A Survey of U.S. Army Aeromedical Equipment
(Reprint)

By
Glenn W. Mitchell
James E. Adams

Biomedical Applications Research Division

September 1989

Approved for public release; distribution unlimited.

United States Army Aeromedical Research Laboratory
Fort Rucker, Alabama 36362-5292
Notice

Qualified requesters

Qualified requesters may obtain copies from the Defense Technical Information Center (DTIC), Cameron Station, Alexandria, Virginia 22314. Orders will be expedited if placed through the librarian or other person designated to request documents from DTIC.

Change of address

Organizations receiving reports from the U.S. Army Aeromedical Research Laboratory on automatic mailing lists should confirm correct address when corresponding about laboratory reports.

Disposition

Destroy this document when it is no longer needed. Do not return it to the originator.

Disclaimer

The views, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other official documentation. Citation of trade names in this report does not constitute an official Department of the Army endorsement or approval of the use of such commercial items.

Reviewed:

GERALD P. KRUEGER, PH.D.,
LTC, MS
Director, Biomedical Application Research Division

Released for publication:

J. D. LAMOTHE, Ph.D.
COL, MS
Chairman, Scientific Review Committee

DAVID H. KARNEY
Colonel, MC
Commanding
(U) A survey of U.S. Army aeromedical equipment

Medical equipment is necessary to support patients requiring air transportation, but it may not be compatible with the aviation environment. Aircraft systems may cause errors in the functioning of medical equipment, or that equipment may interfere with the aircraft. Medical equipment has been tested, primarily for fixed wing aircraft, to military standards by the U.S. Air Force. This study reports 1986 and 1987 surveys which documents the use of such equipment on U.S. Army medical evacuation aircraft and compares items in current use to the U.S. Air Force's test results. Of the 115 different nonissue items reported in use, 32 have been formally evaluated, and 9 of those were judged unacceptable for use on aircraft. Only two items reported in the survey were tested inflight in helicopters. The remaining 83 items have not been tested. Helicopters have unique requirements, and the U.S. Army has begun a program to evaluate medical equipment for helicopter use.

Aeromedical evacuation; helicopter ambulance; MEDEVAC; medical equipment testing;
A Survey of U.S. Army Aeromedical Equipment

GLENN W. MITCHELL, M.D., and JAMES E. ADAMS, B.A.

Aeromedical equipment is necessary to support patients requiring air transportation, but it may not be compatible with the aviation environment. Aircraft systems may cause errors in the functioning of medical equipment, or that equipment may interfere with the aircraft. Medical equipment has been tested, primarily for fixed wing aircraft, to military standards by the U.S. Air Force. This study reports 1986 and 1987 surveys which documented the use of such equipment on U.S. Army medical evacuation aircraft and compares items in current use to the U.S. Air Force’s test results. Of the 115 different nonissue items reported in use, 32 have been formally evaluated, and 9 of those were judged unacceptable for use on aircraft. Only two items reported in the survey were tested inflight in helicopters. The remaining 83 items have not been tested. Helicopters have unique requirements, and the U.S. Army has begun a program to evaluate medical equipment for helicopter use.

The use of the helicopter as a platform for medical evacuation (MEDEVAC) was proven to be effective during the Korean conflict with the use of the H-5 and the H-13 “Angel of Mercy.” But it was not until the transportation of almost 900,000 sick and wounded during the Vietnam conflict (2) that the role of the helicopter in aeromedical evacuation caught the public’s attention. In the Korean conflict, aeromedical evacuation missions carried no medical personnel and provided little in the way of definitive treatment. During the Vietnam conflict, patient interventions by MEDEVAC crews consisted of more definitive emergency treatment, such as airway control and blood volume expansion, using equipment sets carried by the medics. With the establishment of the Military Assistance to Safety and Traffic (MAST) program in the early 1970’s, MAST units, assisting civilian emergency medical services systems, achieved additional advances in onboard patient care with the addition of life support equipment.

Advanced life support equipment carried by MAST and other MEDEVAC units was acquired through interactions with supported medical treatment facilities and civilian emergency medical services. The addition of advanced life support equipment enhanced the quality of medical care available to air ambulance patients, but little consideration was given to the potential hazards of using equipment that may not be compatible with the aircraft or the flight environment.

Use of medical equipment on aircraft presents a unique problem. Items necessary to support a patient requiring air transportation may not be compatible with the aviation environment. Aircraft systems, such as those emitting electrical signals, may cause errors in the functioning of medical equipment and lead to improper diagnoses and treatments which endanger the patient. Onboard medical equipment can also interfere with the aircraft systems and compromise the safety of the entire crew. There are military standards for equipment to be used aboard aircraft, and medical equipment items have been tested by the U.S. Air Force (USAF) for military use (1,3-8). However, most of that testing has been directed toward fixed-wing aircraft. Helicopters have unique requirements, and much of the available medical equipment proposed for use in helicopters must be tested for that application.

The U.S. Army Aeromedical Research Laboratory (USAARL) developed a program to provide technical test and evaluation of medical equipment for use on-board Army helicopters. The focus is on aeromedical evacuation mission medical equipment that is supplemental to the essential medical equipment listed in Army Regulation 40-2 and supplemental to the medical equipment set (MES) authorized by the current Table of Organization and Equipment (TO&E). To obtain information on the types of supplemental medical equipment
Transport incubators
Suction equipment
Respirators/ventilators

DISCUSSION

Army air ambulance units have acquired medical equipment through hospitals and commercial purchase to supplement medical equipment authorized by the TO&E. The acquisition of supplemental medical equipment was an effort by some Army air ambulance units to upgrade the quality of life support provided to the community through the Military Assistance to Safety and Traffic Program. Other medical equipment not owned by air ambulance units routinely accompanies patients during interhospital transfers or from onscene pickup points to a treatment facility.

In most cases, the supplementary equipment used has not been evaluated sufficiently to have formal safety approval. Several adverse situations are possible: 1) the equipment may not be safe to operate in an aviation environment; 2) the equipment may interfere with aircraft systems; 3) the equipment may give false indications of a patient's condition due to aircraft system interference; and 4) the equipment may not be installed on the aircraft safely enough to prevent further injury to the patient during adverse flight conditions.

In the past, clearance to use medical items onboard Army air ambulances has been based on a U.S. Army Health Services Command policy that recommended use of USAF approved medical items. The USAF technical report identifies acceptable or not acceptable status for each item of equipment for all aircraft. An informal review by USAFSAM personnel in 1988 revealed that not all of the medical items listed as acceptable are necessarily suitable for helicopters either by military standards or flight tests. In addition, no known safety-of-flight releases have been obtained through the U.S. Army Aviation Systems Command for any of the listed equipment.

TABLE V. NUMBER OF MEDICAL EQUIPMENT ITEMS DETERMINED NOT ACCEPTABLE OR NOT EVALUATED FOR AIRCRAFT USE (USAFSAM) BY CATEGORY.

<table>
<thead>
<tr>
<th>Equipment category</th>
<th>Not acceptable</th>
<th>Not evaluated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac/defibrillator monitors/recorders</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Infusion pumps</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Electronic blood pressure monitors</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Respirators/ventilators/resuscitators</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Suction equipment</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Transport incubators</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Oxygen equipment humidifiers</td>
<td>1</td>
<td>21</td>
</tr>
<tr>
<td>Miscellaneous*</td>
<td>0</td>
<td>41</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>9</strong></td>
<td><strong>83</strong></td>
</tr>
</tbody>
</table>

* Miscellaneous includes medical items such as extrication devices, traction devices, litter, etc.
The new U.S. Army program will provide technical feasibility testing, including inflight tests, for all medical equipment to be used aboard Army aircraft. The volume of equipment to be tested will be compounded by the rapid development of new medical technology for use during patient transports. For example, advanced cardiac equipment, such as intraaortic balloon pumps, was not used by any of the units in 1986-87, but is now being used during air ambulance transfers. The situation in civilian emergency air ambulance operations is not known, although it is presumed to be similar.

The results of this survey support the need for evaluation of both fixed and rotary wing suitability for all medical equipment to be used aboard aircraft, both military and civilian. Items routinely transferred between aircraft types will, of course, require both types of testing. Liaison between the Army and Air Force programs has already been established.

CONCLUSION

The results of two complementary surveys of U.S. Army air ambulance units show that some units have been using medical equipment that may not be suitable for use onboard helicopters. The U.S. Air Force School of Aerospace Medicine conducts a test and evaluation program for USAF aeromedical equipment, but the program emphasis is understandably fixed-wing oriented due to USAF mission requirements. Although Army aeromedical equipment should be compatible with USAF aircraft for patient transfers, this equipment should also be tested to rotary wing aircraft standards, including inflight testing on appropriate helicopters. A new U.S. Army program has been designed to meet this need. The need for such testing has implications for civilian helicopter aeromedical services as well.

REFERENCES
Initial distribution

Commander
U.S. Army Natick Research and Development Center
ATTN: Documents Librarian
Natick, MA 01760

Naval Submarine Medical Research Laboratory
Medical Library, Naval Sub Base
Box 900
Groton, CT 06340

Commander/Director
U.S. Army Combat Surveillance & Target Acquisition Lab
ATTN: DELCS-D
Fort Monmouth, NJ 07703-5304

Commander
10th Medical Laboratory
ATTN: Audiologist
APO New York 09180

Commander
Naval Air Development Center
Biophysics Lab
ATTN: G. Kydd
Code 60B1
Warminster, PA 18974

Naval Air Development Center
Technical Information Division
Technical Support Detachment
Warminster, PA 18974

Commanding Officer
Naval Medical Research and Development Command
National Naval Medical Center
Bethesda, MD 20014

Under Secretary of Defense for Research and Engineering
ATTN: Military Assistant for Medical and Life Sciences
Washington, DC 20301

Commander
U.S. Army Research Institute of Environmental Medicine
Natick, MA 01760

U.S. Army Avionics Research and Development Activity
ATTN: SAVAA-P-TP
Fort Monmouth, NJ 07703-5401

U.S. Army Research and Development Support Activity
Fort Monmouth, NJ 07703

Chief, Benet Weapons Laboratory
LCWSL, USA ARRADCOM
ATTN: DRDAR-LCB-TL
Watervliet Arsenal, NY 12189

Commander
Man-Machine Integration System
Code 602
Naval Air Development Center
Warminster, PA 18974

Commander
Naval Air Development Center
ATTN: Code 6021 (Mr. Brindle)
Warminster, PA 18974

Commanding Officer
Harry G. Armstrong Aerospace Medical Research Laboratory
Wright-Patterson
Air Force Base, OH 45433

Director
Army Audiology and Speech Center
Walter Reed Army Medical Center
Washington, DC 20307-5001
Commander
U.S. Army Medical Research
Institute of Infectious Diseases
Fort Detrick, Frederick,
MD 21701

Director, Biological
Sciences Division
Office of Naval Research
600 North Quincy Street
Arlington, VA 22217

Commander
U.S. Army Materiel Command
ATTN: AMCDE-XS
5001 Eisenhower Avenue
Alexandria, VA 22333

Commandant
U.S. Army Aviation
Logistics School
ATTN: ATSQ-TDN
Fort Eustis, VA 23604

U.S. Army Training
and Doctrine Command
ATTN: ATCD-ZX
Fort Monroe, VA 23651

Structures Laboratory Library
USARL-AVSCOM
NASA Langley Research Center
Mail Stop 266
Hampton, VA 23665

Naval Aerospace Medical
Institute Library
Bldg 1953, Code 102
Pensacola, FL 32508

Command Surgeon
U.S. Central Command
MacDill Air Force Base
FL 33608

Air University Library
(AUL/LSE)
Maxwell AFB, AL 36112

Commander
U.S. Army Biomedical Research
and Development Laboratory
ATTN: SGRD-UBZ-I
Fort Detrick, Frederick,
MD 21701

Defense Technical
Information Center
Cameron Station
Alexandria, VA 22313

U.S. Army Foreign Science
and Technology Center
ATTN: MTZ
220 7th Street, NE
Charlottesville, VA 22901-5396

Director,
Applied Technology Laboratory
USARL-AVSCOM
ATTN: Library, Building 401
Fort Eustis, VA 23604

U.S. Army Training
and Doctrine Command
ATTN: Surgeon
Fort Monroe, VA 23651-5000

Aviation Medicine Clinic
TMC #22, SAAF
Fort Bragg, NC 28305

U.S. Air Force Armament
Development and Test Center
Eglin Air Force Base, FL 32542

U.S. Army Missile Command
Redstone Scientific
Information Center
ATTN: Documents Section
Redstone Arsenal, AL 35898-5241

U.S. Army Research and Technology
Laboratories (AVSCOM)
Propulsion Laboratory MS 302-2
NASA Lewis Research Center
Cleveland, OH 44135
AFAMRL/HEX
Wright-Patterson AFB, OH 45433

University of Michigan
NASA Center of Excellence in Man-Systems Research
ATTN: R. G. Snyder, Director
Ann Arbor, MI 48109

John A. Dellinger,
Southwest Research Institute
P. O. Box 28510
San Antonio, TX 78284

Product Manager
Aviation Life Support Equipment
ATTN: AMCPM-ALSE
4300 Goodfellow Blvd.
St. Louis, MO 63120-1798

Commander
U.S. Army Aviation Systems Command
ATTN: AMSAV-ED
4300 Goodfellow Blvd
St. Louis, MO 63120

Commanding Officer
Naval Biodynamics Laboratory
P.O. Box 24907
New Orleans, LA 70189

U.S. Army Field Artillery School
ATTN: Library
Snow Hall, Room 14
Fort Sill, OK 73503

Commander
U.S. Army Health Services Command
ATTN: HSOP-SO
Fort Sam Houston, TX 78234-6000

U.S. Air Force Institute of Technology (AFIT/LDEE)
Building 640, Area B
Wright-Patterson AFB, OH 45433

Henry L. Taylor
Director, Institute of Aviation University of Illinois-
Willard Airport
Savoy, IL 61874

COL Craig L. Urbauer, Chief
Office of Army Surgeon General
National Guard Bureau
Washington, DC 50310-2500

Commander
U.S. Army Aviation Systems Command
Library and Information Center Branch
ATTN: AMSAV-DIL
4300 Goodfellow Blvd
St. Louis, MO 63120

Federal Aviation Administration
Civil Aeromedical Institute
CAMI Library AAC 64D1
P.O. Box 25082
Oklahoma City, OK 73125

Commander
U.S. Army Academy of Health Sciences
ATTN: Library
Fort Sam Houston, TX 78234

Commander
U.S. Army Institute of Surgical Research
ATTN: SGRD-USM (Jan Duke)
Fort Sam Houston, TX 78234-6200
Director of Professional Services
AFMSC/GSP
Brooks Air Force Base, TX 78235

U.S. Army Dugway Proving Ground
Technical Library
Bldg 5330
Dugway, UT 84022

U.S. Army Yuma Proving Ground
Technical Library
Yuma, AZ 85364

AFFTC Technical Library
6520 TESTG/ENXL
Edwards Air Force Base,
CAL 93523-5000

Commander
Code 3431
Naval Weapons Center
China Lake, CA 93555

Aeromechanics Laboratory
U.S. Army Research
and Technical Labs
Ames Research Center,
M/S 215-1
Moffett Field, CA 94035

Sixth U.S. Army
ATTN: SMA
Presidio of San Francisco,
CA 94129

Commander
U.S. Army Aeromedical Center
Fort Rucker, AL 36362

U.S. Air Force School
of Aerospace Medicine
Strughold Aeromedical Library
Documents Section, USAFSAM/TSK-4
Brooks Air Force Base, TX 78235

Dr. Diane Damos
Department of Human Factors
ISSM, USC
Los Angeles, CA 90089-0021

U.S. Army White Sands
Missile Range
Technical Library Division
White Sands Missile Range,
NM 88002

U.S. Army Aviation Engineering
Flight Activity
ATTN: SAVTE-M (Tech Lib)
Stop 217
Edwards Air Force Base,
CA 93523-5000

Ms. Sandra G. Hart
Ames Research Center
MS 239-5
Moffett Field, CA 94035

Commander
Letterman Army Institute
of Research
ATTN: Medical Research Library
Presidio of San Francisco,
CA 94129

Director
Naval Biosciences Laboratory
Naval Supply Center, Bldg 844
Oakland, CA 94625

Commander
U.S. Army Medical Materiel
Development Activity
Fort Detrick, Frederick,
MD 21701-5009
Commander, U.S. Army
Aviation Center

Directorate of Combat Developments
Bldg 507
Fort Rucker, AL 36362

Chief
Army Research Institute
Field Unit
Fort Rucker, AL 36362

Commander
U.S. Army Safety Center
Fort Rucker, AL 36362

U.S. Army Aircraft Development
Test Activity
ATTN: STEBG-MP-QA
Cairns AAF
Fort Rucker, AL 36362

Commander
U.S. Army Medical Research and Development Command
ATTN: SGRD-PLC (COL Sedge)
Fort Detrick, Frederick
MD 21701

MAJ John Wilson
TRADOC Aviation LO
Embassy of the United States
APO New York 09777

Directorate of Training Development
Bldg 502
Fort Rucker, AL 36362

Chief
Human Engineering Laboratory
Field Unit
Fort Rucker, AL 36362

Commander
U.S. Army Aviation Center
and Fort Rucker
ATTN: ATZQ-T-ATL
Fort Rucker, AL 36362

President
U.S. Army Aviation Board
Cairns AAF
Fort Rucker, AL 36362

Dr. William E. McLean
Human Engineering Laboratory
ATTN: SLCHE-BR
Aberdeen Proving Ground, MD 21005-5001