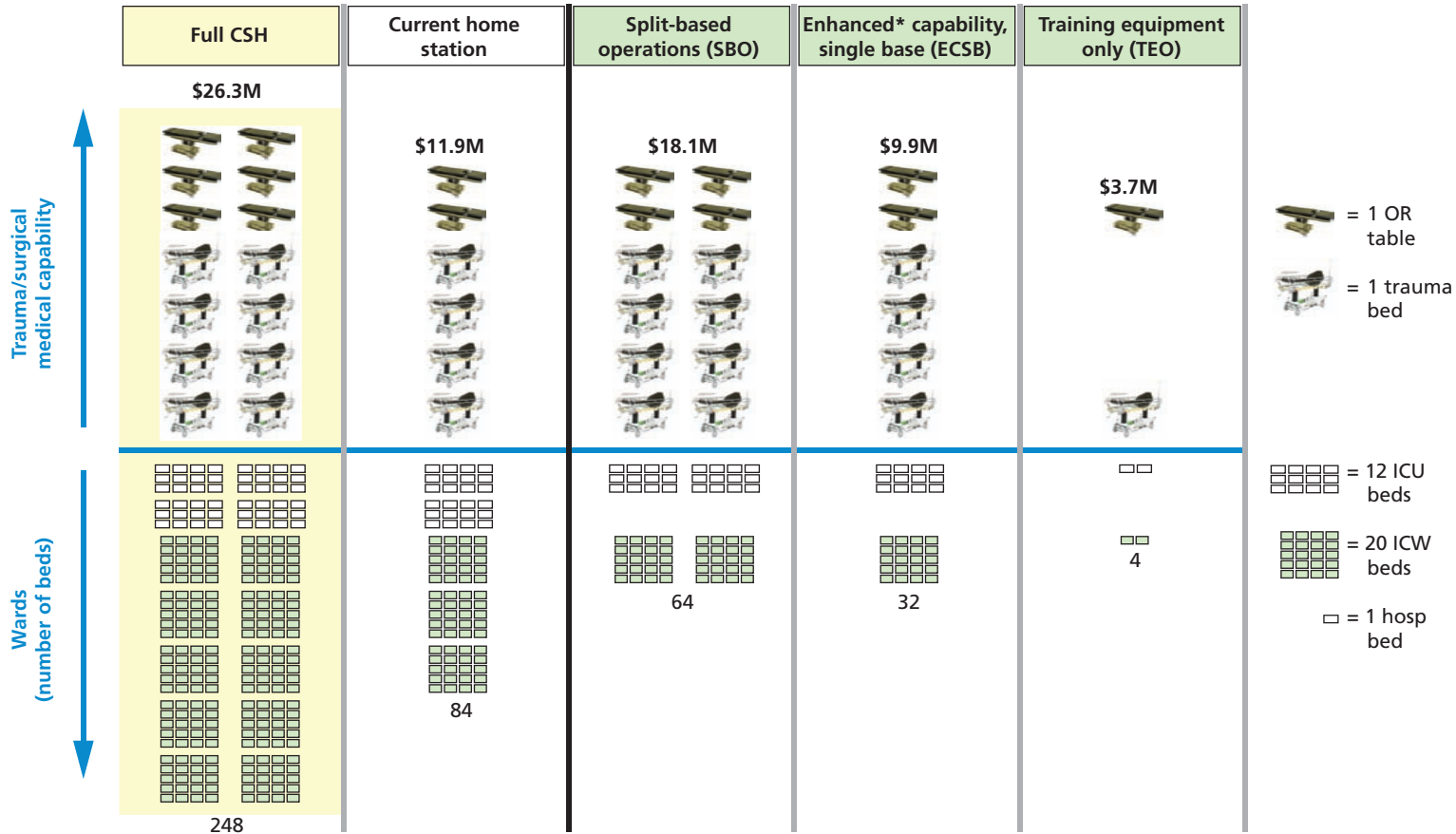
Another design—which we term the Split-Based Operations (SBO) design—would give the CSHs much more medical equipment and training capability at home station than they currently have, while another—the Training Equipment Only (TEO) design—would give them very much less.

Each of the alternative home station equipment designs offers different training and medical capabilities. These are described below in comparison to the current home station equipment set and represented schematically in Figure 3.2. The figure uses icons to graphically summarize the differences in capability among the hospital designs, using two measures of capability. Above the horizontal midline are icons representing the surgical throughput capability of each design in terms of the number of OR sets and emergency medicine trauma beds. Below the midline are icons representing another measure, patient holding capacity, in terms of the number of beds in ICUs, with 12 beds each, and ICWs, with 20 beds each.⁴

- **Current design.** The current home station design for active component CSHs is a deployable, two-module 84-bed hospital with equipment owned solely by the Bravo Company of the CSH. As the figure indicates, the 84 beds consist of 24 ICU beds and 60 ICW beds. The design includes two operating rooms and four trauma beds. In addition to having all of the 84-bed medical company on hand, the current home station design also includes key components of the headquarters and headquarters detachment (HHD). The total equipment value is about \$15.7 million. The portion of the MTOE that the current home station design does not include—namely, most of the 164-bed medical company—is in storage offsite at SIAD, as shown in the left panel of Figure 3.3. The current home station design enables the CSH to establish a single Level III trauma/surgical hospital using its own on-hand equipment; however, the home station equipment set does not support split-based training or operations.
- **Split-Based Operations (SBO) set.** The Split-Based Operations design was created specifically to address the desire for a home station equipment set that would enable training for and executing split-based operations. The set was designed to provide similar equipment and medical capability in both the Alpha and Bravo Companies, providing two 32-bed hospitals, each with 12 ICU beds and 20 ICW beds. Though the SBO design has fewer total beds than the current design, it doubles the surgical and trauma capability at home station and accordingly keeps more of the total equipment cost at home (\$20.3 million versus \$15.7 million).
- **Enhanced Capability, Single Base (ECSB).** The Enhanced Capability, Single Base design represents about the same cost as the current design (\$14.2 million

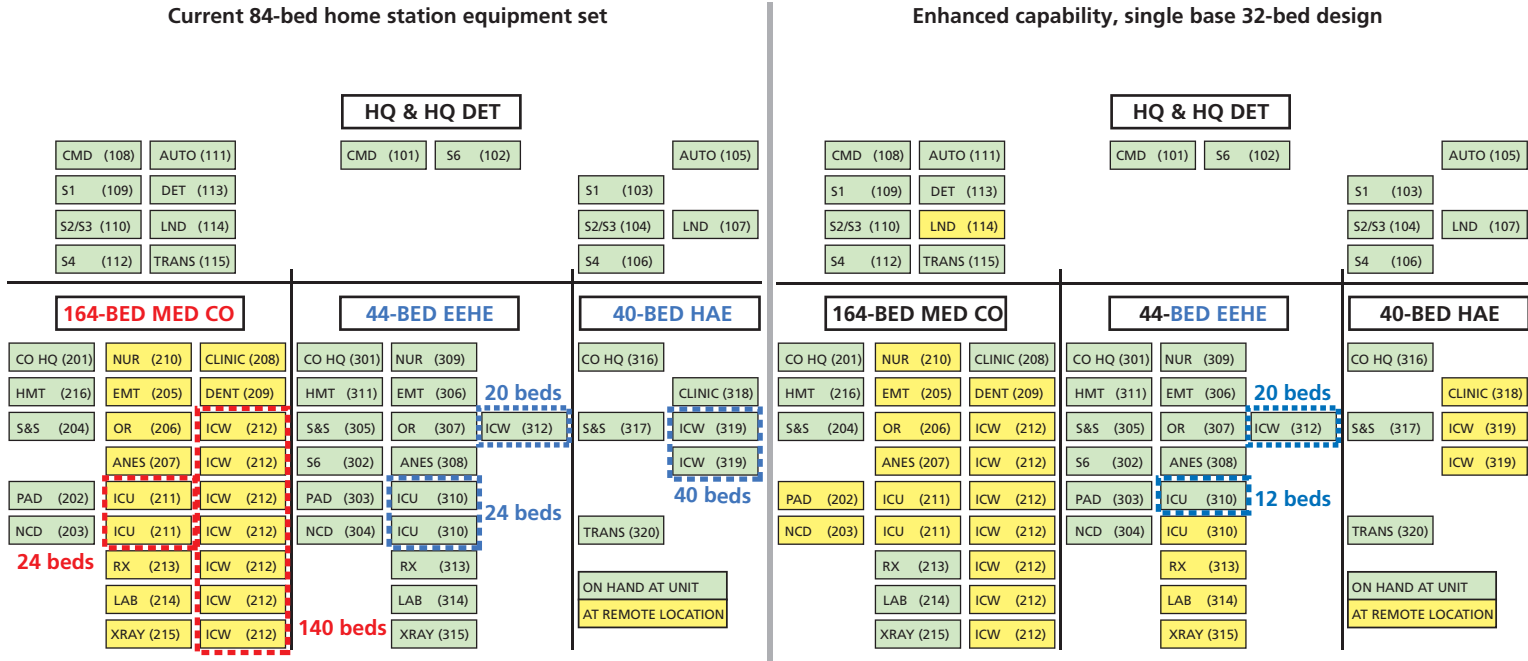
⁴ Because of improved stabilization and evacuation capabilities, the general historical trend has been for CSHs to reduce the length of time they hold patients; for this and other reasons (e.g., to improve mobility), the number of beds in hospital designs has declined. The current MTOE of 248 beds superseded one with 296 beds that had much more intensive care holding capacity.

Figure 3.2
Alternative Home Station Equipment Sets Offer Different Medical and Training Capabilities



*Compared to current, both SBO and ECSB designs have more lab and Rx capability, more hard-shell structures.

Figure 3.3
Comparison of Current and Enhanced Capability, Single Base Designs Within the Context of the Current MTOE for 248-Bed CSH



ECSB provides more Level III medical and training capability at home station than current design.

and \$15.7 million, respectively) in the portion of the equipment at home while providing improved medical capability. The ECSB design would provide a CSH with a single 32-bed Level III hospital at home station on which it could train and execute all hospital functions except for dental.⁵ The design is termed “enhanced capability” because, unlike the current design, it includes the pharmacy, lab, and medical maintenance sets and the specialty clinic from the 164-bed company rather than their smaller counterparts from the 84-bed company (see right panel of Figure 3.3).

- **Training Equipment Only (TEO).** Even more than the SBO design, the TEO design would represent a radical change in the equipment that CSHs have on hand at home station. The TEO design would not provide a CSH with a full hospital or any real capacity to provide medical care locally; rather, it would provide a very limited set of equipment sufficient to allow the CSH personnel to train to conduct certain core hospital functions. To train for other functions, the CSH would need to rely on RTS-Med or MTTs; this and other implications of each home station design will be addressed in the next chapter.

Table 3.1 summarizes the differences in equipment and capability among the four designs for home station equipment sets. The details of the design method and designs are presented in Appendix C.

Table 3.1
Alternative Home Station Equipment Sets Offer Different Medical and Training Capabilities

Home Station Equipment Design	Equipment at Home Station	Mission and Training Capability
Current	1 × 84-bed hospital	84-bed hospital alone does not support split-based missions or training.
Split-Based Operations (SBO)	2 × 32-bed hospitals	64-bed set has more Level III capability than current 84-bed set; enables split-based missions and training
Enhanced Capability, Single Base (ECSB)	1 × 32-bed hospital	32-bed hospital has more Level III capability than current 84-bed hospital; does not support split-based mission and training
Training Equipment Only (TEO)	4-bed (not a hospital)	Emphasizes support of individual training and some collective training; provides no medical mission capability; limited support of unit-level training

⁵ Dental care is not a core competency of the CSH. All three authorized dental personnel are PROFIS, so there would be no full-time personnel assigned to use the equipment. The equipment itself includes a good deal of high-technology items, creating a maintenance burden without a corresponding benefit.

Alternative Equipping Strategies

As indicated in Chapter One, CSH medical equipment resides in four large pools. What the CSHs have in their home station equipment sets has implications for what equipment must be available in the other three pools. In this chapter we address those implications in order to define three alternative equipping strategies, each anchored in one of the three alternative home station equipment sets described in Chapter Three.¹

Estimating the Equipment Requirement for Deployed CSHs

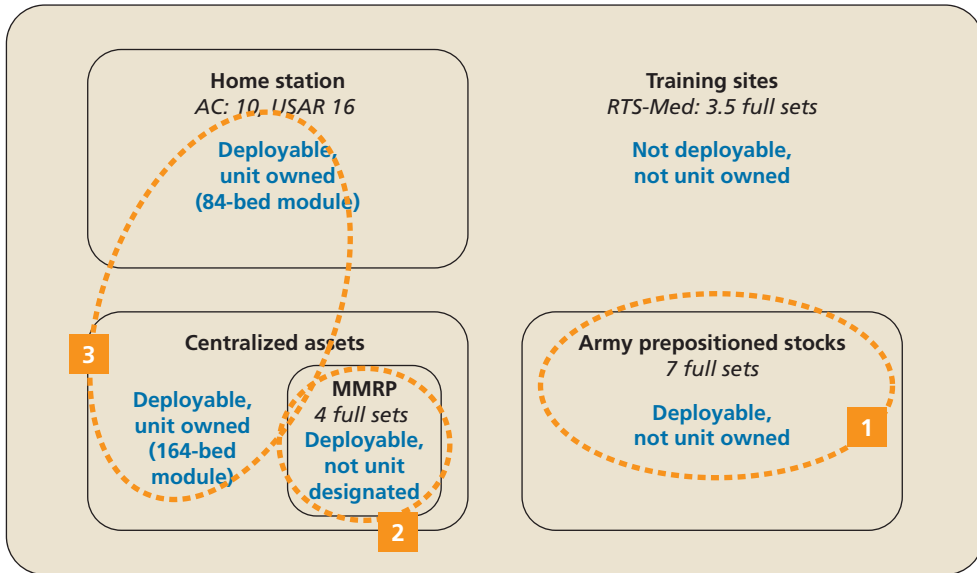
Because none of the alternative home station designs would provide a CSH with a 248-bed hospital, a key consideration of any equipping strategy is where and how a CSH will obtain its full MTOE when it deploys. Looking across the four pools of equipment, there are three possibilities (see Figure 4.1).

- The easiest way for a deploying CSH to acquire a 248-bed hospital would be for its personnel to fall in on a hospital downloaded from APS.
- If for some reason an APS hospital set was not available, the CSH personnel could “marry up” with one of the full 248-bed hospital sets stored at SIAD in the Medical Materiel Readiness Program (MMRP) that was shipped by USAMMA, on demand, to the deployment location.
- If the deploying CSH was unable to use a hospital from APS or MMRP, then a third option would be for it to deploy with its home station equipment and “marry up” with the balance of its MTOE stored at SIAD. This option would require both the home station equipment and the balance at SIAD to be prepared for deployment.² (This option would not be available if the CSH’s home station equipment was the TEO set.)

¹ This chapter will focus on the equipping aspect of alternative equipping and maintenance strategies; maintenance implications of the equipping options are addressed in Chapter Five.

² The tasks involved in preparing elements of a CSH for deployment can be time and labor intensive. A CSH equipment set reportedly fills over 100 ISO containers. In preparation for deployment the CSH personnel would

Figure 4.1
When Deploying, Combat Support Hospitals Have Three Ways to Draw 248-Bed Hospitals (Full MTOE)



RAND MG887-4.1

In all these cases, the Army's capability to deploy CSHs depends critically on the equipment in APS and at SIAD, the latter including both MMRP sets and balances.

How much equipment would be required across all of these pools in order to ensure that each deploying CSH will have a full MTOE? To develop one possible answer to this question, we applied the business rules of the ARFORGEN process. By calculating the maximum number of CSHs that could be deployed under ARFORGEN rules, we determined how many full equipment sets would need to be available to deploying CSHs.

Under ARFORGEN, every CSH in the Available pool is deployable; moreover, if a surge of forces is required, some of the CSHs in the Train/Ready pool could also be deployed.³ More specifically, active CSHs in the Train/Ready pool could be

have to carry out technical inspections of equipment, repair/replace items as needed, and repack the containers of equipment from a "maintenance" pack (maintenance-requiring items packed together to ease labor burdens for maintenance) to a "combat deployment" pack (equipment packed into functional sets for ease of assembly in theater).

³ A surge of forces can also be achieved by delaying the return of some units in the Available pool to the Reset pool; in other words, as units continue to flow into the theater of operations, the units that they were to replace could instead remain, temporarily "surging" the total military presence.

deployed and reserve CSHs in years two and three of their three-year period in Train/Ready could be deployed.⁴ With this construct and given ten existing active component CSHs, six or seven are in the Train/Ready and Available pools at any given time and could be deployed. Of the 16 reserve CSHs, nine or ten would be either in the Available pool or in years two or three of the Train/Ready pool at any given time and could be deployed. Thus, for an overall maximum, we consider that no more than 16 CSHs can be deployed under ARFORGEN business rules. This seems a very conservative estimate, given that there are now only four CSHs deployed to support operations in Iraq and Afghanistan. Note that this would be many more CSHs deployed than if deployments were limited to those levels that would meet rotational dwell-to-deploy time goals of two to one for active forces and four to one for reserve component forces. Regardless, if further Army analysis or different assumptions were to indicate a different maximum simultaneous CSH deployment level, the following analysis could be readily adjusted to allow for fewer or more full equipment sets.

Sources of Deployable Hospitals

Assuming the Army under ARFORGEN requires 16 deployable 248-bed hospitals, seven can be provided by the Army's current APS inventory.⁵ Another two can be provided by the existing MMRP to make a total of nine full CSH sets.

The remaining seven (or potentially different remainder if the 16 full set requirement were adjusted) deployable hospital sets must come from some combination of centralized assets at SIAD and home station equipment, that is, from a combination of additional MMRP sets, balances of home station equipment sets, and home station sets. In developing alternative equipping and maintenance strategies, we have specified combinations of balances and MMRP sets that vary according to the home station equipment design that anchors each strategy. These are summarized in Table 4.1 and compared to the current strategy (second row of the table).

⁴ Interviews with the USARC Surgeon's Office indicated that reserve CSHs in year one of the Train/Ready ARFORGEN pool would not be deployable.

⁵ Seven is a midpoint between the current and planned APS capacity: currently the Army has six full CSH sets and one partial CSH equipment set in APS; it is planning to have seven full and two partial sets by 2015. More specifically, there are currently seven CSH sets in APS, as follows: (1) five full sets in APS-4 (Korea/Japan); (2) one full set in APS-5 (Qatar), which was just reconstituted in 2008; and (3) one 44-bed EEHE in APS-3. (Source: Department of the Army Supply Bulletin 8-75-S7. Headquarters, Department of the Army, Washington, D.C., July 20, 2008.) There are plans under APS Strategy 2015 to expand capacity by one full set and one EEHE, for a total of seven full CSH sets in APS and two 44-bed EEHEs: (1) five full sets in APS-4 (Korea/Japan); (2) two full sets in APS-5 (Qatar); and (3) two 44-bed EEHEs in APS-3. (Source: Headquarters, Department of the Army, Message, November 27, 2007.)

Table 4.1
Centralized Assets and APS Are Critical to Providing 16 Deployable 248-Bed CSH
MTOE Hospitals

Equipping Strategy	Home Station Equipment	Centralized Assets			
		Materiel Mobilization Readiness Program (MMRP)	Balances	Army Prepositioned Stocks	Total
Current	84-bed hospital	4 × 248-bed hospitals ^a	22 × 164-bed ^b	7 × 248-bed hospitals	33
Split-Based Operations	64-bed hospitals	2 × 248-bed hospitals	7 × 184-bed	7 × 248-bed hospitals	16
Enhanced Capability, Single Base	1 × 32-bed hospital	4 × 248-bed hospitals	5 × 216-bed	7 × 248-bed hospitals	16
Training Equipment Only	4-bed (not a hospital)	9 × 248-bed hospitals	Not applicable	7 × 248-bed hospitals	16

^a Two current, two planned.

^b Four of 26 164-bed hospitals in the RCHD program at SIAD were or are planned to be converted to MMRP sets.

- If CSHs have SBO sets at home station, the option of having units deploy with their equipment and marrying up with the balance from SIAD is more attractive than it is with other home station sets. These home station sets would be very well resourced and would support split basing both for training and, if needed, for deployments. The Army would get the most value out of them if they were also used by the unit when it deploys. Accordingly, for the equipping and maintenance strategy anchored in SBO home station sets, we suggest that the Army retain seven balances for possible use by CSHs deploying with their own equipment.⁶ (See third row of Table 4.1.) More generally, the number of balance sets would be the total requirement less the number provided by APS and MMRP. There would be no need under this approach for USAMMA to execute the current plan to expand MMRP from two to four full CSH sets.
- If CSHs have the ECSB sets at home station, the option of having units deploy with their own equipment and marrying up with balances is less attractive

⁶ The balance for a 64-bed hospital is described as a 184-bed hospital; this is because the SBO design has one less ICW (20 beds) than the current home station design, and that ICW must be stored at SIAD. Note that, despite the designation 184 being a larger number than 164, the balance for the SBO set has *less* medical capability than the balance for the current 84-bed set for the simple reason that the 64-bed SBO set has *more* medical capability than the current 84-bed home station set.

though still viable. In this case, it makes sense for USAMMA to execute its plan to expand the MMRP to four full CSH equipment sets from the current two sets. It would then need just five balances to ensure the deployability of 16 CSHs (see the fourth row of Table 4.1).⁷ (The mix of balances and additional MMRP sets could be adjusted if the requirement was more or less than 16, or the additional MMRP sets could be expanded if none of the CSHs were expected to deploy with their own equipment.)

- If CSHs have the TEO sets at home station, they will not be able to deploy with their equipment: the TEO sets are not designed to be deployable, and they have no balances. Accordingly, under this strategy, deploying CSHs will need to marry up with full 248-bed CSH equipment sets, either from APS or MMRP. To meet the requirement to have 16 full MTOE hospitals available for deploying units, USAMMA could expand the MMRP to nine hospitals (see the fifth row of Table 4.1). In this case, the number of needed MMRP sets becomes the total requirement less the number of APS sets.

Sizing the Training Base

The only pool of equipment remaining to be addressed is the training base, currently consisting of an 84-bed set at Fort Polk and full 248 CSH equipment sets at the three regional training sites.⁸ The equipment sets in this pool are nondeployable and so do not figure into the question of how to provide equipment to deploying CSHs.

The extent to which CSHs will need to rely on the training base to complete their training regimen depends in large part on what equipment set they have at home station.

- Currently, active component CSHs report limited use of the RTS-Meds and also try to support their training with their 84-bed equipment set at home station, even though it does not support split-based training. Reserve component CSHs, with their smaller MEET sets at home station, visit the RTS-Med once per ARFORGEN cycle, in the Train/Ready pool.
- If CSHs had the SBO set at home station, they would have limited reasons to visit the RTS-Med to access additional equipment for training. The SBO set is rich with equipment and supports split-based training. Nevertheless, a CSH might still want to visit the RTS-Med in order to take advantage of the resident training

⁷ Because the ECSB hospital has only 32 beds, its balance will include 216 beds of the 248-bed MTOE.

⁸ Fort Polk houses the Joint Readiness Training Center (JRTC). The CSH set there supports units participating in training rotations at JRTC.

expertise and to train on establishing and operating a full 248-bed hospital.⁹ In addition, a CSH scheduled for deployment might want to visit the RTS-Med to prepare for the specific equipment it would have in theater, if different from what it has at home, or for other specific conditions that would be faced upon deployment. As indicated in Chapter Two, CSH commanders in focus groups wanted the opportunity to have their units train on equipment and facilities that mirror those in theater; the RTS-Med could meet this need if the sites had the flexibility to configure their hospital sets continually to reflect theater conditions.

- If CSHs had the ECSB set at home station, they would have more need to visit the RTS-Med. Both active component and reserve component CSHs would need to rely on the RTS-Med both to train split-based operations and to gain experience with establishing and operating a 248-bed hospital. Active component CSHs could visit the RTS-Med once per ARFORGEN cycle in the Train/Ready pool. Reserve component CSHs could follow the same schedule as they do currently.
- If the CSHs have the TEO set at home station, they would rely on the RTS-Med capabilities for some collective and all unit training activities. Active component CSHs might visit RTS-Med as many as three times during the 18 months of the ARFORGEN Train/Ready time. Reserve component CSHs might also visit the RTS-Med three times during each ARFORGEN cycle, once in each of their three years of Train/Ready.

If supplied with well-maintained equipment of the most current technological generation, the Army's CSH training base appears to have sufficient capacity to meet the training requirements for all three alternative strategies. Each of the four sites could accommodate at least ten events per year, for a total of 40 events, though current usage is much lower.¹⁰ This number far exceeds the number of CSHs that are in the Train/Ready pool each year. Of the ten active component CSHs, only three or four are in the Train/Ready pool each year. Even under the TEO strategy, in which active CSHs might visit the RTS-Med twice in twelve months, they would take up only six to eight of the 40 slots, leaving more than enough to meet the needs of the seven or eight reserve component CSHs that are in the second or third year of the Train/Ready phase each year.

Because the capacity of the training base seems sufficient, we retain the current base unchanged in all three alternative equipping strategies. Whether the base could

⁹ The project team did not encounter any reports of CSHs desiring to or actually setting up full 248-bed hospitals. There were also no reports of 248-bed hospitals being set up for training at RTS-Meds.

¹⁰ CSHs typically visit for two weeks of training; for the site itself, the visit is a one-month event because of preparation before the visit and recovery activities afterward. Use of 10 months instead of 12 months of training reflects the standard training schedules for the Combat Training Centers (CTCs). Currently at the RTS-Med sites, 3–5 reserve CSHs use the sets for a Global Medic event each summer) and for JRTC rotations as needed.

be reduced under some strategies would entail an analysis of the services besides CSH training events that the sites provide the Army.

Summary of Alternative Equipping Strategies

Table 4.2 summarizes the three alternative equipping strategies, each anchored in a distinctive design for the home station equipment set, and compares them to the current strategy.

As the table shows, each of three alternative equipping strategies would result in the Army having substantially less total medical equipment in its inventory than it does currently. Two pools of equipment, APS and RTS-Med, would remain unchanged in the alternative strategies; the reduction in total inventory would occur because of changes in the other two pools, home station equipment and centralized assets.

- In all of the alternative equipping strategies, the amount of centralized equipment would be greatly reduced from the current levels now at SIAD. For example, under the SBO strategy, the number of balance sets would be reduced by over two-thirds, from 22 to 7.¹¹ None of the alternative strategies attempts to provide each CSH with its own dedicated balance set on a one-to-one basis; rather, each alternative is designed to ensure that there are sufficient balances and other assets (in APS and MMRP) to support the maximum number of CSHs that can be deployed given the ARFORGEN model and the number of CSHs the Army has. Rather than unit-owned, the balances would be USAMMA owned and managed.
- Two of the three alternative strategies—ECSB and TEO—would also result in there being less equipment in the home station equipment pool. In the SBO strategy, the 64-bed hospital at home station, though smaller in terms of total beds, would have more medical equipment than the current 84-bed hospital.

Among other topics, the next chapter examines the cost and capability (capability in terms of equipment condition and technological currency) implications of a reduced total inventory of CSH medical equipment.

¹¹ The dollar value of remaining equipment in the SBO balances would decrease, even though they are described as 184-bed equipment sets and have one more ICW ward (20 beds) than the current 164-bed balances.

Table 4.2
Summary of Alternative Equipping Strategies

Equipping Strategy	Home Station Equipment	Centralized Assets	Army Prepositioned Stocks	Training Site Equipment
Current	84-bed hospital	4 × 248 22 × 164	7 × 248	3 × 248 1 × 84
Split-Based Operations	64-bed (2 × 32-bed hospitals)	2 × 248 7 × 184	7 × 248	3 × 248 1 × 84
Enhanced Capability, Single Base	32-bed hospital	4 × 248 5 × 216	7 × 248	3 × 248 1 × 84
Training Equipment Only	4-bed training set (not a hospital)	9 × 248	7 × 248	3 × 248 1 × 84

Assessing the Costs and Risks of Alternative Strategies

Compared to most other categories of equipment, medical equipment is generally expensive and subject to frequent upgrading due to technological obsolescence. The Army's process for keeping the medical equipment on the CSH MTOE current is executed by the AMEDD Directorate of Combat and Doctrine Development (DCDD). In coordination with the Medical Materiel Branch (MMB), the DCDD organizes and oversees the review of medical unit assemblages (UAs), such as medical materiel sets and medical equipment sets. The UAs are broken down into groups and cyclically reviewed every three years by subject matter experts. The DCDD coordinates the materiel management expertise of USAMMA with the clinical expertise of various healthcare providers in a comprehensive review of medical sets for operational function and component acquisition. After a medical set upgrade is reviewed and approved by DCDD, the design is provided to USAMMA for resourcing and acquisition. The current generation of medical equipment is referred to as the "N" generation. A CSH set composed of N generation UAs is an N generation set.

Currently, CSHs are not using and training on the N generation of equipment throughout most phases of the ARFORGEN cycle: the exception is when they are in the Available pool and deployed, because the sets established in Iraq and Afghanistan have been upgraded to the N generation. The newly constituted sets stored in MMRP and APS are also of N generation. By contrast, the home station sets in CONUS and the RTS-Med sets are of the previous M generation. Equipment in some of the balances stored at SIAD is of even earlier generations.

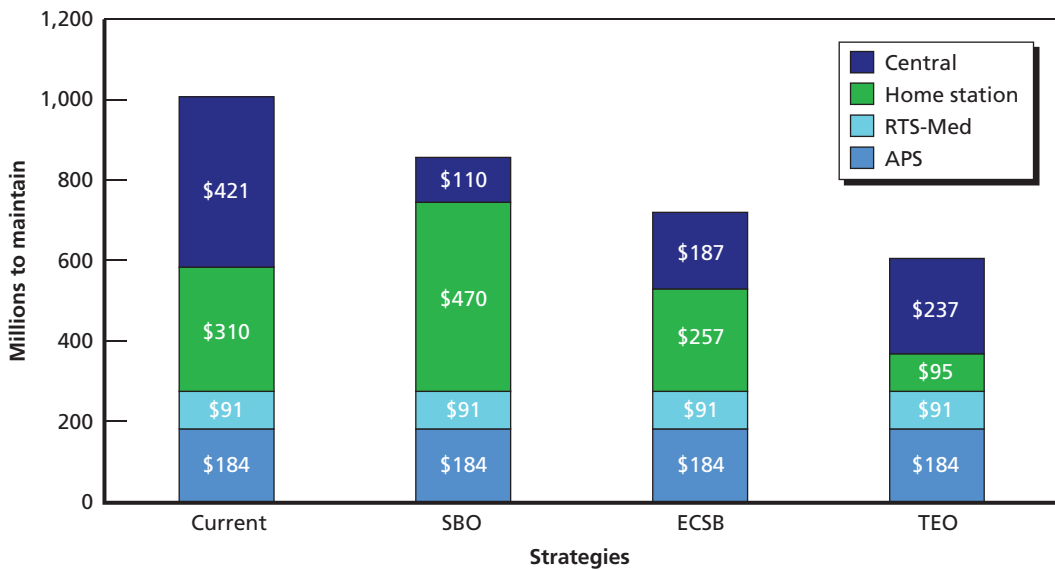
It is widely acknowledged, both by the active and reserve CSH staffs and USAMMA, that the Army has been challenged to keep the current inventory of CSH medical equipment well-maintained and technologically current; a smaller fleet of CSH hospitals would reduce those challenges. Equipping strategies that would reduce the Army's total inventory of medical equipment would reduce procurement costs as equipment sets are modernized and would reduce maintenance costs as well.

Cost Assessment of Alternative Equipping Strategies

Equipment Replacement Cost

Figure 5.1 shows how the total Army required investment (in terms of current equipment value) in CSH medical equipment would be reduced under each of the three alternative strategies. Each stacked bar has four layers corresponding to the four pools of CSH medical equipment: home station equipment, centralized assets (balance sets and MMRP), APS, and RTS-Med. Under each of the three alternative strategies, the replacement cost of equipment in APS and RTS-Med would be the same as under the current strategy.¹ As described in Chapter Two, compared to the replacement cost of equipment at home station under the current strategy, the replacement cost of equipment at home station would be higher under the SBO strategy, about the same under the ECSB strategy, and substantially lower under the TEO strategy. The replacement cost of equipment in the centralized asset pool would be lower under all three

Figure 5.1
New Equipping Strategies Offer Opportunity to Decrease Total Replacement Cost Requirements



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¹ During the course of this research project it became clear that an important aspect of improving materiel stewardship is improving the quality of data related to the procurement, maintenance, and upgrading of equipment. Improvements in how the Army tracks and maintains data on past procurement and maintenance costs for medical equipment (including replacement and upgrade costs), at the NIIN and LIN level, could inform a number of analyses. This would include understanding obsolescence rates for pieces of equipment, across series sets, as well as provide cost comparison data for alternative procurement practices.

alternative strategies than it is currently, with the lowest level occurring under the SBO strategy. In all three alternative equipping strategies, the sum of equipment replacement cost in the home station and centralized asset pools would be lower than under the current strategy.

Upgrade Costs and Obsolescence Management

A reduction in the total Army inventory of CSH equipment would result in a corresponding decrease in the costs of maintenance and periodic equipment set upgrades. Maintenance costs run about 1.5 percent of equipment value annually.²

Upgrade costs are much more substantial (although the Army upgrades medical equipment sets not annually but triennially). Based on the recent expansion and upgrade of two 164-bed hospital sets at SIAD to 248-bed hospitals as part of the MMRP, we estimate that the next generational upgrade from N to O will increase CSH equipment costs by 65 percent.³ Table 5.1 shows the estimated costs to upgrade the medical equipment in the alternative home station equipment sets from N to O.

Currently the Army has \$97 million programmed each year from FY10 through FY15 to upgrade the unit-owned medical equipment in the home station pools and the unit-owned balances and MMRP sets in the centralized asset pools.⁴ As seen in

Table 5.1
The Alternative Home Station Designs Represent Different Levels of Equipment at Home Station and Associated Procurement and Upgrade Costs

Design	Home Station Equipment	Procurement Cost ^a	Upgrade Cost (65%) ^b
Current	1 × 84-bed hospital	\$15.7M	\$9.4M
Split-Based Operations	2 × 32-bed hospitals	\$20.3M	\$12.2M
Enhanced Capability, Single Base	1 × 32-bed hospital	\$14.2M	\$8.5M
Training Equipment Only	4 beds (not a hospital)	\$3.6M	\$2.3M

^a All materiel in unit assemblages, including Ps&Ds; excludes non-UA LINs. Information from Medical Services Information Logistics System (MEDSILS), available at the U.S. Army Medical Materiel Agency's web site. See Appendix D for equipment cost data.

^b Assumes upgrade after three years. 65 percent estimated from USAMMA POM costs for CSH medical sets. Appendix D also discusses upgrade cost estimates.

² Email from Jack Rosarius, Director, Medical Maintenance Management Directorate, USAMMA, Fort Detrick, Maryland, January 5, 2009.

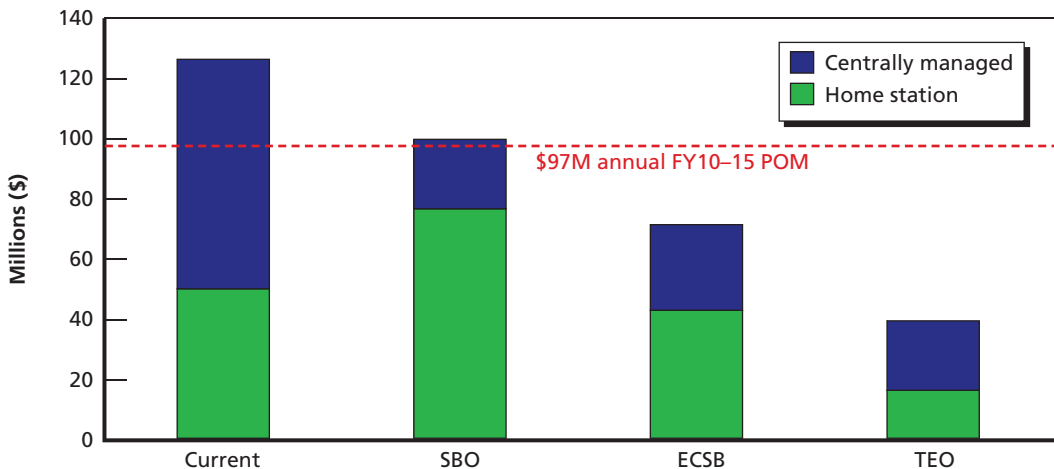
³ See Appendix D for a discussion of equipment cost data. See Appendix E for an assessment of the prospects for using alternative procurement strategies, such as leasing, to help manage technological obsolescence and cost growth in CSH medical equipment.

⁴ USAMMA Resources Management Division, 2008. The CSH sets in the training base will require an additional \$19 million annually to keep current; those in APS will require an additional \$40 million.

Figure 5.2, this amount will not enable the Army to upgrade all of the medical equipment in the home station sets and the centralized assets at SIAD. Assuming that the Army would initially upgrade the home station and MMRP sets, then upgrade as many of the balances as the remaining funds would permit, about two-thirds of the 22 current balances could not be upgraded within the three years after a new generation of equipment was adopted. However, under each of the alternative equipping strategies, with their reduced centralized asset pools, the \$97 million would be sufficient to upgrade all the medical equipment at home station, the MMRP sets, and all of the balances as well. This is shown by the three stacked bars on the right of the figure.

If the Army does not program sufficient resources to upgrade all the medical equipment in its centralized asset pool, over time some of this equipment will fall further and further behind in terms of its technological currency, eventually becoming obsolete. This is the situation depicted in Figure 5.3, which shows what would happen to the generational mix of balances when only one-third of them can be upgraded to the latest-generation equipment during the three years before yet another generation is introduced. For purposes of illustrating the problem, the calculations in the figure assume that, of the \$97 million per year programmed to upgrade equipment in the home station and centralized asset pools, \$50 million is used to upgrade the home station equipment and \$23 million to upgrade four MMRP sets, leaving only \$24 million

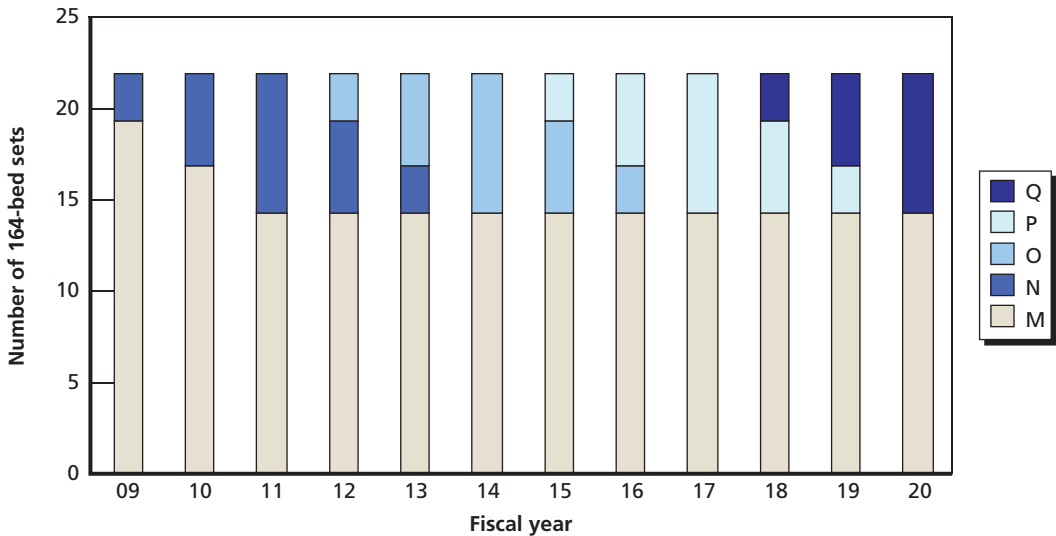
Figure 5.2
Under New Equipping Strategies, POM Budget Would Be Sufficient to Upgrade Home Station and Centralized Assets (Excluding APS and Training Sites)



SOURCE: USAMMA POM data, current replacement cost.

NOTES: Training base will require additional \$19M annually to keep current. APS will require \$40M annually to keep current.

Figure 5.3
Given \$97 Million, Under Current Equipping Strategy AMEDD Can Only Keep One-Third of 164-Bed Sets Upgraded



SOURCE: USAMMA POM data, current replacement cost.

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to upgrade the balances. As the figure shows, after four years, most of the balances would be two generations behind, and after eight years (FY15 in the figure), most of the balances would be three generations behind the most current generation of equipment. This illustrates how the Army arrived at the situation today with outdated balances at SIAD. Given the rapid pace of advances in medical technology, equipment can become obsolete in a relatively short time. It is important for the Army to adopt a CSH equipping strategy that will enable it to maintain the currency of medical equipment within available resources.

To be consistent with the ARFORGEN process model and to keep home station sets ready for deployment during the Train/Ready and Available phases, we propose that the AMEDD should consider a policy to upgrade the sets for CSH units during the Reset phase of the ARFORGEN cycle. This would be every three years for active component units, and every five years for reserve units. Again, this timetable for modernization would be supportable with the alternative equipping strategies and current funding levels, but would require added funding under the current equipping strategy.

Maintenance Burden

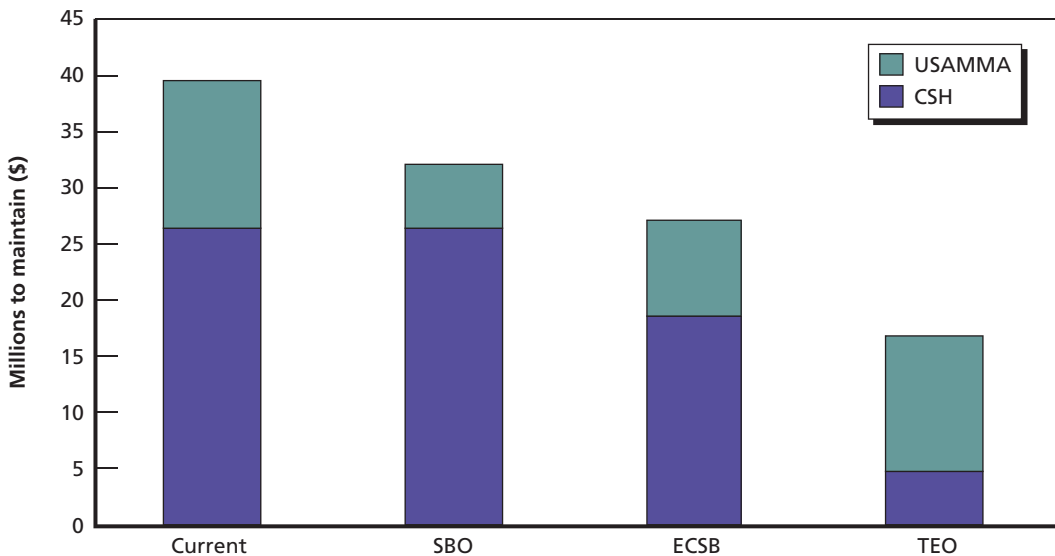
Under an equipping strategy that reduced the Army's total inventory of CSH medical equipment, maintenance costs would decline in direct proportion. The first stacked

bar in Figure 5.4 shows the annual cost of maintaining the medical equipment in the home station and centralized asset pools under the current strategy: almost \$40 million. Under the current equipping and maintenance strategy, this maintenance is conducted by the CSH maintenance personnel themselves; the active component CSHs maintain both their equipment at home station and their balances at SIAD, and the reserve component CSHs maintain their equipment at home station. The remainder of the maintenance is conducted by USAMMA, which has responsibility for maintaining all of the equipment in the centralized asset pool—including the MMRP sets—with the exception of the active component balances. Moreover, deploying CSHs turn their equipment into the LBE program, with USAMMA assuming maintenance responsibility until the CSH redeploys.

Under the alternative equipping strategies, the annual maintenance cost would decline as the total inventory of equipment declines. In addition, the distribution of responsibility for maintenance would shift depending on the allocation of medical equipment between the home station and centralized assets pools.⁵

- Under the SBO strategy, because the centralized asset pool would be sharply reduced compared to what is currently at SIAD, USAMMA’s maintenance responsibilities would decrease substantially. The CSH level of maintenance

Figure 5.4
Annual Maintenance Budget Would Decrease and Shift Under Alternative Equipping Strategies



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⁵ We did not analyze the manning or training implications of maintenance workload shifting.

would remain about the same despite the SBO home station design having more equipment than the current 84-bed set. This is because the increase in the home station maintenance burden would be offset in part by the fact that the active component CSHs would no longer need to maintain their balances at SIAD.

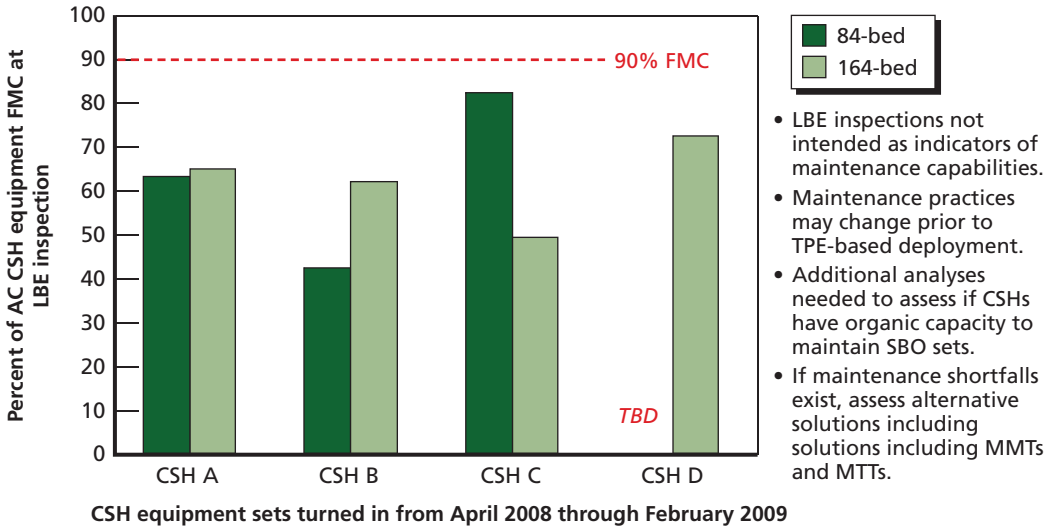
- Under the ECSB strategy, the maintenance burden on the CSHs would fall relative to either the current or the SBO strategy. USAMMA's maintenance burden would be less than under the current strategy, but higher than that under the SBO strategy as more equipment is moved to centralized management.
- Under the TEO strategy, the maintenance burden on the CSHs would be very low due to the small amount of equipment in their home station sets. USAMMA's maintenance burden would grow, reflecting that strategy's reliance on a relatively high number of 248-bed hospitals in the centralized asset pool.

Of the three alternative equipping strategies, two—the ECSB and TEO—would reduce the maintenance burden for CSHs and possibly limit the opportunity for training of maintenance personnel. The SBO strategy would leave the maintenance burden at its current level, though it would move more of the unit's equipment from SIAD to the home station set. The prospect of having larger home station equipment sets with their associated higher maintenance requirements raises concerns among some AMEDD personnel. Although CSH commanders that we spoke with in focus groups expressed confidence in the ability of their units to maintain larger home station equipment sets, other AMEDD personnel have questioned whether the maintenance capacity of the CSH units is sufficient to keep the medical equipment in the SBO designs in good condition.

This concern derives in part from inspections conducted by AMC when deploying CSHs have turned their home station sets into the LBE program. Figure 5.5 shows the overall fully mission capable (FMC) status of medical equipment that four active component CSHs turned into LBE in 2008–2009; in each pair of bars, the left (dark) bar shows the FMC rate for their home station equipment and the right (light) bar for the balance at SIAD (for which active component CSHs retain maintenance responsibility). The figure shows that none of the four CSHs that had equipment sets either at home station or SIAD met the goal of having 90 percent of the equipment they turned in fully mission capable.

However, data from LBE inspections may not be good indicators of how well CSH units are maintaining their medical equipment on a routine basis. There are many reasons why a CSH preparing for deployment might decide to forgo some maintenance actions, particularly if it knows that it will not be deploying with its equipment but rather turning it into a program that will inspect and repair it before the CSH redeploys. More analyses are needed to ascertain whether CSHs have the maintenance capacity to support having the SBO designs at home station before concluding either that the design would be infeasible or that the capacity would require augmentation.

Figure 5.5
Additional Analysis Needed to Determine Whether Units Can Maintain Home Station Sets Larger than the Current One



SOURCE: USAMMA data provided March 11, 2009.

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Risk Assessment of Alternative Equipping Strategies

In addition to estimating the costs of alternative equipping strategies, it is important to evaluate the risks associated with each. An equipping strategy may create risk for a CSH in four domains:

- **Mission risk.** The CSH may not have the equipment it needs to conduct a mission, either deployed to a theater of operations abroad, “outside the gate” of its home station, or as part of a domestic support operation (DSO).
- **Maintenance risk.** The CSH equipment may not be well maintained.
- **Obsolescence risk.** The CSH equipment may not be technologically current.
- **Training risk.** The CSH may not have access to the equipment it needs to support its training regimen.

As we have shown, the three alternative equipping strategies all avoid the obsolescence risk of the current strategy. So we focused our assessment of the other three risk domains.

Our assessments of mission, maintenance, and training risks are summarized in Figures 5.6 and 5.7 for active and reserve component CSHs, respectively. The com-

ponents are treated separately because of differences in the area of maintenance risk, described below.

Figure 5.6 summarizes the mission, maintenance, and training risks (see column heads) for an active component CSH with the current and alternative equipping strategies (see rows). Within the cells, risks are described in summary text and also graded high, medium, or low by means of stoplight colors (red, green, yellow).⁶

The assessment of risk to attribute the stoplight colors in the chart was carried out by interviewing subject matter experts (SMEs) who had experiences with CSH operations and equipment sets. Each cell of the chart was explained and the risks for that cell were articulated by the SME and discussed by members of the research team. Risk factors and risk-ameliorating factors were included in the discussions. Where applicable, data were cited to support arguments regarding judgments.⁷

The results of these risk assessment yielded the following:

- The major mission threat for an active component CSH would occur if it had the TEO set at home station. Because that set lacks operational medical capability,

Figure 5.6
For Active Component CSHs, the Split-Based Operations Strategy Presents the Least Risk Overall

Strategies	Mission		Maintenance		Training Risks
	"Outside the Gate" Medical Capability	Combat Deployment	Home Station	Centralized	
Current	1 x 84 bed hospital	Deploy single hospital	Maint of on-hand	Limited maint of HOSP equipment	No split-base training capability
Split-Based Operations	2 x 32 bed hospitals	Deploy two separate hospitals	Maint only on-hand	USAMMA provided	Variety of local training capabilities
Enhanced Capability, Single Base	1 x 32 bed hospital	Deploy single, enhanced capability hospital	Maint only on-hand	USAMMA provided	No split-base training capability
Training-Equipment-Only Until Deployed	No Level III local mission capability	Lean design requires full reliance on CMAP	Maint only on-hand	USAMMA provided	Reliance on RTS-Med

Risk level: High Medium Low Additional information needed

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⁶ Green signifies that the assessed risk is low; yellow that the risk is moderate; and red that the risk is high.

⁷ For example, USAMMA data on maintenance status of CSH equipment sets turned into the LBE program suggested that maintenance was an area of risk, but with important caveats regarding sample size and incentives of inspectors.

the CSH would not be able to deploy its own hospital in a domestic support operation. Having a TEO set at home station would also create a moderate risk for deployment to overseas contingencies, because the CSH would not be able to deploy with its own equipment. Instead, it would have to rely on marrying up with full hospital sets either from APS or a shared, centrally managed asset pool (CMAP), which would be a CONUS-located set of equipment (potentially at more than one site) that is centrally managed by USAMMA.⁸ The deployment option that is lost under the TEO strategy is the least likely one to be used, but it is one that CSH commanders value strongly, the option to deploy with their own equipment.

- The major maintenance risk for active component CSHs is the risk that would accrue if capacity were insufficient to maintain a relatively large amount of medical equipment on hand at home station. As noted, the status of equipment turned by deploying CSHs may indicate that at least some active component CSHs are challenged to keep their current 84-bed home station sets well maintained. If so, this challenge would increase if they had the SBO set at home station and be about the same with the ECSB set. The AMEDD would need to more carefully assess the maintenance capabilities of CSHs before deciding on a future equipping strategy.
- Training risks are least for active component CSHs when they have the SBO home station sets, because these make it easiest for the CSH to train, as well as immediately execute, split-based operations. Active component CSHs could still utilize the RTS-Med (e.g., to acquire training on a set that mirrored what was established in a theater of operations) but would not be dependent on them to fulfill their standard training regimen. No other strategies support split-based training at home station.

Overall, the SBO strategy would present the least overall risk for active component CSHs. It has the additional attraction that it provides a capability that CSH commanders strongly value. Moreover, although it is the most expensive of the three alternative equipping and maintenance strategies, it is still less expensive than the current strategy.

Figure 5.7 provides a similar summary assessment for the risks that would be faced by reserve component CSHs under alternative equipping and maintenance strategies.

- The major mission and training risks for the reserve component CSHs are the same as those for the active component for each alternative equipping strategy.

⁸ A 2009 estimate from USAMMA put the time to ship a full CSH equipment set from SIAD to a location on the U.S. East Coast at 7–8 days from shipment request to receipt. As of January 2010, USAMMA was also evaluating the movement of a full CSH equipment set from MMRP storage at SIAD to a storage location on the East Coast to speed deployment for domestic use.

- The maintenance risk is higher for reserve component CSHs under all strategies except TEO, because, except when deployed, reserve CSHs have substantially less organic maintenance capability than do their active counterparts. For example, unless deployed, they lack even one full-time maintenance technician: all reserve maintenance technicians are available for one weekend a month plus two weeks per year.

Overall, the TEO strategy would present the least overall risk for reserve component CSHs. It has the additional attraction that it is also the least expensive of the three alternative equipping and maintenance strategies.

The best equipping and maintenance alternative for active component CSHs may not be the same as the best for reserve component CSHs. This difference carries important implications for which strategy the Army should adopt. We address these implications in the next chapter.

Figure 5.7
For Reserve Component CSHs, the Training Equipment Only Strategy Presents the Least Risk Overall

Strategies	Mission		Maintenance		Training Risks
	"Outside the Gate" Medical Capability	Combat Deployment	On-Hand	Balances	
Current	1 x 84 bed hospital	Deploy single hospital	Maint only on-hand	Limited ability for maint of on-hand	No split-base training capability
Split-Based Operations	2 x 32 bed hospitals	Deploy two separate hospitals	Maint only on-hand	USAMMA provided	Variety of local training capabilities
Enhanced Capability, Single Base	1 x 32 bed hospital	Deploy single, enhanced capability hospital	Maint only on-hand	USAMMA provided	No split-base training capability
Training-Equipment-Only Until Deployed	No Level III local mission tasking	Reliance on CMAP or APS	Maint only on-hand	Maint only on-hand	Reliance on RTS-Med

Risk level: High Medium Low Additional information needed

Toward an Improved CSH Equipping and Maintenance Strategy

Our analyses have shown that the current CSH equipping and maintenance strategy has resulted in the Army owning more CSH medical equipment than it appears to need to support units throughout the ARFORGEN cycle, more than it seems to have the maintenance resources to keep in good condition, and more than it has had the budgetary resources to keep technologically current. Each of the three alternative equipping and maintenance strategies that we developed addresses these problems. However, it is evident that no single alternative strategy considered in this study seems clearly superior and that additional information is needed to make a final decision. Therefore, our recommendations include an implementation strategy that is designed to permit additional evaluation and refinement of the selected strategy.

Because our preliminary evaluation indicates that the preferred alternative strategy differs for active and reserve component CSHs, we recommend that the Army move toward blended strategies:

- For active component CSHs, the Army should take steps to move toward adoption of either the SBO or the ECSB strategy, depending on a decision about the need for active component CSHs to have a split-based capability at home station and on an assessment of their ability to keep the larger SBO set well maintained.
 - Under the SBO strategy, each active CSH would have the SBO home station design, providing it with the capability to train and operate in a split-based configuration. It would not need to rely on the RTS-Med to accomplish its training regimen, though it could use those sites for specialized purposes. Compared to the current situation, under the SBO strategy, active CSHs would have more medical equipment to maintain at home station, but they would lose the responsibility to maintain the medical equipment in their balances at SIAD.
 - Under the ECSB strategy, each active CSH would have the ECSB home station design, providing it with fewer beds but more medical capability than the current 84-bed home station design. As with the SBO strategy, the Army would retain only enough equipment balances at SIAD to ensure that when active

component CSHs enter the Available pool, they retain the option of deploying with their home station set and marrying up with the balance at SIAD. The balances would be larger than those needed under the SBO strategy. Under the ECSB strategy, active component CSHs that wanted to conduct split-based training would need to rely on the RTS-Med.

- Under either the SBO or ECSB strategy, the Army would retain only enough equipment balances at SIAD to ensure that when active component CSHs enter the Available pool, they retain the option of deploying with their home station set and marrying up with the balance at SIAD. This implies reducing the current ten HOSP balances to just three or four. Three or four is the maximum number of balances required to meet the goal of having two-thirds of the active component CSHs able to be deployed in a worst-case scenario after the APS and MMRP sets have been deployed. These three or four should be upgraded and made fully serviceable.
- For reserve component CSHs, the Army should take steps to move toward adoption of the TEO strategy.¹ Under this strategy, reserve CSHs would have the TEO design at home station. Since most reserve component CSHs have their Alpha and Bravo Companies dispersed geographically, each company might need its own TEO set. In addition, reserve CSHs would need to rely on RTS-Med to accomplish their full training regimen. Under the TEO strategy, the Army would not retain any RCHD balances at SIAD to support reserve component CSHs when they deploy; rather, these CSHs would rely on APS or MMRP sets. As a result, the Army would need to expand the number of planned MMRP sets in the centralized asset pool at SIAD from four to five or six: this number would be sufficient to provide equipment to all the reserve component CSHs in the second and third years of the Train/Ready pool that might be called upon to deploy in a maximum surge with multiple major contingencies.

As discussed in Chapter Four, the balances and MMRP sets at SIAD should total nine in order to complement the seven APS sets. In the blended strategy, this could be achieved either with three balance sets and six MMRP sets or with four balance sets and five MMRP sets. As balances are somewhat smaller than MMRP sets, the latter is the slightly less expensive solution.² Moreover, the availability of balances

¹ The TEO strategy resembles the current use of the MEET set by reserve CSHs. It differs in that the MEET is a subset of a larger set of equipment owned by the CSH and is intended to be deployable with the rest of the CSH's equipment. The TEO set is a complete, stand-alone home station set and is not intended to be deployable.

² Forgoing balances altogether in favor of having full sets only in centralized storage would not be advisable. In addition to eliminating the option of having a CSH deploy with its home station equipment, this strategy would entail having nine full MMRP sets augmenting seven APS sets. This would be a very expensive way to insure against the very unlikely event that 16 CSHs would be deployed at once. The chances of the Army deploying a fourth or fifth MMRP set in a given year are low; the chances of needing an eighth or ninth to deploy, very much lower still.

gives active component CSHs the additional option of deploying with their home station equipment, an option that commanders value for both domestic and overseas missions. Table 6.1 summarizes the requirements for active component balances and shared MMRP sets under the recommended blended strategy.³

To implement this recommendation, the Army must address how CSHs would report their readiness when some of their MTOE is represented by shared equipment residing in a centralized asset pool.⁴

The recommended strategy would represent a radical departure from the current CSH equipping and maintenance strategy in many respects. Therefore, the concept needs to be vetted with stakeholders in the operations, maintenance, clinical, and training communities, and they should be included in efforts to test and refine the strategy. It would be prudent for the Army to begin moving toward the blended strategy by rolling out the new home station equipment designs at a few active and reserve component CSHs.

Consistent with the strategy of fielding modernized equipment during the Reset phase of the ARFORGEN cycle, the initial implementation could identify participating CSHs while they were in the Available pool and then prepare to field the new designs during Reset. In the case of identified CSHs that were deployed, their home station sets could be repaired, upgraded, and reconfigured to the new designs in the LBE program.

The first wave of implementation should be structured and evaluated to inform successive waves, providing information about the mission, maintenance, training, and manning effects of the designs. For example, the capability of active component CSHs to keep the SBO or ECSB home station designs in good condition using organic

Table 6.1
Recommended Number of Balances and MMRP Sets Under Blended Strategy

	Number of CSHs	Max Deployment Surge	Sources of CSH Equipment		
			APS	MMRP	SBO/ECSB Balances
Active	10	6	7	5–6	3–4
USAR	16	10			N/A
Total	26	16	16		

³ As discussed earlier, if the surge requirement were adjusted from 16, these quantities would have to be adjusted accordingly.

⁴ The concept of Army units not having all their equipment at different points in the ARFORGEN cycle is now receiving attention from the G-8 as a broad method for addressing the same issues with the costs of such an equipping strategy. Headquarters, Department of the Army, ARTEP 8-855, *Mission Training Plan for the Combat Support Hospital* (Medical Reengineering Initiative), June 7, 2000.

maintenance resources could be measured. Lessons learned could be gathered for following CSHs to use in their implementations of the new designs. Also, measurement would help to determine whether noncollocated reserve component CSH companies each need their own TEO sets or whether they could feasibly make arrangements to share home station sets. It may be possible for geographically close active and reserve component CSHs to share equipment for training instead of providing separate TEO sets to reserve CSH companies; the initial fieldings could be structured to test and evaluate this option.

The initial fieldings should include an evaluation of the training capability and efficacy for both the current system and the recommended blended strategy. A formal evaluation program based on the Army Training and Evaluation Program (ARTEP)⁵ could be the capstone event to measure the readiness of the unit. This would necessitate the updating of the ARTEP to current standards and expectations placed on the Corps CSH for split-based operations. It would be important to determine whether the unit improved its ability to perform Level III healthcare when deployed based on the amount of equipment available at home station for training, or whether the unit wasted resources maintaining equipment that did not measurably improve deployed performance. The ability of centralized training equipment sets to support the full range of training should also be evaluated and compared with home station training.

If the efficacy and feasibility of the new home station designs are confirmed, the Army should begin to reduce the number of balances in the HOSP and RCHD programs at SIAD. It should also re-evaluate the planned size of the MMRP program, and the required number of the RCHD balances, if any, should then be expanded and upgraded to become MMRP sets. This should be done systematically over a period of years within the constraints of programmed funding.

The Army should survey CSH commanders to gain a detailed and updated understanding of what training products and services they would like to be able to obtain from the RTS-Med and MTTs.⁶ Input from the commanders of the CSHs that participate in the initial fielding of new home station designs will be particularly pertinent, as will the input of clinicians.

The reserve component CSHs may have a need to expand their reliance on RTS-Med and MTTs; this may also be true of the active component CSHs if they adopt the ECSB strategy. At the minimum, the Army should address the desire of CSH commanders to have the medical equipment in the training base upgraded to current generation. The Army should also anticipate a call for increased flexibility to tailor the training sites to mirror the equipment and facilities that deploying CSHs

⁵ ARTEP 8-855.

⁶ Such a survey might be valuable as a recurring assessment of CSH commanders' training requirements to evolve the training base as operational needs evolve.

will encounter in deployed operations. To improve the ability to do this, the Army should explore leasing as a means of permitting the RTS-Med to acquire equipment temporarily for training when the item is not part of the MTOE but is being used by CSHs in theater.

The Army should further investigate leasing high-cost medical equipment with a short technological lifespan for centralized training and in pools that have a lower chance of deployment. If candidate medical equipment is identified, a simple return-on-investment calculation with the lease versus purchase option should be done. Additionally, the Army should consider the anticipated technological life of the equipment, affordability, effective use of the equipment during its anticipated life, salvage and disposal, and maintenance.

There are cases of commercial companies providing field hospital equipment sets and using different types of vendor-managed inventory (VMI) practices to supply that equipment (see Appendix E). The Army should explore possible impacts on mission capability and the cost-effectiveness of outsourcing aspects of CSH equipment sets. Commercial firms are procuring, assembling, storing and deploying mobile hospitals for emergency response in the United States.⁷ Outsourcing possibilities to explore further would include acquisition methods, maintenance and storage contracts, and training support services.

If the Army were to roll out a new equipping and maintenance strategy for CSHs as recommended in this monograph, it would be “right-sizing” its inventory of CSH medical equipment to improve its ability to maintain those assets and keep them modernized given available funding and maintenance personnel. A critical enabler to further improving materiel is improving data related to the procurement, maintenance, and upgrading of equipment. The Army should more carefully track procurement costs for medical equipment. It should also carefully track the upgrade costs both at the level of complete sets and at the level of specific NIINs and LINs. These data are needed to inform the analyses necessary to support sound planning and decisionmaking regarding the acquisition of future medical equipment. For instance, good cost data are needed to enable the comparison of buying versus leasing specific items. If the Army knew the pace at which specific items, or types of items, moved on and off of the MTOE, it could potentially better manage obsolescence. For example, if the data were captured to track total cost of ownership over the useful life of the item in the CSH MTOE, the Army could make better-informed, data-driven procurement tradeoff decisions. Due to changes in the MTOE that render certain LINs obsolete, the “useful life” of that item to the Army might be very short—in the worst case, the three years of an MTOE revision cycle. Using leasing rather than buying for

⁷ BLU-MED Response Systems received an \$18 million contract from the State of California Emergency Medical Services Authority for three 200-bed Mobile Field Hospitals (MFHs) with support systems. BLU-MED will deploy each of the three MFHs to any location designated by the state and set them up within 72 hours of notification. As of May 10, 2010: http://www.blu-med.com/cal_ems.html

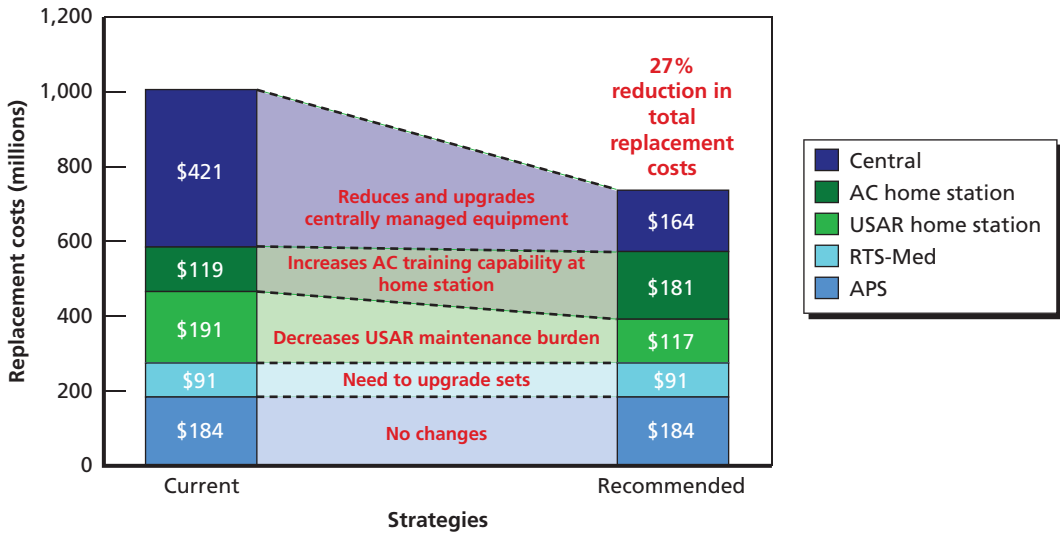
such items might hedge against this fast-paced obsolescence. Depending on estimated cost savings, leasing may or may not be a viable cost-reduction strategy, but without data the best choice is undeterminable.

With improved data, the Army should explore the option of leasing (with buy options) some expensive medical equipment items that, because they are in sets at SIAD or in APS, may never be used before three years have passed and they become eligible for upgrading to the follow-on model. Upon deployment, the Army would purchase the items. Otherwise, if no deployments occur, they would be turned in at the end of the lease to be replaced by the next generation of items. There are potential lessons to be learned from the commercial firms supplying field hospitals. The Army should explore whether for some items a “Lease in Case of Contingency” model is more cost-effective than outright purchase.⁸

By moving to a new equipping and maintenance strategy, the Army could substantially reduce the cost of equipping and maintaining its CSHs at fully modernized levels, while providing them with equipment that is newer and in better condition on average than what they have now. As shown in Figure 6.1, the strategy suggested by our analysis—i.e., Split-Based Operations for active component CSHs and Training Equipment Only for reserve component CSHs—would result in a total inventory that, in same-year procurement dollars, is about one-third leaner than today’s. In a time of rising military challenges and tightening defense budgets, such an opportunity for the Army to achieve more with less is rare and should be appropriately pursued in the AMEDD community.

⁸ There is evidence of vendor-managed inventory for medical equipment (both low-cost and high-cost items, such as defibrillators) by the California Emergency Medical Services Authority in its “Alternative Care Site” caches of equipment. California EMSA has agreements for purchased and VMI equipment at three cache sites that can be rapidly deployed via 53 tractors to an existing fixed facility such as a warehouse and set up into a 200-bed hospital. One such equipment cache was reportedly delivered locally in Southern California in under 12 hours in support of response to wildfires in 2008.

Figure 6.1
The Recommended Equipping and Maintenance Strategy Would Result in a Leaner Total Inventory of CSH Medical Equipment That Is Less Expensive to Maintain and Keep Current



SOURCE: USAMMA POM data, current replacement prices.

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How CSHs Currently Engage in Training to Achieve and Maintain Individual and Collective Skills

CSH commanders have the responsibility to provide training on team skills¹ and collective skills² and maintain/further develop individual skills.³ CSH commanders achieve this training in different ways; however, the most common methods reported are contained in Table A.1 for individual skills for clinical personnel.

Table A.1
Common Methods Reported by CSH Commanders and Staff to Achieve and Maintain Training Proficiency of Individual Skills for Clinical Personnel

Skill Type	Method	Skills and Frequency
Individual Skills: Clinical Personnel	PROFIS system: Practice individual clinical skills working in assigned MTF	Practice some subset of full skill sets on a daily basis
	Medical Proficiency Training (MPT): Clinical personnel assigned to the CSH participate in clinical rotations at the local MTF	Enlisted soldiers: 30 days per year (locally managed) Officers: designated hours per week in clinical rotation
	68W only: Medical Education and Demonstration of Individual Competence (MEDIC) as per Training Circular (TC) 8-800	Annual Combat Medical Skills training and validation test

¹ A team is a group of people who function together to perform a mission or collective task. Team training is the training of selected individuals, not necessarily from the same organization, to function together as a team (U.S. Army TRADOC Regulation 350-70).

² Collective training is training, either in institutions or units, that prepares cohesive teams and units to accomplish their missions on the battlefield and in operations other than war (U.S. Army TRADOC Regulation 350-70).

³ Individual training is (a) “Training which prepares the soldier to perform specified duties or tasks related to an assigned duty position or subsequent duty positions and skill level;” and (b) “Training which officers and non-commissioned officers (NCOs) (leader training) or soldiers (soldier training) receive in schools, units, or by self study. This training prepares the individual to perform specified duties or tasks related to the assigned or next higher specialty code or skill level and duty position (AR 350-41)” (U.S. Army TRADOC Regulation 350-70).

The most common methods reported for training on and maintaining/further developing individual skills for logistics and maintenance personnel are listed in Table A.2. Table A.3 contains the most common methods reported by CSH commanders and staff to achieve, maintain, and further develop team and collective skills.

Table A.2
Common Methods Reported by CSH Commanders and Staff to Achieve and Maintain Training Proficiency of Individual Skills for Logistics/Maintenance Personnel

Skill Type	Method	Skills and Frequency
Individual Skills: Logistics/Maintenance Personnel	Maintaining unit home station equipment and garrison services (supply, automation, personnel actions)	Garrison administrative focus with maintenance limited to personnel skills and availability
	Working in local MTFs	Very limited both in terms of tasks and frequency
	Training or working on medical equipment at RTS-Med	Very limited frequency: One two-week TDY experience every two years
	Working on medical equipment at a depot	Very limited frequency: One two-week period per career

Table A.3
Common Methods Reported by CSH Commanders and Staff to Achieve and Maintain Training Proficiency of Team and Collective Skills

Skill Type	Method	Skills and Frequency
Team Skills: Clinical Staff and Logistics/Maintenance Personnel	FTX at home station	Active: Rare Reserve: Never
	FTX at RTS-Med	Active: Rare Reserve: Common, two weeks per year
Collective Skills: CSH Operations	Garrison operation of CSH HQ operations.	Ongoing execution of personnel and administrative duties
	Practice HQ operations on "field problem" with simulated TOC ^a	Full operational HQ functions, carried out quarterly or annually
	CSH FTX at home station	Active: Rare, once every four years Reserve: Never
	CSH FTX at RTS-Med	Active: Rare Reserve: Common, two weeks per year

^a A Tactical Operations Center, or TOC, comprises an organization and equipment used by a headquarters element to provide command and control for an Army operation, including CSH operations.

Survey Questions

We conducted three surveys to better understand the views of CSH personnel regarding equipping and maintenance practices.

- The first survey sampled all CSH personnel attending the 2008 CSH commanders conference in Reno, Nevada, July 30, 2008 (n=33). A majority of the respondents (88 percent) were from the active component. The respondents varied by current position and included a mix of CSH commanders (n=8), command sergeant majors (n=3), operations officers (n=6), logistics officers (n=8), clinicians (n=6), and other (n=3).
- The second survey sampled reserve component CSH personnel because they were underrepresented at the 2008 CSH commanders conference (n=83). This survey was distributed via email in November and December 2008.
- The third survey was focused exclusively on active component CSH commanders (n=7) and was administered via email in April 2009.

In total, we surveyed over 100 CSH personnel from the active and reserve components with representation from CSH commanders, logisticians, clinicians, and maintainers.

The first two surveys were comprehensive and asked questions about equipping and maintaining medical equipment throughout the various ARFORGEN phases. There was a particular focus on training needs on medical equipment for both clinical and maintenance staff. The third survey administered to the active component CSH personnel was a brief survey containing 16 questions designed to better understand the active component CSH commanders' training, maintenance, and equipping preferences.

Active Component/Reserve Component CSH Survey Description

The instrument for the first two waves consisted of about 60 questions in the following areas:

- Professional demographic information (6 questions related to position and deployment experience)
- Equipping and maintenance questions tied to stages of the ARFORGEN cycle (13 questions)
- Training (20 questions)
- Preparation for deployment (7 questions)
- Deployment (20 questions)
- Redeployment (6 questions)
- General questions regarding CSHs and the ARFORGEN cycle (5 questions)

Active Component Follow-Up CSH Survey Description

The follow-up survey for the active component CSH commander consisted of 16 questions in the following areas:

- Deployment experience (1 question)
- Maintenance effectiveness (2 questions)
- Equipment used for deployment and training (3 questions)
- Training (4 questions)
- Central management of equipment (4 questions)
- Need for split-based operations (2 questions)

The full surveys are reproduced below.

Active Component/Reserve Component CSH Survey

Demographic Information:

1. What is your current position within the CSH?
 - a. ___ CSH Commander
 - b. ___ Command Sergeant Major
 - c. ___ XO Operations Officer
 - d. ___ S3 Operations Officer
 - e. ___ Logistics Officer (S4, Maintenance)
 - f. ___ Clinician (Officer/Enlisted)
 - g. ___ Other

2. Is your CSH in the Active or Reserve component?

___ Active ___ Reserve

3. What stage of the ARFORGEN cycle is your CSH in?
 - a. ___ Don't Know
 - b. ___ My CSH is not in an ARFORGEN Pool
 - c. ___ Reset/Train Pool
 - d. ___ Ready Pool
 - e. ___ Available Home Pool
 - f. ___ Available Deployed Pool

4. Have you deployed with any CSH in any role in the past 10 years?

___ Yes ___ No

If you answered no to Question 4, please skip to Question 38 (page 8).

5. How many times have you deployed with a CSH?

6. What was your position within the CSH when you deployed?
 - a. ___ CSH Commander
 - b. ___ Command Sergeant Major
 - c. ___ XO Operations Officer
 - d. ___ S3 Operations Officer
 - e. ___ Logistics Officer (S4, Maintenance)
 - f. ___ Clinician (Officer/Enlisted)
 - g. ___ Other

Deployment Experience (analogous to ARFORGEN Available Pool – Deployed):

7. In your last deployment, did your CSH fall in on Theater Provided Equipment (TPE) or Stay Behind Equipment (SBE)?
 Yes No

8. In your last deployment, did your CSH deploy a majority of required medical equipment from Organizational Equipment Set?
 Yes No

9. What percent of your CSH’s medical equipment for its Organization Equipment Set did you deploy with?
 <10% 10–20% 20–30% 30–40% 40–50%
 50–60% 60–70% 70–80% 80–90% 90–100%

10. If you answered “yes” to question 8, was your CSH’s deployed equipment from home station or provided by an external location?
 - a. All equipment deployed from home station on-hand
 - b. A combination of home station equipment and USAMMA
 - c. All equipment provided by USAMMA (RCHD/APS/UDP)
 - d. Other external source provided equipment
(name of source): _____

11. Did the medical equipment items/sets provided to your CSH from external sources (that was in addition to its home station organizational equipment) have what your CSH needed or wanted?
 Everything the CSH needed Some of what the CSH needed
 Most of what the CSH needed Nothing the CSH needed

12. Were the medical equipment items/sets provided to your CSH from external sources (that was in addition to its home station organizational equipment) received in a timely manner?
 Yes No

13. Did the medical equipment items/sets provided to your CSH from external sources (that was in addition to its home station organizational equipment) work?
 Yes No

14. Are you aware of any purchasing issues associated with the medical equipment items/sets provided to your CSH from external sources (that was in addition to its home station organizational equipment)?
 Yes No
15. Were there unit-owned medical equipment shortages when your CSH deployed?
 Yes No
16. What percent of your CSH's medical equipment in theater was obtained through the ONS process?
 0% <5% 5–10%
 11–20% 21–30% > 30%
17. How satisfied were your CSH's personnel with obtaining medical equipment in theater through the ONS process?
 Very Satisfied Somewhat Satisfied Neutral
 Dissatisfied Strongly Dissatisfied
18. Rate your CSH's experience with medical maintenance support *organic to your unit* during deployment.
 Excellent Good Average Poor
19. Rate your CSH's experience with medical maintenance *from external sources* during deployment.
 Excellent Good Average Poor

Deployment/Training:

20. How much did the differences in the medical equipment your CSH trained on, as opposed to the *equipment it fell in on in theater*, affect its mission capability when it arrived in theater?
 Large Positive Effect Some Positive Effect No Effect
 Some Negative Effect Large Negative Effect
21. How much did the differences in the medical equipment your CSH trained on, as opposed to the *equipment issued by USAMMA*, affect its mission capability when it arrived in theater?
 Large Positive Effect Some Positive Effect No Effect
 Some Negative Effect Large Negative Effect

22. How long did it take your CSH clinical personnel to train on the new equipment they fell in on so they were mission effective?
Average Number Hours per Clinician: _____
23. How long did it take your CSH medical equipment maintenance personnel to train on the new equipment they fell in on so they were mission effective?
Average Number Hours per Maintainer: _____
24. Based on your last deployment with a CSH, for what percent of your unit-level tasks were you properly trained prior to your last CSH deployment?
___ 0% ___ ~10% ___ ~20% ___ ~30% ___ ~40%
___ ~50% ___ ~60% ___ ~70% ___ ~80% ___ ~90% ___ 100%
25. What would you do to improve training for CSH deployments? (Check all that apply.)
- a. ___ More time for training prior to deployment for clinical/PROFIS staff
 - b. ___ More time for training prior to deployment for maintenance staff
 - c. ___ More medical equipment for training maintenance staff
 - d. ___ Medical equipment for training that matched equipment at CSH in theater is in the field
 - e. ___ Better simulations/simulators for clinical/PROFIS staff
 - f. ___ Better simulations/simulators for maintenance staff
26. What have been the areas of greatest challenges to CSH clinical and maintenance personnel during early stages of the CSH deployment?

Preparation for Deployment (analogous to ARFORGEN Available Pool – Home):

27. How many *weeks* did your CSH have to train as a unit on medical equipment prior to its last deployment?
___ 3 to 6 ___ 7 to 10 ___ 11 to 20 ___ 21 to 52 ___ >52
28. How much of your CSH's personnel training time (before leaving home station) was spent on medical equipment you used during your deployment?
___ 0% ___ 1–25% ___ 25–50% ___ 50–75% ___ 75–100%

29. How much of your clinical staff/PROFIS personnel training time in a *fixed facility* was spent on medical equipment they used during the deployment?
 0% 1–25% 25–50% 50–75% 75–100%

Return from Deployment (analogous to ARFORGEN Reset and Train Pool):

30. At the end of your CSH's deployment, what percent of theater provided equipment (TPE) did it leave in theater?
 0% ~10% ~20% ~30% ~40% ~50%
 ~60% ~70% ~80% ~90% 100%
31. At the end of your CSH's deployment, what percent of the CSH medical equipment with which it deployed did it leave in theater?
 0% ~10% ~20% ~30% ~40% ~50%
 ~60% ~70% ~80% ~90% 100%
32. Approximately what percentage of medical equipment your CSH brought back needed to be repaired?
 0% ~10% ~20% ~30% ~40% ~50%
 ~60% ~70% ~80% ~90% 100%
33. How long do maintainers have to reset medical equipment (to include required components) when your CSH returns from a deployment?
 Less than 30 Days 30–60 Days 60–90 Days
 More than 90 Days Don't Know
34. Please rate your CSH personnel's satisfaction with your CSH's *medical equipment maintenance* during reset from *organic resources*.
 Very Satisfied Somewhat Satisfied Neutral
 Dissatisfied Strongly Dissatisfied
35. Please rate your CSH personnel's satisfaction with your CSH's *medical equipment maintenance* during reset from *other organizational capabilities*.
 Very Satisfied Somewhat Satisfied Neutral
 Dissatisfied Strongly Dissatisfied
36. Please rate your CSH personnel's satisfaction with your CSH's experience with the Left Behind Equipment (LBE) program.
 No Experience Very Satisfied
 Somewhat Satisfied Neutral
 Dissatisfied Strongly Dissatisfied

37. Please rate your CSH personnel's satisfaction with your CSH's experience with the Army Reset Management Tool (ARMT)
- No Experience Very Satisfied
 Somewhat Satisfied Neutral
 Dissatisfied Strongly Dissatisfied

Training (analogous to ARFORGEN Ready Pool / Reset and Train Pool):

38. Overall, how satisfied are you with the current state of your CSH's training of *Individual Personnel for medical equipment usage*?
- Very Satisfied Somewhat Satisfied Neutral
 Dissatisfied Strongly Dissatisfied
39. Overall, how satisfied are you with the current state of *CSH Collective Unit* training for *medical equipment usage*?
- Very Satisfied Somewhat Satisfied Neutral
 Dissatisfied Strongly Dissatisfied
40. Overall, how satisfied are you with the current state of your CSH's training of *Individual Personnel for medical equipment maintenance*?
- Very Satisfied Somewhat Satisfied Neutral
 Dissatisfied Strongly Dissatisfied
41. Overall, how satisfied are you with the current state of *CSH Collective Unit* training for *medical equipment maintenance*?
- Very Satisfied Somewhat Satisfied Neutral
 Dissatisfied Strongly Dissatisfied
42. Overall, how satisfied are you with the current state of *CSH Collective Task* training for *medical equipment usage*?
- Very Satisfied Somewhat Satisfied Neutral
 Dissatisfied Strongly Dissatisfied
43. Overall, how satisfied are you with the current state of *CSH Collective Task* training for *medical equipment maintenance*?
- Very Satisfied Somewhat Satisfied Neutral
 Dissatisfied Strongly Dissatisfied

44. What equipment does your CSH use for training?
(check all that apply)
- a. 44-bed set
 - b. 84-bed set/MEET Set
 - c. 164-bed set
 - d. Central pool of medical equipment
 - e. Central location for medical training
(e.g., RTS-Med – Reserve Training Site – Medical)
 - f. No medical equipment available
 - g. Fixed facilities training
 - h. Other, please describe:

45. How often does your CSH train on these equipment sets?
(Equipment Sets Listed Include: 44-bed set of unit equipment, 84-bed set/
MEET Set of unit equipment, 164-bed set of unit equipment, RTS-Medical
Set at your location, RTS-Medical Set at a central location, Fixed facilities
training)
 N/A Never Once a Year Twice a Year
 Three Times a Year More than Three Times a Year
46. How often does your CSH train on medical equipment from the following
clinical service areas?
(Clinical Service Areas Listed Include: Nutrition Care Section, Triage/
Pre-Op/EMT Section, Operating Room/CMS Section, Anesthesia Service
Section, Specialty Clinics Section, Dental Section, Nursing Service Section,
Intensive Care Unit, Intermediate Care, Pharmacy Section, Lab Services/
Blood Bank, Radiology Section)
 N/A Never Once a Year Twice a Year
 Three Times a Year More than Three Times a Year
47. Does your CSH use any computer-based simulations or simulators for
training on medical equipment?
Clinicians: Yes No
Maintainers: Yes No

48. If yes, how satisfied are you with the current use of computer-based simulations or simulators for training on medical equipment?

Clinicians (Officer/Enlisted):

Very Satisfied Somewhat Satisfied Neutral
 Dissatisfied Strongly Dissatisfied

Maintainers:

Very Satisfied Somewhat Satisfied Neutral
 Dissatisfied Strongly Dissatisfied

49. Does your CSH use any computer-based simulations or simulators for training on clinical skills?
 Yes No

50. If yes, how satisfied are you with your CSH's personnel with the current use of computer-based simulations or simulators for training on clinical skills?
 Very Satisfied Somewhat Satisfied Neutral
 Dissatisfied Strongly Dissatisfied

51. Does your CSH use any mobile training teams or their assets for training?
 Yes No

52. If yes, how satisfied are your CSH's personnel with the current use of mobile training for training on medical equipment?
 Very Satisfied Somewhat Satisfied Neutral
 Dissatisfied Strongly Dissatisfied

53. Does your CSH use Regional Training Site - Medical (RTS-MED) sites or resources for training?
 Yes No

54. If yes, how satisfied are your CSH personnel with the current use of Regional Training Site - Medical (RTS-MED) sites or resources for training?
 Very Satisfied Somewhat Satisfied Neutral
 Dissatisfied Strongly Dissatisfied

55. Have there been issues with getting access to equipment for training your CSH clinical and maintenance personnel? If yes, please describe:

56. How useful would it have been to have been able to train on the same equipment that you fell in on in theater? Please explain:
-

Local Taskings:

57. Over the last 12 months, how often has medical equipment from your CSH has been used for local taskings?
-

58. Short summary description of last three local taskings (location, activity).
-

General Question Regarding CSHs and the ARFORGEN Cycle:

59. Please rate your level of agreement/disagreement with the following statement:

“Based on my knowledge of ARFORGEN, placing CSHs in an ARFORGEN-based maintenance and equipping cycle can realistically support CSH training and deployment requirements.”

___ Strongly Agree ___ Agree ___ Neutral
 ___ Disagree ___ Strongly Disagree

60. Please rate your level of agreement/disagreement with the following statement:

“I believe that using a centrally managed CSH equipment set could meet a CSH’s mission requirements for deployment.”

___ Strongly Agree ___ Agree ___ Neutral
 ___ Disagree ___ Strongly Disagree

61. Please rate your level of agreement/disagreement with the following statement:

“I believe that using a centrally managed CSH training equipment set could meet a CSH’s training requirements.”

___ Strongly Agree ___ Agree ___ Neutral
 ___ Disagree ___ Strongly Disagree

62. Please rate your level of agreement/disagreement with the following statement:

“I believe a comprehensive AMEDD Solution that incorporates Equipping, Manning, and Training is required to support ARFORGEN.”

Strongly Agree Agree Neutral
 Disagree Strongly Disagree

63. What are your concerns regarding the possibility of your CSH not having a complete equipment set, owned by your unit, available at all times prior to a deployment?

Active Component Follow-Up CSH Survey

1. Have you deployed with a CSH?
 Yes No

2. Please rate your satisfaction with the maintenance of your CSH's *medical equipment on hand in the 84-bed Company at home station*.
 Very Satisfied Somewhat Satisfied Neutral
 Dissatisfied Very Dissatisfied

3. Please rate your satisfaction with the maintenance of your CSH's *medical equipment in the 164-bed Company at SIAD*.
 Very Satisfied Somewhat Satisfied Neutral
 Dissatisfied Very Dissatisfied

4. What was the FMC % of your medical equipment prior to deployment?
 <50% 50–75% 75–90% 90–100% Did not deploy

5. If you deployed with a CSH, did you receive medical equipment items/sets from TPE or from APS and/or USAMMA provided equipment?
 (Check all that apply)
 TPE
 APS
 USAMMA provided equipment
 I deployed only with my own equipment set (home station and SIAD)
 I did not deploy with a CSH

6. Please rate your level of satisfaction with the medical equipment items/sets provided to your CSH from TPE, APS or USAMMA provided equipment.
Maintenance of medical equipment:
 Very Satisfied Somewhat Satisfied Neutral
 Dissatisfied Very Dissatisfied

State-of-the-art technology for MTOE medical equipment:
 Very Satisfied Somewhat Satisfied Neutral
 Dissatisfied Very Dissatisfied

Completeness of set:
 Very Satisfied Somewhat Satisfied Neutral
 Dissatisfied Very Dissatisfied

7. Has your CSH used any Mobile Training Teams (MTTs) or their assets for training?
 Yes No
8. If yes, how satisfied are your CSH's personnel with the current use of MTTs for training on medical equipment?
 Very Satisfied Somewhat Satisfied Neutral
 Dissatisfied Very Dissatisfied
9. Has your CSH used a Regional Training Site - Medical (RTS-Med) for training?
 Yes No
10. If yes, how satisfied are your CSH personnel with the Regional Training Site-Medical (RTS-Med) sites or resources for training?
 Very Satisfied Somewhat Satisfied Neutral
 Dissatisfied Very Dissatisfied
11. Please rate your level of agreement/disagreement with the following statement:

“I believe that using a centrally managed CSH training equipment set (e.g., RTS-Med or MTT) could meet a CSH's training requirements.”

- Strongly Agree Agree Neutral
 Disagree Strongly Disagree

Please explain briefly:

12. Please rate your level of agreement/disagreement with the following statement:

“I believe that using a centrally managed CSH equipment set could meet a CSH's mission requirements for deployment.”

- Strongly Agree Agree Neutral
 Disagree Strongly Disagree

Please explain briefly:

13. Please rate your level of agreement/disagreement with the following statement:

“I would feel comfortable with USAMMA maintaining the portion of our CSH’s medical equipment stored at SIAD.”

Strongly Agree Agree Neutral
 Disagree Strongly Disagree

Please explain briefly:

14. Please rate your level of agreement/disagreement with the following statement:

“If USAMMA has responsibility for maintaining my off-site equipment, I have confidence that my unit could maintain the equipment left at home station.”

Strongly Agree Agree Neutral
 Disagree Strongly Disagree

Please explain briefly:

15. Please rate your level of agreement/disagreement with the following statement:

“It is important to me to have the capability to do local missions with split-based operations.”

Strongly Agree Agree Neutral
 Disagree Strongly Disagree

Please explain briefly:

16. Please rate your level of agreement/disagreement with the following statement:

“It is important to me to have the capability at home station to train for split-based operations.”

Strongly Agree Agree Neutral
 Disagree Strongly Disagree

Please explain briefly:

Development of Alternative Designs for Home Station Equipment Sets

As described in Chapter Three, we used the information and insights gained from the focus groups and surveys to devise several alternative designs for the equipment sets that CSHs have at their home stations (i.e., when they are not deployed). This appendix provides detail on the designs and how they were developed. The alternative designs were developed to explore the tradeoffs of training and mission capability with the maintenance and property accountability burden for units.

Several baseline criteria were established before developing the alternative designs for home station equipment sets.

1. The sets were to be based on a current MTOE¹ for a split-based capable Corps-level CSH, the objective of the TOE for all CSHs in the Army inventory.²
2. The sets, kits, and outfits in the CSH were assumed to be the most current generation.
3. The development of the training sets would be based on capability to support training and operations. Personnel and maintenance capabilities were assumed adequate.
4. We assumed a minimum level of required administrative and support equipment as listed on the MTOE in all cases. This MTOE equipment is required for daily operations and required training separate from the medical training and mission requirements.

The CSH Modified Table of Equipment Design Framework

Each of the three alternative designs for home station equipment sets is based on MTOE SRC 08945AFC04, 0109, the current MTOE for the 248-bed Corps CSH

¹ DOCNO 08945AFC04, CCNUM 0109. USAFMSA FMSWeb.

² TAA 08-13.

capable of split-based operations. This MTOE was selected as a representative MTOE for Corps-level CSHs. CSH-specific medical equipment sets (MES) and medical materiel sets (MMS) used in the study are the N series sets as detailed on the USAMMA web site under MEDSILS.³ These are the current configurations as per the most recent DCDD review completed in FY08.⁴

In developing the different sets, the equipment authorized in the CSH MTOE was first grouped by paragraphs. Each paragraph in the MTOE represents a distinct capability, either medical or nonmedical, in the CSH. Each paragraph was then detailed to the individual LIN authorizations in the MTOE for analysis. Table C.1 is an example of an MTOE paragraph for the CSH at the LIN level. This paragraph is the intensive care unit, the ward responsible for postoperative care and for in-patients who require specialized nursing care:

Table C.1
LIN-Level Description of Two Intensive Care Units (MTOE Paragraph 211)

LIN	ERC	NOMENCLATURE	REQEQ	AUTEQ	PUREQ	PUAEQ
A26852	A	AIR CONDITIONER: 54000 BTU 208V-AC 3PH 50/60 HZ	4	4	4	4
C13825	A	CONTAINER CARGO: REUSABLE W/O – MECHANICAL RESTRAINT SYSTEM	2	2	2	2
C68719	A	CABLE TELEPHONE: WD-1/TT DR-8 ½ KM	2	2	2	2
D86072	A	DEFIBRILLATOR MONITOR RECORDER: 120/230V 50/60HZ AC OR DC	2	2	2	2
E67355	A	COMPRESSOR – DEHYDRATOR DENTAL EQUIPMENT	6	6	6	6
H00586	A	HEATER: DUCT TYPE PORTABLE 1200-00 BTUS	2	2	2	2
K25342	A	HEATER IMMERSION LIQUID FUEL FIRED: 34-3/4 IN LG OF HEATER	4	4	4	4
L65295	A	LIGHT SURGICAL FIELD: 110 VOLT AC OR 24 VOLT DC	4	4	4	4
M09576	P	MEDICAL MATERIEL SET POST-OP/ICU WARD	2	2	2	2
M66558	A	MONITOR PATIENT VITAL SIGNS	4	4	4	4
M79195	A	MONITOR-RECORDER ECG	16	16	16	16
R59160	A	REELING MACHINE CABLE HAND: RL-39	1	1	1	1
T00381	A	THERMOREGULATOR: PATIENT AUTO&MANUAL 115/220V 50/60 HZ AC	4	4	4	4
T47745	A	TENT: EXTENDABLE MODULAR 64LX20W MEDICAL FOREST GREEN TYPE II	2	2	2	2
T60464	A	SINK UNIT SURGICAL SCRUB AND UTENSIL HOSPITAL FIELD: 110V 60C AC	4	4	4	4
V31211	A	TELEPHONE SET: TA-312/PT	2	2	2	2
V99788	A	VENTILATOR VOLUME PTEL	20	20	20	20

NOTE: REQEQ is Required Equipment, AUTEQ is Authorized Equipment, PUREQ is Parent Unit Required Equipment, and PUAEQ is Parent Unit Authorized Equipment.

³ As of May 10, 2010: <http://www.usamma.army.mil/homepage.cfm>

⁴ Phone interview with Mr. John Lisenbee, US AMEDD DCDD, November 19, 2008.

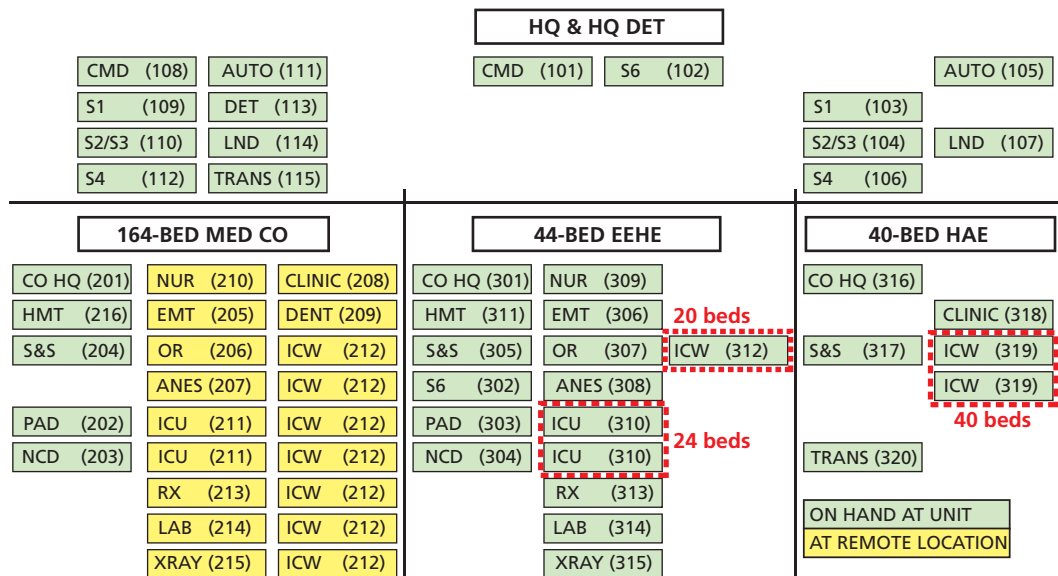
Sets, kits, and outfits (SKOs) were treated as one LIN rather than being broken into components. LIN M09576, Medical Materiel Set Post-Op/ICU Ward, has 479 component items. Given that each SKO LIN represents a unique component of the paragraph’s capability, further analysis down to the item level within the sets would add complexity without understanding for this analysis.

Current Home Station Equipment Set (Active)

The “current set” is a representation of today’s configuration of active component CSHs, since each individual CSH in the inventory has different pieces of equipment either on hand, in central storage, or not fielded. The current set has the key components of all HHD equipment on hand, all of the 84-bed medical company on hand, and most of the 164-bed medical company in storage.⁵ This gives the CSH a Level III training and operational capability.

From an operational standpoint, this equipment set gives the CSH the capability to establish a Level III trauma/surgical hospital with unit-owned equipment for either

Figure C.1
The CSH MTOE Consists of Four Modules with 84 Beds at Home Station and 164 Beds at SIAD



RAND MG887-C.1

⁵ SB 8-75-S7, Department of the Army Supply Bulletin, July 20, 2008.

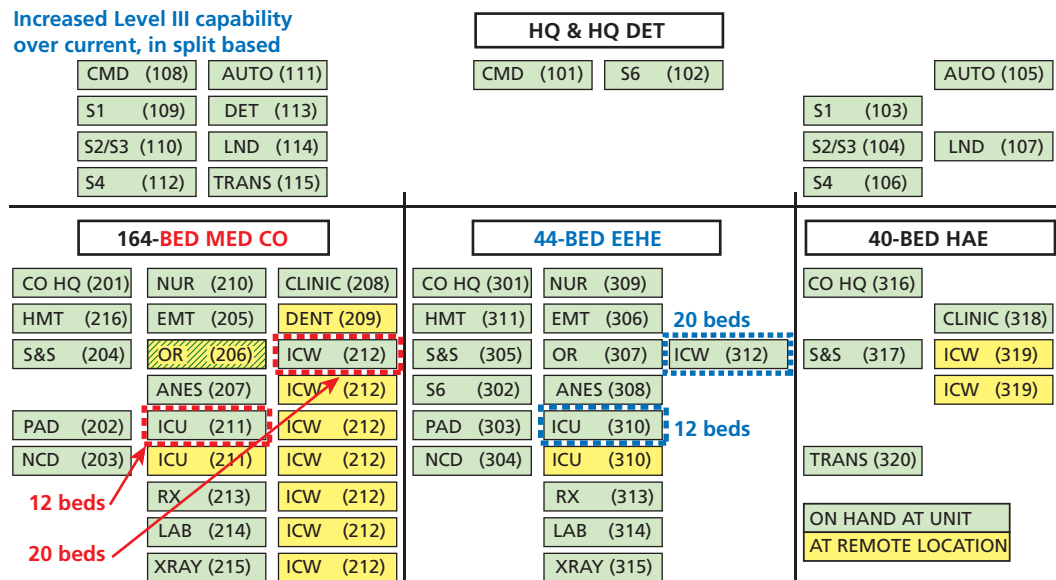
training at home station or in support of mission requirements. The reserve component has a similar concept for equipping CSHs, but the amount of equipment at home station is less than what the active component CSHs have at home station for training. This set represents the current option for equipping CSHs in the ARFORGEN cycle.

Split-Based Operations Equipment Set for Home Station

The “SBO set” is a broad-based set of equipment designed to allow the CSH to train and execute all hospital functions, except for dental, on unit-maintained equipment. Compared to the current home station set, it represents a substantial increase both in cost and capability. This set was developed to meet the need for training and executing split-based operations. While split-based operations for the MRI CSH are not specified in ARTEP 08-855(MRI) 2000, it is a mission requirement in the MTOE narrative for Corps-level CSHs and part of the employment doctrine found in FM 4-02.10, *Theater Hospitalization*, 2005. CSH commanders and staff interviewed expressed a desire to have split-based training and operational capability at home station.

To meet this requirement, the set was designed with like capability in both medical companies. The number of ICUs and ICWs maintained at home station was reduced to the minimum required to achieve a Level III capability for each company

Figure C.2
The Split-Based Operations Design for Home Station Would Provide CSHs with Two 32-Bed Hospitals



as a means to lighten the equipment burden on unit personnel. In the 164-bed medical company, the operating room set was limited to one set with two OR tables to equal the surgical capability of the 84-bed medical company. This is the most equipment-intensive option even though it does not have the most ward beds.

Enhanced Capability, Single Base Set for Home Station

The ECSB is a focused set of equipment designed to allow the CSH to train and execute all hospital functions, except for dental, on the minimum amount of unit-maintained equipment. While it appears similar to the current set configuration and would be similar in cost, there are two significant differences. First, the equipment sets authorized at home station are distributed between the two medical companies, instead of all coming from the 84-bed medical company, as is the case in the current set. Second, the “enhanced capability” is derived from the enhanced pharmacy, lab, and medical maintenance sections of the CSH at home station. These sets in the 164-bed medical company have more equipment and are housed in ISO containers rather than tents, as per the N series UA for these functions authorized in MTOE SRC 08945AFC04. The specialty clinic in the 164-bed Medical Company also has greater capability than the like clinic in the 84-bed medical company used in the current set.

The ECSB set provides the equipment and sets required to support training on all ARTEP tasks, as well as to establish a functioning Level III hospital. The use of the ISO shelters and larger sets from the 164-bed medical company provides for the maximum training capability at home station and for greater operational capability using on-hand equipment. The use of equipment from both companies also distributes the responsibility for accountability and maintenance between the two units rather than concentrating it all under one company. This configuration achieves the enhanced capability at the cost of a higher maintenance burden, an increased transportation requirement, and fewer ward beds at home station.

Training Equipment Only Set for Home Station

The TEO set is a limited set of equipment designed to allow the CSH to train to conduct certain core hospital functions on unit-maintained equipment. Compared to the current set, this set represents a sharp reduction both in cost and capability. This configuration is the most radical change, not only in amount of equipment maintained at home station, but in the concept that the training equipment at home station is not considered available for deployment. This configuration maximizes the used of centrally managed equipment sets for training and for deployments.

In this set, there is a significant difference from previously configured sets in that equipment provided for training at home station is done at the LIN level rather than at the set or MTOE paragraph level. This set allows for about 50–60 percent of ARTEP tasks to be trained at home station, with training for the remainder requiring equipment support from a centrally managed equipment pool such as RTS-Med. The maintenance and accountability burden for equipment is removed from units and placed on USAMMA and RTS-Med. This comes at the cost of limited collective and unit training using unit-owned equipment at home station and the lack of equipment at unit locations for domestic support operations.

Figure C.4
We Developed a New, Leaner Set with One 32-Bed Hospital to Support Training and Taskings

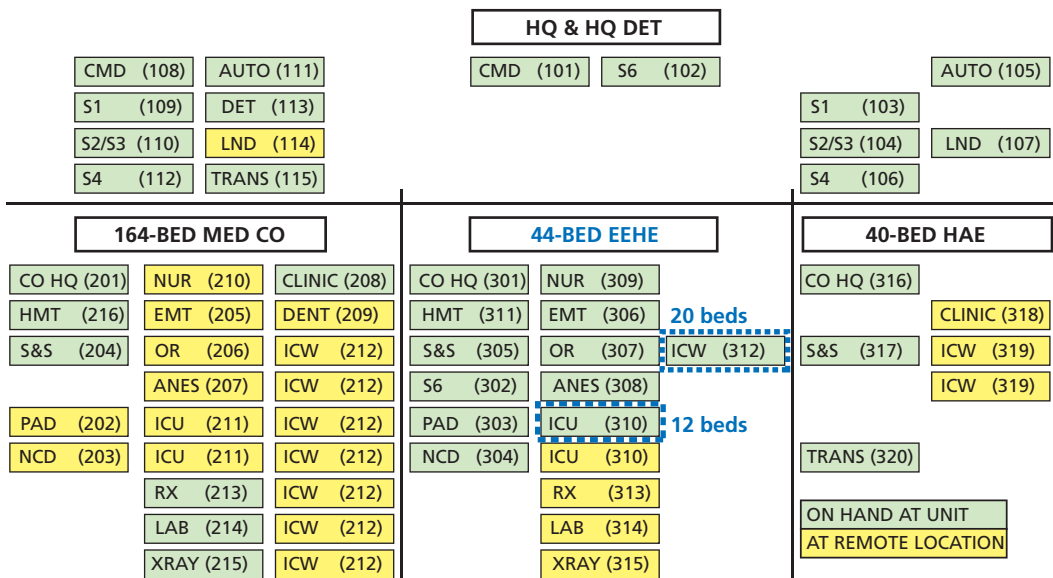
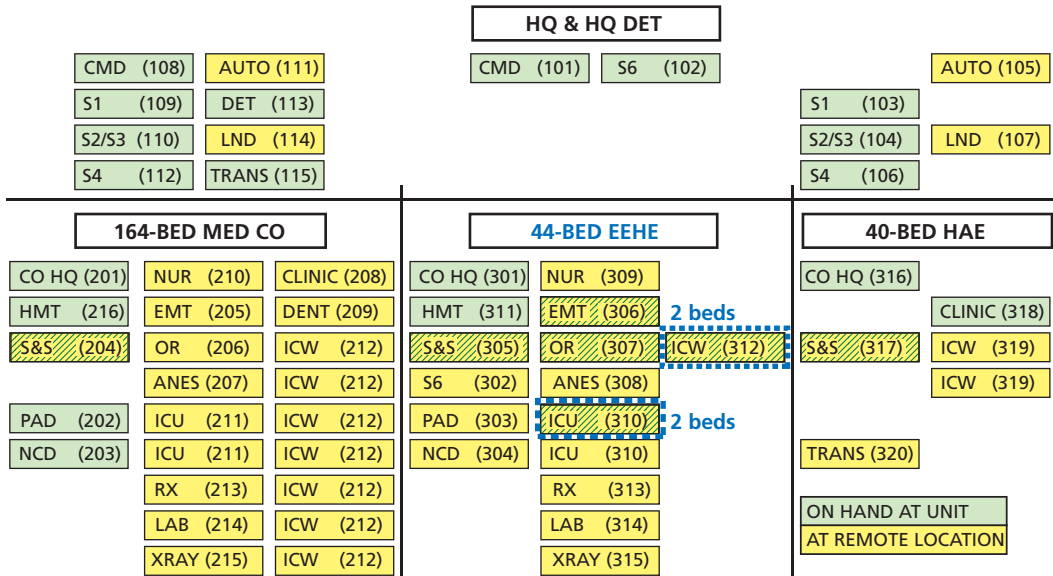


Figure C.5
We Developed a Very Lean “Training Equipment Only” Set with No On-Hand Mission Capability



Data Sources for Procurement and Upgrade Costs

Data on Procurement Costs

To estimate CSH equipment set procurement costs, we considered three sources of data on equipment costs:

- The MTOE contains information on the capabilities of a unit, as well as the personnel and materiel necessary to meet the unit mission. We downloaded the LINs in the CSH MTOE from the FMSWeb database, maintained by USAFMMSA.¹ We downloaded LIN costs from the MEDSILS database maintained by USAMMA.² These data indicate that a CSH set costs \$13 million.
- When USAMMA assembles a CSH set, it refers to the unit assemblages (UAs). The UAs are also defined by LIN, and include procurement costs. The UAs indicate that a CSH set costs \$16 million. UA lists were provided to RAND by USAMMA.
- When USAMMA submits a proposal for inclusion in the Army POM, it projects costs over the upcoming six fiscal years. In the FY10–15 POM submission, USAMMA included a program to procure CSH equipment. This program included a list of LINs and costs for each LIN. The total cost of a CSH set in this data is \$26 million. The source of these data is USAMMA.

Because the cost data from these three sources differed substantially, we summarized these three methods for estimating the procurement cost of a CSH set and asked USAMMA for its judgment regarding which data we should use in our research to project the cost of future CSH set procurements. On USAMMA's recommendation, we used the third source listed above, the FY10–15 POM submission data, in order to project the cost to procure a CSH set. The figure quoted by USAMMA was a CSH cost of \$26 million.

¹ As of May 10, 2010: <https://webtraads.belvoir.army.mil/unprotected/splash/>

² As of May 10, 2010: http://www.usamma.army.mil/assets/apps/qbca_medsils/qbca_index.cfm

Data on Upgrade Costs

As part of evaluating alternative equipping strategies, we projected the cost of upgrading CSH sets. The MTOE for the CSH is updated every three years to reflect changes in the unit materiel. But the UAs are continually updated with new LINs entered into the sets.

In order to estimate the cost of upgrading a CSH unit set, we turned to USAMMA data for costs incurred while implementing the MMRP upgrades. In the MMRP program, four RCHD 164-bed CSH decrements were expanded and upgraded to become full, current-generation 248-bed CSH sets. USAMMA incurred a cost of \$17 million per set for two sets in FY09. These data were provided by USAMMA.

The MMRP upgrades were performed on unit sets that had not been upgraded in several years. So the time span between prior upgrades and the MMRP upgrades is a reasonable estimate of the expected duration between future upgrades. With the MMRP upgrades, the component of the total upgrade costs associated with time between upgrades should be a good estimate of this cost component for future upgrade costs.

MMRP sets were upgraded from 164-bed sets to 248-bed sets, so significant additional materiel was added to the sets by replacement value; the 164-bed company comprises less than half of the equipment in the CSH MTOE. Thus, the \$17 million incurred with MMRP set upgrades may be high compared to future costs to upgrade an existing 248-bed set. However, USAMMA was able to utilize some excess materiel to supplement the MMRP upgrade process. The AMEDD owns some excess materiel at SIAD that it has stockpiled when CSH units were retired in recent years. Being able to reuse some of this materiel may have made the MMRP upgrades cheaper than future upgrades will be. On this basis, the \$17 million MMRP upgrade costs may be low compared to future set upgrade costs.

Given that we had one indication that the MMRP upgrade costs may be higher than future upgrade costs, and one indication that the MMRP upgrade costs may be lower than future upgrade costs, we could not conclude that the \$17 million estimate is either a high or low estimate for future CSH set upgrades. We concluded that it is a reasonable estimate for future upgrade costs.

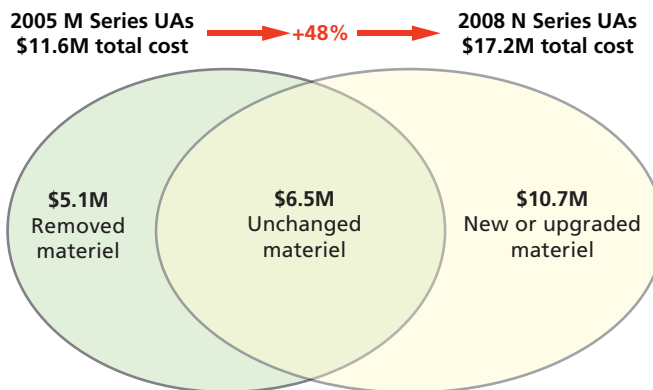
Note that the \$17 million CSH set upgrade cost represents 65 percent of the \$26 million CSH set procurement cost. We used the 65 percent rate as a cost estimate for upgrades to smaller-than-full CSH sets, such as the alternative home station sets developed in this research.

Procurement Options to Manage Cost Growth and Obsolescence Risk in Medical Equipment

Introduction

Because much medical equipment advances at a relatively fast pace, the Army is challenged to continuously upgrade the equipment in its CSHs. The problem of keeping up with technological change is exacerbated by the cost increases that tend to accompany technological advances. For instance, when the Army upgraded the unit assemblage (UA) kits in CSHs from the M series to the (current) N series, it discovered that the UAs in N series CSH sets are 48 percent more costly than prior M series versions of these same UAs (see Figure E.1).

Figure E.1
N Series CSH Sets Are 48 Percent More Costly than M Series



- New equipping and procurement strategies may help control recurring costs of upgrading CSH sets to state of the art.
- UA equipment costs from USAMMA Website, includes Ps&Ds.

The Army is interested in developing an equipping strategy that includes procurement and maintenance options that can help manage the costs of avoiding equipment obsolescence. Managing technology obsolescence and keeping medical equipment updated while managing costs provides a motivation for understanding procurement strategies used by other organizations. We undertook a number of analytic means to identify procurement options in the continuously evolving medical field. These options included leasing, deferred procurement, and vendor-managed inventory. Key considerations in adapting these options to a new equipping strategy for CSHs include medical equipment technology lifecycle, equipment and materiel procurement lead times, and DoD's and industries' ability to support equipment and materiel requirements.

Approach

Literature reviews and structured interviews were conducted to identify various procurement and maintenance practices used by other organizations. Specifically, two separate literature reviews were conducted. The first literature review focused on understanding high-level concepts from commercial best practices in medical equipment procurement, such as when leases are used and group purchasing organizations. This was followed by interviews, and then a second literature review was conducted to gain additional understanding of the key concepts from the interviews. In addition, the second literature review also focused on leasing options for the Army, procurement regulations, and trade literature on leasing opportunities with the government.

The interviews were conducted in two waves. The first interview sample included academic medical centers, consulting agencies, and a medical equipment manufacturer. The second wave of interviews included for-profit medical systems and federal government agencies. Table E.1 provides the list of organizations and positions of the interviewees who gave permission to be identified. (For organizations that did not provide permission for identification, a simple description is used instead.)

Findings from the initial literature review were used to develop the interview instrument for the hospital and medical equipment manufacturer interviews. Initial structured interviews focused on the following questions:

- What are the procurement practices in your organization?
- What are the practices for managing technology obsolescence?
- What are the key considerations in leasing versus buying?
- What are the maintenance practices, including the use of in-house engineers or contracts with vendors?
- What resources are used to improve the procurement process?

Table E.1
Interview Sample

Organization	Position
Health Systems and Hospitals	
Ronald Reagan UCLA	Chief Administrative Officer, Radiology
Johns Hopkins Hospital	Clinical Engineering Services
Johns Hopkins University	Senior Radiology Engineer Supervisor
Duke University and Health System	Sourcing Manager, Capital Equipment and Equipment Planning, Strategic Sourcing, Procurement & Supply Chain Management
Partners Healthcare	Operations Manager, Radiology Engineering
Brigham and Women's Hospital	
Massachusetts General Hospital	
Academic Medical Center A	Chairman, Imaging Institute
Academic Medical Center B	Director, Department of Radiology
Academic Medical Center C	Director, Department of Radiology
New York Presbyterian University Hospital	Director, Major Project Equipment Planning
Equipment Manufacturers Medical	
Medical Equipment Manufacturer	Director, Customer Service Operations
Consulting Organizations	
Nonprofit Patient Care Research Institute	National Account Manager, Health Care Market Intelligence
Deloitte Consulting, LLP	Manager, Strategy and Operations, Sourcing and Procurement
For-Profit Health Systems and Hospitals	
Community Health Systems	Chief Purchasing Officer
Large, National Commercial Health System	Chief Supply Chain Operations
Kaiser Permanente Medical Groups	Chief Procurement Officer and Vice President of Procurement
Federal Government	
Department of Veterans Affairs	Director, National Contract Services
Army Medical Department (AMEDD)	Director, MEDCOM Center for Health Care Contracting/Health Care Acquisition Activity
Army Medical Center	Deputy Chief of Staff, Contracting
Army Medical Fixed Facility	Chief, Department of Logistics

Summary of Findings

The health care organizations we interviewed used a variety of procurement options. The academic medical centers both purchased and leased medical equipment, while the two for-profit organizations (Kaiser Permanente Medical Groups and Community Health Systems) were more likely to purchase equipment than lease. The reported drivers of leasing include limited access to capital and rate of medical equipment technology obsolescence. The hospitals that were using leasing as a procurement strategy reported that operational leases are most common.

The for-profit health care organizations we interviewed had access to capital and therefore chose not to lease medical equipment. However, for-profit health care orga-

nizations did report leasing nonmedical equipment such as copiers, furniture, and computers. Centralized purchasing of standard equipment is very common in health systems and other networks, with some local purchasing authority. For-profit health systems generally utilize a centrally managed capital procurement process that grants a specified level of purchasing authority to the local level. This strategy provides local hospital leadership with the flexibility to tailor health care at their level, while harnessing corporate buying power for capital investments. For-profit health care organizations typically use varying levels of group purchasing organizations (GPOs) such as Broadlane and medical equipment information databases such as MD Buyline. Kaiser Permanente was the only for-profit hospital that reported having a robust contracting office that reduced the need for exclusive relationships with GPOs. Most of the hospitals and health systems interviewed report use of external resources such as equipment databases and group purchasing/consulting organizations.

The maintenance used by the hospitals and health systems varies. We found blends of in-house and vendor-managed (for purchased or leased equipment) maintenance. For-profit hospitals typically use a blend of “in-house” and vendor-maintained medical equipment. The increase in technological advancement in medical equipment was often cited as the driver for vendor maintenance contacts. There appears to be a shift toward more vendor maintenance that is primarily driven by technology advancement. All hospitals using master maintenance contracts with vendors reported a favorable experience.

Conclusions and Recommendations

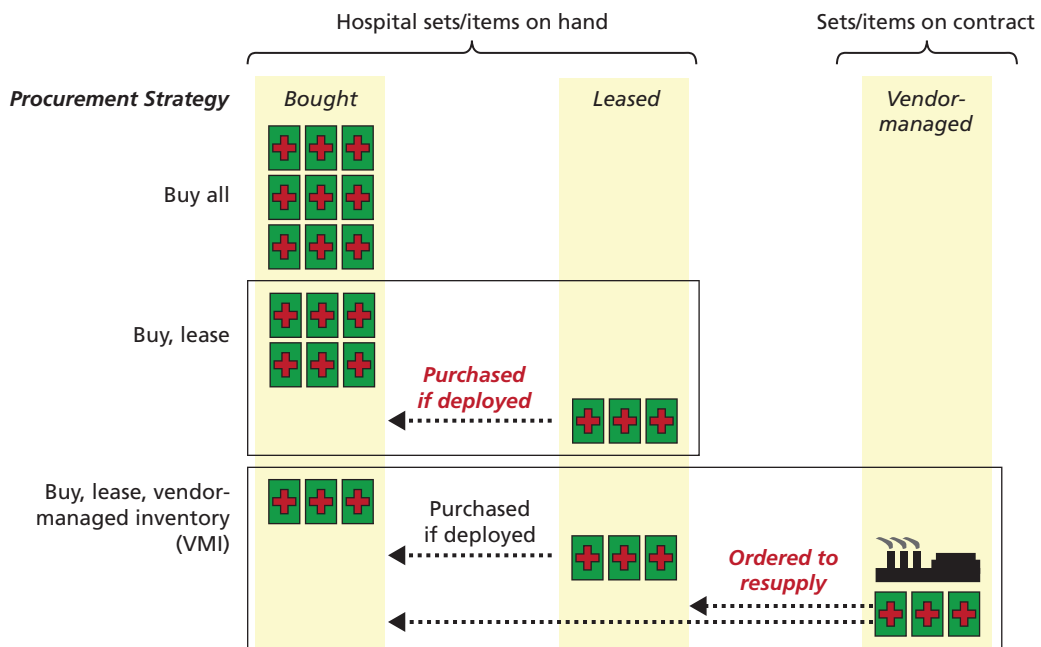
There are a variety of procurement strategies that may enhance the ability of AMEDD to manage equipment at SIAD. Currently AMEDD purchases all of the CSH equipment maintained in its equipment pools. It should consider leasing medical equipment, vendor-managed inventory, or a combination of both to supplement its equipment procurement strategy. Figure E.2 shows how these strategies might be combined.

Leasing

AMEDD should more systematically evaluate leasing medical equipment under some conditions. These conditions revolve largely around cost, technology obsolescence, and a need for flexibility in equipment. As a guiding principle, AMEDD should consider the commercial hospital leasing guidance to only lease medical equipment that costs more than \$50,000 with a useful life of between three to ten years (or more conservatively, five to seven years) if analysis shows that this is less than the total cost of ownership.

The first and most important factor to consider is the simple return-on-investment calculation with the lease-versus-purchase option. A calculation to quantify the cost

Figure E.2
Vendor-Managed Inventory Could Be Combined with Leasing and Purchasing

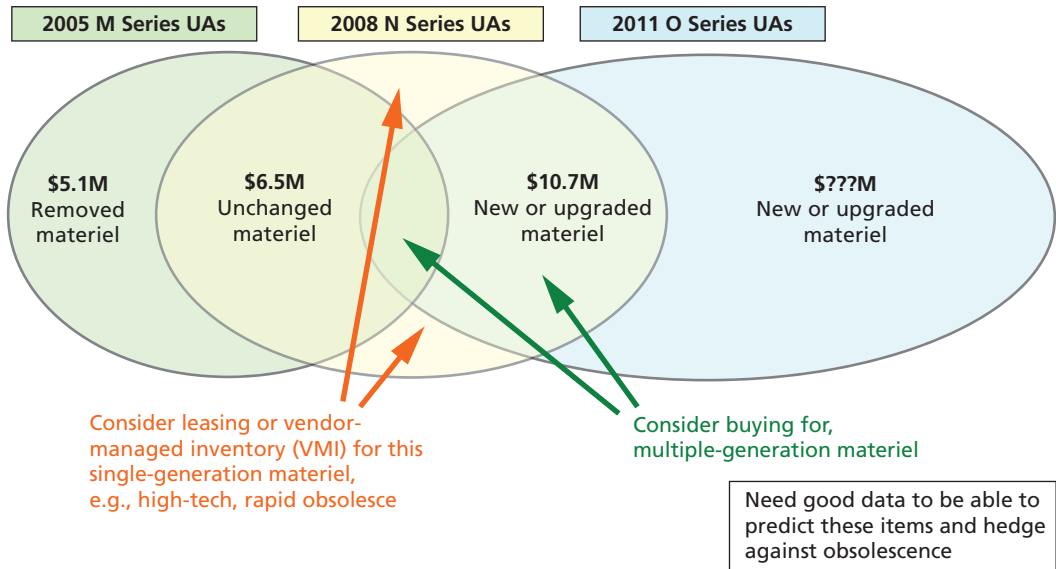


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difference between leasing versus buying the equipment and a comparison of the total cost of ownership are essential to understanding the actual costs associated with the lease-versus-buy decision. Leasing should be considered when total management costs, including maintenance and disposal, favor leasing (e.g., complex, expensive equipment). The potential for savings is available when net leasing costs are less than purchase cost during the Army's "useful life" of the item.

After costs are considered, other reasons for leasing medical equipment include technology obsolescence. If medical equipment may not be used before it obsolesces (e.g., in medical equipment found in APS, decrements, and MMRP), the Army could lease medical equipment using an operating lease and return the equipment at the end of the lease or use a cancellation clause to upgrade medical equipment to manage technology. This should be done for medical equipment with a short useful life or when an upgrade to another type of technology is planned. The Army is continuously reviewing the medical equipment in the medical materiel sets. Each set is scheduled on a review cycle of every three years, and occasionally this is done more frequently. Figure E.3 shows the shift of the medical materiel sets from the M-series to the N-series and from the N-series to the O-series. There may be certain types of medical equipment that will be upgraded between the N and O series that may be a good candidate for leasing.

Figure E.3
Consider Leasing LINs Predicted to Stay in the CSH TOE for Only One Generation



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When the Army is likely to change medical equipment during unit assemblage upgrade, leasing may be an attractive option. Often, this can be predicted by past procurement data, useful life data, or data from ONS procurement.

Additionally, leasing may be a good option when flexibility in equipment is needed. For example, if the Army moves to centrally owned medical equipment that is maintained with a high-level modernization, the Army may want to lease the medical equipment used in the RTS-Med or Mobile Training Team sets. In this way, the training sets could consistently be modified on demand to mirror the medical equipment that is provided in theater to best support new training needs.

Deferred Procurement: Lease in Case of Contingency

A variant of the leasing arrangement is a form of deferred procurement that RAND terms lease in case of contingency (LICC). LICC is a strategy where the AMEDD would engage in an operational lease with a vendor for the medical equipment in a complete set (e.g., deployable CSH set). The set would be maintained by the vendor, but located at SIAD. If the AMEDD required the equipment for a contingency operation, the equipment would be immediately purchased. If the equipment is never purchased, the vendor would continue to maintain the equipment and field the most current technology within the sets. The key to LICC is the use of an operational lease. Utilizing an operational lease, where the cost of the equipment is not fully amortized,

significantly improves the possibility that the cost of the operational lease will be less than the total cost to purchase the equipment outright.

Vendor-Managed Inventory (VMI)

Vendor-managed inventory is a procurement strategy where a manufacturer is responsible for guaranteeing an amount of inventory for a customer. Maintaining this capability usually requires the customer to pay a retainer fee equal to a percentage of the total cost of the guaranteed inventory. Executing a successful VMI strategy requires the customer to compute proper “on-hand” inventory levels and collaborate with the manufacturer to determine accurate lead times that ensure timely delivery of equipment and supplies. This strategy could be particularly useful for the management of SIAD balance sets. The AMEDD could decide on an optimal level of balance sets to maintain at SIAD, and when additional inventory is required, an order could be placed with a manufacturer to replenish the existing inventory. Benefits to the AMEDD for using a VMI model include maintaining less “on-hand” inventory of medical equipment at SIAD, and less inventory translates into lower maintenance costs. Additionally, a VMI model would provide the AMEDD with additional equipment capacity without significant up-front capital outlay.

The major disadvantage of utilizing a VMI model is that the AMEDD loses control of on-hand equipment. This increases risk to the AMEDD due to dependence on a manufacturer to provide a timely supply of deployable medical equipment. This disadvantage can be mitigated by providing proper oversight of, and accurate lead times to, the manufacturer. Information management is crucial to the execution of VMI, especially considering the AMEDD readiness mission.

Simulation of Flows of CSH Units and Equipment in ARFORGEN Cycle

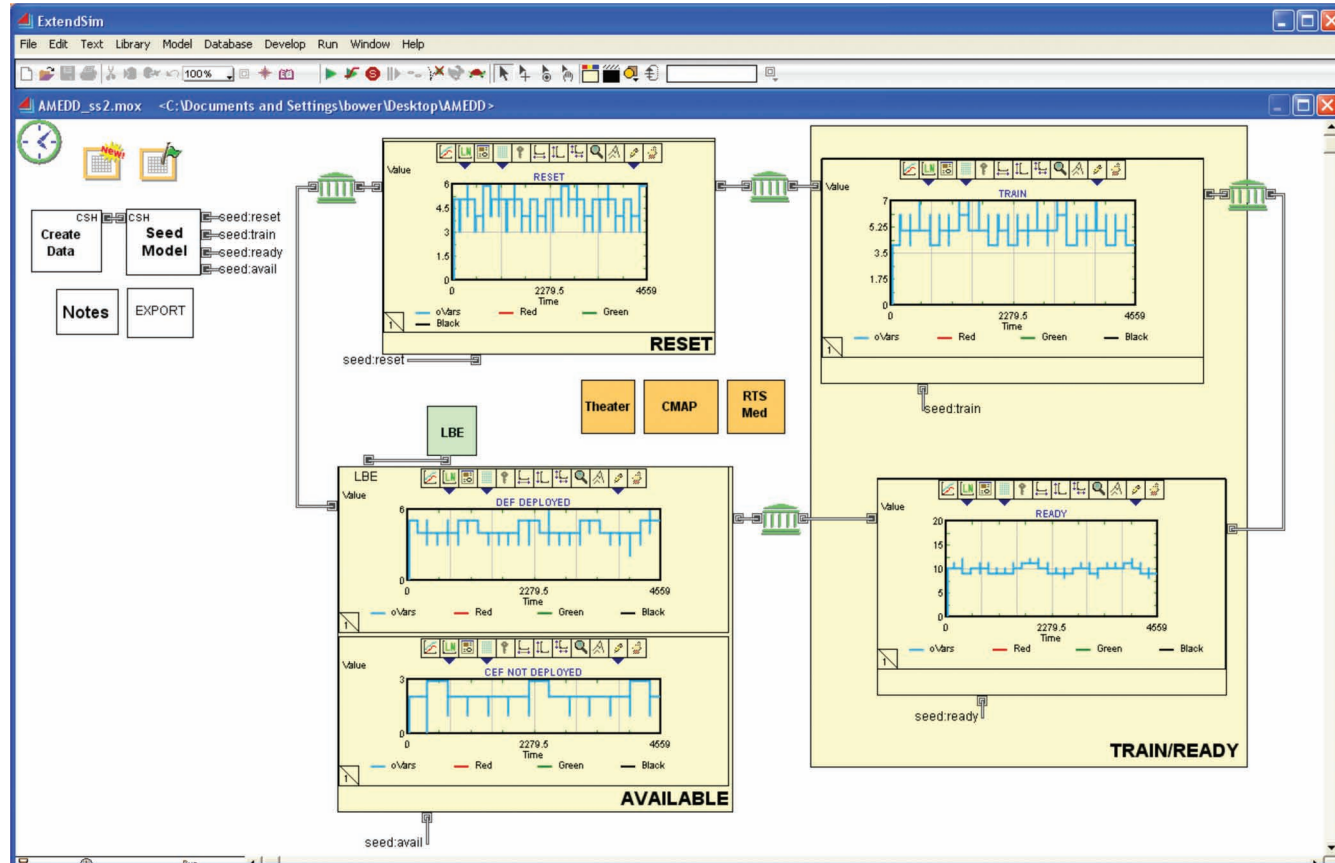
This appendix briefly describes a model built to evaluate the performance of alternative equipping strategies for CSHs progressing through the ARFORGEN cycle. The discrete event simulation tracks CSHs as they move through the ARFORGEN pools. It also tracks medical equipment, at the LIN level, as those items are acquired by the CSHs or released from them (e.g., into the LBE program). The model was built using EXTENDSIM software (version 7.0.4).

Model Structure

Figure F.1 shows a top-level view of the model. As the simulation runs, CSHs move through the three pools shown in the yellow boxes: Reset, Train/Ready, and Available. The model distinguishes between the three-year and five-year cycles for active and reserve component units, respectively.

As CSHs move into the Available pool of the ARFORGEN cycle, they can be designated for a specific deployment as part of Deployment Expeditionary Forces (DEF) or can remain at home station as part of the Contingency Expeditionary Forces (CEF). The model directs CSHs onto the deployed path according to business rules that reflect alternative demands for deployments. These business rules can be formulated to represent alternative scenarios for operations. For instance, to represent the demand for CSH units to support a single major regional contingency (MRC) or major combat operation (MCO), the rules can stipulate that every active component CSH will deploy when it reaches the Available pool; this would generate a continual supply of three to four CSHs in the theater of operations. The charts in the boxes show how many CSHs are in each pool throughout the model run.

Figure F.1
Discrete Event Simulation Tracks Movement of CSHs and Equipment Through ARFORGEN Pools



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Resources in terms of medical equipment LINs are kept track of in the orange boxes—one each for theater resources, CONUS resources, and resources at the training facilities. The “silos” of resources shown in Figure F.1 include the following:

- **Theater.** Theater includes APS and TPE. When a combat operation begins, units draw equipment from the APS and deposit it into the TPE program when they redeploy for use by the next unit. As the APS is depleted, units draw from the TPE instead. The unit first checks APS for equipment. If there is not enough equipment in APS, the unit draws from TPE instead.
- **CMAP (Centrally Managed Asset Pool).** For scenarios that involve shared resources, units draw and deposit equipment into the CMAP.
- **RTS-Med (Regional Training Site, Medical).** Units draw and deposit equipment from the training silo when engaged in off-site training activities.
- **LBE (Left Behind Equipment).** When units deploy, they leave equipment in the LBE program. They draw equipment from LBE when they redeploy, in the Reset pool.

Other silos that could be created include:

- **Leasing silo.** To account for medical equipment leased rather than purchased.

Parameters controlling the time spent in each silo must be specified by the user. The input can be either a specified value, such as an average, or drawn from a distribution. Furthermore, if detailed data are available, the input can be LIN-based.

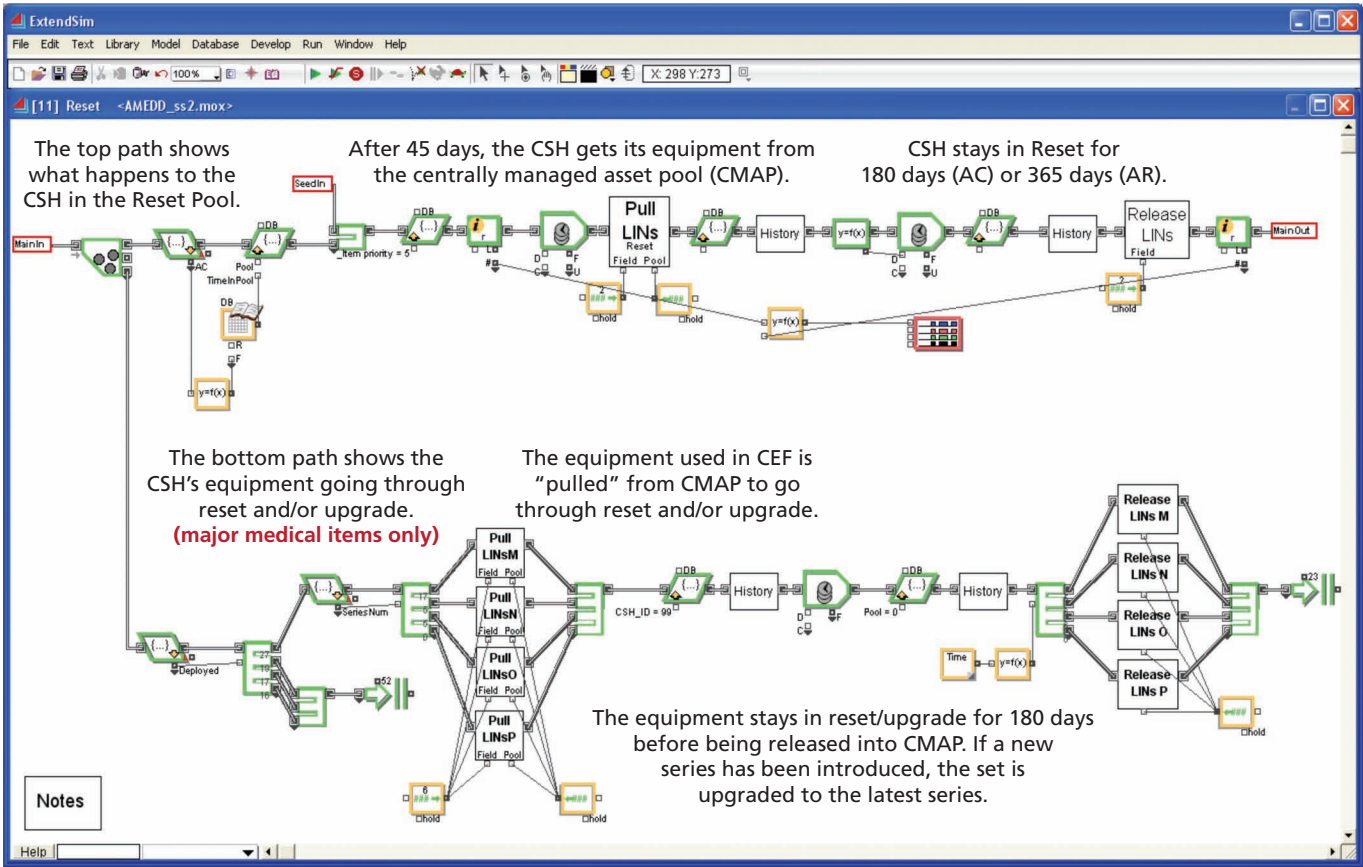
This can be done at the LIN level if data are available, for example, on repair times or procurement times for a specific item of medical equipment.

When a CSH enters a given pool, it pulls the LINs it needs from the resource blocks. When it leaves the pool, it releases the LINs back into the resource blocks.

Figure F.2 presents a detailed look at the Reset block. The top path shows what happens to CSHs in the Reset pool. The CSH enters the Reset pool, and after 45 days, the CSH pulls its equipment from the centrally managed asset pool. At the end of the Reset pool, the CSH releases its equipment back into the pool.

The bottom path shows the CSH’s equipment going through reset and upgrade.

Figure F.2
Discrete Event Simulation Tracks Movement of Major Medical Equipment Through ARFORGEN Pools



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Parameters and Assumptions

Key parameters and assumptions used in developing and testing the model are listed in Table F.1.

Table F.1
Key Parameters and Assumptions

26 CSHs: 10 active, 16 reserve.
39 key medical devices (all OMA LINs on the CSH MTOE).
Model run is 12 years.
Next-generation equipment series are introduced every three years for active CSHs, and every five years for reserve CSHs.
Sets are upgraded to next generation in LBE for units that deployed. For units that did not deploy, sets are upgraded in the Reset pool.
APS contains seven 248-bed CSH sets.
APS is replenished two years after it is used (i.e., before the onset of the next contingency in the series of wars).

Model Inputs

The data that drive the model are stored in an EXTENDSIM internal database. The key input data to the model are listed in Table F.2.

Table F.2
Key Model Inputs

Seeding for CSHs (i.e., initial allocation of the CSHs in the ARFORGEN cycle).*
Seeding for LINs: how many of each LIN are initially in APS, CMAP, and at the training sites.
LIN requirements: how many of each LIN are required by the CSHs in Reset, Train/Ready, Available-DEF and Available-CEF.
Model timing: how long CSHs spend in each of the pools.
Training policies: frequency and duration of time at RTS-Med.

*SOURCE: Headquarters, U.S. Army Reserve Command, Surgeon.

Model Outputs

The model has two primary outputs: (1) the number of LINs, by generation,¹ in each of the resource pools (CMAP, APS, and training sites) throughout the model run; and (2) a record of equipment deficiencies that may (or may not) occur during the model run.

¹ The current technological generation of CSH medical equipment is referred to as the N series: it is superseding the M series and will be superseded by the O series. Today, some CSHs still retain equipment from the L series.

Results

We tested the model using two deployment scenarios and four equipping strategies. The first deployment scenario features a series of single, successive MCOs. Under this scenario, each active component CSH deploys every time it reaches the Available pool and one reserve CSH is deployed at a time, resulting in three to four CSHs deployed at once. The second deployment scenario doubles the demand for CSHs by featuring a series of two successive, nearly simultaneous MCOs: that is, at any given time, CSHs are deployed to two contingencies. To meet this demand, all CSHs deploy every time they reach the Available pool; this results in six to seven CSHs deployed at once.

We tested the model simulating each of the four equipping strategies described in Chapter Four—Current; Split-Based; Enhanced Capability, Single Base; and Training Equipment Only—under both scenarios.

Conclusions

The model confirmed that all four equipping strategies would provide adequate equipment for the CSHs during all phases of the ARFORGEN cycle. The model also highlighted the excess capacity in the current system.

In addition to identifying potential equipping shortfalls, the original intent of the modeling effort was to identify areas of friction. We envisioned using detailed LIN-level repair times, upgrade costs, and lead times to determine where the system was constrained. However, we were not able to use the model in the planned fashion due to data limitations: we were unable to obtain LIN-level repair times, upgrade costs, and lead times. As more robust data become available, the model could be used to provide more nuanced insights into the CSH equipping and maintenance process.

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