USAMRMC: 50 Years of Dedication to the Warfighter

1958–2008

Preface

A most solemn responsibility of our elected leaders that is equally shared with our Defense Department leadership—civilian and uniform—is to provide world-class medical technologies to protect and sustain our service men and women across the full continuum of military operations. We are all equally challenged to provide effective care for sick and wounded service members so as to minimize morbidity and mortality and hasten full return to productive duty and a fulfilling life. Beneficiaries of the Military Health System, whether they are uniformed, dependents, or retirees, deserve quality medical care.

This book marks the first 50 years of the U.S. Army Medical Research and Materiel Command (USAMRMC). It documents a chronology highlighting some of the Command's many contributions to ensuring that world-class medical technologies are available to our service men and women. Our organizations and programs have evolved to support the needs of the warfighter in training, pre-deployment operations, deployment to nonhostile and hostile operations, post-deployment recovery and reconstitution, and into retirement.

Over this 50-year period, disease and non-battle injury casualty rates have plummeted as a direct consequence of the nation's relatively modest investments in military medical research, development, acquisition, logistics, information systems and technologies, and health facilities. Similarly, USAMRMC contributions to successful medical treatment and management of combat casualties and their care have increased survival rates. The Command's many contributions to modernization of the Military Health System have provided the tools needed for decisive victory on the battlefields of tomorrow. Of particular importance is the unique organization of the Command that allows it to be the life-cycle manager for all medical systems. We literally have ownership from concept development to testing, partnering for manufacturing, acquisition, and fielding. This organization is unique within the Department of Defense and has proven its value in the all-time historically high survivability rates seen in Operation Iraqi Freedom and Operation Enduring Freedom to date. The chronology also documents congressional recognition of the benefits of USAMRMC programs to civilian as well as military health. It documents the many programs, particularly over the past decade, which advanced civilian and military health.

Our Army today is without peer. The men and women of the USAMRMC have contributed greatly to this status and to our ability to effectively project military power irrespective of disease, operational, and environmental threats to our fielded forces. We thank them for their selfless service and look forward to future medical technological advances to protect, project, and sustain the fighting force.

George W. Weightman
Major General, Medical Corps
Commanding General

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Acronym List

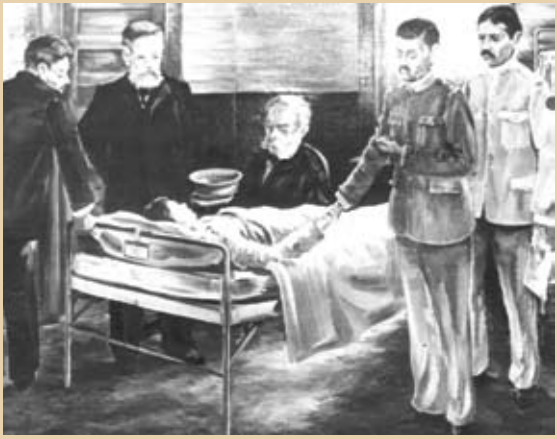
AFIRM	Armed Forces Institute of Regenerative Medicine
AFRIMS	Armed Forces Research Institute of Medical Sciences
AMEDD	U.S. Army Medical Department
APRL	U.S. Army Prosthetics Research Laboratory
ASA(ALT)	Assistant Secretary of the Army (Acquisition, Logistics, and Technology)
ASGRD	Assistant Surgeon General for Research and Development
BAMC	Brooke Army Medical Center
BMIST	Battlefield Medical Information System Tactical
BRAC	Base Realignment and Closure
BSL	Biosafety Level
CANA	Convulsant Antidote Nerve Agent
CDMRP	Congressionally Directed Medical Research Programs
DCSPER	Deputy Chief of Staff, Personnel
DLA	Defense Logistics Agency
DoD	U.S. Department of Defense
EIC	Wireless Information Carrier
FAR	Federal Acquisition Regulation
FASA	Federal Acquisition Streamlining Act
FBI	Federal Bureau of Investigation

FDA	U.S. Food and Drug Administration
HMMWV	High-Mobility Multipurpose Wheeled Vehicle
IED	Improvised Explosive Device
IM/IT	Information Management/ Information Technology
IMR	Institute for Medical Research
IND	Investigational New Drug
IOM	Institute of Medicine
JTAPIC	Joint Trauma Analysis and Prevention of Injury in Combat
LAIR	Letterman Army Institute of Research
MATMO	Medical Advanced Technology Management Office
MEDCOM	U.S. Army Medical Command
MRAP	Mine-Resistant, Ambush-Protected
MUST	Medical Unit, Self-Contained, Transportable
NAAK	Nerve Agent Antidote Kit
OTSG	Office of the Surgeon General
PDU	Pesticide Dispersal Unit
PH/TBI	Psychological Health and Traumatic Brain Injury
PTSD	Post-Traumatic Stress Disorder
RAD	Research Area Directorate
RDT&E	Research, Development, Test, and Evaluation

SARDA	Assistant Secretary of the Army for Research, Development, and Acquisition
SEATO	Southeast Asia Treaty Organization
SMART	Special Medical Augmentation Response Team
SVPSS	Steam Vacuum Pulse Sterilizer System
TAMMIS	Theater Army Medical Management Information System
TATRC	Telemedicine and Advanced Technology Research Center
TBI	Traumatic Brain Injury
TCAM	TAMMIS Customer Assistance Module
TCP	Tropical Canine Pancytopenia
TFA	Task Force Aesculapius
TLAMM	Theater Lead Agent for Medical Materiel
UAH-CCK	Up-Armored HMMWV Casualty Evacuation Conversion Kit
USAARL	U.S. Army Aeromedical Research Laboratory
USABRDL	U.S. Army Biomedical Research and Development Laboratory
USACEHR	U.S. Army Center for Environmental Health Research
USADRD	U.S. Army Dental Research Detachment
USAHFPA	U.S. Army Health Facility Planning Agency
USAIDR	U.S. Army Institute of Dental Research
USAISR	U.S. Army Institute of Surgical Research

USAMBRDL	U.S. Army Medical Bioengineering Research and Development Laboratory
USAMBRL	U.S. Army Medical Biomechanical Research Laboratory
USAMERDL	U.S. Army Medical Equipment Research and Development Laboratory
USAMISSA	U.S. Army Medical Information Systems and Services Agency
USAMITC	U.S. Army Medical Information Technology Center
USAMMA	U.S. Army Medical Materiel Agency
USAMMCE	U.S. Army Medical Materiel Center-Europe
USAMMDA	U.S. Army Medical Materiel Development Activity
USAMRAA	U.S. Army Medical Research Acquisition Activity
USAMRD	U.S. Army Medical Research Detachment
USAMRDC	U.S. Army Medical Research and Development Command
USAMRICD	U.S. Army Medical Research Institute of Chemical Defense
USAMRIID	U.S. Army Medical Research Institute of Infectious Diseases
USAMRMC	U.S. Army Medical Research and Materiel Command
USAMRU-Belem	U.S. Army Medical Research Unit-Belem
USAMRU-Brasilia	U.S. Army Medical Research Unit-Brasilia
USAMRU-E	U.S. Army Medical Research Unit-Europe

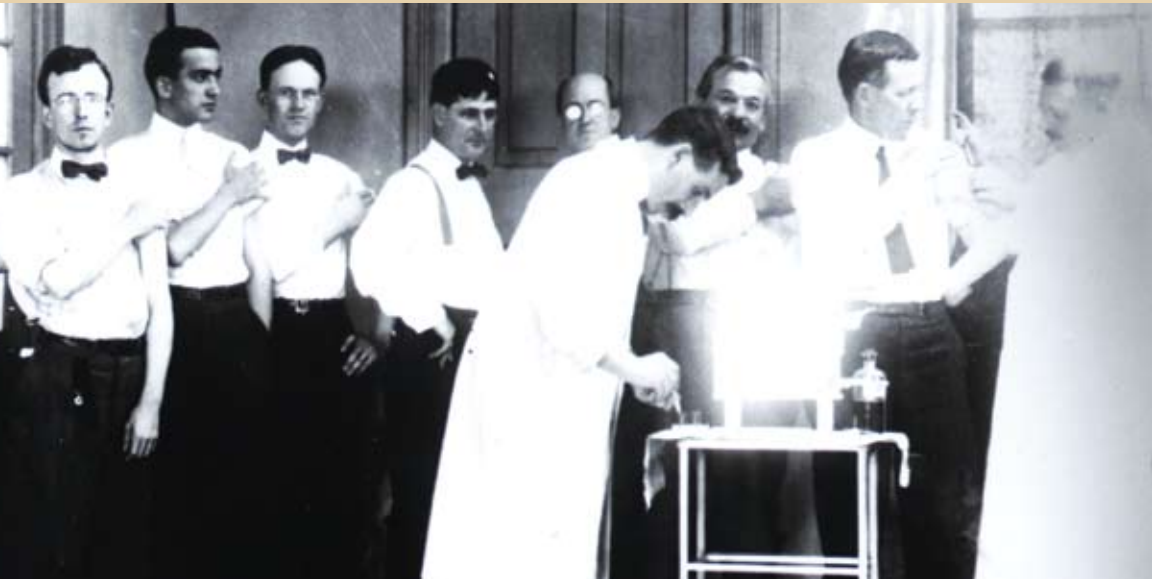
USAMRU-FB	U.S. Army Medical Research Unit-Fort Bragg
USAMRU-K	U.S. Army Medical Research Unit-Kenya
USAMRU-P	U.S. Army Medical Research Unit-Panama
USAMRU-ROK	U.S. Army Medical Research Unit-Republic of Korea
USARIEM	U.S. Army Research Institute of Environmental Medicine
USMHRP	U.S. Military HIV Research Program
VA	U.S. Department of Veterans Affairs
WRAIR	Walter Reed Army Institute of Research



Chapter 1

Introduction

Biomedical research programs are among the oldest research programs in the Armed Forces. From the first command-directed immunization program—inoculation for smallpox in Washington's Army—through the initiation of health and weather reporting in 1818, Beaumont's studies of digestion beginning in 1824, the founding of the first American School of Preventive Medicine and Public Health in 1893, Walter Reed's proof in 1900 that mosquitoes transmit yellow fever, and up to and including the present time, many military and civilian medical scientists working on behalf of the U.S. Army continue to make seminal contributions to military and general medicine.



Army medical research has played an important role in national defense throughout history by continually responding to emerging battle and non-battle threats. The medical achievements of the Army for more than 200 years have benefited people throughout the world. For example, the U.S. Army has figured prominently in many areas of vaccine development. Adenovirus, influenza, meningococcal diseases, hepatitis A and B, and Japanese encephalitis vaccines had roots in Army research and development programs. Today, the Army continues to work on vaccines against dengue, hepatitis E, drug-resistant malaria, HIV-1 (human immunodeficiency virus 1), and a number of bioterrorism-related vaccines. Additionally, Army researchers have had leadership roles in improvements in burn care and treatment and hemorrhage control. This commemorative volume is not merely a history of the U.S. Army Medical Research and Materiel Command (USAMRMC) but an insight into key advances in modern medicine. The following time line lists some of these innovations in both medical materiel and medical information starting in the late 1700s to the 1950s and the establishment of the U.S. Army Medical Research and Development Command (USAMRDC), the predecessor of USAMRMC. Over the past 50 years, USAMRMC research programs have made contributions to this record of achievement along with military and civilian medical scientists and various military medical programs of the past.

1777 - General Washington ordered the variolation of the Continental Army to prevent smallpox. This was the first time an entire army was immunized for a contagious disease.

1778 - The first Pharmacopoeia to be printed in America was compiled by Army surgeons at Valley Forge and known as the *Lititz Pharmacopoeia.*
- *Directions for Preserving the Health of Soldiers: Recommended to the Consideration of the Officers of the Army of the United States* was the first textbook on preventive medicine published in this country.

1779 - The first effort to construct isolation wards to guard against cross infection.

1812 - The War Department ordered that vaccination be substituted for inoculation to prevent smallpox. This was a milestone in military preventive medicine.

1818 - Meteorological records were kept to investigate the relation of disease incidence to climate and weather.

1819 - The Surgeon General ordered the collection of records of the sickness and mortality of troops to collate data and make comparisons among geographical areas. These reports became the first American health statistics, published in 1840.

1833 - Surgeon W. Beaumont published *Observations on the Gastric Juices and Physiology of Digestion* based on a 10-year study of an accidental stomach fistula. This study became the cornerstone of modern gastroenterology.

1862 - Establishment of the Army Medical Museum (today's Armed Forces Institute of Pathology) for collecting and preserving specimens illustrative of wounds and diseases causing death and disability in the Army.

Time Line of Military Medical Innovations

1864 - The first clinical definition of causalgia and nerve regeneration was published in *Gunshot Wounds and Other Injuries of Nerves* based on observations made by Silas Weir Mitchell, M.D., during the Civil War.

1892 - Major G.M. Steinberg introduced the virus neutralization test.

Surgeon General George Sternberg

1892 to 1914 - Studies regarding wound ballistics proved that wounds from bullets were not sterile, and in contrast to the accepted view that the heat of the bullet destroyed the micro-organisms on skin and clothing, they were actually conveyed directly into the wound.

1893 - The Army Medical School, the oldest school of preventive medicine and public health in the United States (now the Walter Reed Army Institute of Research), was founded by U.S. Army Surgeon General George Sternberg.

1898 - The Reed-Vaughan-Shakespeare Typhoid Board found that typhoid fever was spread mainly by contact between persons and documented that the control of sanitation was the responsibility of the line commander.

1899 - It was discovered that Puerto Rican anemia was caused by a New World type hookworm, *Necator americanus*. A drug therapy and a prevention and control program were developed that reduced an endemic disease to a sporadic occurrence.

Major Walter Reed

1900 - Major Walter Reed proved that yellow fever was transmitted by *Aedes* mosquitos.

1904 - Colonel W.C. Gorgas' work as a sanitarian in Panama resulted in the control of malaria in the Zone as well as a marked reduction in tuberculosis and other diseases and enabled the building of the Panama Canal. This work was based on findings of the Yellow Fever Commission on which Gorgas had previously served.

Time Line of Military Medical Innovations (cont.)

1909 to 1911 - Major F.F. Russell developed an effective antityphoid vaccine. Immunization against typhoid fever was made compulsory for the Army and Navy in 1911. Typhoid fever, a major cause of manpower loss in all previous wars, was eliminated.

- Development of chlorine to purify drinking water.

1911 - Captain Vedder demonstrated the specific use of emetine in treating amoebic dysentery.

1918 - A simplified test for the detection of syphilis was devised and used as the primary standard serological test for a number of years.

1918 - A therapeutic system for treating patients with "shell shock" was developed based on field observations by Army medical personnel. Manpower losses and long-term disability were reduced.

1923 - The closed method for treating compound fractures was developed.

1925 - *The Medical Aspects of Chemical Warfare* was published based on research during and after WWI. It included a full discussion of the means of both individual and collective protection against chemical warfare agents.

1927 to 1933 - The rinderpest vaccine and a new chloroform-treated rabies vaccine were developed.

1929 - First Lieutenant C.F. Craig demonstrated that amoebae produced antibodies in the serum of humans and developed the first serological test (complement fixation) for amoebiasis.

Time Line of Military Medical Innovations (cont.)

The body of the Unknown Soldier is loaded on the train in France. *(World War I Signal Corps Collection, photo by USAMHI).*

Mule-drawn, rubber-tired ambulance being tested and compared to an iron-rimmed, spoke-wheel ambulance, 1930. *(Carlisle Barracks Collection, photo by USAMHI).*

1933 - Atabrine (quinacrine; mepacrine) was tested as a substitute for quinine in combating malaria.

1939 to 1949 - Mass production techniques developed for growing the viruses of Western and Eastern equine encephalitis in eggs enabled the large-scale production of killed virus vaccines for these diseases.

1940 to 1945 - Studies of whole blood preservation brought about the development of kits for sterile collection of blood from donors and for rapid typing of blood, the first system for mass collection and shipment of liquid and dried plasma, the use of human albumin to treat shock, and contributions to the development of the system for collecting and refrigerating whole blood and shipping it overseas.

1942 - The discovery of a specific soluble polysaccharide antigen from rickettsial cultures restored the potency to the vaccine that prevented epidemic typhus.

1943 - DDT was given its first major field test in Naples where it stopped an epidemic of typhus. Army malaria control teams introduced the use of DDT for mosquito control in the Pacific in 1944.

- The Surgical Research Unit at Halloran General Hospital, Staten Island, evaluated antibiotic treatment of war wounds (moved to Brooke Army Medical Center in 1947).

1935 - Studies on effects of high-velocity missiles documented the fact that they create a transient, negative pressure cavity in passage and cause deformation and injury beyond the obvious.

1941 to 1943 - The biological warfare threat was exemplified when Japan used germ weapons against China.

1942 - Foundations were laid for the present scientific capability to design protective clothing and individual equipment to define water requirements in the heat, describe the processes of acclimatization and physical conditioning, and relate physical anthropometry to human engineering of vehicles.

Time Line of Military Medical Innovations (cont.)

Use of Field Ration C in the jungle, May 1942. *(Source: QM Food Rations Photograph Collection, photo by USAMHI).*

February 1945: Fifth Army, Mt. Belvedere, Italy. Walking wounded and a litter squad carry a wounded Corporal across a field to the battalion aid station. *(Unit History Collection, photo by USAMHHI).*

1944 to 1945 - Studies of shock and the resuscitative process showed the need for using whole blood rather than plasma and made clear that many hypotheses about shock were in error.

1945 - The Surgeon General added "transient personality reactions to acute stress" to the list of standard diagnoses and incorporated WWII experience with combat fatigue; similar nomenclature subsequently adopted by AMA and VA.

1949 - The first American center for the study of patients with burns was established as the U.S. Army Surgical Research Unit. The unit (now the U.S. Army Institute of Surgical Research) was the prototype for the many "burn centers" now established throughout the country.

1949 - The first specific cure of typhoid fever with chloramphenicol was reported.

1951 - Studies in Madagascar demonstrated that broad spectrum antibodies would cure septicemic and pneumonic types of human plague.

1955 - The soft ear insert was developed for defeating noise, which was a major improvement for comfort, safety, and acoustical seal, over the hard acrylic ear insert.

1955 to 1960 - A gastrointestinal biopsy capsule was developed that permitted in vivo biopsy of the human gut.
- The jet injector "gun" was developed for mass immunization of troops eliminating the need for needles and syringes.

1956 - The U.S. Army Medical Unit was established at Fort Detrick, and studies were initiated in research and development in defensive biological warfare.

1958 - USAMRDC was established.

Time Line of Military Medical Innovations (cont.)

USAMRMC: 50 Years of Dedication to the Warfighter

Since USAMRMC's inception in 1958, many different subordinate commands have been created, attached, detached, closed, or continue to contribute significantly to the USAMRMC mission. While early years were focused on military medical research, this changed in 1994 to include full military medical life-cycle support from research, licensure, production, logistic support, and delivery of products to U.S. forces anywhere in the world.

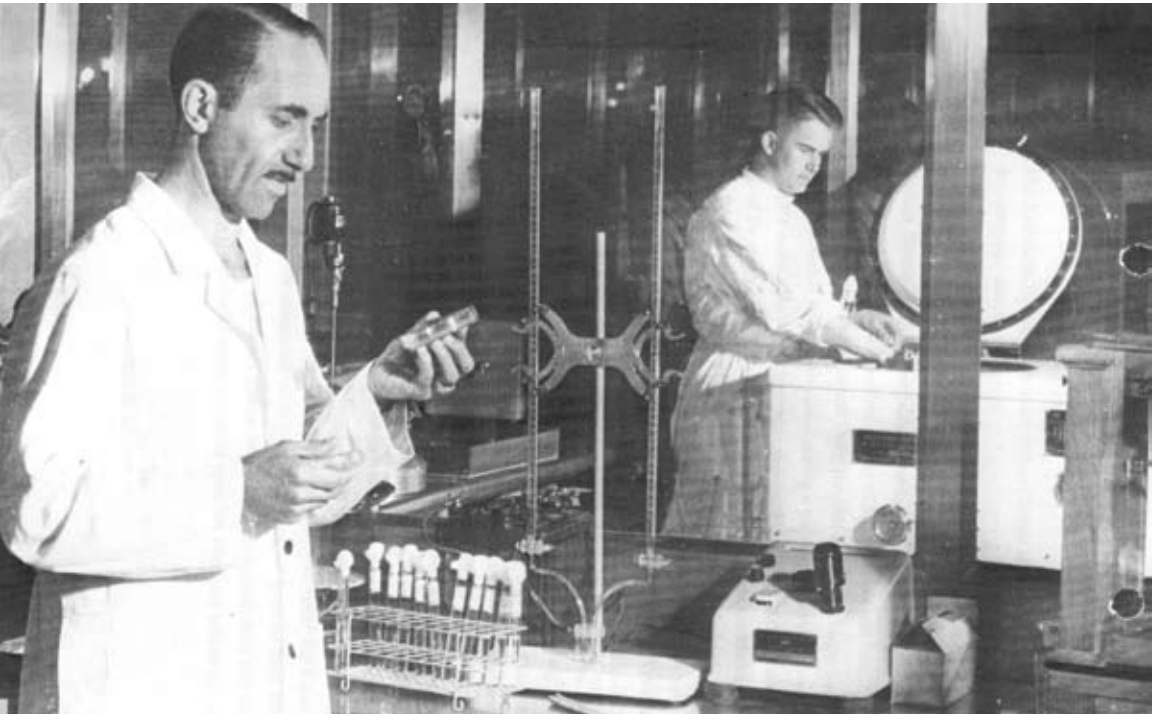
The remainder of this 50-year commemorative book will provide the historical details of not only USAMRMC but many of its subordinate activities over time. The U.S. military has been involved in many conflicts and wars over the past 50 years. In each case, medical problems arose that had to be overcome—some immediately and others over time—that challenged USAMRDC/USAMRMC. This book attempts to identify these issues by major chronological event or era and describes how USAMRMC met these challenges by researching, developing, producing, and delivering solutions to protect, project, and sustain the fighting force.

Chapter 2

Formation of USAMRDC

Biomedical research programs have existed since the formation of the U.S. Armed Forces. Army medical research, in particular, has played an important role in national defense throughout history by continually responding to emerging threats.

In responding to emerging threats to national security, the Army Surgeon General has always had the ability to reach out to the biomedical community in the United States to gather support. This support has been harnessed in various commissions, boards, and committees. These boards were often both advisory and execution bodies. For example, the Army Medical Research Board in Panama conducted studies to demonstrate the efficacy of atabrine as a prophylactic drug against malaria. This drug was used effectively by U.S. forces in the Pacific theater during WWII. Correspondingly, Dr. Bailey K. Ashford, working as a member of the Army Medical Board in Puerto Rico, identified the cause of anemia in Puerto Rican farm workers (the American hookworm), and this discovery dramatically reduced the rates of this illness in Puerto Rico and the American south. A third example of such a body was the America Typhus Commission, a joint military–civilian organization that did significant work demonstrating the effectiveness of DDT as a preventive measure in addition to implementing field trials for vaccines. One overarching conclusion to be drawn from the work of these boards is that they have served as models of epidemiological investigation for subsequent infectious disease outbreaks.



Scientists isolate organisms from human blood—the first step in determining the pathology of an infectious disease.

One major effort in military-sponsored medical research occurred during WWII with an urgent objective—to solve problems fast. In 1943, the Army Surgeon General's Medical Research and Development Board was established to coordinate all medical department research with the National Research Council's Office of Scientific Research and Development, other components of the Army, and outside agencies. After the war, the Office of Scientific Research and Development transferred its existing medical research efforts to the Public Health Service; the Surgeon General of the Public Health Service and the Director of the National Institutes of Health directed these efforts toward a large-scale, peacetime program of long-term support to scientific research in medicine through extramural research grants and fellowship awards. Concomitantly, the Army Surgeon General's Medical Research and Development Board continued to monitor Army-related, military-unique research. It was this board that evolved to eventually become USAMRDC in 1958.

The Army Medical Research and Development Board

"A board to be known as the Army Medical Research and Development Board has been constituted in the Office of the Surgeon General. It will be responsible for the planning and general supervision of all Medical Department research and development activities. The membership will include the chiefs of the various professional services and division of the Office of the Surgeon General; the air surgeon; the ground surgeon; the chairman of the Division of Medical Sciences of the National Research Council (by invitation); and the chairman of the Committee on Medical Research, Office of Scientific Research and Development (by invitation). The board has two operating divisions, the Research Division and the Development Division, to carry out its plans. It is the intent of the Surgeon General to carry on an active program of research and development during the postwar period and the new board should provide the means for maximum coordination of effort within the military service and cooperation with civilian and Federal research agencies. The immediate tasks facing the board are three in number. Essential research must be continued in the existing research and development laboratories of the Medical Department in spite of the personnel difficulties of the period of demobilization. Plans must be made and implemented for the continuation or actual expansion of research and development in the postwar period. The demobilization of the Office of Scientific Research and Development necessitated finding other sponsorship for those research contracts of the Committee on Medical Research which warrant continuation even though hostilities have terminated. A group of these contracts will be taken over by the Medical Department and administered by the board."

From "The Army Medical Research and Development Board," Science *102: 440–441 (1945). Reprinted with permission from AAAS.*

The U.S. Army – At the Forefront of Modern Medicine

The U.S. Army Medical Department (AMEDD) has continually recognized and utilized the talents of the most successful practitioners of modern medical research.

Military Medical Research and the Lasker Award

In 1946, the Lasker Awards Committee recommended that an award for outstanding administrative achievements in science be given to the Committee on Medical Research of the Office of Scientific Research and Development for the organization and administration of the medical research effort during WWII. In Baehr's 1946 overview of the history of the Lasker Awards it was written, "During the war, research in the field of the medical sciences in medical and other laboratories throughout the country was carried out under contract with this Committee, and under the supervision of its Director, Dr. Alfred Newton Richards. This included the mass production of penicillin in time to help save the lives of hundreds of thousands of our troops on the battlefronts, the search for a better antimalarial drug than quinine to prevent and cure malaria, the development of efficient insecticides and insect repellents for the fight against the louse which transmits typhus fever and the mosquito which transmits malaria, the creation of new techniques for the preparation of plasma and whole blood transfusion, and hundreds of other important research projects. In the opinion of the Awards Committee, the work of the Committee on Medical Research, under Dr. Richard's leadership, constituted one of the greatest accomplishments in nationwide coordination and administration of organized medical research which this or any country has ever witnessed."

Major Breakthroughs in Cancer Chemotherapy and Dr. Alfred Gilman

Dr. Alfred Gilman, known by many for his co-authorship of the seminal textbook, *The Pharmacological Basis of Therapeutics*, served in the Army as Chief of the Pharmacology Section in the Medical Division at Edgewood Arsenal, Maryland, with the rank of major. During WWII, he worked at developing antidotes for nerve gas organophosphates and nitrogen mustards, both of which it was feared would be used against American troops. He came to Edgewood "armed" with a contract with the Office of Scientific Research and Development to investigate these chemical warfare agents. The study of nitrogen mustards was conducted by Dr. Gilman and his colleague, Dr. Louis S. Goodman. Early in the course of this study, it became apparent that the agents were cytotoxic following absorption; in particular, they destroyed lymphatic tissue. Drs. Goodman and Gilman

Soldiers brave harsh winter conditions in Bastogne, Belgium, in 1944.

African American troops of the 784th Tank Battalion and their Sherman tanks preparing to cross the Rhine River, March 1945. *(World War II Signal Corps Photograph Collection).*

exploited this finding. Soon after the nitrogen mustard treatments were shown to cause regression of experimental lymphoma in mice, Dr. Gustaf E. Lindskog, Assistant Professor of Surgery, was persuaded to supervise a clinical trial involving a patient in the terminal stages of lymphosarcoma, which was resistant to x-ray therapy. The response of this first patient was as dramatic as that of the first mouse. Within 48 hours after initiation of therapy, softening of the tumor masses was detected. By the fourth day, cervical masses were no longer palpable and a few days later the axillary masses had completely receded; however, as one might have anticipated from the mouse studies, the tumor slowly regenerated. That the treatment was only a partial success is less important than the fact that tumor growth had been clearly shown to be susceptible to chemotherapy, and treatment was no longer limited to just radiation or radical surgery. From this insightful beginning medical oncology grew and is now one of the recognized medical subspecialties.

The Nobel Prize and Dr. David Hubel

Dr. David Hunter Hubel (born 27 February 1926) was co-recipient with Dr. Torsten Wiesel of the 1981 Nobel Prize in Physiology or Medicine for their discoveries concerning information processing in the visual system. In 1954, Dr. Hubel was drafted by the Army and served at the Walter Reed Army Institute of Research (WRAIR). There he began recording from the primary visual cortex of sleeping and awake cats. He also invented the modern metal microelectrode out of Stoner-Mudge lacquer and tungsten, and the modern hydraulic microdrive, for which he had to learn rudimentary machinist skills to produce. In 1958, he moved to Johns Hopkins University, began his collaborations with Dr. Wiesel, and discovered orientation selectivity and columnar organization in the visual cortex.

U.S. Army Medical Research and Development Command

USAMRDC was designed to be the central agency for Army military medical research and development to improve preventive medicine and rapid treatment techniques. The research programs of USAMRDC were to address military-unique medical problems and were to be applied directly to preserving the health and safety of Soldiers.

USAMRDC was established on 20 August 1958 by direction of Surgeon General Silas B. Hayes as a Class II Activity under the Office of the Surgeon General (OTSG). Five days later, Headquarters, Department of

the Army published General Order 31 formally establishing the Command as of 20 August 1958. The Headquarters of the Command was formed and staffed by the 12 officers and 20 civilians who constituted the Research and Development Division, OTSG. Colonel Bob Hullinghorst was the Commander until 17 October 1958 when Brigadier General Joseph McNinch returned from Japan and assumed command.

The 10 original laboratories assigned to the Command in October 1958 are presented as follows and include overseas laboratories in Malaysia, Germany, and Puerto Rico. Only 3 of the original 10 remain as vital elements of the Command today. Of these, the oldest and most established is WRAIR. Along with WRAIR, the U.S. Army Institute of Surgical Research (USAISR), established in 1943 as the U.S. Army Surgical Research Unit, also existed before USAMRDC and has provided significant contributions to military medical research over time. The third laboratory that has remained continuously under the command and control of USAMRDC/USAMRMC since 1958 is the U.S. Army Medical Unit, Fort Detrick, which was later renamed and became today's U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID). Reorganization and consolidation of the remaining seven laboratories gradually led to USAMRMC's present structure.

The OTSG assigned the following units to the Command effective October 1958:

- Walter Reed Army Institute of Research, Washington, DC
- U.S. Army Medical Equipment Research and Development Laboratory, Fort Totten, New York
- U.S. Army Prosthetics Research Laboratory, Washington, DC
- U.S. Army Medical Research Unit-Malaya
- U.S. Army Medical Unit, Fort Detrick, Maryland
- U.S. Army Tropical Research Medical Laboratory, Fort Brooke, Puerto Rico
- U.S. Army Medical Research Laboratory, Fort Knox, Kentucky
- U.S. Army Surgical Research Unit, Fort Sam Houston, Texas
- U.S. Army Medical Research and Nutrition Laboratory, Denver, Colorado
- U.S. Army Medical Research Unit, Germany

Walter Reed Army Institute of Research (WRAIR), Forest Glen, Maryland

History: WRAIR's distinguished history dates back to 1883 when the predecessor of WRAIR, the Army Medical School, was founded by Surgeon General George M. Sternberg. The institute underwent a series of name changes including the Army Medical Department Professional Service Schools in 1923, the Army Medical Department Research and Graduate School in 1947, the Army Medical Service Graduate School in 1950, and finally to WRAIR in 1955. In 1958, WRAIR, then located in Building 40 on the campus of the Walter Reed Army Medical Center, became a major subordinate activity of the newly formed U.S. Army Medical Research and Development Command.

In 1958, the WRAIR Pilot Production Facility was constructed and became operational as the Department of Biologics Research. This unique asset can manufacture, under current Good Manufacturing Practice guidelines, vaccines and biological products for use in Phases 1 and 2 human clinical trials. Vaccines are produced that will protect Soldiers against diseases they might encounter in areas of deployment. In 1964, WRAIR completed a staff study on blood transfusion that resulted in the establishment of the Blood Transfusion Research Division at the U.S. Army Medical Research Laboratory, Fort Knox, in July 1965. Later, in 1971, it was designated as the American Association of Blood Banks Reference Laboratory. In June 1993, this institute, now called the Blood Research Division of Letterman Army Institute of Research, formally moved to WRAIR under the provisions of Base Realignment and Closure in 1989 and 1991 and became the Division of Blood Research, WRAIR.

In September 1992, the Division of Ocular Hazards of the Letterman Army Institute of Research relocated from the Presidio of San Francisco to Brooks Air Force Base in accordance with Base Realignment and Closure of 1991, and on 1 October 1992, the division was established as a detachment at Brooks Air Force Base under the command and control of WRAIR. The mission of the detachment was to determine and resolve military medical issues associated with hazards of laser and radio frequency radiation. In 2001, a new main facility, named in honor of Senator Daniel K. Inouye, was completed on the Forest Glen Annex where WRAIR would be collocated with the Naval Medical Research Institute.

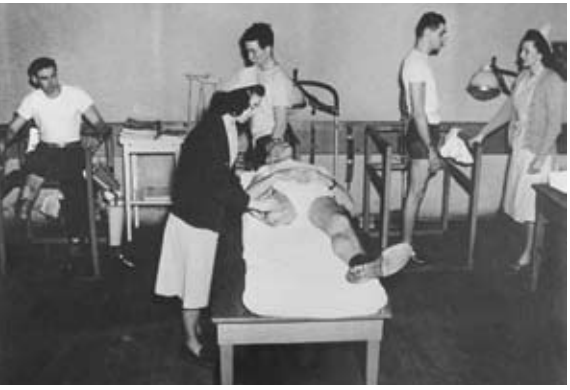
Mission: To conduct biomedical research that is responsive to DoD and U.S. Army requirements and delivers life-saving products including knowledge, technology, and medical materiel that sustain the combat effectiveness of the warfighter.

Historical Highlight: WRAIR is the largest, most diverse, and oldest research program in USAMRMC. It is also the largest military laboratory in the Department of Defense and the direct descendant of the oldest school of public health and preventive medicine in the United States.

The AMEDD has effectively utilized the talents of the most successful practitioners of modern medical research. Within months after the formation of USAMRDC, the newly appointed Surgeon General, Leonard D. Heaton, challenged the AMEDD. Advocating a bold approach to military medical research, General Heaton urged the AMEDD as early as 1959 to undertake "active research aimed at discovering measures which will increase man's resistance to radiation and protect him against the incapacitating and lethal effects of toxic chemicals." Since that date, projects for medical defense against biological and chemical agents, the biological effects of lasers, and prophylaxis and treatment of ionizing radiation injury have been included in the Army medical research and development program. Indicative of General Heaton's insight was the fact that emphasis on both chemical and biological threats was renewed in later decades.

A masked Soldier is protected from biological and chemical threats.

It is also important to recognize the impact of world developments and the changing requirements of the Army on the evolution of the Command to its present structure. This evolution is particularly visible when examining the six laboratories present at USAMRDC's inception, which have been consolidated or closed.



Nurses care for amputee Soldiers at Letterman Hospital during WWII, during which time significant advances in the field of orthopedics and physical therapy were made.

The U.S. Army Medical Equipment Research and Development Laboratory, Fort Totten, New York, was established in 1921, and its mission was to conduct basic research in the areas of field medical materiel. One example is the laboratory's successful work on jet injection technologies conducted as early as the 1950s. The U.S. Army Medical Equipment Research and Development Laboratory was disestablished on 1 September 1972 and consolidated into the U.S. Army Medical Bioengineering Research and Development Laboratory at Fort Detrick.

U.S. Army Institute of Surgical Research (USAISR), Fort Sam Houston, Texas

History: USAISR, originally named the U.S. Army Surgical Research Unit, was established in 1943 to evaluate the role of newly discovered antibiotics in the treatment of war wounds. The unit was stationed at Halloran General Hospital, Staten Island, New York.

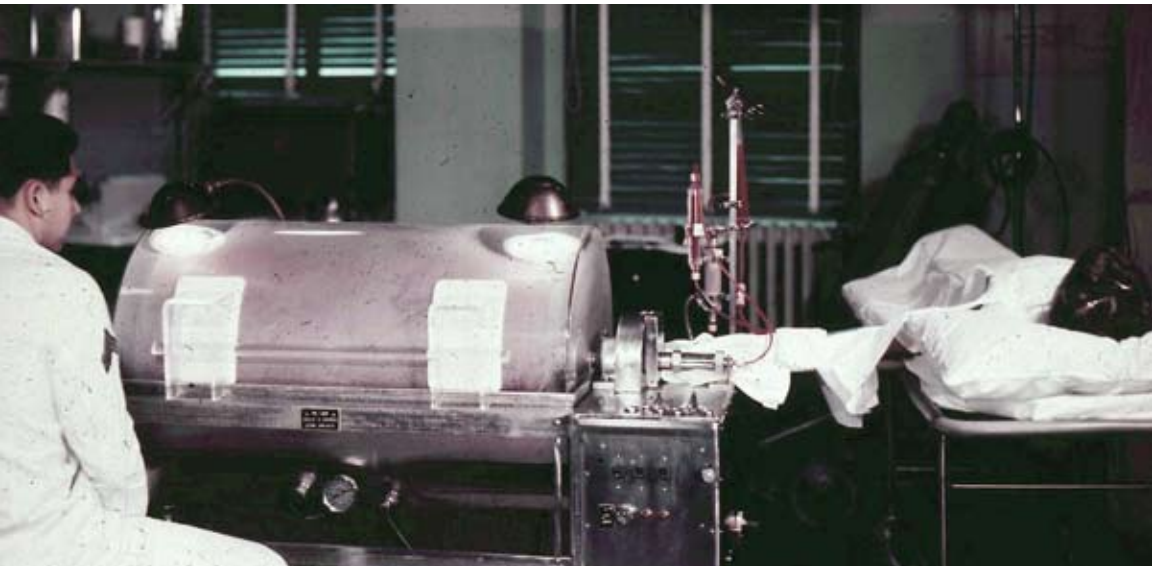
The institute became a permanent unit and moved to Brooke General Hospital, Brooke Army Medical Center (BAMC), Fort Sam Houston, Texas, in 1947, and had 12 personnel assigned. In addition to the study of antibiotics, the unit was also charged with the study of innovative new surgical techniques and developments. In 1949, the unit's mission was expanded to encompass the study of thermal injury due to concern regarding the large number of possible casualties generated by nuclear weapons. The advent of improved grafting procedures and continued use of antibiotics in new applications grew along with this mission.

In May 1953, the unit became a Class II activity of the Surgeon General. It was assigned to Headquarters, U.S. Army Medical Research and Development Command in September of 1958. Research flourished with the institute evaluating the use of plasma extenders, grafting and preservation of blood vessels, and the use of an "artificial kidney" among other forward-thinking medical research initiatives. As the "Army's burn unit," it has served as a prototype and model for burn units all over the world. During this time, it was also a premier dialysis research center serving south central Texas and neighboring states.

In 1996, the institute moved to its current location adjacent to the newly constructed BAMC. At this time, the research focus of the mission changed from thermal injury to the full spectrum of combat casualty care. In April 2003, the USAISR Burn Center and BAMC's Trauma and Critical Care Service were combined to form the Department of Defense's only Trauma Division under the direction of the Commander, USAISR.

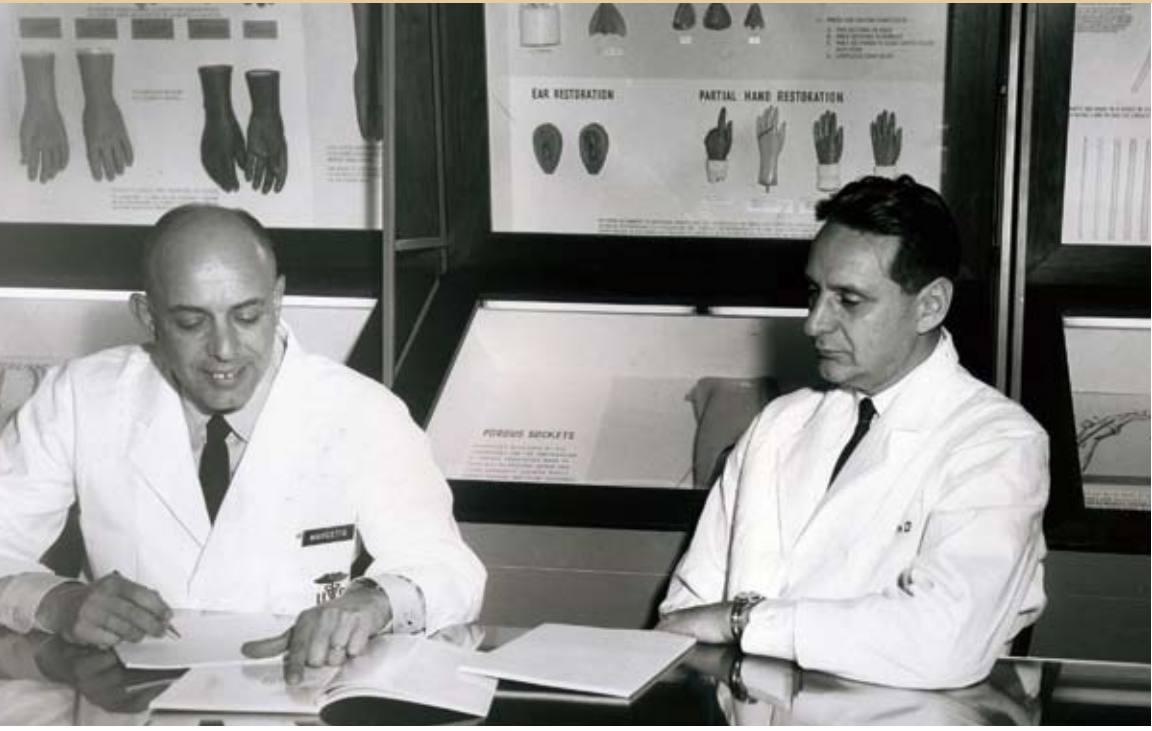
Mission: To provide requirements-driven combat casualty care medical solutions and products for injured soldiers, from self-aid through definitive care across the full spectrum of military operations; provide state-of-the-art trauma, burn, and critical care to DoD beneficiaries around the world and civilians in our trauma region; and provide Burn Special Medical Augmentation Response Teams.

Historical Highlight: USAISR is the only Department of Defense medical resource providing both a Level I Trauma Center and a Burn Center.



An artificial kidney as used in 1952.

A burn patient being unloaded from a fixed wing aircraft in 1952.



Details of research projects are planned by Colonel Peter Margetis, Director, and Dr. Fred Leonard, Scientific Director, U.S. Army Medical Biomechanical Research Laboratory.

The U.S. Army Prosthetics Research Laboratory (APRL), Washington, DC, came about toward the end of WWII when amputees in military hospitals in the United States began voicing disappointment about the performance afforded by artificial limbs. To ensure that they received the best care possible, Surgeon General of the Army Norman T. Kirk, an orthopedic surgeon by training, turned to the National Academy of Sciences for advice. A conference attended by surgeons, prosthetists, and scientists organized by the National Academy of Sciences early in 1945 revealed that little modern scientific effort had gone into the development of artificial limbs, and a research program was launched later in 1945 through the academy to address this issue. The effort was initially funded by the Office of Scientific Research and Development. At the end of the war when the Office of Scientific Research and Development was disbanded, the OTSG of the Army continued to support this effort thus forming APRL. Its primary mission in a coordinated national effort toward improving prosthetics was the development of artificial arms with emphasis on artificial hands. Out of this effort came the voluntary-closing APRL hand and the APRL hook. These devices were well received by a significant proportion of the amputee population. Although the APRL hand and hook are no longer used widely, this basic research led to the development of the sizes and configurations that

are now standard for most artificial hands produced today. The manufacture of nearly all of the cosmetic gloves provided for artificial hands is based on techniques developed at APRL. In the early 1960s, APRL became the U.S. Army Medical Biomechanical Research Laboratory, which was later consolidated into the U.S. Army Medical Bioengineering Research and Development Laboratory at Fort Detrick in 1972.

The U.S. Army Medical Research Unit-Malaya (later renamed the U.S. Army Medical Research Unit-Malaysia) originated based on events of WWII when U.S. forces in the Pacific theater experienced staggering levels of morbidity and mortality due to scrub typhus and malaria. In 1948, Dr. Joseph E. Smadel of WRAIR went to the medical research unit, Kuala Lumpur, Malaysia, to test a new antibiotic (chloramphenicol) for the treatment of scrub typhus. The unit conducted medical research on the transmission, control, prevention, and treatment of malaria and rickettsial diseases. Research missions also included the identification, exploration, and in-depth characterization of a variety of populations and geographical areas in which malaria vaccines and therapeutics could be evaluated. The medical research unit also served as the Rickettsial Disease Reference Center for Southeast Asia. It was authorized five officers and one enlisted service member. The unit was closed in 1989 and its missions were reassigned to WRAIR.

U.S. infantrymen traversing a swampy area of the Mekong Delta. Frequent exposure to water was common during infantry operations in the delta and other wet, lowland regions of the country.

The U.S. Army Tropical Research Medical Laboratory, Fort Brooke, Puerto Rico, also had a distinguished history in the study of infectious diseases. Two examples are schistosomiasis, a parasitic disease, and tropical sprue, a maladsorption disease commonly found in tropical areas that was responsible for one-sixth of all casualties sustained by Allied Forces in India and Southeast Asia during WWII. The laboratory was disestablished in 1968 and its work reassigned to WRAIR.

The U.S. Army Medical Research Laboratory, Fort Knox, Kentucky, was established as the Armored Medical Research Laboratory in 1942. It was originally established to solve environmental problems of Soldiers in tanks. Later it was concerned with studies in sensory psychophysiology, the biological effects of laser radiation, and methodology related to the preservation, transfusion, collection, processing, and shipment

Glass bottles are prepared for blood transfusion; advancing techniques in the preservation of blood remains a common theme in military medicine throughout history.

of human blood. Many of these efforts were later transferred to a state-of-the-art, new laboratory built at the Presidio of San Francisco in the early 1970s, the Letterman Army Institute of Research.

The U.S. Army Medical Research and Nutrition Laboratory, Denver, Colorado, had been conducting research in the following areas: basic nutritional biochemistry, basic biochemical processes of metabolism, basic and applied nutrition, clinical nutrition, basic and applied aspects of the influence of environment on man, the metabolism of normal man and as altered by disease, performance of man and military dogs, and research computer science. As with the laboratory at Fort Knox, many of these efforts would be transferred to the Letterman Army Institute of Research in the early 1970s, and the laboratory was closed on 24 August 1973.

Growth in the Early Years

Stimulated by the demands of the time, notably the increasing scope of military operations in Vietnam, the budget for military medical research substantially increased from 1958 to 1968. As the volume and scope of medical research activities increased, the size and responsibilities of USAMRDC grew correspondingly in the decade since it was activated. In fact, during 1968, the Command provided management, personnel, and

research facilities for 31 multiarea projects. These efforts were about equally divided between intramural and extramural programs.

By 1968, intramural research was conducted in 14 research institutes, 15 military hospitals, and the Armed Forces Institute of Pathology. The largest of the research institutes under USAMRDC was WRAIR where nearly half of the Command's intramural research efforts were conducted. The professional staff at WRAIR, composed at that time of more than 300 doctoral-level scientists, was engaged in a wide range of activities embracing basic and applied research in all aspects of military medicine, especially infectious diseases. WRAIR also served as an educational and advisory center. Additionally, the institute supported large field teams at the Southeast Asia Treaty Organization (SEATO) Medical Research Laboratory, Bangkok, Thailand (later the Armed Forces Research Institute of Medical Sciences), and in Saigon, South Vietnam, where these teams conducted extensive research in tropical medicine.

The extramural program of USAMRDC consisted of contracts and grants with universities and other research institutions as well as fund transfers to other government research institutes. More than 1,000 contracts, grants, and fund transfers were awarded during 1968. It is noteworthy that even as early as the 1945 foundation of the Army Surgeon General's Medical Research and Development Board the need for a procurement arm for this research and development enterprise was noted. This problem would not be completely resolved until the late 1970s.

USAMRDC in 1958

- Walter Reed Army Institute of Research, Washington, DC
- U.S. Army Medical Equipment Research and Development Laboratory, Fort Totten, New York
- U.S. Army Prosthetics Research Laboratory, Washington, DC
- U.S. Army Medical Research Unit-Malaya
- U.S. Army Medical Unit, Fort Detrick, Maryland
- U.S. Army Tropical Research Medical Laboratory, Fort Brooke, Puerto Rico
- U.S. Army Medical Research Laboratory, Fort Knox, Kentucky
- U.S. Army Surgical Research Unit, Fort Sam Houston, Texas
- U.S. Army Medical Research and Nutrition Laboratory, Denver, Colorado
- U.S. Army Medical Research Unit, Germany

Chapter 3

Vietnam Era

The Vietnam Conflict, commonly known as the Vietnam War, occurred from 1959 to 1975. The war was fought between the communist Democratic Republic of Vietnam (North Vietnam) and its communist allies and the U.S.-supported Republic of Vietnam (South Vietnam). U.S. troop involvement began in 1964 and ended by 1973.

Vietnam presented a multitude of new challenges to be overcome by the U.S. military. Endemic tropical diseases and extreme environmental conditions such as heat and humidity took a toll on Soldiers' abilities to perform their duties. The majority of tropical diseases are both endemic and epidemic in South Vietnam. The high ambient temperature and humidity adversely affected the efficiency and health of U.S. troops fighting in this area and the medical personnel supporting them. These also made it difficult to preserve and maintain medical supplies and sophisticated medical equipment.

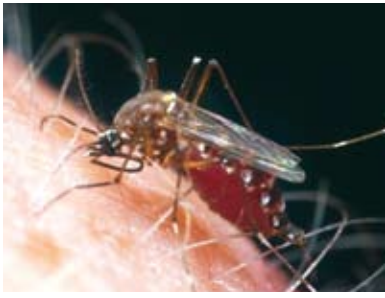
The lack of experienced officers due to retirement and death on the lines combined with a draft force fighting a war that did not have popular approval nationwide fostered low morale, which led to increased use of alcohol and drugs. Psychological health issues resulted from the low morale and combat stress. Logistical problems resulted from an overtaxed medical supply system and the need to move men, equipment, and supplies over long distances far removed from standard resources. South Vietnam's terrain, with its waterways and jungles, impeded patient evacuation and supply distribution even without the interference of combat operations.

The nearest offshore U.S. hospital was almost 1,000 miles away at Clark Air Force Base in the Philippines. The nearest logistical support base was approximately 1,800 miles away in Okinawa. The nearest complete hospital center was in Japan approximately 2,700 miles away. Patients being evacuated to the United States had to travel some 7,800 miles to reach Travis Air Force Base in California or almost 9,000 miles to reach Andrews Air Force Base near Washington, DC.

U.S. Medical Involvement in Vietnam

At the beginning of 1965, the U.S. Military Assistance Command, Vietnam advisory effort was the predominant medical support function in Vietnam. There were approximately 20,000 U.S. troops in-country receiving medical support from two 100-bed hospitals (the U.S. Navy Hospital in Saigon and the U.S. Army's 8th Field Hospital in Nha Trang) plus some miscellaneous small medical detachments providing air evacuation and dispensary, laboratory, dental, and veterinary services.

In Vietnam, as in Korea and the Asiatic and Pacific theaters in WWII, the cumulative effect of disease was the greatest drain on the strength of the American combat and support effort. Disease admissions accounted for just over two of every three (69 percent) hospital admissions in Vietnam in the period 1965–1969. In 1970, as a result of the diminution of the American combat role, disease and non-battle injury accounted for more than half of the days lost to the Army in that theater.



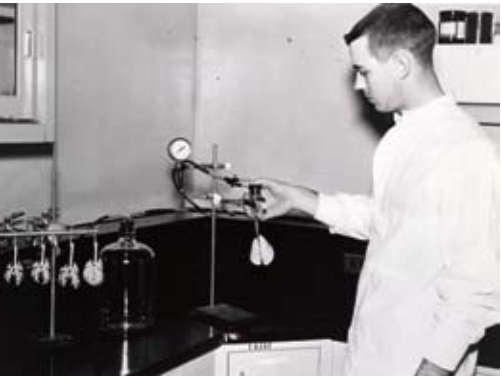
Diseases of major military import for which the incidence in Vietnam exceeded the incidence in the Army as a whole included malaria, viral hepatitis, diarrheal diseases, diseases of the skin, fever of undetermined origin, and venereal disease. Malaria, especially the drug-resistant *Plasmodium falciparum* strain, was widespread and incapacitating for relatively long periods and, therefore, was the greatest medico-military disease problem in Vietnam. As a chronic disease, malaria also affected military personnel with instances of malarial relapse and neurologic deficits from cerebral malaria after their return to the United States.

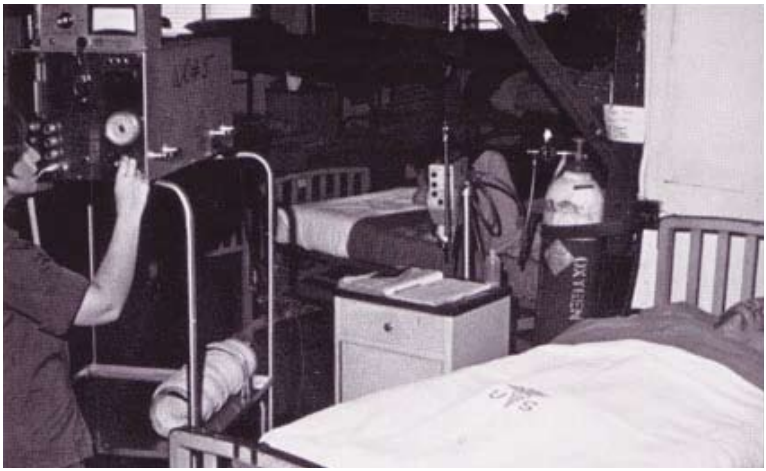
The other diseases found in Vietnam fell into two general groups: those, such as hepatitis, which affected relatively few men but incapacitated them for long periods, and those, like most diarrheal and skin diseases endemic to Vietnam, which incapacitated large numbers of men for relatively short periods.

Other diseases were of grave concern due to their exotic nature, such as melioidosis, Japanese B encephalitis, and amebiasis. Diseases with a widespread presence in the civilian population that presented a concomitant threat to American troops included plague, tuberculosis, cholera, and rabies. These diseases, although constantly monitored for preventive medicine purposes, had no material effect on U.S. fighting strength.

Research and Development

USAMRDC, as the main agency responsible for military medical research within the Army, saw its budget for medical research grow more than fivefold during the Vietnam era from the sum of $12 million in 1958 to more than $53 million in 1968. Medical research and development during Vietnam covered a broad spectrum. The main thrust of military medical research was toward the resolution of problems that would improve the performance of the Soldier in the field by reducing losses from wounds, infectious diseases, and environmental stress. However, certain basic research to contribute new knowledge and advancement in the field of medical science was also included in the program. Representative studies included metabolic patterns of pathogenic bacteria, pathophysiologic activities of microbial agents, role of





A patient with Japanese B encephalitis under therapy at the 93d Evacuation Hospital with controlled hypothermia. Control of fever during the acute phase of this illness was consistently practiced in the support of patients in Vietnam.

endotoxins in shock, genetic mechanisms of enteric bacteria, etiology of viral hepatitis, biochemistry of wound healing, organic repair and replacement, immunohematology, and anaphylaxis and purification of antigens and antibodies.

Combat Injury Reconstruction/Prosthetics

Although the majority of hospital admissions were due to disease, the average hospital stay for combat injuries was considerably longer than that resulting from disease. Battle injuries and wounds were responsible for approximately one of six admissions during the period from 1965 to 1969. In 1966, the U.S. Army Medical Biomechanical Research Laboratory (USAMBRL) developed a dexterous and more natural-looking artificial hand than had previously been available to injured Soldiers. The new hand was electromechanical, designed primarily for severely handicapped upper-extremity amputees, and contained a piezoelectric crystal at the heart of the system. Its designers hailed it as a breakthrough in automatic proportionate control of prehension. Unlike previous electrical devices, it incorporated feedback and control of position, velocity, and force, utilizing a system that responds to slippage signals. This allowed an amputee to focus on positioning and grasp decisions; the applied force was controlled by the hand itself. It was run by a 12-volt planetary-gear-reduced motor that provided a grasp of 15 pounds and could be recharged at night.

In the 1973 reorganization of the AMEDD, USAMBRL, located in Forest Glen, Maryland, and the U.S. Army Medical Equipment Research and Development Laboratory in Fort Totten, New York, were consolidated and moved to Fort Detrick to create the U.S. Army Medical Bioengineering Research and Development Laboratory. In 1973, the U.S. Army Medical Environmental Engineering Research Unit at Aberdeen Proving Ground, Maryland, was also moved under the U.S. Army Medical Bioengineering Research and Development Laboratory. Its mission was to conduct environmental health engineering research. The Health Effects Research Division conducted research in support of the development of health protection criteria for Army personnel; criteria to protect air, land, and water quality during the production and use of Army-unique materiel; health effects of smoke and visibility-limiting materials, new conventional and chemical weapon systems, and synthetic fuels; and new methods to predict possible adverse effects as well as facilitate the detection of Army-unique chemicals.

USAMBRL developed an electromechanical artificial hand that provided an amputee with a controlled, secure grasp. *(U.S. Army, 1968).*

U.S. Army Biomedical Research and Development Laboratory (USABRDL) Fort Detrick, Frederick, Maryland

History: USABRDL can trace its beginnings to 1921 with the establishment of the U.S. Army Medical Equipment Research and Development Laboratory (USAMERDL), which was created to provide engineering development of medical items for field use. USAMERDL became a subordinate element of the U.S. Army Medical Research and Development Command (USAMRDC) in 1962 and continued to develop medical materiel specific to the needs of the Armed Forces. In September 1972, USAMERDL merged with the U.S. Army Medical Biomechanical Research Laboratory forming the U.S. Army Medical Bioengineering Research and Development Laboratory (USAMBRDL). In October 1973, USAMBRDL incorporated the U.S. Army Medical Environmental Engineering Research Unit, which had been activated the previous year to conduct continuing environmental health engineering research in support of the Surgeon General's responsibilities in air and water pollution control, solid waste, and pesticide disposal.

In November 1986, the name of the laboratory was changed to USABRDL, which more accurately reflected the diverse array of professional capabilities dedicated to the accomplishment of the mission. USABRDL was identified for closure under the 1991 Base Realignment and Closure legislation with the current medical materiel development, occupational health, and environmental quality missions being transferred to other USAMRDC laboratories and to the Air Force Armstrong Aerospace Medical Research Laboratory, Dayton, Ohio.

Mission: USABRDL focused on the protection of Soldiers in combat and training scenarios, military and civilian employees in Army-unique industrial exposure settings, and protection and enhancement of the environment. It conducted basic research in the areas of field medical materiel, vector control systems, health hazard assessments, and environmental health effects.

Historical Highlight: One item that has had worldwide application is the hypodermic jet injector. Designed specifically for the effective and economical immunization of large numbers of people, it was used routinely at U.S. Army Induction Centers and extensively by the U.S. Army Disaster Assistance Relief Missions. In January 1971 during a flood disaster in Malaysia, more than 250,000 people were immunized against typhus and/or cholera in a 3-week program conducted by Malaysian health officials assisted by U.S. Special Forces. Similarly, in the Republic of the Philippines, more than 350,000 immunizations were administered during a 3-week period in July and August of 1972. In a larger 3-year program sponsored by the World Health Organization and the U.S. Agency for International Development, the majority of the 120 million inhabitants of Western and Central Africa were vaccinated against smallpox, and more than 15 million children were vaccinated against measles using this device.

Early dental chair completely assembled with tools necessary for this work. *(Carlisle Barracks collection).*

Dental Research

Stimulated by the need to reduce time-consuming dental emergencies occurring in troops in South Vietnam, clinical testing of a new dental restorative material that could be inserted quickly in individual teeth, was easily manipulated, and set in 2 minutes was initiated in 1968.

U.S. Army Dental Research Detachment (USADRD)
Great Lakes, Illinois

History: USADRD was established in 1994 and actually replaced a predecessor, the U.S. Army Institute of Dental Research (USAIDR), which was established and collocated with the Walter Reed Army Institute of Research in 1962 to conduct research designed to reduce dental sick call in deployed troops and provide dental education. In November 1990, Public Law 101-510 mandated that USAIDR collocate with the Naval Dental Research Institute at the Great Lakes Naval Training Station in Illinois. In 1994, prior to this move, USAIDR was disestablished, and USADRD was established in its place. Following extensive renovations, USADRD moved to the Great Lakes Naval Training Station in 1998.

That same year, congressional language was modified, overriding a 1982 Defense Appropriation Bill that inhibited the ability to conduct a full scope of dental research and limited the Army's dental research to combat dentistry and oral maxillofacial trauma. This change allowed USADRD to conduct a full range of mission-driven research. USADRD's current research is focused on developing an antimicrobial, antiplaque peptide to include in field rations, more stable dental materials, and a method that monitors changes in saliva to determine whether a warfighter is becoming dehydrated.

Mission: Enhances operational preparedness and far-forward dental support by improving dental materials, devices, and methodologies.

Historical Highlight: During the Vietnam era, USAIDR developed IRM (interim restorative material), which was available in red (existing caries in posterior teeth), white (for front teeth), and blue (no existing caries in posterior teeth). It is still in use today as a temporary filling material.

From 1969 to 1972, the U.S. Army Institute of Dental Research modified the dental "water pick" into a sophisticated surgical tool. The tool's pulsing water jet removed (debrided) dead tissue and bacteria faster and with less damage to healthy tissue than scalpel and forceps. Later, by adding detergents/disinfectants to the water stream, the machine also became a much faster method for cleaning surgical teams' hands.

Parasitic Infections

During the Vietnam era, the USAMRDC unit in Panama devised more accurate laboratory methods for the serological identification and tissue culture of *Leishmania* organisms. Additionally, this laboratory proved Camolar®, originally an antimalarial, to be effective against the cutaneous and mucocutaneous forms of new world leishmaniasis, a significant therapeutic advance over the previously available toxic pentavalent antimony compounds. Camolar®, however, did not prove to be effective against old world strains.

U.S. Army Medical Research Unit-Panama (USAMRU-P)
Ancon, Canal Zone, Panama

History: USAMRU-P was established by the Walter Reed Army Institute of Research in 1959 as a research program devoted to the study of infectious diseases of military importance in Latin America. It was collocated with the Middle America Research Unit, a field entity of the National Institute of Allergy and Infectious Diseases in Ancon, Canal Zone, Panama, and administratively supported by the U.S. Army Forces Southern Command. The Panama Canal Zone was created on 18 November 1903 with the signing of the Hay-Bunau Varilla Treaty and was under U.S. military control from that date until 1979 when it returned to Panamanian control. USAMRU-P was disestablished on 2 July 1973.

Mission: The original research focus of USAMRU-P was on the study of histoplasmosis and other fungal diseases of military importance. The focus at USAMRU-P expanded over subsequent years to include leishmaniasis, Venezuelan equine encephalitis, malaria, yellow fever, hepatitis A, arboviral infections, and others.

Historical Highlight: Some key accomplishments included more accurate laboratory methods for identification and culture of *Leishmania* organisms. USAMRU-P also proved that the antimalarial drug, Camolar®, was effective against both cutaneous and mucocutaneous leishmaniasis. The previous therapy for leishmaniasis was extremely toxic making this a significant advance.

Burn Research

During the Vietnam War, burn cases were stabilized in-country and then evacuated to the 106th General Hospital in Japan where a special burn unit had been established. Of the burns treated by the 106th, 27 percent returned to duty, 66 percent were evacuated to the burn unit at Brooke Army Medical Center, and 7 percent died.

USAISR at Brooke Army Medical Center, Fort Sam Houston, Texas, developed a new topical antibacterial preparation, Sulfamylon, which resulted in a 50-percent reduction of burn mortalities due to infection.

Blood Preservation

The logistics of furnishing fresh whole blood to combat medical facilities was limited by its 21-day shelf life. Studies at the U.S. Army Medical Research Laboratory, Fort Knox, Kentucky, demonstrated a twofold prolongation of shelf life by the addition of adenine to the preservative.

Environmental Medicine

Medical problems associated with geography, new environments, and extremes of climate received particular attention during the Vietnam War. The effects of hot and cold climates and high terrestrial altitude on Soldier performance had been under investigation by USAMRDC scientists for several years.

Spearheading the USAMRDC effort in this area was the U.S. Army Research Institute of Environmental Medicine (USARIEM), located in Natick, Massachusetts. A new laboratory for USARIEM was dedicated in October 1968. This modern building, with research facilities in environmental and altitude chambers, provided the finest single laboratory in the country for the study of environmental medicine. A subordinate unit of USARIEM was stationed at Fort Wainwright, Alaska, and performed clinical research on cold injury.

Operating in extreme climates posed an additional challenge for Soldiers.

U.S. Army Research Institute of Environmental Medicine (USARIEM) Natick, Massachusetts

History: Recognizing the importance of environmental and operational contingencies for the health, performance, and effectiveness of troops in training or combat, USARIEM was activated in 1961 as a research laboratory under the U.S. Army Medical Research and Development Command and as a composite of elements associated with a number of outstanding federal and academic laboratories, including the Harvard Fatigue Laboratory in Cambridge, Massachusetts; the Armored Medical Research Laboratory at Fort Knox, Kentucky; the Climatic Research Laboratory in Lawrence, Massachusetts; and the Quartermaster's Environmental Protection Research Division and Earth Sciences Division in Natick, Massachusetts. USARIEM's research focus in the early 1960s included effects of heat- and cold-induced stress and temperature regulation and effects of altitude exposure. In 1967, the Arctic Medical Research Laboratory at Fort Wainwright, Fairbanks, Alaska, was opened specializing in research on frostbite, hypothermia, and other injuries associated with cold weather military operations; the laboratory subsequently closed in 1978.

USARIEM moved to a permanent space of 76,000 square feet in 1968. This facility contains 2 altitude chambers (added in 1969), 5 biophysical evaluation chambers, a biomechanics laboratory, 13 environmental chambers, and a water immersion laboratory. In 1978, USARIEM reorganized under missions—altitude research, exercise physiology, heat research, health and performance, military ergonomics, and experimental pathology (including cold research). USARIEM is currently organized into four research divisions: Biophysics and Biomedical Modeling, Military Nutrition, Military Performance, and Thermal and Mountain Medicine. The John T. Maher Altitude Research Facility at Pikes Peak, Colorado, is also part of the USARIEM laboratory as is the USARIEM/ Womack Medical Research Facility in Fort Bragg, North Carolina.

Mission: To conduct basic and applied research to determine how exposure to extreme heat, severe cold, high terrestrial altitude, occupational tasks, physical training, deployment operations, and nutritional factors affect the health and performance of military personnel.

Historical Highlight: USARIEM has long been recognized internationally as a Center of Excellence in environmental (climatic) physiology and occupational medicine. USARIEM personnel were consultants on the establishment of the Olympic Training Center in Colorado Springs, Colorado.

One of USARIEM's support laboratories is at Pikes Peak, Colorado. This location was the site of studies on the performance of infantrymen at high altitude—14,000 feet. These studies showed a significant decrement in gross motor performance during the first 5 days but revealed that fine motor performance and some aspects of cognitive behavior were relatively unaffected at that altitude.

The U.S. Army Pikes Peak Research Laboratory, Pikes Peak, Colorado

The John T. Maher Altitude Research Facility, or simply the "Pikes Peak Lab," is a medical research laboratory that assesses the impact of high altitude on human physiological and medical parameters of military interest. It is a satellite facility of the U.S. Army Research Institute of Environmental Medicine (USARIEM) located in Natick, Massachusetts.

The Pikes Peak Lab is at the summit of Pikes Peak (4,304 meters or 14,110 feet) in central Colorado. The summit is approximately 5 acres of relatively flat, rocky terrain and is directly and easily accessible by automobile via the Pikes Peak Highway.

The laboratory has been maintained by USARIEM since 1969 and has 2,267 square feet of floor space divided into a kitchen and dining/day room, common area/bathroom and shower, common area/sleeping quarters accommodating up to 16 research volunteers, a wet laboratory, a research area, and a mechanical room housing steel storage tanks for water and sewage. The building is well insulated and protected from the elements, supplied with electrical power, and heated by natural gas.

The question of the influence of heat rash on heat exhaustion was investigated in a collaborative study between USARIEM and the Letterman Army Institute of Research, Presidio of San Francisco. These studies demonstrated that heat rash can predispose to heat exhaustion and that this predisposition can persist for as long as 3 weeks after the skin appears to be clinically healed. The effect has been shown to be due to the slower recovery of sweat glands following heat rash with a subsequent decrease in sweat production and evaporative cooling.

Psychological Health

Jet Lag

The distance of Vietnam from the logistical support base had an adverse effect on the efficiency and morale of troops newly arrived in-country. For the first time, the phenomenon of jet lag for troops being transported across time zones with limited time allowed for adjustment upon arrival becomes evident. Jet lag is a specific instance of desynchronosis, situations in which external time cues are out of synchrony with the body's internal rhythms, the body's internal rhythms are out of synchrony with each other, or both. Symptoms of jet lag include cognitive performance impairment, sleep difficulties, gastrointestinal problems, fatigue, and mild depression. All of the above performance decrements were studied in USAMRDC laboratories. The following statements reflect findings from this research. The body's cyclic processes (hormonal rhythms and body temperature) readjust slowly to changes in external cues. For deployment across multiple time zones, complete readjustment can take 5 to 8 days. Shift work also can cause desynchronosis; hence, the combination of jet lag and shift work upon arrival in Vietnam made the initial adjustment difficult. Doctrinal solutions were recommended for this problem.

Substance Abuse

One of the emergent problems facing the Army in Vietnam was the generally accepted use of illegal drugs by troops in theater. Drugs listed as illegal under U.S. law were considered illegal by the U.S. Army; these same drugs were not necessarily considered illegal in Asia and Vietnam. The growth of illegal drug use within the Army kept pace with that in larger society; the ready availability of marijuana, barbiturates, amphetamines, heroin, opium, and other substances in Vietnam, at a lower price for a less adulterated product than that available in the United States, exacerbated the problems of drug abuse. The peak of drug abuse in the Army occurred in 1973 at which time 34 percent of American Soldiers in Vietnam had commonly used heroin. Growing Command awareness of the nature and extent of the drug problem in Vietnam led to a search for a flexible, nonpunitive response that would

encourage drug users to seek professional help in solving their problems, thus aiding them and, at the same time, serve the Army's interest in conserving the fighting strength. This search resulted in a program to educate key commissioned and noncommissioned officers with facts regarding drug abuse who, in turn, would provide believable advice about drug abuse to the troops in Vietnam.

When drug abuse was recognized as a major national problem in 1971, USAMRDC was tasked with the initial studies. During March to May 1971, a study was conducted by WRAIR scientists who provided the Department of Defense (DoD) with the first meaningful data on drug abuse in the military. Their observations led the DoD to deploy drug screening laboratories to Vietnam. Within the first 90 days, over 300,000 urine samples were tested. Soldiers who tested positive for heroin were often given in-patient treatment prior to discharge but were not charged with any violation of the Uniform Code of Military Justice. Informational activities were directed at men who had not yet become deeply involved with drugs. The long-term drug user who voluntarily sought assistance was aided through limited hospitalization to determine the nature and extent of the addiction through extensive psychiatric and other counseling, including group therapy when possible, and through assignment of a "buddy" to give positive reinforcement in the effort to give up drugs. During the period of counseling and rehabilitation, the patient continued as much as possible to perform full military duties.

U.S. Army Medical Research Team (WRAIR)-Vietnam

In July 1962, researchers from WRAIR were directed to evaluate existing U.S. military medical research laboratories in Southeast and East Asia with the goal of improving coordination among the laboratories and possibly expanding their capabilities. The group visited five laboratories including the U.S. Army component of the SEATO Medical Research Laboratory, U.S. Naval Medical Research Unit No. 2 then in Taipei, and the U.S. Army Medical Research Unit-Kuala Lumpur, Malaysia.

U.S. Army Medical Research Unit-Kuala Lumpur
Kuala Lumpur, Malaysia

History: During WWII, U.S. forces in the Pacific theater experienced staggering levels of morbidity and mortality due to scrub typhus and malaria. In 1948, Dr. Joseph E. Smadel, from the Walter Reed Army Institute of Research (WRAIR), went to Kuala Lumpur to test a new antibiotic (chloramphenicol) for the treatment of scrub typhus. In 1953, the association of investigators from WRAIR with British and Malaysian investigators at the Institute for Medical Research (IMR) in Kuala Lumpur led to the establishment of a small U.S. Army unit under the command and control of WRAIR at the IMR. Under the continued sponsorship of WRAIR and the U.S. Army Medical Research and Development Command, the research missions included the identification, exploration, and in-depth characterization of a variety of populations and geographical areas in which malaria vaccines and therapeutics could be evaluated. The unit was closed in 1989.

Mission: To conduct research on the transmission, control, prevention, and treatment of malaria and rickettsial diseases including scrub typhus.

Historical Highlight: The unit served as the Rickettsial Disease Reference Center for Southeast Asia.

Among the group's recommendations to expand existing programs was a specific recommendation to establish a WRAIR medical research unit in Saigon. This recommendation led to the arrival of a 19-person team (7 officers and 12 enlisted personnel) in Vietnam in November 1963.

Operation Arrowhead: Civilians are gathered and moved to safe areas for protection during the search of the area. *(Vietnam Photograph Collection).*

U.S. Army Medical Research Team (WRAIR)-Vietnam Saigon, Vietnam

History: In July 1962, researchers from the Walter Reed Army Institute of Research (WRAIR) were directed to evaluate existing U.S. military medical research laboratories in Southeast and East Asia with the goal of improving coordination among the laboratories and possibly expanding their capabilities. The group recommended expansion of the existing medical research program to include the establishment of a WRAIR medical research team in Saigon. The team was established in November 1963 and formed liaisons with U.S. and Vietnamese medical units, the Public Health Division of the U.S. Operations Mission, the U.S. Agency for International Development, the Minister of Health, the Pasteur Institute, medical school faculties, medical missionaries, and representatives of private U.S. charitable and medical foundations. The team initially studied infectious disease, combat surgery, and military psychology, and evaluated new medical materiel. The team became collocated with the Pasteur Institute of Vietnam and worked closely with it on essentially all infectious disease research efforts. The team conducted psychiatric studies at military mental health facilities. There were also several special projects supported by WRAIR and the U.S. Army Medical Research and Development Command (USAMRDC) including a FEST (Field Epidemiologic Survey Team), which consisted of Special Forces personnel trained at Fort Bragg and WRAIR and deployed to Vietnam on 26 September 1966. During the rainy season, the rates of disabling skin disease could reach 50 percent so USAMRDC sent a special epidemiological research team from WRAIR to the Mekong Delta in 1968. In less than 6 months, the team identified and isolated the causative pathogens and recommended new methods for prevention and treatment. By June 1968, the team had grown to 60 military personnel, 7 Vietnamese administrative personnel, and 3 attached personnel from the 20th Preventive Medicine Unit and the Armed Forces Research Institute of Medical Sciences. In addition, there were 39 Vietnamese personnel that made up the Institute of Pasteur of Vietnam.

Mission: To study infectious diseases important to the war effort including cholera, plague, malaria, fevers of unknown origin, enteric diseases, rabies, insect-borne hemorrhagic fevers (dengue and chikungunya viruses), fungal-borne skin diseases, and vectors of disease.

Historical Highlight: In 1967, a field photography team from WRAIR was attached to the WRAIR research team in Saigon and provided support to that team as well as the Surgeon, U.S. Army Vietnam. The result was at least three major film productions including an award-winning effort entitled “Army Medicine in Vietnam.”

The team initially studied infectious disease, combat surgery, and military psychology, and evaluated new medical materiel. Its first effort was a serologic survey among U.S. military advisors in the Delta region for evidence of viral hepatitis, leptospirosis, and dengue-related viruses. By its third year, 1965–1966, the medical research team expanded its mission to include specific research studies by individual team members, support of other research studies by outside investigators, and collection of medical information or health data for WRAIR, which would serve as a guide for research in USAMRDC laboratories.

Field Epidemiologic Survey Team

The Field Epidemiologic Survey Team was organized in May 1966 to study the epidemiology of tropical diseases in the environment in which they were transmitted. The team was composed of Special Forces officers and enlisted technicians trained at Fort Bragg, North Carolina, and WRAIR in laboratory and field epidemiological skills. Scientific areas of focus included tropical sprue, febrile illness, schistosomiasis, filariasis, dengue, and malaria. The Field Epidemiologic Survey Team was considered part of the Saigon team for administration and logistics and was constituted as an element of WRAIR, but it was attached to Headquarters, 5th Special Forces Group. Studies continued through 1968.

Malaria Program

A major focus of Army medical research and the largest single program of medical research in the history of the Army has been in malaria. Malaria research efforts for fiscal year 1968 alone included more than 200 contracts and grants with universities, research institutes, and private concerns, as well as studies at Army installations, and totaled more than $10 million.

Most of this effort was directed toward developing new chemoprophylactic drugs, such as diaminodiphenylsulfone (Dapsone), a medication proven effective with strains of malaria resistant to quinine or atabrine, for the control of chloroquine-resistant *P. falciparum* malaria. In addition to Dapsone, WRAIR developed mefloquine as a synthetic analogue of quinine. The impetus for this research came from data collected by the WRAIR team that showed a rise in the number of cases of chloroquine-resistant *P. falciparum* malaria in troops in Vietnam. The team can also be credited with discovering asymptomatic malaria with its potential for importation to the United States through unknowing Soldiers. The team documented the success and failure of control measures and studied regimens for the treatment of malaria, including the introduction of new therapeutic drugs such as Fanasil and pyrimethamine.

More than 130,000 chemicals were screened in a 4-year period. The use of prophylactic Dapsone in South Vietnam was a result of this program. The efficacy of the drug in the United States was proven in volunteers; in 1966 a field test in Vietnam showed its effective use in theater as well. Additional research on dosage led to a new diformyl preparation of Dapsone, which required administration only once a week compared to the original daily administration.

As a result of a recommendation from the WRAIR team, the Surgeon General approved the establishment of a central hospital for malaria patients known as the 6th Convalescent Center at Cam Ranh Bay. The center was used for treating patients, studying the disease, and evaluating new therapeutic agents. Formal linkage with the Navy preventive medicine unit in Da Nang allowed the exchange of information and research data.

New advances in malaria chemotherapy came from studies conducted at WRAIR and in South Vietnam that showed that single doses of a combination of the long-acting sulfonamides, sulphormethoxine and pyrimethamine, were successful in the treatment of *P. falciparum* malaria when given alone or with quinine. Another study showed that these drugs, when used with quinine, reduced relapse rates to 2 percent whereas they had been as high as 41 percent on chloroquine therapy alone.

Another positive outcome of the team's studies of malaria came about when team members instituting clinical research studies on extracellular fluid, blood function, and renal function noted that the delay involved in evacuating patients for hemodialysis treatment to Japan and the Philippines was causing an increase in morbidity and mortality from malaria. This led to the establishment of the first renal unit in Vietnam at the 3d Field Hospital.

Other investigators, working under contract with USAMRDC, proved that a single dose of a new drug combination, trimethoprim and Kelfizina, rapidly eradicated both chloroquine-sensitive and -resistant *P. falciparum* malaria strains obtained from Africa and Southeast Asia.

Scientists at WRAIR also developed a battery of in vitro techniques for screening antimalarial drug activity. A most promising version was based upon inhibition of C14-methionine uptake by parasitized red blood cells; other automated in vitro tests were also under investigation. Additional aspects of the program focused on the more basic problems of biological and immunological characteristics of the parasite, host–parasite relationships, and vector control.

Other Infectious Diseases

The program of research in military medical problems in South Vietnam included, in addition to malaria, studies of the prevention and treatment of many infectious diseases such as plague, dengue, cholera, hepatitis, melioidosis, scrub typhus, leptospirosis, and diarrheal diseases.

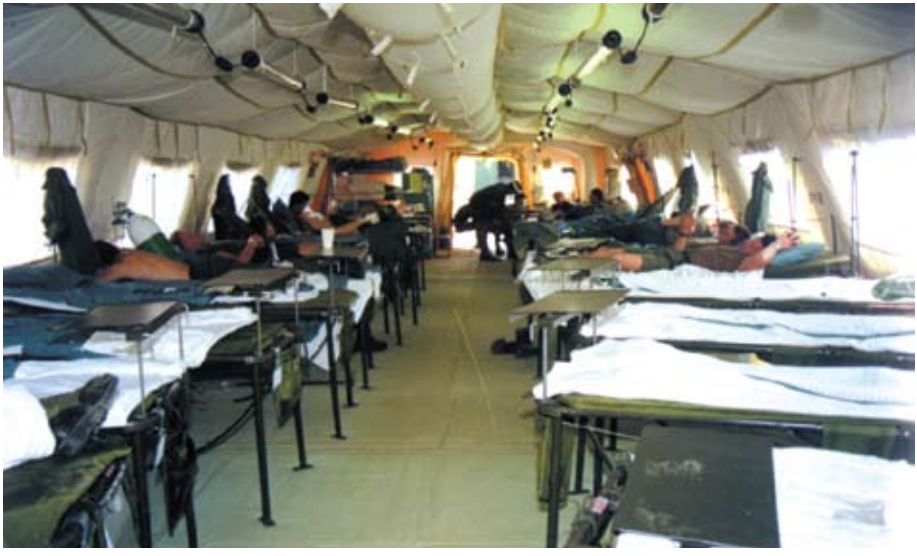
Although cholera did not have a material effect on U.S. troops, an intensive recurrence in the Vietnamese population within a 2-month time period overwhelmed existing clinics and hospitals. Team members from WRAIR, SEATO, the Navy, and the U.S. Naval Medical Research Unit No. 2 taught the Vietnamese the mass treatment system for replacement of fluids and electrolytes, virtually eliminating further deaths from cholera.

A disease that did pose a potential threat to U.S. troops was the plague. A joint study by the Ministry of Health, the Pasteur Institute, and the WRAIR team led to the construction of a plague research laboratory. This laboratory tracked 4,500 cases of plague in 1965. Studies of rodent reservoirs and flea vectors revealed new endemic foci as well as a realization that rat fleas were resistant to DDT. As a result, rat and flea survey programs and insecticide evaluation programs were expanded, and a program was initiated for the production and evaluation of a lyophilized, attenuated living plague vaccine.

A major collaborative study by the team with the 93d Evacuation Hospital and the SEATO laboratory resulted in the determination of the specific etiology of fever of undetermined origin in 60 percent of the patients studied. Of the cases diagnosed, 50 percent were due to dengue; chikungunya virus, scrub typhus, and malaria accounted for the remaining 10 percent.

Marking the culmination of sustained research efforts, in 1968, WRAIR developed a meningococcal vaccine consisting of purified polysaccharides of *Neisseria meningitidis.* The vaccine was prepared from both types A and C. Studies at Fort Dix, New Jersey, with type C polysaccharide showed that vaccinated groups had a markedly lower meningococcus carrier rate when compared with controls, effectively preventing the spread of meningitis. This vaccine was approved by the U.S. Food and Drug Administration (FDA) in 1970.

Rubella vaccine to control German measles, produced by the National Institutes of Health in 1969, was derived from a virus strain isolated by Army physicians at Fort Dix in 1962. The Fort Dix doctors used techniques pioneered by WRAIR. In the late 1960s a new adenovirus vaccine was developed that reduced respiratory infections in trainees. Large-scale field trials of orally administered vaccine of adenovirus type 4 demonstrated its ability to terminate an epidemic of type 4 acute respiratory disease. The use of gamma globulin was tested in overseas troops resulting in the finding that injections gave significant protection against hepatitis but not against most other infections common in Vietnam.



Hepatitis researchers developed the first satisfactory animal model to study this disease. Studies during this time showed that the marmoset develops typical histological and biochemical evidence of hepatitis when given infected human serum. Long-term hepatitis studies were significantly aided by collaboration between WRAIR and the Armed Forces Institute of Pathology in the establishment of a central laboratory where reference sera, candidate viruses, and tissue culture stocks were maintained and distributed.

Tropical Canine Pancytopenia

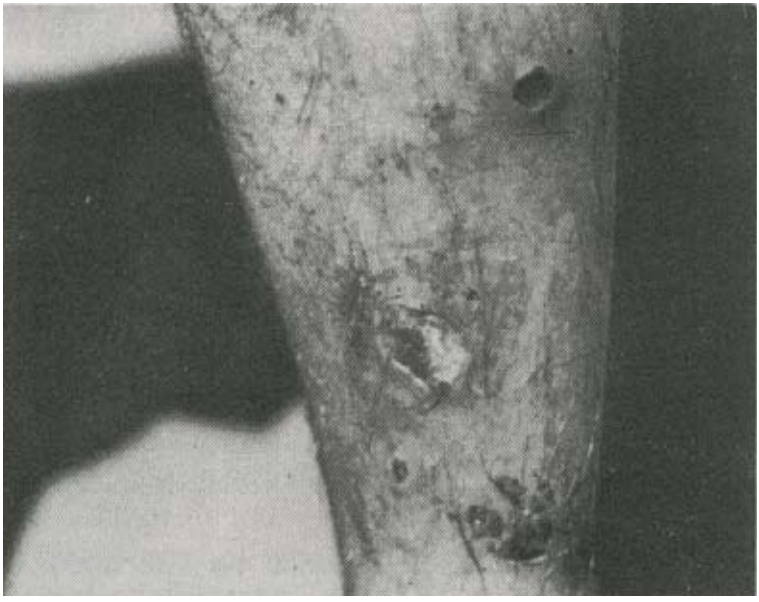
Tropical Canine Pancytopenia (TCP), an unusual disease characterized by hemorrhage, severe emaciation, pancytopenia, and high mortality, broke out in 1968 in U.S. military dogs in Vietnam. Known first as IHS (Idiopathic Hemorrhagic Syndrome) and ultimately as TCP, the disease seriously jeopardized the operational efficiency of combat units dependent on military dogs. Between July 1968 and December 1970, about 220 U.S. military dogs, primarily German Shepherds, died of the disease, and it was the contributing reason for the euthanasia of many others. Near the end of 1969, a program of tetracycline and supportive therapy for 14 days, based on recommendations from WRAIR laboratories in Saigon, was initiated for all TCP cases. This therapy returned to duty approximately 50 percent of the dogs treated for the disease.

A Soldier and his scout dog on patrol in Vietnam.

Skin Diseases

Skin disease is a leading cause of morbidity in any tropical military campaign. The tactical situation, particularly in the Mekong Delta region, required continuous and prolonged exposure to a wet environment, predisposing infantrymen to bacterial and fungal invasions of the skin. Rates of disability among infantrymen reached as high as 50 percent in some rifle companies.

From November 1968 through February 1969, a field dermatology research team from WRAIR, led by Captain Alfred M. Allen, studied dermatological conditions in Soldiers and civilians in the 9th Division area and published several articles addressing skin diseases in Vietnam. Those articles formed the basis for the understanding of skin diseases in the area. Based on this research and similar work by the other services, Operation Safe Step, a medical research program designed to control and minimize foot problems in troops, ensued. It was a three-pronged effort to test foot gear, protective skin ointments, and skin disease in volunteers exposed to paddy water for varying lengths of time.



Researchers pinpointed the cause of painful skin ulcers, "jungle sores," shown on the leg of a U.S. Army infantryman, as the beta-hemolytic streptococcus.

A unit located at the Letterman Army Institute of Research, Presidio of San Francisco, led by Colonel William Akers, provided the ointments while the U.S. Army Natick Research Laboratory provided the footgear. Captain Allen's field dermatology team worked in consultation with Colonel Akers and the division surgeons in charge of the program. Before deployment to Vietnam, the team trained in the Everglades in a simulated tropical combat environment. Upon arrival in theater, the team was given a completely equipped MUST (Medical Unit, Self-Contained, Transportable) unit as a laboratory. The team accompanied infantrymen in active fire zones and units on patrol to evaluate proposed methods of skin disease prevention. The use of portable field laboratories and special culture media permitted isolation of pathogens that had eluded detection by previous methods. In less than 6 months, Captain Allen's team had identified the populations most likely to develop disabling skin diseases, isolated the pathogens, measured the effects of exposure, and initiated effective new methods of prevention and treatment.

As a result of these studies, Major General Ewell, 9th Infantry Division, altered division tactical procedure by limiting operations in paddies to 48 hours (unless pinned by the enemy) followed by a 24-hour drying period. Time lost to skin diseases dropped from over 3,000 days per month to 1,000 days per month, a significant preservation of combat power.

The chief causes of cutaneous disability in American combat forces were inflammatory ringworm, ecthymatous pyoderma, and tropical immersion foot. Elastase-producing fungi were found to be the major cause of inflammatory ringworm. A search for the source of infection revealed that 25 percent of rats tested were infected with a morphologically similar organism. A preliminary study showed that daily administration of griseofulvin was an effective prophylactic against fungus diseases of the skin, and its use reduced incapacitating dermatophytosis in certain special military units from 36 percent to 6 percent, a major contribution of preventive medicine during this period. Nondisabling skin diseases included prickly heat, acne vulgaris, and tinea versicolor.

Letterman Army Institute of Research (LAIR) San Francisco, California

History: LAIR was incorporated into the U.S. Army Medical Research and Development Command in August 1968. It represented a combination of four Army research activities: The Army Medical Research and Nutrition Laboratory, Denver, Colorado; the blood research component of the U.S. Army Medical Research Unit, Fort Knox; the Joint Laser Safety Team, Frankford Arsenal, Pennsylvania; and the Dermatology Unit of the U.S. Army Medical Research Unit, Presidio of San Francisco.

In 1966 the Surgeon General had established the Western Medical Research Laboratory in five buildings at Letterman General Hospital. Research was conducted in tropical medicine, nutrition, surgery and blood replacement, pathology, and psychiatry. The collocation of the laboratories and units listed above led to the construction of a state-of-the-art laboratory in July 1971. The construction was accomplished in three phases yielding a 361,000 square foot laboratory. The initial cost was $7.4 million. The first phase of construction was the Research Support component, followed by the Research Laboratory component, and finally, the Administrative Support component. Construction was completed in 1976.

It consisted of four concrete buildings that housed research in artificial blood, laser physics, and the treatment of trauma. During the course of its 25-year history in the U.S. Army Medical Research and Development Command, LAIR made significant contributions to military medicine in three areas: ocular hazards, cutaneous hazards, and blood research. Outstanding research milestones included an increased understanding of the nature and extent of ocular injury, improvement in the medical management of ocular injury, and reduction of ocular trauma. Milestones in blood research included the design and development of new military-adaptable resuscitation fluids and improved blood products. The laboratory was deactivated as a result of the 1991 Base Realignment and Closure Act.

Mission: LAIR conducted research in battlefield casualty assessment and management, military trauma and resuscitation, bioeffects of military lasers, development of blood substitutes, and blood cell preservation.

Historical Highlight: In 1979, a blood preservative, CPDA-1 (citrate phosphate dextrose adenosine 1) was approved by the U.S. Food and Drug Administration. The use of this preservative extended the shelf life of thawed blood by a factor of 6 or up to 600 percent.

Combat Surgery

In the fourth year of the U.S. Army Medical Research Team (WRAIR)-Vietnam's existence, it added a surgical unit called the Surgical Research Team, which developed improved techniques for the treatment of trauma and shock. The team demonstrated that studies of wound trauma and accompanying shock, the type conducted in "shock units" in the United States, could be carried out with satisfactory results on combat casualties in the field. The management of shock was also assisted by the introduction of cardiodensitometers, blood gas analyzers, and flame photometers into field hospitals. Recognition of the seriousness of pulmonary insufficiency in shock, particularly in patients with nonthoracic injuries, led to extensive research in the management of this complication and was highlighted by the work of this team.

An early "anesthesia machine" used at the Army Surgical Research Unit.

Further progress was made in the development and use of plastic polymers as tissue adhesives in controlling bleeding and repairing internal organs. The control of hemorrhage with new chemical polymers—a butyl cyanoacrylate spray—was found to be remarkably successful. Spray guns containing the adhesive were provided to the Surgical Research Team for use in treating casualties in Vietnam. In addition, tissue adhesives and new techniques of repairing internal organs without sutures were other promising developments to start during this time period.

New methods for the fixation of mandibular fractures were placed under study. Furthermore, the investigation of a new technique for managing avulsive wounds of the oral region, which utilized a silicone plastic that cures at room temperature, was started. After debridement, this material was placed directly into the defect to restore oral integrity until the time of reconstructive surgery.

Other innovations under study by the research group were the use of electrical anesthesia, laser irradiation, synthetic blood vessels, plasma expanders, and new additives in the preservation of whole blood. Sulfamylon ointment for control of infection in burns and various methods

for suppression of an immune response of the body to homografts and transplants were also developed.

The Surgical Research Team tested several experimental items developed to aid wound healing. An antibiotic preparation, packaged as an aerosol, was distributed to aidmen in various tactical units. Immediate use on an open wound acted to retard bacteria growth and resulted in decreased morbidity. Tissue adhesives that had low toxicity, degraded relatively rapidly, and spread well proved valuable in surgery on the lung, kidneys, and liver. The Surgical Research Team utilized them with excellent results as early as 1968.

Aviation Medicine

The U.S. Army Aeromedical Research Laboratory (USAARL) was established in October 1962 with the mission to provide direct aviation medical research support to all Army aviation and airborne activities. Technical evaluation of aircraft and personnel equipment, aeromedical in-flight observations, and analyses of field problems reported by other aviation agencies were part of the unit's early research.

U.S. Army Aeromedical Research Laboratory (USAARL) Fort Rucker, Alabama

History: USAARL was established in October 1962 at Fort Rucker, Alabama, as the U.S. Army Aeromedical Research Unit to provide direct aviation medical research support to all Army aviation and airborne activities. Technical evaluation of aircraft and personnel equipment, aeromedical in-flight observations, and analyses of field problems reported by other aviation agencies were part of the unit's early research. In 1969, it was redesignated a laboratory (USAARL), and construction began on a new vivarium. One year later, the Helicopter In-flight Monitoring System, an airborne system capable of simultaneously measuring pilot and helicopter performance, was installed aboard the laboratory's JUH-1H research helicopter, and a burn laboratory was constructed for studies of post-crash fire characteristics of helicopters and human survival and protection.

In 1974, USAARL was designated as the lead medical laboratory for vision and acoustics research, and a field research facility was completed to permit research assessing physiological and psychological aviator performance during sustained operations. A helmet evaluation facility was completed in 1975, and investigations into human effects of helicopter vibration were initiated. In 1977, the laboratory began conducting health hazard assessments and countermeasures research on air and tactical ground vehicles and weapons systems.

During the 1980s, USAARL became increasingly involved in field studies, assessing hazards of military systems and operations, as well as the biomedical means of enhancing Soldier selection, performance, and protection. In the 1990s, laboratory and field studies on the ground and in helicopter flight continued in vision and visual enhancement/protection, auditory injury/protection, impact injury/protection, jolt effects, crew stress/workload, and physiological life support.

In the 21st century, USAARL is expanding its research to include the understanding of human injuries and damage to personal protective equipment from a crash and analyzing design and deficiencies in flight helmets, crashworthy seating, and restraint systems, and developing criteria for Future Force warfighter systems.

Mission: Through research—to preserve and enhance the health, safety, combat effectiveness, and survivability of the warfighter.

Historical Highlight: The development of the UH-1 medevac came about as a result of the search for a safer, more effective means of evacuation for wounded Soldiers. The UH-1 had defined space for six litters and removable seats for ambulatory patients. In addition to providing guidance for space specifications, USAARL was involved in the design of crashworthy fuel cells for the UH-1.

The aeromedical problems that faced Army aviation units in Vietnam provided a challenge to their supporting flight surgeons. No problem, however, was more common yet more elusive than that of optimizing crew rest and endurance. It became more pronounced after 1965 when the buildup of U.S. forces gained momentum and remained a significant limiting factor in the conduct of airmobile operations. By the end of 1966, aviators were flying 100 to 150 hours or more per month, and the need to know the limits of aviator endurance became evident.

Army aviators were assailed by a multitude of stresses, each to some extent capable of endangering their missions. The stress from hostile fire was aggravated by such factors as heat, dehydration, noise, vibration, blowing dust, hazardous weather, exhaust from engines and weapons, and labyrinthine stimulation. Additional stress was caused by psychic elements, such as fear, insufficient sleep, family separation, and frustration. These stresses, acting on the aviator day after day, combined with the physical exertion of long hours of piloting an aircraft, caused fatigue.

The ever-increasing requirements during the years 1967–1968 for aviation support caused the accrual of extremely high aviator flying times in all units. Night operations, with their extra demand upon the critical judgment of the aviator, increased. The shortage of crews often forced an individual to undertake both day and night missions without adequate rest.

In response to expressed concerns of unit commanders and aviation safety officers, flight surgeons at all levels of aeromedical support studied every aspect of crew rest and endurance. Because fatigue was the result of many variables, it defied easy definition and precise measurement.

The Vietnam War saw an important change in the role of the helicopter in casualty evacuation in that, for the first time, casualties were evacuated from the battlefield to medical treatment directly by helicopter. The time from injury to treatment or hospitalization dropped dramatically—the median time between wounding and treatment fell to 1.5 hours, and 55 percent of casualties were hospitalized the same day as they were wounded.

In 1970 the Helicopter In-flight Monitoring System, an airborne system capable of simultaneously measuring pilot and helicopter performance, was designed, built, and installed aboard the USAARL JUH-1H research helicopter. Researchers assessed prototype lighting systems and paint schemes for helicopter collision avoidance. A burn laboratory was constructed for studies of post-crash fire characteristics of helicopters and human survival and protection.

During 1965 and 1966, USAARL scientists conducted studies on the effectiveness of armor for both men and equipment. By the end of 1965, crashes had caused 101 fatal and 79 nonfatal injuries, and "missiles and shells" had caused 43 fatal and 673 nonfatal wounds. The ineffectiveness of seat armor was a contributing factor, implicit in the notation "most fatalities [are] due to wounds of head, throat, and upper torso."

In April 1966, Captain James W. Ralph, MC, produced a staff study on aviation casualty reporting for the Army Concept Team in Vietnam in an attempt to determine whether the data being compiled were being analyzed and could be applied to studies of protective equipment. With the collaboration of Major (later Colonel) James E. Hertzog, MC, Surgeon, 1st Aviation Brigade and Aviation Medicine Consultant, U.S. Army Vietnam, a form was developed for reporting wounds.

In January 1966, the Department of the Army approved a project for USAARL to develop flight clothing that would provide fire protection, be compatible with cockpit design, and resemble the uniform worn by the foot Soldier. Deliveries to Vietnam of a two-piece Nomex uniform began early in 1968, and by year's end adequate quantities were on hand to meet all requirements. In 1969, the fire-resistant flight uniform, having been well received by aircrews, was made Standard A for the Army.

Prior to 1969, aircrews were wearing a mixture of APH-5 and AFH-1 helmets. In 1969, a new flight helmet, the SPH-4, incorporating markedly improved retention and noise attenuation qualities, was procured for use in Vietnam and received immediate acceptance in the field. It proved effective in the prevention of injuries and became Standard A early in 1970.

Medical Materiel

The AMEDD took great pride in its development of a totally new concept in combat hospital design—the MUST (Medical Unit, Self-Contained, Transportable) hospital. This concept combined quick assembly and easy transport capability with self-contained power, utility, and air conditioning features in a new shelter design.

The first MUST hospital was deployed to South Vietnam in 1966 with the 45th Surgical Hospital for testing in a combat situation. Six other MUST hospitals were later deployed to South Vietnam, four supporting the Army and two supporting the Marines. The MUST hospital represented improved protection against mortar and small arms fire.

A 60-bed surgical hospital displayed the use of MUST equipment in a demonstration at Camp Bullis, Texas, in September 1968. (Army Medical Pictorial Service photograph by William W. Warrell).

In addition to the MUST hospital, USAMRDC was actively engaged in the development of new medical materiel for use in the field. Development was completed on a new lightweight field hospital bed offering more stability and flexibility, a lightweight and portable x-ray apparatus with an accompanying film processing unit, a field resuscitator, a surgical operating light, a scrub sink, a helicopter-mounted insecticide sprayer by the U.S. Army Biomedical Research and Development Laboratory (USABRDL), and a hypodermic jet injection gun by WRAIR.

A new field medical laboratory system was developed that was fully mobile and built on a modular concept. It was capable of providing up-to-date and sophisticated laboratory support on an area basis for a large field army located anywhere in the world. Individual items of equipment for the laboratory were tested and modularized.

Other equipment development completed for use in the field included an improved surgical operating table and a lightweight distiller to produce sterile water in conjunction with prepackaged bags of electrolytes.

Headquarters area of the 8th Field Hospital "under canvas" in 1962.

A typical hospital support laboratory. Laboratory services were the functional backbone of practice for hospitalized medical patients.

Medical Supply

Shortcomings in the medical supply system began to take their toll in 1965. The system lacked qualified medical logistics personnel in Vietnam, suffered from a bottleneck at the Inventory Control Point in Hawaii that was unable to keep up with the increased demand for medical supplies, and lacked for accountability as the Surgeon General was responsible for the provision of supplies to theater but had no authority over the Inventory Control Point. This changed in 1966 with the realignment of medical supply activities under the overseas command surgeons. This realignment was based on the Surgeon General's recommendation that the AMEDD be given control over medical depots and medical inventory control activities.

Under this realignment, the responsibility for determining requisition objectives for stocked medical items and for ordering supplies moved from the Inventory Control Point to the U.S. Army Medical Depot in the Ryukyu Islands. The depot ordered replenishment supplies from the Defense Personnel Support Center through the U.S. Army Medical Materiel Agency (USAMMA). At this point, USAMMA was not part of USAMRDC, but this changed after USAMRDC became a full life-cycle Command in the 1990s.

Summary

A multitude of medical challenges were overcome by USAMRDC during the U.S. involvement in Vietnam. Resolution of problems that would improve the performance of Soldiers in the field by reducing losses from wounds, infectious diseases, and environmental stress took precedence. The U.S. Army Medical Research Team (WRAIR)-Vietnam addressed disease and combat wound/surgical complications while USARIEM conducted vital research on heat stressors encountered in tropical environments. Vietnam was the beginning of rapid deployment across multiple time zones, a concept that would be more fully developed and implemented in the 1980s and 1990s. These deployments, and resulting care of troops in theater and deployment of casualties out of theater, would engage both USAARL and USAISR in developing improved evacuation and transport care for casualties in the decades following the Vietnam War.

Chapter 4

USAMRDC in Transition

The 1970s were a period of transition and change both within American society as well as within USAMRDC. The 1970s saw an explosion in technical and scientific advances. It was the birth of the modern computer age. Apple, Microsoft, and numerous other hardware and software companies were started during this time. In 1976, Cray introduced the world's first supercomputer that revolutionized both science and engineering computations with its speed and the ability to perform multiple complex calculations simultaneously. In 1977, the first three nodes in the Army's ARPAnet were brought online.

The decade also saw an explosion in biotechnology yielding growth of medical products and increased money for research and development. There were also significant advances in modern molecular biology, virology, and genetics. These advances laid the foundation for the medical discoveries that were to occur in the remaining years of the 20th century.

Garrison Fort Detrick

The first of the 1970s' organizational changes to Army medical research came in August 1971 when General Order 255 established the U.S. Army Garrison as the owner of Fort Detrick under the Army Materiel Command. In April 1972, Fort Detrick was reassigned to the OTSG of the Army, which in turn assigned the Garrison to the control of USAMRDC. At that time, the Headquarters for USAMRDC was in Washington, DC. In 1978, the Headquarters for USAMRDC was moved to Fort Detrick.

In 1973, the Army was reorganized, and the Army Health Services Command was stood up at Fort Sam Houston, Texas, to serve as the overarching medical command within the continental United States. The Fort Detrick Garrison was assigned to the Health Services Command as a subordinate command on 1 July 1973. However, USAMRDC remained a Field Operating Agency of the OTSG and separate from the Health Services Command.

Détente and the End of Offensive Biological and Chemical Weapons Research in the United States

The year 1969 marshaled in the era of Détente in the Cold War between the United States and the Soviet Union. Both countries began the SALT (Strategic Arms Limitation Treaties) talks, two rounds of bilateral talks and corresponding international treaties between the Soviet Union and the United States on the issue of armament control. In conjunction with the reduction in nuclear arms, President Richard Nixon also ordered a review of U.S. policy and programs regarding chemical and biological warfare.

On 25 November 1969, President Nixon declared that the United States unilaterally renounced first use of lethal or incapacitating chemical agents and weapons and unconditionally renounced all methods of biological warfare. The U.S. biological program would be confined to research on strictly defined measures of defense, such as immunization. On 14 February 1970, the White House announced extension of the ban to cover toxins. The Biological Weapons Convention was signed in April of 1972, ratified by Congress in December of 1974, and signed by President Gerald Ford in January of 1975, but the offensive weapons program had already been terminated through an executive order from President Nixon in 1969. The year 1969 was also when the United States began to pull its ground troops from Vietnam; by 1971 no U.S. ground troops were fighting in Vietnam, and by 1973 all offensive operations were halted, including air power. U.S. diplomatic goals focused on promoting peace in the Middle East and deterring communism in Europe.

President Richard Nixon greets the public outside former Fort Detrick Headquarters, Building 812, during a visit on 19 October 1971. It was his announcement that changed the face of Fort Detrick.

In 1971, President Nixon signed the National Cancer Act into law, declaring a "War on Cancer," and announced the creation of the Frederick Cancer Research Facility of the National Cancer Institute. Nixon stated that the new center's utilization of the former Army biological warfare laboratory

buildings was a clear message that America "could and would beat its swords into plowshares." This entailed the transition of 70 former Army laboratory buildings on 68 acres at Fort Detrick to conduct cancer research. It also meant job opportunities for hundreds of Fort Detrick biological warfare researchers and technicians who otherwise would have been laid off when the offensive program ended. Although the National Cancer Institute owns the land and buildings it occupies at Fort Detrick, it maintains agreements with the DoD for some of its infrastructure support.

U.S. Army Medical Research Institute of Chemical Defense

As mentioned previously, all chemical research in the United States also became defensive in nature with the 1969 executive order. USAMRDC was not directly involved in chemical research until 1979 when the U.S. Army Biomedical Laboratory, the precursor to the U.S. Army Medical Research Institute of Chemical Defense (USAMRICD), was reorganized under USAMRDC. Prior to 1979, precursor organizations such as the U.S. Army Biomedical Laboratory had conducted chemical research but were not part of USAMRDC. On 1 July 1979, the U.S. Army Biomedical Laboratory became part of the OTSG and was subsequently reorganized under USAMRDC.

USAMRICD traces its beginnings to elements of the AMEDD that were responsible for defense against chemical weapons used in WWI. The earliest laboratories were first directed by the Bureau of Mines of the Department of the Interior (1917) and later by the Gas Defense Service of the U.S. Army. In October 1922, the Medical Research Division was organized at Edgewood Arsenal in Maryland. The division was formed to study the pharmacological actions of chemical warfare agents, develop treatments for chemical casualties, and provide information and medical recommendations to the Army about these agents. During this period, Edgewood Arsenal became the U.S. government's center for research, development, test, and evaluation (RDT&E) in support of chemical defense operations. The Medical Research Division was renamed the U.S. Army Biomedical Laboratory in the early 1960s and moved into its current research and administrative building in 1968.

In 1979, the U.S. Army Surgeon General became responsible to the Secretary of the Army as the DoD executive agent for all aspects of medical chemical defense. As a result, the Commanding General of USAMRDC assumed responsibility for medical chemical defense RDT&E. The U.S. Army Biomedical Laboratory was designated the lead laboratory for medical chemical defense technology-based programs by Permanent Orders 8-1, OTSG, Department of the Army (29 May 1979).

USAMRICD historical photos depict an old chemistry laboratory during the 1950s and equipment used to gather physiological data.

In the late 1970s and throughout the 1980s, the pace of research and development at the institute significantly quickened in response to a renewed awareness of the threat of chemical agents and to developments in biotechnology. Significant advancements in protection and therapy for exposure to nerve agents led to a shift in emphasis in the research program to medical countermeasures for vesicating compounds, particularly sulfur mustard. In the late 1980s, program activities expanded to include basic research on neurotoxins in support of the Medical Biological Defense

U.S. Army Medical Research Institute of Chemical Defense (USAMRICD) Aberdeen Proving Ground, Maryland

History: The nucleus of what is USAMRICD was formed in 1915 when the War Department gave responsibility for designing protective equipment against chemical agents to the Army Medical Department. Although the first U.S. laboratories to work with chemical agents were under the direction of the Bureau of Mines in 1917 at the American University in Washington, DC, by 1918 the Gas Defense Service of the Army Medical Department was responsible for the majority of these laboratories.

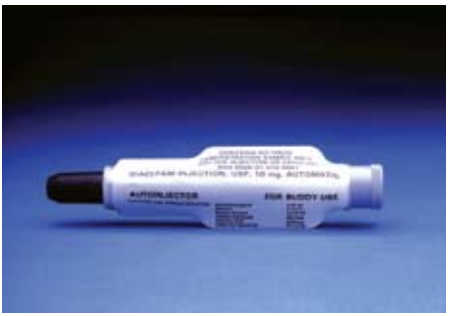
From the end of WWI through the post-WWII years up to the 1970s there was continual progress in the area of medical defense against chemical agents. A new clinical research building was dedicated in 1968 and became the core of what is today's USAMRICD. In addition, an ultramodern veterinary medicine facility was opened in 1979. Several of these events were related to increased concerns of the size of the Warsaw Pact chemical arsenal and its possible technology transfer to third parties in the Middle East and elsewhere. In July 1979, the U.S. Army Biomedical Laboratory became part of the Office of the Surgeon General and the U.S. Army Medical Research and Development Command (USAMRDC). The laboratory was renamed the U.S. Army Medical Research Institute of Chemical Defense in May 1981.

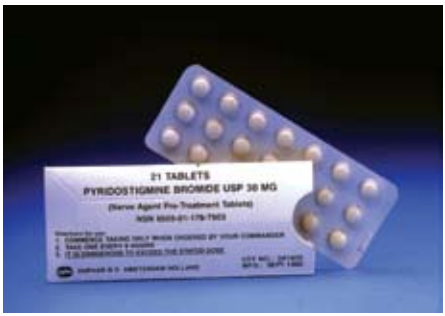
USAMRICD's capabilities have been upgraded several times since 1981 due to heightened concerns over readiness to respond to chemical warfare threats. For example, in 1989, USAMRICD celebrated its 10th anniversary in the USAMRDC (now the U.S. Army Medical Research and Materiel Command) with the dedication of a new facility, the Colonel Edward B. Vedder Classroom building.

Mission: To discover and develop medical countermeasures to chemical warfare agents for U.S. military and U.S. citizens; to train and educate personnel in the medical management of chemical casualties; and to provide subject matter expertise in developing defense and national policy and in proper crisis management.

Historical Highlight: Application of the research findings and the products of USAMRICD are central to a national strategy to mitigate the health effects of toxic chemicals for U.S. military personnel as well as for the nation's civilian population. As the lead Department of Defense laboratory for medical chemical defense, the institute is the only medical research laboratory to maintain a unique facility for the storage, usage, and distribution of chemical surety material, such as chemical warfare agents.

Research Program. Specific products include pyridostigmine bromide pretreatment tablets and an anticonvulsant autoinjector containing diazepam. Both products improved the effectiveness of atropine and 2-PAM (2-pralidoxime chloride) as nerve agent antidotes.





Another key element of USAMRICD's mission has been and is aiding and training military health care providers in the management of chemical and biological casualties. USAMRICD is the lead laboratory for chemical casualty care training. The goal is to save lives, minimize injury, maximize return to duty, and conserve fighting strength.

The training educates military health care providers in the characteristics of various threat agents, the symptoms of exposure to each class of agent, and specific methods of treatment and decontamination. The course combines classroom instruction, a laboratory exercise, and field experience to establish essential skills, instill confidence, and define limitations. A weeklong course is held several times a year. Shorter versions are exported overseas and throughout the United States. Similar training has been developed for Medical Service Corps officers (67A), Chemical Corps officers, and noncommissioned officers in medical or chemical specialties to prepare them to become trainers in the first echelon management of chemical and biological agent casualties. Training has also been developed for hospital-based medical professionals, including physicians, nurses, dentists, paramedics, hospital administrators, medical planners, and others who plan, conduct, or have responsibility for hospital management of mass-casualty incidents or terrorism preparedness. Classroom instruction, scenarios, and tabletop exercises equip military and civilian hospital-based medical and management professionals with skills, knowledge, and information resources to carry out the full spectrum of health care facility responsibilities required by a chemical, biological, radiological/nuclear, explosive, or mass-casualty event. Since 1984, nearly 30,000 persons have received training through one of these courses.

U.S. Army Medical Research Institute of Infectious Diseases

As a result of President Nixon's executive order, all chemical and biological research in the United States became defensive in nature. USAMRIID, originally known as the U.S. Army Medical Unit, Fort Detrick, became part of USAMRDC in 1971 when the Command was a Field Operating Agency of the OTSG.

According to a 1969 fact sheet, USAMRIID's original research program was designed to provide the military forces of the United States with better means of medical protection against intentionally disseminated microorganisms. Its original mission was "Performs studies on the pathogenesis, diagnosis, prophylaxis, treatment, and epidemiology of naturally occurring infectious diseases of military importance with emphasis on problems associated with the medical defense against biological agents and on those microorganisms which require special containment facilities." By 1971, USAMRIID had become the primary laboratory for defensive biological research on pathogens, vaccines, and prophylactics, receiving additional funding and personnel authorizations to hire bio-laboratory scientists who were losing their jobs as a result of President Nixon's executive order. USAMRIID's primary research focus was and is highly virulent diseases.

Throughout its history, USAMRIID has been a major contributor to the development of drugs and vaccines against those diseases determined to be biological threat agents.

Groundbreaking for the current laboratory facility at Fort Detrick began in 1967. At the time, it was the largest biocontainment laboratory built in the United States. Phase 1 construction cost $7.6 million, and Phase 2 cost $6.33 million. A total of 300 military and 100 civilian personnel started moving into the new building of Phase 1 in 1971 and Phase 2 in 1972. The current facility has more than 15,000 square feet of biosafety level (BSL)-4 and 50,000 square feet of BSL-3 laboratory space. A special BSL-4 patient containment ward is available for treating individuals exposed to virulent diseases in the laboratory or endemically. There is also a BSL-4 containment morgue. USAMRIID possesses unique aerosol and animal model development capabilities to evaluate efficacy of medical products against airborne threats. USAMRIID provides "national" laboratory capabilities and specialized medical and scientific consultation and often collaborates with other agencies such as the Centers for Disease Control and Prevention in Atlanta, Georgia.

USAMRIID's researchers had many accomplishments to be proud of from the first 20 years of the defensive biological research program. Much of USAMRIID's research, both then and now, is unclassified, and appropriate information is reported in the medical literature.

USAMRIID Accomplishments

- 1977: Clinical and field trials of Argentinean, Korean, and Bolivian hemorrhagic fevers resulted in investigational new drug vaccines.
- 1978: Large amounts of Rift Valley fever vaccine were shipped to Egypt to quell an outbreak.
- 1980: A new program was initiated to improve the anthrax vaccine in response to the Sverdlovsk incident.
- 1982: USAMRIID's treatment facility was used to provide care for two Centers for Disease Control and Prevention researchers exposed to Lassa fever virus.
- 1989: USAMRIID rushed immune globulin to San Francisco to save a baby from infant botulism.
- 1989–1990:
    - A USAMRIID researcher isolated an Ebola-like virus that was killing primates in Virginia used for biomedical research.
    - A university hospital in Sweden requested assistance with the diagnosis and treatment of a patient recently returned from Africa who was suspected of having an unknown infectious disease. USAMRIID staff traveled with the portable patient isolation equipment, trained the staff, and treated the patient who survived.

U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID) Fort Detrick, Maryland

History: USAMRIID was established in January 1969 by the Office of the Surgeon General of the Army to develop medical defenses against biological warfare threats. Originally known as the U.S. Army Medical Unit, Fort Detrick, it became part of the U.S. Army Medical Research and Development Command in 1971. USAMRIID's primary research focus was and is highly virulent diseases.

Since its inception, USAMRIID has played a key role as the Department of Defense's (DoD's) lead laboratory for medical aspects of biological defense. The institute develops vaccines, drugs, diagnostics, and information to protect U.S. service members from biological warfare threats and endemic diseases. The current facility consists of 13 buildings with approximately 356,000 gross square feet of research laboratory and administrative space. It houses the nation's largest collection of biosafety level (BSL)-4 space (approximately 15,000 square feet) and 50,000 square feet of BSL-3 laboratory space. The BSL-4 facility is the largest highest-level biocontainment laboratory in the United States. A special BSL-4 patient containment ward is available for treating individuals exposed to virulent diseases in the laboratory or endemically. USAMRIID is the world leader in the development of animal models for aerosol exposure biothreat agents. Aerosol exposure most closely mimics the likely route of exposure for these agents and allows for the best evaluation of the effectiveness of vaccines and prophylactics. Deployable teams are available on short notice to assist with establishing diagnostic laboratories in theaters of combat operations, and epidemiological and aeromedical isolation teams specialize in rapid response to investigate disease outbreaks anywhere in the world. While USAMRIID's primary mission is to protect the warfighter, its research has applications that benefit society as a whole.

Mission: To conduct basic and applied research on biological threats resulting in medical solutions to protect the warfighter.

Historical Highlight: USAMRIID's science and technology base serves to address current threats to U.S. military personnel and is an essential element in the medical response to any future biological threats that may confront our nation at home or abroad. In addition, it is the only laboratory within the Department of Defense with the capability to study highly hazardous viruses requiring maximum containment at BSL-4.

Throughout this time period, USAMRIID's funding and research in biological defense came under scrutiny by Congress. Prior to 1969, medical defense was prioritized by addressing vaccines and treatment modalities for agents being studied in the offensive program. After the cessation of these programs and the signing of the Biological Weapons Convention, medical defense became a low priority with few intelligence resources being devoted to assessing existing foreign programs or threats. At times, USAMRIID was criticized for its choice of research and development efforts, Congress believing that it was duplicating research at the Centers for Disease Control and Prevention and National Institutes of Health that did not address valid biological warfare threats. Since no unified threat list existed, it appeared that USAMRIID was researching an infectious disease, when in reality it was researching specific biothreat aspects, such as route of delivery, for an agent that also happened to be an infectious disease. Even events such as the Sverdlovsk incident and the Yellow Rain incidents of the late 1970s and early 1980s were not always enough proof at the time to support increased funding for biological agent research. This attitude would change with the advent of the Gulf War and Iraq War and the terrorist incident of September 11th.

Yellow Rain

The United States investigated reported incidents of Yellow Rain (alleged chemical/toxin weapons attacks) that occurred in Asia in 1976 and 1978. The United States suspected that the Soviet Union was supplying mycotoxins (poisonous compounds synthesized by fungi) to Vietnamese and Laotian communist allies for use against resistance forces. The reported death rate was up to 20 percent of those exposed. Immediate reactions included burning skin, vomiting, eye pain, blurred vision, dizziness, rapid heartbeat, low blood pressure, and diarrhea. The U.S. Army Medical Research Institute of Infectious Diseases' division of Physical Sciences received collected biomedical and environmental samples for laboratory analysis. In addition, the United States acquired medical data on alleged victims, administered questionnaires regarding alleged attacks, and searched for other information that could confirm or refute aspects of the refugee reports. Investigations continued through the mid-1980s.

Sverdlovsk Incident

"In 1979 a loud explosion was followed by residents developing high fever and difficulty breathing with an eventual death toll of over 200 people due to pulmonary anthrax."

President Boris Yeltzen admitted in 1992 that the event was a biosafety breach at a state research laboratory.

USAMRDC and Human Use Research

Major Walter Reed

The Army pioneered ethical standards for the protection of human research volunteers. The 1900 Yellow Fever Commission, headed by Major Walter Reed, was the first recorded use of informed consent in human research. Researchers wanted to be certain that all subjects understood the potential hazards of the research. In 1925, the Army actually established a formal regulation (AR 40-210) mandating that only volunteers could be used in infectious disease research.

In 1942, the War Bureau of Consultants Committee on Medical Research (the oversight group that coordinated all biological warfare research during WWII) mandated that "Human experimentation is not only desirable but necessary in the study of many of the problems of war medicine which confront us. When any risks are involved, volunteers only shall be used as subjects and these only after the risks have been fully explained and after signed statements have been obtained which shall prove that the volunteer offered his services with full knowledge and that claims for damage will be waived. An accurate record should be kept of the terms in which the risks involved were described." This has formed the basis for informed consent since that time.

After WWII, the Nuremberg war crimes trials convicted 23 Nazi physicians of murder. These trials and the resulting ethical debate led to a list of 10 conditions that must be met for human experimentation in healthy subjects. These conditions became the standard measure of ethical conduct for all military research involving humans and were codified under the Wilson Memorandum of 1953 to the Secretaries of the Army, Navy, and Air Force. The Wilson Memorandum added additional provisos including that informed consent must be in writing and that the minimum number of subjects must be used for a valid outcome with no use of prisoners allowed. However, it was not until 1972 that this directive was codified by an amendment to 10 U.S. Code 980 by Congress.

10 U.S. Code 980

Sec. 980. Limitation on use of humans as experimental subjects

(a) Funds appropriated to the Department of Defense may not be used for research involving a human being as an experimental subject unless—

(1) the informed consent of the subject is obtained in advance; or

(2) in the case of research intended to be beneficial to the subject, the informed consent of the subject or a legal representative of the subject is obtained in advance.

(b) The Secretary of Defense may waive the prohibition in this section with respect to a specific research project to advance the development of a medical product necessary to the armed forces if the research project may directly benefit the subject and is carried out in accordance with all other applicable laws.

Army Regulation 70-25 was published on 26 March 1962. This regulation requires multiple levels of review from the local unit's "human use committee" to several other screens up the chain of command. The last major revision was 25 January 1990 when it was retitled "Use of Volunteers as Subjects of Research." Army Regulation 70-25 mandates that the Surgeon General of the Army will "Establish and maintain the Human Use Review and Regulatory Affairs Office (HURRAO) attached to the U.S. Army Medical Research and Development Command (USAMRDC) and reporting to the Assistant Surgeon General for Research and Development." In recent years, this structure has been modified to include an office at the Surgeon General with oversight authority for the Human Use Review and Regulatory Affairs Office to ensure a fair and unbiased process in the use of volunteers in Army research.

Project Whitecoat and Informed Consent

USAMRIID's precursor, the U.S. Army Medical Unit, Fort Detrick, originated in 1956 under the Surgeon General to serve as principal investigator managing the already existing Pilot Project CD-22, the exposure of volunteers to aerosols containing *Coxiella burnetii*, the etiologic agent of Q fever. That project resulted in an Investigational New Drug (IND) application submitted for the killed Q fever vaccine. (It should be noted that all volunteers completely

recovered from Q fever with no adverse after effects.) The CD-22 project operated under the principle and process of "informed consent" whereby research subjects become familiar with the purpose and scope of a study to understand the risks involved before agreeing to participate. Each medical investigator prepared a protocol that was extensively reviewed by an ethics committee and modified to comply with each of the 10 ethical principles of the Nuremberg Code as outlined in Cs-385, the Department of the Army Directive on Ethical Use of Human Volunteer Subjects in Research. When the committee determined that ethical requirements and scientific validity were ensured, the protocol was then approved by Army officials. Potential volunteers were then briefed as a group on the approved protocol and attended a project interview with the scientist where they could ask questions about the study. Informed consent documents would be signed after an obligatory waiting period that ranged from 24 hours to 4 weeks depending on the presumed risks of the study. Volunteers were encouraged to discuss the study with family members, clergy, and personal physicians before making a final decision.

Project Whitecoat (1954–1973, including pilot project years) was the extension of the CD-22 project into a permanent volunteer program for conscientious objectors of the Seventh-Day Adventist Church. After a comprehensive evaluation and screening, volunteers were accepted into the program to work in the laboratory. In addition to assigned duties such as medical technician, corpsman, and maintenance technician, individuals also volunteered as human test subjects for clinical trials.

The one-million-test sphere, nicknamed the "Eight Ball," was a cloud chamber used to study static microbial aerosols. During Project Whitecoat, volunteers breathed metered aerosols of Q fever or tularemia organisms through ports along the perimeter of the sphere. This photo shows a volunteer seated with his face in a rubber mask at one of the ports. The individual to his left is a medic who was there to assist the subject and to respond to any emergency that occurred during the exposure. These types of studies were used first to determine safe dosages of infection and for subsequent studies of efficacy of vaccines or therapeutic drugs.

Since the Project Whitecoat volunteers had all been trained as medics prior to assignment to Fort Detrick, many of them participated as clinical clerks and phlebotomists (wearing white coats) during one study and then as subjects (wearing bathrobes) during another.

The authorized number of personnel under Project Whitecoat in 1969 was 172. By the end of the project more than 20 years later, more than 1,900 Seventh-Day Adventist service men and other noncombatants had participated in Project Whitecoat. Colonel Dan Crozier, the first USAMRIID Commander, stated "participation in these research projects has not been without risk. The contribution these young men in Project Whitecoat have made to medicine is invaluable." By the end of Project Whitecoat, approximately 150 studies were completed on the prevention, diagnosis, and treatment of various diseases, including Venezuelan equine encephalitis, plague, tularemia, Rocky Mountain spotted fever, and Rift Valley fever.

USAMRDC and Medical Procurement

During the 1960s and 1970s, there were a number of public disclosures related to government procurement fraud and abuse. As a result, a number of procurement integrity and control procedures were put in place. In 1970, Congress established the original Cost Accounting Standards Board to standardize defense contractor cost accounting standards and establish regulations to require defense contractors and subcontractors to disclose in writing their cost accounting practices and to follow those practices.

In 1979, the Purchasing Division of USAMRDC was combined with the Purchasing Division of WRAIR and the Procurement Division of USAMMA to create a new medical procurement organization under the command of USAMRDC. This organization was officially named the U.S. Army Medical Research Acquisition Activity (USAMRAA) in 1984. The initial USAMRAA mission was simply to serve as a centralized procurement office for the three organizations. This move was part of a larger response to increase accountability for contracting and acquisition. However, as the mission of USAMRDC evolved so too did the mission of USAMRAA.

During the 1980s, as USAMRDC increased its support of extramural programs, USAMRAA became the Command's contacting activity for all contract actions. Today, USAMRAA holds unlimited contracting authority and limited grant approval authority and now provides acquisition support across a broad range of efforts not only to USAMRMC commands and laboratories but also to other non-USAMRMC DoD organizations such as the TRICARE Management Activity.

U.S. Army Medical Research Acquisition Activity (USAMRAA)
Fort Detrick, Maryland

History: USAMRAA was established as part of a 1977 consolidation of the procurement and contracting functions of the U.S. Army Medical Research and Development Command (USAMRDC), U.S. Army Medical Materiel Agency, and the Walter Reed Army Institute of Research (WRAIR) to form a single contracting group within Headquarters, USAMRDC. At this time, the Commander of USAMRDC was designated as the head of the contracting activity.

In 1984, USAMRAA was established as a subordinate command with contracting authority from the Head of Contracting Activity through the Commander (now Director), USAMRAA to the contracting officers. In the same year, the organization was redesignated from agency to activity by Permanent Orders 26-2, dated 2 October 1984, Office of the Surgeon General. USAMRAA converted to civilian leadership under a civilian director in 1993. USAMRAA currently provides expert advice and Contracting and Assistance Agreement support for USAMRMC and its subordinate commands, the U.S. Army Garrison, Fort Detrick, and U.S. Army tenant organizations at Fort Detrick as well as medical materiel and services in support of foreign military sales.

Mission: To provide quality, timely, and cost-effective business advice and solutions for our Command, our customers and other stakeholders; respect, personal growth, and well-being to ourselves; and public trust and good citizenship for our community.

Historical Highlight: USAMRAA received multiple achievement awards for having awarded 486 contracts worth $73 million in 1994 to the benefit of the troops in-theater in Operation Desert Shield.

WRAIR Overseas Laboratories

In 1973, as part of a reorganization, WRAIR assumed control of a number of overseas research laboratories. The medical research units in Malaysia and Panama, as well as the Army component of the laboratory in Bangkok, were all reorganized into the WRAIR Special Foreign Activity. In addition, two new overseas laboratories were established and placed under the WRAIR Special Foreign Activity. The U.S. Army Medical Research Institute-Brasilia was established in 1973 as a cooperative effort between WRAIR and the University of Brasilia. In 1978, by mutual agreement, the program was

U.S. Army Medical Research Unit-Brasilia (USAMRU-Brasilia)
Brasilia, Brazil

History: USAMRU-Brasilia was first established in 1973 as a cooperative effort between the Walter Reed Army Institute of Research and the University of Brasilia to perform screening of drugs to prevent and treat schistosomiasis. The initial program was expanded in 1978 to include a multidisciplinary research program on clinical, immunological, epidemiological, and vector transmission dynamics of malaria in the Amazon Basin. In 1980, vector and host studies of cutaneous leishmaniasis began in the state of Bahia. In March 1989, the unit terminated its relationship with the University of Brasilia and moved into temporary laboratories at the Army Institute of Biology in Rio de Janeiro under an Interim Agreement signed by the Army Surgeon Generals of the United States and Brazil. Architectural and engineering designs for a new laboratory were completed, but the construction of the building never came to fruition so the unit moved into larger facilities at the Institute of Biology compound. The mission was expanded to improve the diagnosis, treatment, and prevention of infectious diseases of importance to Brazil, and a new program was established to study the epidemiology of retroviruses in Brazil. An important field site was established in Itaquara, Bahia, where a Phase 3 study was conducted on a topical antipenetrant to prevent schistosomiasis. Another key field site was operated in Costa Marques, Rondonia, which was later moved to Peixoto de Azevedo, Mato Grosso. However, because of the political and logistical difficulties of conducting research in Brazil, the full potential of the unit was never realized, and USAMRU-Brasilia was closed in 1999.

Mission: To conduct a multidisciplinary research program on clinical, immunological, epidemiological, and vector transmission aspects of malaria, schistosomiasis, retroviruses, leishmaniasis, and dengue fever.

Historical Highlight: The unit conducted landmark studies on the competency of various mosquito species to vector disease.

U.S. Army Medical Research Unit-Belem (USAMRU-Belem)
Belem, Brazil

History: In 1973, USAMRU-Belem was established as a Special Foreign Activity of the Walter Reed Army Institute of Research in Belem, Brazil. The unit, in conjunction with the Instituto Evandro Chagas and the Pan American Health Organization (PAHO), investigated disease transmission patterns in colonists settling along the new Trans-Amazon highway in an area that extended more than 300 kilometers between Maraba and Santarem, Para. From 1973 through 1976, this unit worked on investigations including epidemiological, vector, and host studies. The ecology of arbovirus study in 1977 examined specimens taken from insects, mammals, and birds collected from south and east of Santarem, Para, at the Instituto Evandro Chagas in Belem from 1977 to 1979. The unit was closed in 1979.

Mission: To investigate disease transmission patterns in colonists settling along the new Trans-Amazon highway.

Historical Highlight: Working with PAHO in this effort built scientific relationships that produced many important future collaborations.

expanded to also include research in malaria. Also in 1973, the U.S. Army Medical Research Unit-Belem (Brazil) was established as a WRAIR Special Foreign Activity to investigate disease transmission along the Trans-Amazon highway.

The U.S. Army Medical Research Unit-Kenya (USAMRU-K) was established to conduct research on African trypanosomiasis. In 1979, the narrow research mission was expanded to include other tropical diseases of interest.

The Armed Forces Research Institute of Medical Sciences (AFRIMS) originally came into being as a response to the cholera epidemic of 1958 in Thailand. Its involvement with USAMRDC started as early as 1959 when a combined team of scientists from WRAIR and the National Institutes of Health worked collaboratively with U.S. Naval Medical Research Unit No. 2 and Thai investigators. The success of that work led the U.S. Department of State to consult with the Director of the National Institutes of Health to develop a health program under the auspices of SEATO; this program became the SEATO Medical Research Laboratory in 1961. The original group of investigators included scientists from Jefferson Medical College, Case Western Reserve University, University of Pennsylvania Medical School, University of Maryland Medical School, and a colonel from WRAIR.

U.S. Army Medical Research Unit-Kenya (USAMRU-K)
Kenya, Africa

History: In 1969, the Walter Reed Army Institute of Research (WRAIR) was invited by the Kenyan government to undertake research in trypanosomiasis in the Lambwe Valley. In 1973, USAMRU-K was established co-jointly with the Veterinary Research Laboratory, Kabete, as a Special Foreign Activity of WRAIR to conduct further research on African trypanosomiasis.

In 1979, USAMRU-K partnered with the Kenya Medical Research Institute to conduct medical research throughout the Republic of Kenya. The institute is composed of 10 centers with main campuses located in Nairobi, Kisumu, Mombasa, and Alupe. The administrative hub of USAMRU-K is located in Nairobi. The Kisumu field site serves as the USAMRU-K malaria field site and has one of the highest disease rates for malaria in the world. Since 2000, USAMRU-K has embarked on a program to deploy malaria-specific personnel and infrastructure to Kisumu to take advantage of the epidemiology of the disease. The USAMRU-K HIV/AIDS field site is located in Kericho. Kericho experiences highland epidemic and imported malaria in contrast to hyperendemic malaria seen in Kisumu. This provides an opportunity to integrate disease-specific projects between the two major sites as Kisumu is known to have one of the highest HIV/AIDS prevalence rates in Kenya. A GEIS (Global Emerging Infections Surveillance and Response) Program was initiated at USAMRU-K in 2000 and has recently expanded to include a network of active sites throughout the country because of funding and concern over Avian and pandemic influenza.

Mission: To develop and test improved means for predicting, detecting, preventing, and treating infectious disease threats to military and civilians in East Africa.

Historical Highlight: On 7 August 1998, the U.S. Embassy was bombed causing great loss of life and many injuries. Medical personnel from USAMRU-K were some of the first to arrive on the scene where they rendered immediate aid to the injured. USAMRU-K personnel assisted the U.S. Ambassador and his staff in meeting a myriad of medical requirements over the next several weeks including medical evacuation of the wounded.

The United States contributed personnel, equipment, supplies, and funds for travel and office expenditures. Essential supporting funds were derived both through the United States Operating Mission in Bangkok and from USAMRDC of the OTSG of the U.S. Army and WRAIR.

Members of the virology department study hemorrhagic fever.

In 1977, a new bilateral agreement between the Thai and U.S. governments led to the new name of AFRIMS. The diseases researched remained essentially unchanged. Products originally field tested or developed at AFRIMS include hepatitis A vaccine, Japanese B encephalitis vaccine, doxycycline prophylaxis for malaria, mefloquine antimalarial drug prevention, and halofantrine antimalarial drug treatment.

As a result of discussions between operational commanders and medical commanders, the Army established the U.S. Army Medical Research Unit-Europe (USAMRU-E), in Heidelberg, Germany in 1977. This unit was different from previous overseas medical research units in that its focus was on behavior rather than infectious diseases. The unit's primary mission was the study of factors influencing psychiatric casualties and performance breakdown in the deployed Army. The unit's wartime mission is to collect and interpret information on battle fatigue and to advise the Theater Surgeon on the management of stress and other behavioral and psychological factors. Since its inception, this unit has been a leader in the investigation of the

relationship between drug and alcohol abuse and unit performance as well as unit cohesion. Focusing on the behavior of Soldiers in operational exercises, in 1979, these researchers looked at the effects of jet lag and stress during the annual REFORGER (Return of Forces to Germany) exercise. Their work on large-scale studies of jet lag in conjunction with the REFORGER exercises resulted in standard operating procedures for reduction of jet lag in rapid deployment forces.

Armed Forces Research Institute of Medical Sciences (AFRIMS)

History: AFRIMS traces its origin to a group of military medical scientists that responded to a cholera epidemic in Thailand in 1958. The Southeast Asia Treaty Organization (SEATO) recognized the significance of the cholera problem and established the SEATO Cholera Research Laboratory in 1959. The laboratory's mission was expanded in 1961 to include research on other tropical diseases and was renamed the SEATO Medical Research Laboratory. The laboratory became AFRIMS upon dissolution of SEATO in 1977 and today operates as a joint Thai-American military medical research partnership. It is composed of both Royal Thai Army and U.S. Army medical components. Today it functions as a Special Foreign Activity of the Walter Reed Army Institute of Research in Forest Glen, Maryland, and of the U.S. Army Medical Research and Materiel Command, Fort Detrick, Maryland. It employs over 450 staff members working in Bangkok and over 40 field sites in Thailand, Nepal, Cambodia, Vietnam, Laos, Philippines, and Bangladesh. AFRIMS also has the largest medical library in Southeast Asia and a modern research animal facility, which is accredited by the Association for the Assessment and Accreditation of Laboratory Animal Care, International.

Mission: The mission of the USAMC-AFRIMS is to conduct basic and applied research for development of diagnostic tests, drugs, and vaccines for infectious diseases of military importance.

Historical Highlight: AFRIMS is the largest overseas U.S. Army biomedical research laboratory and plays a vital role in the study of tropical infectious diseases, conducting cutting-edge research and development projects that address medical threats facing U.S. Soldiers deployed in over 75 countries.

U.S. Army Medical Research Unit-Europe (USAMRU-E)
Heidelberg, Germany

History: USAMRU-E was established in September 1977 in affiliation with the 7th Medical Command as a Special Foreign Activity of the Walter Reed Army Institute of Research. The unit's primary mission is the study of factors influencing psychiatric casualties and performance breakdown in a deployed Army and the development of medical measures for the prevention and management of battle fatigue. In addition, the unit advises the Chief Surgeon, 7th Medical Command, on stress management for disaster and mobilization. The unit's wartime mission is to collect and interpret information on battle fatigue and to advise the Theater Surgeon on the management of stress and other behavioral or psychological factors that lead to manpower losses or decreased combat effectiveness. Since 1986, the unit has had a strong interest in military family topics. This research has examined financial stress and quality of life for Soldiers and families living in Europe. The unit also provides consultation to senior medical officers, line commanders, and community leaders, relaying critical and timely information, which is a significant part of its role.

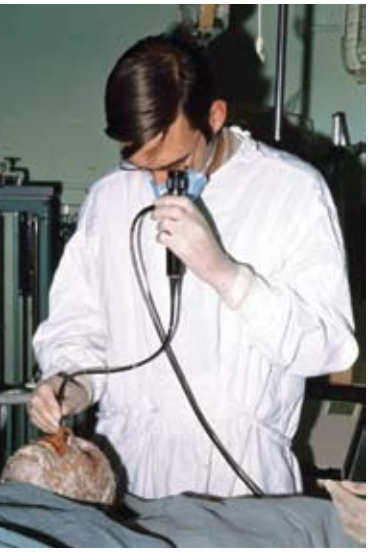
Mission: To conduct applied psychological research for the purpose of protecting, optimizing, and enhancing warfighter psychological resilience.

Historical Highlight: In 2004, USAMRU-E published a systematic assessment of the mental health of service members who participated in ground combat operations and hazardous security duty entitled, "Combat Duty in Iraq and Afghanistan, Mental Health Problems, and Barriers to Care" in the *New England Journal of Medicine*. This study was instrumental in developing policy with regard to the optimal delivery of mental health care to returning veterans.

The Evolution of Modern Burn Treatment Research

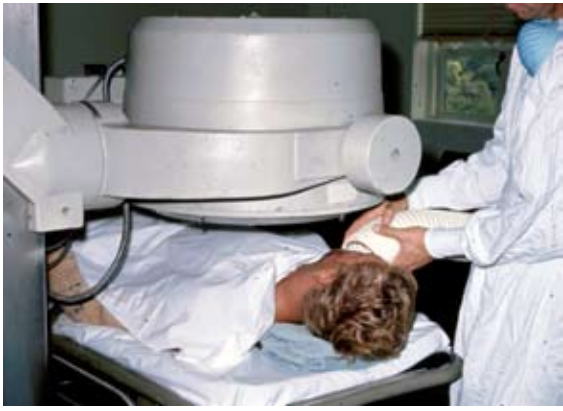
The U.S. Army Surgical Research Institute, one of the original laboratories within USAMRDC, was renamed in 1970 as USAISR. Although the institute was assigned to USAMRDC, it was also aligned to Brooke Army Medical Center for administrative and logistical support. During the 1970s, the primary emphasis for USAISR was clinical research and treatment of burn casualties.

The work at this institute laid the basis for most other burn centers throughout the world. Colonel Basil Pruitt, considered by many clinicians to be the father of modern burn treatment, was assigned to USAISR from



1964 until his retirement in 1995. In 1964, after completing his Army residency, Colonel Pruitt was assigned to the burn center as a staff surgeon, and 1 year later he was promoted to chief of the Burn Study Branch. While working at the burn center, he participated in the air transport of Soldiers wounded in Vietnam. In 1967, he was assigned to the busiest Combat Surgical Hospital in Vietnam for a 1-year tour as part of the WRAIR Surgical Research Team. In 1968 upon his return from Vietnam, Colonel Pruitt was selected to serve as Commander, USAISR. He held this position until he retired from active duty in 1995, a span of 27 years as Commander of the same military organization.

USAISR's outstanding research milestones included an increased understanding of the nature and extent of cutaneous and inhalational burns and their treatment, including use of a fiber optic broncoscope and xenon scans for diagnosis and evaluation of inhalation injury. This work set the standard for future burn units throughout the world. In 1979, the largest mass casualty operation to date in the institute's history was carried out by 18 USAISR personnel deployed to treat and transport 45 Marines injured in a barracks fire at U.S. Marine Corps Camp Fuji. In 1970, staff at USAISR pioneered the development of pulse-pressure lavage for presurgical scrub. Additional clinical research included an analysis of ketamine analgesia for limited debridement and serial management of pulmonary function.



The Evolution of Environmental Medicine in the 1970s

During the mid- and late 1970s, USARIEM directed its focus to the medical impact on troops serving in cold weather areas and in desert, jungle, and mountainous environments. Researchers and staff initiated lectures and briefings to Army line officers as part of courses at the Command and General Staff College (Fort Leavenworth), Medical Field Service School (Fort Sam Houston), and the Flight Surgeon's Course (Fort Rucker). This evolved into a comprehensive network of classes and courses to include an environmental medicine course hosted at USARIEM.

In 1978, to better focus on the specific environmental problems faced by the military, the institute was reorganized around mission areas rather than scientific disciplines; areas encompassed altitude and heat research, exercise physiology, health and performance, and military ergonomics. This encouraged researchers within a specific mission area to be located together and cross-fertilize each others' research ideas. It also allowed researchers to develop working relationships with specific military field units and collect research data on these units by taking part in field exercises.

Soldiers double time across an open field during physical training.

Over the years, the USARIEM research mission remained focused on research to support the Soldier in all environments as well as research in nutrition and performance. However, in the mid-1970s a new mission was added to the institute—physical fitness requirements and training. Additionally, the efforts related to information dissemination were formalized as part of the organization's overall mission.

Outstanding research milestones included the first demonstration in 1971 in humans that stress suppressed circulating levels of plasma testosterone. Also in 1971, the first mass screening laboratory for urinalysis for heroin in large populations was established and expanded to include amphetamines and barbiturates. *Medical Problems of Man at High Terrestrial Elevations* was published in 1975, and the use of acetazolamide as a prophylactic and ameliorative for acute mountain sickness was validated in 1976. In 1979, USARIEM developed and implemented a Military Entrance Physical Strength Capability Test (MEPSCAT) for evaluating and qualifying new accessions for military occupational specialty assignment.

Medical Problems at High Terrestrial Elevations

- Acute Mountain Sickness
- High-Altitude Cerebral Edema Decrements
- High-Altitude Pulmonary Edema
- Physical Performance Decrements
- Cognitive Performance

Summary

The 1970s were a period of transition for USAMRDC. Organizational changes came about with the advent of the Health Services Command and the move of USAMRDC to Fort Detrick. Changes within USAMRDC were significant with USAMRIID and USAMRICD being added to the Command along with the inclusion of several overseas WRAIR components. Research for Vietnam War-related injuries and diseases peaked and then subsided; biological and chemical research was refocused to be only defensive in nature. Significant advances in molecular biology, virology, and genetics not only led to new research methods for existing problems but also opened the door to new research questions. This decade of change gradually moderated leading into the relatively quiet sustainment period of the 1980s.

Chapter 5

An Era of Sustainment

The 1980s were a time of adjustment and equilibration for USAMRDC. Between 1980 and 1990, the U.S. military's active global involvement centered on South America, the Caribbean, Africa, and the Middle East with forward-deployed troops in Europe, Korea, and Japan.

Most of the 1980s military offensives were not large missions, but they highlighted the scientific and technological advances that were just beginning to grant the U.S. military the ability to support numerous deployments at once. There was a large emphasis on rapid deployment and "come as you are." The increasing prevalence of asymmetrical warfare led to an increase in nonconventional casualties. This trend was first identified in the Vietnam War, but the medical aspects of asymmetrical warfare were not actively researched until the 1980s.

The increase in deployments to tropical and equatorial areas led to more research in the prevention, diagnosis, and treatment of diarrheal and infectious diseases affecting readiness and deployment. The increase in the number and rapidity of these deployments was one of the many factors that led to more attention on preventive medicine, including nutrition and performance, as well as on the effects of combat stress and the benefits of unit cohesion and morale. The focus in the 1980s was on the sustainment of the fighting force as well as protection and projection of the force.

Locations of U.S. Military Full-Spectrum Involvement in the 1980s

South America and the Caribbean

Bolivia (1986, 1989) – Anti-drug operations

Columbia (1989) – Andean Initiative in War on Drugs

El Salvador (1981) – Counterinsurgency Training

Grenada (1983) – Operation Urgent Fury

Honduras (1988) – Operation Golden Pheasant

Panama (1988–1989) – Deposed General Manuel Noriega

Peru (1989) – Andean Initiative in War on Drugs

Africa

Chad (1983) – Assisted Chad against Libyan and rebel forces

Egypt (1983) – Assisted Sudan and Egypt against Libya

Liberia (1990) – Evacuation of U.S. citizens from Liberia

Libya (1981) – First Gulf of Sidra Incident

Libya (1986) – Operation El Dorado Canyon

Libya (1989) – Second Gulf of Sidra Incident

Middle East

Iran (1980) – Operation Eagle Claw

Iran (1987–1988) – Operation Praying Mantis

Lebanon (1982–1983) – Multinational Force in Lebanon

Persian Gulf (1984) – Shot down Iranian fighter planes over Gulf

Persian Gulf (1987–1988) – Operation Earnest Will

Persian Gulf (1988) – Operation Praying Mantis

Saudi Arabia (1990) – Assisted Saudi Arabia against Iraq

Sinai (1982) – Multinational Force and Observers

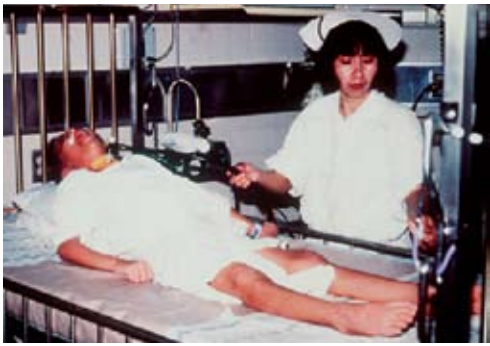
Other

Philippines (1989) – Assisted the Acquino government against a coup

Infectious Diseases of Military Significance

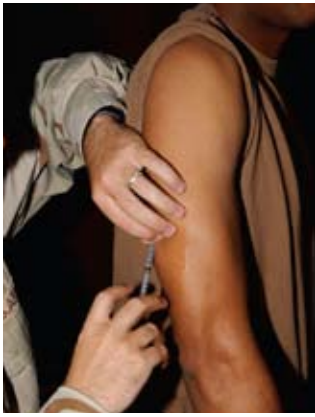
The Military Infectious Diseases Research Program focuses on prevention, diagnosis, and treatment of naturally occurring disease-causing microorganisms with major potential to reduce mission effectiveness. The discovery and development of vaccines are a priority of this program and to the associated laboratories within USAMRMC.

U.S. military physicians and researchers have collaborated in the development of eight U.S.-licensed vaccines since 1934 when product efficacy requirements were added to product safety requirements mandated in 1902. These vaccines include influenza (1945); rubella (1969); adenovirus types 4 and 7 (1980); meningococcus A,C,Y, and W-135 (1981); hepatitis B (1981); oral typhoid (1989); Japanese encephalitis (1992); and hepatitis A (1995).



In the 1980s, the reaffirmation of tropical deployments led to an increase in focus on infectious diseases including Japanese encephalitis, malaria, hepatitis A, HIV/AIDS (human immunodeficiency virus/acquired immunodeficiency syndrome), leishmaniasis, Korean hemorrhagic fever, leptospirosis, scrub typhus, and ebola at numerous USAMRDC laboratories including, but not limited to, WRAIR, AFRIMS, USAMRU-K, the U.S. Army Medical Research Unit-Brasilia, and the U.S. Army Medical Research Unit-Republic of Korea (USAMRU-ROK) as well as activities of the U.S. Military HIV Research Program (USMHRP).

U.S. military medicine provided many major contributions to human immunization in the 1980s. WRAIR and AFRIMS worked together throughout the 1980s on a Japanese encephalitis vaccine that was licensed by the FDA in 1992. Studies on visceral and cutaneous leishmaniasis were successfully performed at WRAIR, USAMRU-K, and the U.S. Army Medical Research Unit-Brasilia with assistance from the U.S. Army Medical Materiel Development Activity (USAMMDA).



As introduced in Chapter 2, WRAIR was working on vaccines for malaria. In 1982, WRAIR immunologists began work to develop the world's first promising malaria vaccine, a pre-erythrocytic vaccine candidate named RTS,S/AS02A.

Japanese Encephalitis

Japanese encephalitis is a mosquito-transmitted viral disease. It is characterized by flu-like symptoms that start to occur approximately 1 week after transmission and can advance into confusion, agitation, serious brain infection, and coma. There is no specific treatment other than managing the symptoms.

The United States first experienced Japanese encephalitis outbreaks near Okinawa, Japan, in 1945. Larger outbreaks among American Soldiers were identified in Southeast Asia in the late 1940s, 1950s, and 1960s with intermittent outbreaks occurring after that time.

In the early 1980s, a military and diplomatic need for a Japanese encephalitis vaccine led researchers at the Armed Forces Research Institute of Medical Sciences (AFRIMS), Walter Reed Army Institute of Research, and the U.S. Army Medical Materiel Development Activity (USAMMDA) to advance a vaccine that was originally developed in Russia in 1943. In 1988, AFRIMS and USAMMDA published the results of a large (60,000 volunteers), complex, and successful Phase 3 clinical trial on this vaccine. The Japanese encephalitis vaccine produced by the U.S. Army Medical Research and Development Command was fully licensed by the U.S. Food and Drug Administration in 1992.

In 1985, a formalin-inactivated hepatitis A vaccine named Havrix® was tested at WRAIR, AFRIMS, and USAMMDA. A large Phase 3 efficacy trial (40,000 volunteers) conducted in Thailand in 1994 found a protective efficacy effect of 94 percent. This vaccine was licensed in 1995.

HIV was discovered in 1981 with the subsequent identification of AIDS, a related condition, as a serious public health threat. USAMRDC alerted the DoD to the threat HIV posed to the U.S. Army, and in October of 1985, the U.S. military began routinely testing enlistees for military service for serologic evidence of infection of HIV-1. In response to increasing public concern regarding the disease, Congress mandated the DoD lead agency for an AIDS research program to supplement and enhance the existing national AIDS program. Then Secretary of Defense Caspar Weinberger designated USAMRDC as the lead agency for the program under the guidance of the Assistant Secretary of Defense for Health Affairs.

The original program consisted of five areas of research: (1) the progression of disease; (2) improved diagnostic methods, for example, assays; (3) the epidemiology in the military population; (4) a military center to test therapeutic drugs in cooperation with the Public Health Service; and (5) the evaluation of vaccines and the conduct of clinical trials. The original mission of USMHRP was to develop accurate and sensitive screening tests and a globally effective HIV vaccine. USMHRP resides at the Division of Retrovirology of WRAIR with support from USAMRU-K and AFRIMS.

In 1988, USAMRU-ROK was established as a Special Foreign Activity of WRAIR to study febrile diseases of military importance, especially Korean hemorrhagic fever, leptospirosis, and scrub typhus to identify specific risk factors for these diseases and recommend preventive measures.

Leishmaniasis

Leishmaniasis is a persistent public health threat to U.S. military personnel deployed in tropical and semitropical regions such as those that were gaining in military importance in the 1980s. It is a parasitic disease transmitted by sand flies that presents as visceral, cutaneous, or mucocutaneous. Leishmaniasis infection is characterized by skin sores with potential for fever, damage to the liver or spleen, and anemia. In its long and not very distinguished history, it has been known by many names: Orient Boils, Jericho Buttons, kala azar, black fever, sandfly disease, Dum-Dum fever, espundia or, most recently, Baghdad Boil.

International Walter Reed Army Institute of Research units including the U.S. Army Medical Research Unit-Kenya (USAMRU-K) and the U.S. Army Medical Research Unit-Brasilia (USAMRU-Brasilia) spent much time in the 1980s working on leishmaniasis. In 1979, USAMRU-K established a new program with the Kenya Institute of Medical Research to study visceral leishmaniasis. In 1980, USAMRU-Brasilia began vector and host studies of cutaneous leishmaniasis in the state of Bahia.

U.S. Army Medical Research Unit-Republic of Korea (USAMRU-ROK) Seoul, Korea

History: USAMRU-ROK was established as a Special Foreign Activity of the Walter Reed Army Institute of Research (WRAIR) in 1988 to study febrile diseases of military importance present in Korea. The technology base was drawn largely from the U.S. Army Medical Research Institute of Infectious Diseases. In addition, the unit provided support to the Eighth U.S. Army and to units that deployed to the Republic of Korea. Funding was provided partially by WRAIR and largely through a grant to Korea University. The laboratory was an old warehouse that was renovated into a fully functional modern laboratory including construction of state-of-the-art biosafety level 3 modules in 1 year's time. During that same period, the personnel rose from 3 people to 21 U.S. and Korean personnel. The unit also supported the 121st Evacuation Hospital and the Capital Armed Forces General Hospital (ROK) by testing sera from patients for diseases of interest, and it supported deployed forces by trapping suspected rodent hosts in areas of planned deployment and testing them for the presence of human pathogens. In 1992, funding constraints caused a planned field trial of Hantavax to be abandoned; however, disease surveillance continued. When it became clear that funding constraints were even more severe than originally anticipated, it was decided that the new cooperative agreement with Korea University would be terminated on its first anniversary, 15 February 1993, and the laboratory was closed.

Mission: To study febrile diseases of military importance especially Korean hemorrhagic fever, leptospirosis, and scrub typhus to identify specific risk factors for these diseases and to recommend preventive measures.

Historical Highlight: The unit conducted several field studies including a case control study to evaluate risk factors on the three main diseases of interest and a study to evaluate the risk of Japanese encephalitis in military working dog handlers.

Between 1989 and 1990, USAMRIID was called upon to assist a commercial laboratory in Reston, Virginia, that was experiencing a mysterious illness killing primates. USAMRIID scientists isolated an Ebola-like virus later termed "Ebola Reston," and a USAMRIID team decontaminated the laboratory. There was no spread to personnel, local residents, or the environment.

Medical Materiel Development and Fielding

As evidenced by the many successful products in infectious disease research in the 1980s, USAMMDA has been an integral component of USAMRMC since its inception in 1984.

U.S. Army Medical Materiel Development Activity (USAMMDA)
Fort Detrick, Maryland

History: USAMMDA was established as a Command Activity (provisionally in 1984 and approved by the Office of the Surgeon General in 1985). It is a subordinate activity of the U.S. Army Medical Research and Materiel Command (USAMRMC) of the U.S. Army Medical Command. In 1987, USAMMDA created the Mission Area Materiel Plan, in conjunction with the U.S. Army Medical Department (AMEDD) Center and School and the U.S. Army Medical Materiel Agency (USAMMA), to identify and prioritize funding for advanced development and fielding of the most promising medical products. As the designated Program Manager, Combat Medical Systems, it develops and fields medical products for the U.S. Armed Forces in conjunction with the AMEDD Center and School (the combat developer), USAMMA (the logistician), and other service input.

USAMMDA's work includes equipment for the diagnosis, treatment, and evacuation of combat casualties and the development of prophylactic and therapeutic drugs and vaccines to protect and treat U.S. warfighters against infectious diseases or chemical/biological warfare threats. USAMMDA has been able to achieve its success through partnerships with industry, academia, and other government agencies.

In 1992, due to Base Realignment and Closure, the U.S. Army Biomedical Research and Development Laboratory medical materiel development mission was incorporated into USAMMDA's Applied Medical Systems Project Management Division.

Mission: To develop and manage medical materiel to protect and sustain the warfighter on point for the nation.

Historical Highlight: USAMMDA developed and employs a Decision Gate model to apply proven business techniques to USAMRMC programs to conserve resources and speed medical products to all U.S. forces. This effort was designed to more effectively bridge the gap from research and development to advanced product development.

Products Developed in the 1980s

USABRDL was very active in the 1980s in occupational and environmental health surveillance and environmental health technology. USAMMDA assisted with development and management of the advanced development of these products. Some of the many accomplishments by USABRDL with USAMMDA's assistance are listed as follows.

Products Developed in the 1980s

1981 – Definitive keystone research completed on *Bacillus thuringiensis* var. *israelensis (Bti)*, a selective biological insecticide for control of immature black flies. This research resulted in the labeling of *Bti* by the U.S. Environmental Protection Agency for control of black flies.

1982 – Steam Vacuum Pulse Sterilizer System (SVPSS). The SVPSS incorporates new technologies to enhance the steam sterilization process, increases throughput capacity, and minimizes power and water consumption. It is a microcomputer-controlled, automatic steam sterilizer designed to provide sterilized instruments, linens, and solutions for field hospitals.

1982 – Field Optometry Set. The new design is easy to assemble without tools and is packed into five containers along with optometry components. The optometry set consists of 44 line items of supplies and equipment to provide a functional workstation for optometric procedures.

1982 – Aid Bag. The new bag was a trifold with six separate compartments for medical supplies plus a separate pocket for medical report cards. It had a carrying handle, a shoulder strap, and a backpack harness. It was made of a breathable water repellent nylon with a lightweight rubberized overbag to protect against chemical warfare agents and for use in forging streams.

1985 – Special Operations Forces Sterilizer. A rugged, lightweight, aluminum steam sterilizer was created for use by Special Operations Forces medical personnel operating in very mobile, unconventional scenarios.

1987 – Helicopter Slung Pesticide Dispersal Unit (PDU). The new PDU is a rigid, streamlined, fiberglass hopper with a dorsal fin for flight stability. It allowed for the aerial dispersal of both liquid and solid pesticide by helicopter.

1987 – Water Recovery Reuse System. The stand-alone unit was designed for the Army field sterilizer and condenses exhaust steam for the sterilizer into hot water and returns it to the boiler on demand.

1989 – Lightweight, Portable Scrub Sink. The new lightweight, portable sink featured improved pump and heater reliability, improved maintainability, and a 60-percent reduction in weight.

Occupational and Environmental Stress

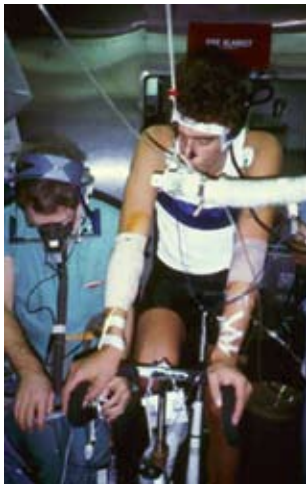
Numerous occupational and environmental factors influence a Soldier's performance ability in continuous and sustained operations including nutrition, hydration, heat, cold, altitude, fatigue, and combat stress. The 1980s decade saw many limited, rapid deployments to high-stress, tropical environments. Given advances in communications, logistics, and weapons technologies, the U.S. Army was also preparing force readiness to be able to sustain longer and more continuous operations of large deployments. In this decade, USAMRDC was active with research programs in preventive medicine to address these occupational and environmental factors. The main contributing laboratories to this research were USARIEM, USAARL, and WRAIR.

Military Nutrition

In 1917, the Office of the Surgeon General established a Nutrition Division for the purpose of nutrition research in the Army. The mission of this division was to conduct surveys at Army Camps to determine the actual consumption and wastage of foods and evaluate the ration to determine if it provided the proper amount and distribution of nutrients to support the requirements of the Soldier. This remains an important part of military nutrition studies, and the program has advanced in preceding years as it has moved from Washington, DC, to laboratories in Chicago, Denver, San Francisco, and to its current location at the U.S. Army Research Institute of Environmental Medicine in Natick, Massachusetts. This is also the location of the U.S. Army Natick Research, Development, and Engineering Center with the mission, among others, to develop novel packaging for rations and to ensure palatability.

USARIEM is the USAMRDC leader in environmental medicine. The Health and Performance Division conducted research in the 1980s on the interactive effects of environmental stress, nutrition, physical fitness, and the demands of Army operations on psychological functioning, operational effectiveness, and the health and morale of Army personnel.

The Military Nutrition Division was formed at USARIEM in 1984 in response to a research initiative and a formal mission. Nutrition research in the 1980s at USARIEM included defining nutritional standards for operational rations, developing nutritional strategies to support and enhance military performance during sustained operations in all extremes, and evaluating the effects of rations on health, nutritional status, and performance. The division also conducted field trials on a cold-weather ration and a lightweight ration for special operations.



Heat strain and hydration were important topics at USARIEM in the 1980s, and research was directed at the prevention, diagnosis, and treatment of heat cramps, heat exhaustion, and stroke. USARIEM developed Army doctrine for water consumption and work–rest cycles under various conditions of heat and humidity. Heat acclimation to promote combat effectiveness and reduce casualties was also studied extensively. In contrast to the Heat Research Division at USARIEM is the Cold Research Division. As discussed in Chapter 3, USARIEM at its Pikes Peak laboratory and other locations continued to conduct ongoing research on the pathogenesis, treatment, and management of major cold injuries of trench foot, frostbite, and hypothermia. The Altitude Research Division conducted basic and applied research in the 1980s on problems encountered by military personnel exposed to acute and long-term subnormal levels of oxygen, such as those associated with high terrestrial elevations, confined areas of operation, or artificial breathing apparatus.

WRAIR, USAARL, and USARIEM had strong sleep and fatigue research programs in the 1980s. Some of this research was tied to the altitude research performed at USARIEM. Sleep and fatigue both focused on the deleterious performance effects of sustained or continuous operations and rapid reversals of sleep and rest cycles with specific emphasis on pilots and flight crews. There were three main lines of research in this area: (1) activity/rest rhythm of personnel participating in extended operations, (2) studies on the neurobiology of sleep and waking including the determination of physiological and psychological correlates of fatigue for the assessment and prediction of performance degradation, and (3) the effects of behavioral and pharmacological ways to increase the recuperative value of sleep during continuous operations and to sustain Soldier effectiveness when no sleep is possible. Pharmacological means studied included benzodiazapines (i.e., triazolam), imidazopyridines (i.e., zolpidem), and the hormone melatonin.

The sleep research at USAARL was designed specifically for pilots and flight crews and the special rigors that they endure in terms of sleep and fatigue in continuous operations.

Combat and Operational Stress and Unit Cohesion

Lessons learned from history demonstrate that combat and operational stress is influenced by numerous factors including, but not limited to, personal and family morale, leadership, and interpersonal relationships in terms of unit cohesion, group identification, and group support. Brigadier General S.L.A Marshall stated it well in his 1947 book, *Men Against Fire*: "I hold it to be one of the simplest truths of war that the thing which enables an infantry

soldier to keep going with his weapons is the near presence or presumed presence of a comrade." The medical and unit response and management of stress symptoms and the combat stress casualty response can strongly affect the recovery process of individual Soldiers and units. This requires unit leadership to balance concern for mission completion with regard to unit cohesion and morale.

Evolution of Military Neuropsychiatric Casualty Terminology

Neuropsychiatric casualties have been referred to by numerous names in the history of combat in the United States. The Surgeon General of the Union Army during the Civil War termed it "nostalgia." It was first officially recognized in WWI when casualties were attributed to "shell shock" and suspected neurological injury. By WWII, these symptoms were recognized even in Soldiers who had not been exposed to artillery fire, and symptoms were attributed to "combat fatigue" and "combat exhaustion." Many neuropsychiatric casualties in the Korean War were primarily attributed to brainwashing techniques of prisoners of war by the opposition leading to what was termed at the time, "zombie reaction." Substance abuse and delayed stress reactions (post-traumatic stress disorder) were identified during the Vietnam War. Combat stress in the late 1980s was re-termed "battle fatigue."

Prior to 1981, the U.S. Army used the Combat Arms Regimental System to replace deployed Soldiers on an individual basis. In 1981, the Army replaced this system with a new manning system that utilized unit rather than individual replacement. This Unit Manning System consisted of two parts: the U.S. Army Regimental System and the COHORT (Cohesion, Operational Readiness, and Training) Unit Movement System. In 1979, WRAIR psychologists played a major role in developing the Unit Manning System, and following the implementation of this system, many USAMRDC laboratories, including WRAIR, USAMRU-E, and the U.S. Army Medical Research Unit-Fort Bragg, played large parts in implementing and evaluating the system.

One of the main reasons for the Unit Manning System was to improve unit cohesion in the U.S. Army. Numerous laboratories at USAMRDC assisted in studies and data analysis to prove the connection between unit cohesion and increased Soldier and family morale. Although the natural tendency of leadership was to "fill spaces with faces," studies at USAMRDC established that keeping small preformed groups of between four to eight Soldiers together provided a powerful and inexpensive technique to reduce stress and improve psychological health.

Boys in the Barracks

L.H. Ingraham and F.J. Manning performed a landmark study of drug use in the U.S. Army from 1973 to 1974 that was published in May 1979 as an article in the *Army Times* and in 1984 as a book titled, *Boys in the Barracks: Observations on American Military Life.* Their research suggested that drugs were being used in dysfunctional or relatively inactive units of the military as a means to bond, build trust, and create a sense of comradeship in a constantly changing group environment. This study and the resulting publications were very influential to the psychological initiatives enhancing unit cohesion in the 1980s.

It is well recognized and documented that too much combat and operational stress is not good for the Soldier, but USAMRU-E performed research that concluded that not only is too little engagement not good for the Soldier but that some stress can actually have very positive outcomes. This phenomenon has been coined "posttraumatic growth" by the psychiatric community and is characterized by positive outcomes in the aftermath of stressful or life-threatening situations. These can include enhanced self-reliance and empathy, development of new and improved coping skills, better relationships with family, increased personal strength, and appreciation for life to name a few. USAMRDC contributed research in the 1980s and beyond to determine how to maximize posttraumatic growth.

Effect of Spouses on Soldier Performance and Morale

A Soldier's personal and family morale has always been a very important aspect of psychological health, and spouses are an important factor in the medical readiness of a Soldier. There are numerous reasons for this, including that as of 1991, more than half of the deployable Soldiers in the U.S. Army were married, family issues can be important areas of life stress as well as life satisfaction, and it is known that all stress is cumulative.

Ongoing studies in the 1980s found that Soldiers' spouses were a very important part of a Soldier's psychological health and morale. A spouse's attitude about a Soldier's unit leadership directly impacts morale, and a Soldier's decision to re-enlist is strongly based on a spouse's attitude toward the U.S. Army, which is highly related to small-unit behavior. In addition to studies and conclusions drawn from the Unit Manning System, research into small-unit behavior and its interactions with families led to policy changes including attempts to ensure predictable schedules for personal and family well-being.

Since 1986, USAMRU-E has had a strong interest in military family topics. This research has examined financial stress and quality of life for Soldiers and families living in Europe. One study demonstrated that most adolescent family members make a successful adaption to overseas life given a number of important factors to facilitate adjustment. The U.S. Army Medical Research Unit-Fort Bragg also had research programs that were designed to identify and describe psychosocial detractors of deployment readiness. These studies commonly examined data on unit cohesion, perceived unit stressors, burnout, bonding, leadership, marriage, family, and community support.

U.S. Army Medical Research Unit-Fort Bragg (USAMRU-FB)
Fort Bragg, North Carolina

History: In January 1984, USAMRU-FB was established to address medical issues of units within the XVII Airborne Corps that may impede deployment readiness. Special emphasis was placed on behavioral and psychological consequences of stress. Research programs were driven primarily by corps and division-level units at Fort Bragg for studies to identify and describe psychosocial detractors of deployment readiness. The unit then redefined each request into a research format and tailored a questionnaire to provide answers to commanders' questions. The unit was aligned with the Division of Neuropsychiatry at the Walter Reed Army Institute of Research before being transferred to the U.S. Army Research Institute of Environmental Medicine.

Mission: To develop and execute research protocols examining current health problems identified by the XVII Airborne Corps units or the Walter Reed Army Institute of Research that may impede deployment readiness.

Historical Highlight: Studies that were conducted commonly examined data on unit cohesion, perceived unit stressors, burnout, bonding, leadership, marriage, family, and community support.

Summary

Many small, simultaneous, rapid deployments around the world occurred during the 1980s that challenged and invigorated USAMRDC. Much was accomplished in the field of infectious diseases including the licensure of four new vaccines and significant progress toward the licensure of two more. Focus was also placed in this decade on the physical and mental health of the Soldier through research in occupational, environmental, and combat stress as well as unit cohesion. The 1980s created a very solid platform for work that would continue in the 1990s at USAMRDC.

Chapter 6

Moving Forward: Growth and Realignment

By the start of the 1990s, the Soviet Union had dissolved and democracy was on the rise. Numerous former Eastern block countries were embracing democratic forms of government and moving toward membership in the European Union and NATO (North Atlantic Treaty Organization).

However, this meant that the United States was the only remaining superpower in the world. In addition to Iraq's invasion of Kuwait (resulting in Operations Desert Shield and Desert Storm), localized conflicts such as those in Haiti, Somalia, and the Balkans prompted the United States to send in troops as peacekeepers. Islamic radicals overseas loudly threatened assaults against the United States for its ongoing military presence in the Middle East and even staged the first World Trade Center attack, a truck bombing in New York's twin towers, killing six people and injuring thousands, in what would become the beginning of terrorist attacks on U.S. soil.

Locations of U.S. Military Involvement in the 1990s

Middle East

- Iraq (1990–1991) – Operations Desert Shield and Desert Storm
- Northern Iraq (Kurds) (1991) – Operation Provide Comfort
- Kuwait (1992) – U.S. assisted Kuwait
- Iraq (1998) – Operation Desert Fox
- Afghanistan and Sudan (1998) – Operation Infinite Reach

Africa

- Somalia (1992–1995) – Operation Restore Hope
- Kenya and Tanzania (1998–1999) – Medical/disaster assistance after bombings of the U.S. Embassies in Kenya and Tanzania

Europe

- Macedonia (1993–1994) – Operation Able Sentry
- Bosnia (1995) – Operation Deliberate Force
- Serbia (1999) – Operation Allied Force

Caribbean and Asia

- Haiti (1993–1995) – Operation Uphold Democracy
- East Timor (1999–2001) – U.S. military assisted with peace restoration

Military Operations

Operations Desert Shield and Desert Storm

During this decade, as in earlier periods of conflict, the military and civilian members of USAMRDC demonstrated why the Command logo was "Research for the Soldier." Not only did the Command produce relevant and needed products and information for the Army and DoD, the military members of USAMRDC also manned multiple teams that deployed to various combat zones to provide both clinical diagnosis and care as well as collecting critical information that would shape future research programs for the AMEDD.

As in nearly every previous conflict and military deployment, disease and injuries not related to battle took a toll on deploying Soldiers. USAMRDC addressed several threats, including environmental and operational, combat casualty care, infectious disease, and chemical and biological, through the use of information packets, newly developed field medical equipment, drugs and vaccines, deployable teams, and other solutions.

Environmental and Operational Threats

USARIEM addressed environmental and other hazards in support of Operations Desert Shield and Desert Storm by publishing *A Pocket Guide to Environmental Medicine for Operations in Southwest Asia* in December 1990 in response to the request of the Deputy Chief of Staff, Personnel, Headquarters, Department of the Army (Army, DCSPER). Designed to fit in battle dress uniform pockets, the guide addressed medical problems caused by heat, cold, dust, sand, wind, stress, and other hazards expected to be

encountered by forces in Southwest Asia. It offered concise advice on first aid and buddy aid and a summary of key points and reminders for surviving and functioning effectively in the desert and was shipped directly to Army units deployed in Southwest Asia. Copies were also provided to the U.S. Marine Corps for distribution to deployed Marine units and to the British embassy for distribution to British Army units.

This guide, intended for use by small unit commanders, provided environmental and preventive health advice in an easy-to-read format. Some extremely valuable information was provided, including recommended water intake of up to 4 gallons per Soldier per day and the "weak link" rule, which says that the first heat casualty indicates that the unit is near its limit, and more casualties will follow unless there is an immediate break for rest and rehydration.

Also at the request of the Army, DCSPER, USAMRDC dispatched teams of research psychologists to Southwest Asia to assess the psychological well-being of deployed Soldiers. These teams visited deployed units to survey Soldiers individually and in small groups to identify causes of stress and possible ways to minimize stress. The work of these teams was a critical step in the recognition that combat stress has a negative impact on entire unit functioning and not just on specific individuals.

In addition, a work/sleep cycle evaluation team accompanied combat aviation units from the 101st Airborne Division into Iraq to measure sleep quantity and quality and to advise commanders on avoiding performance decrements due to sleep loss. A primary result of these efforts was a series of recommendations to the leadership intended to minimize stress-related performance deterioration.

Operations Desert Shield and Desert Storm (1990–1991)

History and Geography: Although the modern state, the Republic of Iraq, is quite young, the history of the land and its people dates back more than 5,000 years. Iraq contains the world's richest known archaeological sites. In ancient Mesopotamia, the world's first civilization, Sumar, appeared in the Near East.

Operation Desert Shield: "On the morning of 2 August 1990, the mechanized infantry, armor, and tank units of the Iraqi Republican Guard invaded Kuwait and seized control of that country. The invasion triggered a U.S. response, Operation Desert Shield, to deter any invasion of Kuwait's oil-rich neighbor, Saudi Arabia. On 7 August, deployment of U.S. forces began. United Nations Security Council Resolutions 660 and 662 condemned Iraq's invasion and annexation and called for the immediate and unconditional withdrawal of Iraqi forces. On 20 August, President George Bush signed National Security Directive 45, 'U.S. Policy in Response to the Iraqi Invasion of Kuwait,' outlining U.S. objectives, which included the 'immediate, complete, and unconditional withdrawal of all Iraqi forces from Kuwait,' and the 'restoration of Kuwait's legitimate government to replace the puppet regime installed by Iraq.'"

Operation Desert Storm: "A United Nations ultimatum, Security Council Resolution 678, followed on 29 November. It stipulated that if Iraqi dictator Saddam Hussein did not remove his troops from Kuwait by 15 January 1991, a U.S.-led coalition was authorized to drive them out. Early in the morning of 17 January, the U.S.-led coalition launched air attacks against Iraqi targets. On 24 February, coalition ground forces begin their attack. On 27 February, Kuwait City was declared liberated, and with allied forces having driven well into Iraq, President Bush and his advisors decided to halt the war. A cease-fire took effect the following morning."

Richelson JT. http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB39/.

Combat Casualty Care

Operations Desert Shield and Desert Storm resulted in very few combat casualties. Because of this, the Combat Casualty research program served primarily in an advisory role. Because the Army Burn Center at USAISR was/is the DoD premier research and clinical center for the treatment of burn casualties, teams from USAISR were mobilized to provide a readily available treatment if burn casualties materialized.

Three burn care teams from the Army Burn Center of USAISR deployed to Saudi Arabia. One team deployed to King Khalid Military City where it treated coalition forces,

civilians, and enemy prisoners of war. A second team set up in Riyadh to treat U.S. headquarters forces. The third team deployed to Dharan just in time to treat victims of the barracks scud attack.

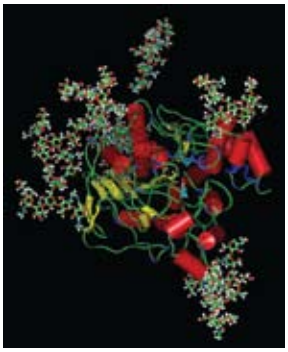
Infectious Diseases and Vaccines

Researchers at WRAIR were called upon very early in Operation Desert Shield to provide information about the infectious disease threats in the region for the preventive health officers assigned to military units. They responded with a detailed pamphlet describing 19 types of infectious diseases found in Southwest Asia. This was distributed to all preventive health officers in deploying units and proved invaluable for identification and protection against these problems.

Vaccines are important for force health protection and are valuable tools in protecting Soldiers from disease. Vaccines act as pretreatments, stimulating the body's defenses against possible future exposure to infectious diseases. Disease threats to deployed Soldiers come from consuming contaminated food or water, from the bite of an infected insect, or from contact with infected persons. USAMRDC scientists worked to develop new generations of vaccines to protect against malaria, hepatitis, anthrax, and smallpox as well as a multi-antigen vaccine for protection of Soldiers from multiple agents with just one shot or tablet.

An essential element of casualty management and disease control is accurate and speedy diagnosis of infectious diseases. Both WRAIR and USAMRIID developed highly specific, easy-to-perform laboratory tests for several infectious diseases found in the Middle East. These tests were used in Army and Navy clinical laboratories in Saudi Arabia, Egypt, and Europe to define the disease risks and provide valuable information to health care providers. Six laboratory teams received training and diagnostic supplies and equipment at USAMRIID before deploying to provide medical laboratory support.

Chemical and Biological Defense



From the very beginning of Operations Desert Shield and Desert Storm, the DoD and the mass media acknowledged the potential threat of both chemical and biological weapons. Iraq had previously used chemical weapons against both internal and external foes. The Iraqi military had used vesicant and nerve agents against Iranian soldiers during the Iran–Iraq War. It had also used these agents and others against the Iraqi Kurds during their uprising against Saddam Hussein. Pre-war intelligence indicated that the Iraqi military still possessed these weapons and was capable of using them. However, not all of the necessary medical chemical and biological countermeasures had been approved by the FDA prior to Operation Desert Storm. The DoD formally requested that the FDA waive the informed consent rule for medical chemical and biological defense products. In response to the DoD's request, the FDA approved the waiver for botulinum toxin administration on 31 December 1990 and the waiver for pyridostigmine bromide in January of 1991. USAMRDC's Human Use Review and Regulatory Affairs Office maintained constant contact with the FDA during Operations Desert Shield and Desert Storm to ensure compliance with all regulatory standards.

As noted in previous chapters, the safe and ethical testing of chemical and biological defense products was a focus of USAMRDC since these missions were transferred to the Command in the 1970s. The Gulf War brought renewed consideration of the role that animal data must play in the approval to use both chemical and biological medical pretreatments and treatment compounds. Although not formally accepted, a concept similar to the animal efficacy rule had been utilized by USAMRDC from 1964 to 1987 through Memoranda of Understanding between the DoD and FDA; these Memoranda of Understanding allowed the DoD to test products on animal models and use surrogate efficacy data in humans to compare to the analogous data in animals to see if correlates of protection could be ascertained. After 1989, the FDA began requiring all of the DoD's IND products to be under clinical research protocols; this proved morally impossible to implement for bioterrorist threats and infectious diseases with severe consequences and high mortality rates such as those that potentially faced Soldiers deployed in Operations Desert Shield and Desert Storm. This was resolved during the

war with the granting of the informed consent waivers discussed previously but did not solve the problem going forward. In 1994, the DoD asked the FDA for a blanket animal efficacy rule and a contingency licensure to allow the DoD to use its IND products in any emergencies (wars or bioterrorist events). In 1997, the FDA responded with a draft animal efficacy rule. The rule was put out for public comment in 1999 and was ultimately used to license ciprofloxacin, the antibiotic used in the anthrax events of 2001, and to license pyridostigmine bromide for use in the mitigation of nerve agent exposure in the early phase of Operation Iraqi Freedom. Essentially the animal rule as finalized by the FDA allows the use of well-characterized animal models as a surrogate for human efficacy testing where there is no available vaccine or treatment against the compound or disease in question.

Each U.S. warfighter deployed in Operations Desert Shield and Desert Storm was issued four types of medical protection against chemical warfare agents. All four were products of the Medical Chemical Defense research program with significant basic research conducted at USAMRICD at Aberdeen Proving Ground, Maryland, and product development supported by USAMMDA at Fort Detrick, Maryland.

Pyridostigmine was identified in the mid-1980s as an effective pretreatment for nerve agent exposure. When taken prior to nerve agent exposure, the pretreatment enhanced the effectiveness of the antidote drugs. As mentioned previously, although pyridostigmine had not been approved yet in 1990 by the FDA for pretreatment of nerve agent exposure, the FDA did approve a waiver of informed consent during January 1991 for its use during Operation Desert Storm. This meant that it could be used by the U.S. military as if it were an FDA-approved product. Commanders could order its use when the operational situation warranted. Packets were issued to all Soldiers in the theater with instructions to take one pill three times a day upon instructions from their commanders.

Second, the Mark I Nerve Agent Antidote Kit (NAAK) consisted of two autoinjectors, one containing atropine, a drug that interrupts the activity of chemical nerve agents, and a second that contains 2-PAM (2-pralidoxime chloride), a drug that restores normal nerve function. Soldiers were issued three NAAKs with instructions to self-administer the first kit upon the first symptoms of nerve agent exposure. Although these compounds would provide effective treatment against nerve agent poisoning, they would not stop the convulsions resulting from nerve agent exposure.

Third, Convulsant Antidote Nerve Agent (CANA) is the anticonvulsant drug diazepam in a disposable autoinjector. This product was developed by USAMRICD in the 1980s, and USAMMDA worked with the FDA for approval. CANA went into full production in 1990. CANA was intended to supplement the effects of the NAAK by reducing/terminating convulsions and facilitating recovery. Unlike other medical chemical defense items, the CANA was not to be issued to Soldiers until there was a threat of nerve agent exposure. In addition, it was not intended for self-administration. Because it was only to be used when convulsions had begun, directions were to administer to a fellow Soldier when he/she began to have convulsions. Unlike pyridostigmine, the CANA was intended for treatment rather than for pretreatment.

Finally, all deploying Soldiers were issued a chemical agent skin decontamination kit. Prototypes of this kit had been subjected to numerous tests throughout the 1980s. The successful skin decontamination kit, M291 Skin Decontamination Kit, was developed at USAMRICD in 1989 and fielded in 1991 by USAMMDA. Each kit contained six individual decontamination packets, enough for three complete skin decontaminations. It was designed to remove, absorb, and neutralize toxic agents.

There was also a significant concern that the Iraqis might try to use biological weapons against U.S. forces. After the war, United Nations inspectors determined that the Iraqis had an active research program on the offensive use of *Bacillus anthracis*, botulinum toxins, and *Clostridium perfringens*. As a result of intelligence, in December 1989 during the build up for Operations Desert Shield and Desert Storm, the FDA approved a waiver of informed consent for the use of anthrax immunization vaccine products for the military. Because virtually none of the deployed troops had received even one of the six shot regimens and the anthrax vaccine required specific cold-chain custody, special immunization teams accompanied shipments of the anthrax vaccine to the theater of operations. The teams were responsible for ensuring proper handling of the vaccines in the medical logistics system and for advising and assisting medical personnel who helped administer the vaccines to up to 10,000 Soldiers per day.

Products Developed

USAMRDC laboratories responded to the needs of warfighters with a wide variety of medical products ranging from drugs and vaccines to medical diagnostics and information products. In addition to the products given to deployed warfighters, several other noteworthy products were also fielded during the 1990s. Additionally, the basic research conducted at the Command laboratories in the 1990s led to products of the new millennium.

Drugs, Vaccines, and Diagnostics

Licensed Vaccines and Drugs

Doxycycline (WRAIR) – This drug was approved for use as an antimalarial in 1992 for treating chloroquine-resistant malaria parasites. It requires daily administration.

Hepatitis A Vaccine (WRAIR, USAMMDA) – This is an inactivated viral vaccine for the prevention of hepatitis A infection. It was the first inactivated viral vaccine against hepatitis A and was completed in 1995.

Japanese Encephalitis Vaccine (WRAIR, USAMMDA) – This is a formalin-inactivated whole-virus vaccine to prevent Japanese encephalitis that was completed in 1992.

Medical Aerosolized Nerve Agent Antidote (USAMRICD, USAMMDA) – This is a pressurized inhaler containing aerosolized atropine, is used to counteract the effects of nerve agents, and was completed in 1994.

Test-Mate Cholinesterase Kit (USAMRICD, USAMMDA) – This kit measures blood enzyme AChE and plasma cholinesterase providing detection of nerve agent exposure in less than 4 minutes. Each kit contains a battery-operated colorimeter, photometric analyzer, and all equipment necessary to perform 96 tests. The kit was approved in 1997.

Investigational New Drug Vaccines and Drugs

Rift Valley Fever Virus Vaccine (USAMRIID, USAMMDA)

Chikungunya Virus Vaccine (USAMRIID, USAMMDA)

Next-Generation Anthrax Vaccine (rPA) (USAMRIID, USAMMDA, JVAP [Joint Vaccine Acquisition Program])

Recombinant Botulinum Neurotoxin Vaccine (USAMRIID, USAMMDA)

Development of First Licensed Clinical Tests for Anthrax, Plague, and Tularemia (USAMRIID)

Field Medical Equipment

Far-Forward Surgical Table (USABRDL, USAMMDA) – A surgical table with accessories was designed for use by the Special Forces and forward surgical teams. It used a standard field litter as the operating platform and was packaged with accessories including surgical lighting, IV poles, armboard, and instrument tray. It could be assembled by one person in 5 minutes without tools.

Portable Surgical Scrub Sink (USABRDL, USAMMDA) – This sink was designed to be lightweight and portable. A collapsible, anodized aluminum frame supported a waterproof fabric basin, and a foot pedal-operated switch and valve assembly controlled water flow from pressurized and nonpressurized sources and temperature through an electric heater. The sink was half the weight volume of the previous field surgical scrub sink.

Decontaminable Folding Field Litter (USABRDL, USAMMDA) – This litter was developed for evacuating battlefield casualties from a chemically contaminated environment. The litter also provided a surface for patient decontamination. Instead of wooden poles and canvas fabric, it was made entirely of polypropylene and was easier to decontaminate than the wood and canvas model. It was lightweight, rugged, stable, and foldable to reduce storage volume. The initial production of this litter was provided in support of Operation Desert Shield.

Handheld X-Ray (USAIDR, USAMMDA) – Dental researchers at USAIDR developed a handheld x-ray system that was used in Operation Desert Storm. With a total weight of 251tl, the suitcase-sized system could be used for dental x-rays or to view limb fractures. It was battery powered and could be recharged from alternating current or from vehicle batteries. A film-less imaging subsystem produced a Polaroid-type self-developing picture.

Extended Duration DEET (LAIR, USAMMDA) – An improved, extended-duration version of the Army's standard bug repellent, DEET, developed by USAMRDC, was used by Soldiers in the desert. The extended-duration version of DEET works for up to 12 hours after application. Insect repellent can also be processed into the battle dress uniform fabric with a kit issued to individual Soldiers.

Ballistic Laser Protective Spectacles (LAIR, USAMRDC, USAMMDA) – Development and fielding of ballistic laser spectacles that protect Soldiers' eyes from low-intensity laser beams used as target designators and range finders. USAMRDC contributed laser bioeffects research and optical correction inserts. These spectacles were valuable in the desert for protecting eyes from wind-blown sand and dust.

By the end of Operation Desert Storm, the Army developed an improved capability to diagnose infectious diseases and operate a clinical laboratory, the Theater Army Medical Laboratory. Staffed with a small permanent cadre of military laboratory officers and technicians, this laboratory was intended to draw scientists and technicians from USAMRDC laboratories when it was deployed and fully staffed. Because it was designed in a modular fashion, the Theater Army Medical Laboratory could complete a range of missions, including the capability for tailored teams and split-base operations. Its missions included laboratory detection of biological, chemical, nuclear, occupational health, and endemic disease threats.

As a result of the lack of knowledge about the treatment of biological warfare casualties, USAMRIID published the first edition of the "Blue Book," *USAMRIID's Medical Management of Biological Casualties Handbook* in 1993. The book is intended to provide concise reading and suggested treatment for biological casualties. This product has been distributed to DoD and civilian health care providers on a gratis basis since its inception.

Since the 1980s, the USAMRICD Medical Management of Chemical Casualties course has trained active duty and reserve health care professionals in techniques for dealing with chemical casualties. As a result of the build up to Operation Desert Storm, in August 1989 instructors began training active and reserve units preparing to deploy. A team was in Saudi Arabia for most of the operation working with medical units on the ground and at sea. This education removed some of the mystery surrounding the chemical threat and emphasized survivability through proper use of protective equipment, doctrine, and medical countermeasures. A similar team was deployed from USAMRIID to teach the Medical Management of Biological Casualties course.

In 1997, the two courses were combined into a week-long Medical Management of Chemical and Biological Casualties course taught at both USAMRIID and USAMRICD. The original purpose of the course was to train active and reserve military health care professionals on biological and chemical medical defense. As the demand for this training grew, USAMRIID began teaching the Medical Management of Biological Casualties course via satellite to federal, state, and local health care workers and first responders.

USAMRAA Support of Operations Desert Shield and Desert Storm

USAMRAA absorbed a surge of purchasing and contracting workload in direct support of Operations Desert Shield and Desert Storm. The vast majority of the purchasing and contracting actions for medical materiel shipped to the overseas theater, amounting to approximately 65 percent of a normal annual workload, was above and beyond the normal mission of the unit. Items purchased included antibiotics and vaccines for biologic defense, skin decontamination kits, chemical agent antidotes, hospital equipment, medical supplies, laser protective aviation spectacles, and ballistic laser protective spectacles for Soldiers.

Somalia

In the 1980s, insurgents in North Somalia broke away from Somalia, proclaimed themselves the Somaliland Republic, and named their own president, Mohammed Ali Mahda. This political dissonance combined with the worst drought in a century led to severe famine and war and left approximately 300,000 Somalians dead. Due to the warring factions, the United Nations was unsuccessful in its initial relief mission. Intensifying clan violence in Somalia in 1992 was exacerbating an already dangerous humanitarian crisis.

Photo above: A military physician looking into the ear of a young Somali boy who is experiencing hearing loss. *(Courtesy of SGT G. Robinson, DefenseImagery.mil)*

Photo at left: A 10th Mountain Division Soldier keeps close watch on a road leading to the intersection he was posted at during a sunset raid on the Somali village of Afgooye during Operation Restore Hope. *(Courtesy of, PHCM Terry Mitchell, DefenseImagery.mil)*

The United Nations Security Council adopted Resolution 794 on 3 December 1992 that authorized the use of "all necessary means to establish as soon as possible a secure environment for humanitarian relief operations in Somalia." The UNITAF (Unified Task Force) U.S. operation began on 8 December 1992. USAMRDC involvement in Somalia led to the publishing of a document by USARIEM and WRAIR titled, *Sustaining Soldier Health and Performance in Somalia: Guidance for Small Unit Leaders* in December 1992. Identical in format to the previously published guidance from Operations Desert Shield and Desert Storm, the material in this pocket guide was tailored to the unique environment of the horn of Africa.

Former Republic of Yugoslavia

USAMRDC, in particular the staffs of USARIEM and WRAIR, also prepared a handbook of preventive medicine and behavioral guidance for unit commanders and noncommissioned officers deploying to the Former Republic of Yugoslavia. The handbook, *Sustaining Soldier Health and Performance in the Former Republic of Yugoslavia: Guidance for Small Unit Leaders*, was published in 1993. Like previous pocket handbooks, it included suggestions for sustainment of health and performance through pre-deployment, deployment, conduct of operations, and re-deployment.

It addressed a broad range of important health issues, including avoiding disease hazards, environmental exposure, managing work–rest cycles, and maintaining Soldier morale in the face of destruction and human suffering. This guidance drew heavily upon knowledge and experience gained by USAMRDC medical researchers over many years. Physicians, scientists, and technicians obtained this knowledge conducting laboratory research and during field observations of troops deployed around the world for training, peacekeeping, and combat operations.

The guide made the Command's "lessons learned" available to unit commanders in a small, easy-to-read format. This guide was designed to help unit leaders accomplish the mission by providing information on how to sustain Soldiers' health and fitness while deployed to the Former Republic of Yugoslavia. It provided an aid to identify anticipated health hazards and described some actions that could be taken to minimize the effects of these hazards.

Operation Able Sentry (1993–1995)
USAMRDC Support to the Federal Republic of Yugoslavia

History and Geography: The Former Federal Republic of Yugoslavia has undergone numerous name changes and has been divided by factional and religious differences for hundreds of years. After WWII, religious, ethnic, and nationalistic tensions were held in check by the Yugoslavian government. After 1991, Yugoslavia divided into five countries: Croatia, Macedonia, Slovenia, Bosnia-Herzegovina, and Serbia-Montenegro. Over four million people were displaced by the civil war. The conflict and turmoil disrupted treatment, sanitation, and basic public health systems.

Operation Able Sentry: The adoption of United Nations Security Council Resolution 721 on 27 November 1991 led to the establishment of peacekeeping operations as the old Socialist Federal Republic of Yugoslavia transitioned into the Federal Republic of Yugoslavia. U.S. military involvement started with Operation Able Sentry in July 1993 with a mission to monitor and report destabilizing or threatening activity on the border between the former Yugoslavia Republic of Macedonia and Serbia.

U.S. military personnel were extremely susceptible to disease, accidents and non-battle injuries, food and water contamination, climate and terrain, ticks and biting insects, pollution, and psychological stress created in part by operating in an environment where it was difficult to identify friend or foe.

The Realignment of the Command

Although still a Field Operating Agency of the OTSG, the Headquarters, USAMRDC had grown from the small staff of 32 military personnel and civilians in 1958 to an authorized strength of 58 military personnel and 89 civilians by the end of the 1980s.

Since 1958, the Headquarters of USAMRDC had evolved with certain scientific staff focusing on specific research areas. Ultimately the research program staff was organized into Research Area Directorates (RADs). The Commanding General, USAMRDC, delegated the RDT&E planning, budgeting, and management responsibilities to each Research Area Director who, with the subordinate laboratory commanders, were responsible for overall staff management of the medical RDT&E program. From the time USAMRDC moved from Washington, DC, to Fort Detrick, Maryland, in 1978 until the 1990s, there were a total of four RADs: Military Disease Hazards (RAD 1), Combat Casualty Care (RAD 2), Army Systems Hazards (RAD 3), and Combat Dentistry (RAD 4). Medical Chemical Defense (RAD 5) was added when USAMRDC added medical chemical defense and USAMRICD to the Command mission in 1979. At this time, medical biological defense was included under RAD 1 since the majority of biological threats was considered to be infectious disease. In 1987, RAD 4, Combat Dentistry, was disestablished, and the mission subsumed under Combat Casualty Care (RAD 2) as the dental research funding level and program content did not warrant separate RAD funding. In 1995, the Medical Chemical and Medical Biological research programs were combined into a single research area (RAD 4). This coincided with the movement of medical chemical and biological funding from Army funding lines to defense funding lines with the Army remaining as executive agent. In 2007, RAD 4 (Medical Chemical Biological Defense) was changed to the Partnership Support Directorate to reflect the fact that the Defense Threat Reduction Program had assumed responsibility for planning, programming, and budgeting for the Medical Chemical and Biological Defense research programs although the executing laboratories remained a part of USAMRMC.

The Army via execution by USAMRMC serves as the executive agent or lead agency for many research areas. USAMRMC executes the DoD lead agency functions for infectious diseases, combat dentistry, and military HIV research. USAMRMC also carries out the Army's executive agency functions for military nutrition.

The relatively stable USAMRDC laboratory and Headquarters organization of the 1980s began a massive transformation and evolution as a result of

the Base Realignment and Closure (BRAC) process. A total of three of the Command's nine laboratories were ultimately closed with the realignment of several programs. In the first BRAC process in 1988, the Presidio of San Francisco, home of the Letterman Army Institute of Research, was recommended for closure. The process of disestablishing the institute began in the early 1990s. In September 1992, the Ocular Hazards program departed the Letterman Army Institute of Research and was transferred to Brooks Air Force Base, San Antonio, Texas, to establish the U.S. Army Medical Research Detachment as an element of WRAIR. Approval came in October 1992 to move the Military Trauma research program to USAISR and the Blood research program to WRAIR.

U.S. Army Medical Research Detachment (USAMRD), Brooks Air Force Base, Texas

History: In September 1992, the Division of Ocular Hazards of the Letterman Army Institute of Research relocated from the Presidio of San Francisco to Brooks Air Force Base in accordance with Base Realignment and Closure legislation (BRAC) of 1991, and on 1 October 1992, USAMRD was established at Brooks Air Force Base under the command and control of the Walter Reed Army Institute of Research. The detachment originally consisted of two branches: the Laser Bioeffects Branch, which focused on laser radiation effects, and the Microwave Bioeffects Branch, which focused on radio frequency radiation effects. However, in June 2004, no requirements for biomedical research of biomedical effects of radio frequency radiation were identified, and coupled with a funding shortfall, the Microwave Bioeffects Branch was closed. BRAC 2005 legislation indicated that the detachment would become part of the new U.S. Army Institute of Surgical Research at Fort Sam Houston, Texas, which would then be renamed the Center of Excellence for Battlefield Health and Trauma Research.

Mission: To assure the protection and sustainment of Soldier health and safety in training, combat, and special operations with military laser systems through: Developing medical triage and treatment for laser-induced ocular trauma; assisting in development of far-forward military medical doctrine and procedures for laser environments; determining the cellular and molecular mechanisms of laser-induced injury and repair; augmenting the laser bioeffects database to update safe exposure limits for military laser hazard assessment and eye protection specifications; evaluating and modeling vision and visual performance changes from laser exposure in military scenarios; and developing and maintaining a Laser Accident and Incident Registry.

Historical Highlight: USAMRD's research accomplishments and collaborative efforts since its inception have made Brooks Air Force Base the center for nonionizing radiation hazards research a national resource. No other government, academic, or corporate entity has the physical and organic assets required to conduct this research.

These moves were completed by mid-1993. As a result of the 1991 BRAC, the U.S. Army Institute of Dental Research was disestablished in 1993. It was converted into a detachment of WRAIR and moved from Washington, DC, to be collocated with the Navy Dental Research Institute at Great Lakes Naval Base, Illinois, in 1997. The second BRAC process in 1991 also designated the disestablishment of USABRDL. This occurred during 1992 to 1993. The Field Medical Materiel Development mission was transferred to USAMMDA. The Applied Entomology mission was transferred to WRAIR. The Health Advisories Environmental Fate research program was transferred to the Army Environmental Hygiene Agency, Aberdeen Proving Ground, Maryland. The remaining nonmammalian toxicity and on-site biomonitoring research efforts remained at Fort Detrick, Maryland, but were reassigned as a detachment of USARIEM. This detachment was the inception of the U.S. Army Center for Environmental Health Research (USACEHR). The 1991 BRAC also mandated the move of the Microwave Bioeffects research program from WRAIR to the Air Force's Armstrong Laboratory at Brooks Air Force Base, San Antonio, Texas. In addition, the Navy was mandated to move its infectious disease research program from the Naval Medical Research Institute and collocate it with WRAIR. Thus over a period of a few years, USAMRDC lost one-third of its laboratories as a result of the BRAC process.

As early as 1989, the Headquarters, Department of the Army identified the need to improve the linkage of medical RDT&E (USAMRDC) and medical logistics (USAMMA, the U.S. Army Medical Materiel Center-Europe [USAMMCE], and the U.S. Army Health Facility Planning Agency [USAHFPA]), which up to that time were in separate commands. An ongoing Headquarters, Department of the Army Transformation Study was charged by the Chief of Staff of the Army to determine the best structure for the Headquarters, Department of the Army while reducing the size of the Army staff. The reduction in Army staff would be realized, at least in part, by a reduction in the number of Field Operating Agencies in Headquarters, Department of the Army, notably several in the Army Surgeon General's Office.

By 1990, the Commanding General of USAMRDC fulfilled a number of assigned functions. As the Medical Materiel Developer, he was responsible for the development and fielding of all medical materiels for the Army. As the Assistant Surgeon General for Research and Development (ASGRD), the Commanding General served as Chairman of the Human Subjects Research Review Board and as a senior advisor on medical RDT&E to the Surgeon General, the Chief of Staff of the Army, and the Army Acquisition Executive. He also served as the senior medical advisor to the Commander, Army Materiel Command, for all medical RDT&E matters. As Head of

U.S. Army Center for Environmental Health Research (USACEHR)

History: USACEHR is an outgrowth of a robust and comprehensive toxicology program that existed as part of the U.S. Army Biomedical Research and Development Laboratory (USABRDL). Although USABRDL was closed under the 1991 Base Realignment and Closure Act, a small contingent remained on-site to support research on the use of sentinel species and bioassays for detecting environmental pollutants. Supported by the U.S. Army Corps of Engineers as part of installation remediation, this effort established key elements and innovative concepts for medical and environmental surveillance. This effort was renamed the U.S. Army Center for Environmental Health Research (USACEHR) and was organizationally placed under the U.S. Army Research Institute of Environmental Medicine. Currently, USACEHR is a detachment of the U.S. Army Research Institute of Chemical Defense. In partnership with Pacific Technologies, USACEHR received the Department of the Army's 2004 Small Business Innovative Research Phase II Quality Award for its role in the development of the Coliform Analyzer. In the area of biomarker discovery work, the center made significant strides in the evaluation of new methods and their application to provide awareness of exposures to hazardous chemicals and materials.

Mission: To plan, direct, and conduct research, development, testing, and validation for occupational and environmental health surveillance (OEHS) and environmental health technology in support of Force Health Protection.

Historical Highlight: The organization successfully transitioned the Intelligent Automated Biomonitor System (iABS), a 2004 Department of the Army Research and Development Award winning technology, to its commercial partner Intelligent Automation Corporation. The iABS is used nationwide by several large municipalities to help provide early warning of chemical contamination in both source waters and water distribution systems. The Biomonitoring Program also won the Commander's Environmental Award for implementing continuous, real-time biomonitoring for the protection of the people and natural resources of the Monocacy River watershed. More recently, the Biomonitoring Program received the Army's endorsement for a new Science and Technology Objective to develop the Environmental Sentinel Biomonitor, a device that will be portable and logistically more sustainable for ensuring field drinking water safety.

the Research Contracting Activity, he was responsible for ensuring that all biomedical research and development contracts and purchases were in accordance with applicable federal regulations and directives. As Commander of USAMRDC, his responsibilities included directing and supervising the staff, establishing functions for the Command group, and exercising command and control over the commanders of subordinate commands.

USAMRDC Headquarters included special staff for the Office of the ASGRD and Office of the Special Assistant to the Surgeon General for Biotechnology as well as other offices such as the Office of the Inspector General, Office of Internal Review, Office of the Command Judge Advocate, Human Use Review and Regulatory Affairs, Animal Use Review Office, Public Affairs Office, Safety and Environmental Affairs, and Acquisition Management Office.

Prior to 1994, the Commander, USAMRDC, by virtue of his dual role as ASGRD, was also a staff member of the Assistant Secretary of the Army for Research, Development, and Acquisition (SARDA). To perform these duties, the Headquarters, USAMRDC maintained a liaison office within SARDA. As a result of both the Goldwater–Nichols DoD Reorganization Act of 1986 and Task Force Aesculapius (TFA), which reorganized the AMEDD, the position of ASGRD was abolished. Because SARDA's successor office, the Assistant Secretary of the Army (Acquisition, Logistics, and Technology) (ASA[ALT]) is still responsible for all planning, programming, and policy for Army research, development, acquisition, and logistics, USAMRMC maintains a liaison office within ASA(ALT). The Commander, USAMRMC is now dual-hatted as the Deputy for Medical Systems to the ASA(ALT) with all of the responsibilities previously assigned by Army Regulation to the ASGRD.

Task Force Aesculapius and Task Force Mercury

TFA was chartered by the Army Surgeon General in early 1993 to recommend alignment of the missions, functions, and structure of the AMEDD to support its strategic vision. TFA was also tasked to prepare a plan for the transformation of the AMEDD. TFA conducted its analysis from 1993 to 1995 concurrent with the ongoing Headquarters, Department of the Army Transformation Study.

TFA was chaired by Brigadier General Russ Zajtchuk, who later commanded the restructured USAMRMC. In the Executive Summary of Volume I of TFA's report, Brigadier General Zajtchuk and his team detailed that (1) by dual-hatting the Surgeon General as the Medical Command (MEDCOM) commander, the Surgeon General now possessed the authority for

administering worldwide health care commensurate with his accountability, (2) the major subordinate commands of the MEDCOM are now better organized along product-specific lines accountable to the MEDCOM commander, and (3) the major subordinate commands are now better postured to provide their various services to the Soldier, family member, and eligible beneficiaries.

TFA significantly restructured the AMEDD. First and foremost, USAMRDC was no longer a Field Operating Agency under the OTSG. A new Command was established as a subordinate Command under the new MEDCOM. Several other OTSG Field Operating Agencies were realigned and became subordinate commands under the new medical research and logistics command. All operational logistics efforts were centralized under this command. For example, USAMMA and USAMMCE discussed later in this chapter, were realigned as a result of the preliminary analysis in 1993. Thus, in the time frame 1993 to 1995, USAMRDC was designated as the U.S. Army Medical Research, Development, Acquisition, and Logistics Command (Provisional) and finally as USAMRMC (the U.S. Army Medical Research and Materiel Command), a major subordinate Command of the U.S. Army MEDCOM.

Federal Acquisition Streamlining Act (FASA) of 1994

In 1996, regulations that came about as a result of the FASA were implemented at USAMRAA. This implementation was the single most significant change of USAMRAA's business practices in 31 years. FASA created Federal Acquisition Regulation (FAR) Part 12 acquisition of commercial Items. It emphasized utilizing business practices more closely associated with those in industry. FASA, through FAR Part 12, permitted purchase orders for commercial goods and services up to $5 million. Previous practice was to go through a protracted contract award process for any amount over $25,000.

Under TFA, one functional area considered too complex to address from the preliminary analysis was that of information management. Expecting a need for significant reengineering of AMEDD's information management business, the Surgeon General formed Task Force Mercury headed by Major General James Peake and Brigadier General James Hastings. After nearly 18 months of intensive study, Task Force Mercury issued 29 recommendations for information management business process changes in August 1996. One of the findings of the task force was the absence of a coherent strategy for corporate information management and the resource prioritization necessary to achieve synchronization with corporate AMEDD strategic goals. Effective 1 April 1997 a new unit was provisionally formed

and assigned to USAMRMC. The U.S. Army Medical Information Systems and Services Agency (USAMISSA), subsequently reorganized and renamed the U.S. Army Medical Information Technology Center (USAMITC), assumed AMEDD corporate responsibility for life-cycle management and operation of information systems. USAMISSA represented the organizational consolidation of the Health Care Systems Support Activity, the Corporate Executive Information Systems Office, the Fort Detrick Directorate of Information Management, the Patient Administration and Biostatistics Activity, and the Army's Defense Management Information Systems Office. These five units historically provided major contributions to the information management mission of AMEDD and the Military Health Services System. This mainstreaming of information systems acquisition and operations with that of development and acquisition of combat medical systems and materiel, all under the management of USAMRMC, resulted in a significant enhancement in the effectiveness of information systems modernization.

USAMRMC Operational Commands

Advances in medical logistics were brought about through significant improvements in the logistics automation architecture that occurred during and as a result of Operation Desert Storm. During Operation Desert Storm, the Theater Army Medical Management Information System (TAMMIS) was initially deployed to medical logistics battalions, combat support hospitals, and division medical supply offices in the theater. Customers in dispersed logistics units relied upon manual methods to manage and requisition medical supplies. Within a few years, USAMCCE had pioneered software to extend automation to nonautomated customers. These software improvements were key to more efficient supply chain management.

One of the key software improvements that emerged during the first Gulf War was the TAMMIS front-end customer order entry capability, the TAMMIS Customer Assistance Module (TCAM). Customer friendly, TCAM was configured to easily reach or communicate with any medical unit in peacetime or war. This improved logistics automation capability that was driven by events in Operations Desert Shield and Desert Storm was operational by the mid-1990s. It proved valuable in Kosovo and Bosnia. TCAM enabled users to order medical supplies, review catalogs, and check order status and on-hand balances as well as available substitutes. Battalion aid stations, medical companies, and nonmedical units now had an automated method to order from any TAMMIS-supported medical logistics unit. TCAM was able to be used anywhere in the world through an Internet connection or by dial-up using satellite communications or even an iridium phone.

Theater Army Medical Management Information Support (TAMMIS)

Designed, deployed, and sustained by the U.S. Army Medical Information Technology Center to assist with wartime operations, TAMMIS supports the information management requirements of field medical units in times of war, peace, and conflict. It is an automated, online, interactive microcomputer system designed to assist commanders and their staffs by providing timely, accurate, and relevant medical information in the following areas:

- Medical assemblage management
- Medical maintenance
- Medical patient accounting and reporting
- Medical regulating
- Medical supply

The medical supply component of TAMMIS automated the comprehensive management and requisitioning of medical materiel required to support medical units. It was designed to operate at the DMSO within U.S. Army divisions, at the Medical Logistics battalions (forward and rear), and at Table of Organization and Equipment hospitals within the corps and Communications Zone. At the Medical Logistics battalions, TAMMIS operates on the CTASC II computer, which is a mini-mainframe computer. The medical supply component of TAMMIS interfaces with the Standard Army Management Information System and its component supply, logistics, and transportation systems.

U.S. Army Medical Information Technology Center (USAMITC) San Antonio, Texas

History: USAMITC was originally established in April 1997 as a new unit called the U.S. Army Medical Information Systems and Services Agency (USAMISSA) and was provisionally formed to assume corporate responsibility for life-cycle management and operation of information systems.

USAMISSA represented the organizational consolidation of the Health Care Systems Support Activity, the Corporate Executive Information Systems Office, the Fort Detrick Directorate of Information Management, the Patient Administration and Biostatistics Activity, and the Army's Defense Management Information Systems Office.

USAMISSA came about as the result of Task Force Mercury, commissioned by then Surgeon General Lieutenant General Alcide LaNoue, headed by Major General James Peake and Brigadier General James Hastings, to reengineer the Army Medical Department's (AMEDD's) information management business. The result of this process was to extend the normal roles of the Medical Command (MEDCOM) Headquarters, the AMEDD Center and School, and the U.S. Army Medical Research and Materiel Command to the information mission area. One of the findings of the task force was the absence of a coherent strategy for corporate information management and the resource prioritization necessary to achieve synchronization with corporate AMEDD strategic goals. Under the Task Force Mercury construct, the Information Management Directorate focused on strategy, architecture, and plans, and all operational matters were moved under USAMISSA originally. USAMISSA assumed system development and operational responsibilities for corporate AMEDD. This fixed accountability for both strategy and operations. Its original offices were at Fort Detrick, Maryland; San Antonio, Texas; Falls Church, Virginia; and Washington, DC.

In October 2003, USAMISSA changed its name to USAMITC and reorganized. Fort Detrick staff transferred to the Fort Detrick Directorate of Information Management for centralization and the dedication of staff to Fort Detrick support. The other USAMISSA offices transitioned to other organizations, such as the Falls Church, Virginia, office to the Office of the Surgeon General. USAMITC then moved to San Antonio, Texas, dedicated to the MEDCOM enterprise.

Mission: To implement and sustain an integrated and protected medical information enterprise for the MEDCOM, to enhance health care delivery, and improve the health status of our warfighters and our military family.

Historical Highlight: USAMITC provided the infrastructure for a single, worldwide Army medical network operating environment spanning more than 400 servers and 65 sites and supporting more than 80,000 users.

U.S. Army Medical Materiel Center-Europe

The mission of USAMMCE has been to provide the best medical logistics support as the Single Integrated Medical Logistics Manager for the European Command. USAMMCE's missions also include out-of-sector support to the Department of State Humanitarian Assistance Program and the U.S. Central Command in Southwest Asia. From the Gulf War through the Bosnia and Kosovo deployments, business process improvements at USAMMCE benefitted deployed forces in the European theater. USAMMCE was assigned to USAMRMC in October 1994.

As the TLAMM (Theater Lead Agent for Medical Materiel) designee, USAMMCE evolved into a multifunctional Class VIII provider of logistics, training, and innovation. While providing world-class support to the warfighter, USAMMCE trained thousands of Soldiers to handle logistical missions anytime anywhere. Through the Humanitarian Assistance Program, USAMMCE added to the $284 million worth of Class VIII material used to support the independent nations of the former Soviet Union through the Department of State mission deemed Operation Provide Hope. The core function of USAMMCE is to provide logistical support to the warfighter.

U.S. Army Medical Materiel Center–Europe (USAMMCE)
Pirmasens, Germany

History: USAMMCE was activated as the Rhein Medical Depot in December 1951 in Einsiedlerhof, Germany. In the spring of 1957, the Rhein Medical Depot was reorganized as the U.S. Army Medical Depot, Einsiedlerhof (USAMDE) and assumed the operation control of the 67th Medical Depot. USAMDE and the Medical Supply Division of the U.S. Army, Europe, were combined to form the U.S. Army Medical Materiel Center-Europe (USAMMCE) in October 1968.

USAMMCE moved to its current location in Pirmasens, Germany, in November 1975 as part of an Army–Air Force restationing initiative.

The following medical supply, optical, and maintenance (MEDSOM) battalions were formed as subordinate units to USAMMCE in January 1980: 37th MEDSOM to support the U.S. V Corps, 428th MEDSOM to support the U.S. VII Corps, and the 226th MEDSOM to support the Communications Zone. USAMMCE was designated as the Theater Single Integrated Medical Logistics Manager in June 1986 and assumed medical logistics support responsibility for all U.S. Armed Forces serving the U.S. European Command. The 226th MEDSOM was redesignated as the 226th Medical Battalion (Logistics, Rear), the 37th was redesignated as the 37th Medical Detachment (Logistics), and the 428th the Theater Medical Materiel Management Center (TMMMC) in June 1993. In October 1994, the 226th Medical Battalion (Logistics, Rear) was redesignated as the 226th Medical Battalion (Logistics, Forward) and was assigned to the 30th Medical Brigade, and the 37th Medical Detachment and the 428th TMMMC were inactivated.

Upon inactivation of the U.S. Army's 7th Medical Command, USAMMCE was assigned to the U.S. Army Research and Materiel Command in October 1994. USAMMCE became the executive agent for the Department of State's Humanitarian Assistance Program on 1 October 1996.

In 2007, USAMMCE was designated as the TLAMM (Theater Lead Agent for Medical Materiel). This designation allows USAMMCE to be more involved in logistical planning and coordination for two major combatant commands.

Mission: To provide and project medical logistics support across the full spectrum of military operations to EUCOM and supported commands.

Historical Highlight: USAMMCE received the Vice Presidential Hammer Award on 17 June 1997 and 11 March 1999 for setting new standards of excellence in supporting its customers and supporting the concepts of President Bill Clinton's Reinvention of the Government initiative. In August 2001, USAMMCE became the first medical logistics unit in the Army to be certified ISO 9000.

U.S. Army Medical Materiel Agency

USAMMA has sustained U.S. forces by providing medical logistics support for the full spectrum of DoD health care missions worldwide. It became a part of USAMRMC in October of 1994 via Permanent Orders 109-25. The equipment, maintenance, and training provided by this agency have been essential to enhancing the readiness of U.S. forces as they deploy and provide medical care in harsh field environments. Innovative logistics concepts, technologies, and programs have been a constant thread through USAMMA's efforts in the sustainment of deployed U.S. forces.

U.S. Army Medical Materiel Agency (USAMMA)
Fort Detrick, Maryland

History: The genesis of USAMMA began in 1943 when the Procurement Division of the Supply Service, Office of the Surgeon General (OTSG), was renamed the Purchase Division and transferred to the Army Medical Purchasing Office in Manhattan, New York. Later that year, the Inventory Control Branch, Distribution and Requirements Division, OTSG, was also transferred to the Army Medical Purchasing Office. The Medical Testing Laboratory transferred from Binghamton, New York, in February 1943. Later that year, the Contract Termination Branch was added. In 1944, the Renegotiation and Stock Control Divisions were moved from the OTSG to New York.

On 21 May 1953, the Army Medical Supply Control Office was organized at Brooklyn, New York, and assigned to the Surgeon General. On 30 April 1965, the unit was redesignated the Army Medical Supply Control Office. On 1 January 1957, the office was redesignated the Army Medical Supply Support Activity, a Class II off-post activity of the Surgeon General. On 2 April 1965, the activity transferred from Brooklyn to Valley Forge General Hospital, Phoenixville, Pennsylvania, and was renamed USAMMA effective 15 April 1965.

On 1 March 1974, the agency reached the largest authorized strength level in its history—27 officers, 8 warrant officers, 37 enlisted personnel, and 200 civilians. On 1 October 1978, the agency's Medical Test and Evaluation Division, located at Fort Sam Houston, Texas, was transferred to the U.S. Army Health Services Command. This transfer provided the nucleus for what is now the Army Medical Department Board. Also, on that date, the USAMMA Procurement Division was transferred to the U.S. Army Medical Research Acquisition Activity located at Fort Detrick, Maryland.

Mission: To provide optimal medical acquisition and logistics support and solutions across the full spectrum of military health care missions worldwide.

Historical Highlight: Through continued development and implementation of innovative logistics concepts, technologies, and programs, USAMMA has revolutionized the sustainment of the medical capability of deployed U.S. forces.

U.S. Army Health Facility Planning Agency
USAHFPA is USAMRMC's operational command that supports planning and execution of AMEDD facility life-cycle management worldwide. It was realigned into USAMRMC in 1994 as part of TFA.

As the MEDCOM's deployable experts in planning, programming, design, construction, transition, and sustainment of medical facilities, USAHFPA assists the AMEDD and other customers in assessing and refining their medical facility requirements and developing their strategic business plans through market analyses, research, and on-site consulting. Planning and programming brings a unique corporate view: AMEDD-wide, best-practice insight; system-wide assessment and evaluation; private industry collaboration; and space management to assist organizations with successful planning.

U.S. Army Health Facility Planning Agency (USAHFPA), Falls Church, Virginia

History: In 1972, the Secretary of Defense initiated a program to modernize all military health facilities to meet minimum civilian standards (Department of Defense [DoD] Health Facility Modernization Program). Many of the Army's hospitals and other related facilities were operating in deteriorated and dysfunctional WWII cantonment hospitals and older vintage buildings.

USAHFPA was organized on 1 September 1975 by the Department of the Army, Office of the Surgeon General to standardize and formalize project management procedures, providing uniformity, standardization, and continuity in a large number of medical facility construction projects to be undertaken in the DoD Health Facility Modernization Program.

Mission: USAHFPA is responsible to the Surgeon General for the centralized management of the Army Health Facility Construction Program including Army medical facilities program development; participating in development of DoD space planning for health care facilities; providing technical advice and assistance in designing health and medical research and development facilities; and overseeing the functional aspects of health facility construction projects to ensure cost effectiveness and timely project completion. Upon mobilization, USAHFPA provides health facility planners to augment deploying medical command and control units. USAHFPA will continue to execute the Surgeon General's responsibilities for medical facility programming, planning, design, and construction from the forward deployed units through the continental U.S. base.

Historical Highlight: USAHFPA supports the TO&E medical commander with task-organized capabilities for missions of all types, ranging from war and low-intensity conflict to peace keeping, humanitarian assistance, and disaster relief.

The MEDCOM's continued investment in its infrastructure and facilities throughout the 1990s was essential to sustaining and enhancing its capital assets and supporting the Army's medical and research missions. The MEDCOM Capital Investment Program works by identifying major sustainment, restoration, and modernization investment requirements in 3-year intervals. Planning for capital investments is an ongoing process; investment priorities change with the aging of the infrastructure, technological advances, and changes in methods of health care delivery. To maintain a firm liaison with the field, USAHFPA assigned a Project Integrator to each installation. The Project Integrator assisted in developing projects that met the medical treatment facility master plan, improved the infrastructure, and met the corporate investment strategy. USAHFPA's Capital Investment Management Team ensured that the MEDCOM benefited from an informed and comprehensive application of the investment strategy.

In addition to its historic role in the MEDCOM's Capital Investment Program, medical laboratory recapitalization moved under the scope of USAHFPA as a recommendation of TFA. USAHFPA's intent for laboratory recapitalization involved leading initiatives to recapitalize the existing Army medical research and biomedical laboratory inventory, shaping and improving facilities for science's quick and efficient response to the ever-changing face of military medical research that protects the Soldier and the nation.

Congressional Influences

The early 1990s consolidated changes to the way in which the Command received funding. Prior to this time, the only program not funded through the President's Budget Request was the previously mentioned HIV program (USMHRP). During the 1990s, Congress increased its influence on the programs funded within the DoD by including additional congressional special interest markups in the annual appropriations laws. This substantially increased the funding appropriated to Army medical research, particularly in comparison to funding requested through the President's Budget Request.

Although the main focus and mission of USAMRMC is the warfighter, the addition of congressional special interest programs brought with them an acknowledgement that military medical research and its accompanying research management techniques can both support the warfighter and benefit the American public. In many cases, programs that began as USAMRMC congressional markups expanded to also include participation from the Joint Services, international health organizations, the U.S Public Health Service, and industry and academia from around the world. Collaboration has become the key to improving, accelerating, and advancing medical research.

Telemedicine and Advanced Technology Research Center

The original impetus for the Telemedicine and Advanced Technology Research Center (TATRC) was the joint need in 1990 of the Army and Air Force for a filmless medical diagnostic imaging system. The medical diagnostic imaging system was born as a program in 1991, and by 1993 the Army, Navy, and Air Force were involved in the effort to jointly develop, procure, and deploy this system. The organization created for this effort was originally established as the Medical Advanced Technology Management Office (MATMO). MATMO became better known as the DoD "telemedicine test bed" after the Assistant Secretary of Defense for Health Affairs designated the Army as executive agent for telemedicine in 1994. During the mid-1990s, a broad array of advanced and developing technologies were used to meet military medicine requirements including biomedical science, a secure global positioning system, wireless networking, data compression, and adaptable tactical and mobile networks. From its inception, MATMO played a prominent role in developing advanced technologies in areas such as health informatics, medical imaging, mobile computing and remote monitoring, and simulation and training. In 1998, MATMO was reorganized and renamed the Telemedicine and Advanced Technology Research Center.

Telemedicine and Advanced Technology Research Center (TATRC)
Fort Detrick, Maryland

History: What is now TATRC actually began in the early 1990s when the Army and Air Force medical departments wanted to jointly develop, procure, and deploy a filmless medical diagnostic imaging system at a time when such a system did not exist. By 1993, the Navy had also joined this effort and a formal organization, the Medical Advanced Technology Management Office (MATMO) was established. In 1994, the Assistant Secretary of Defense for Health Affairs designated the Army as executive agent for telemedicine, and MATMO became known as the Department of Defense "telemedicine test bed." During the mid-1990s, a broad array of advanced and developing technologies were used to meet military medicine requirements, including biomedical science, a secure global positioning system, wireless networking, data compression, and adaptable tactical and mobile networks. In 1998, MATMO was reorganized and renamed as TATRC.

Since its inception, TATRC has played a prominent role in developing advanced technologies in areas such as health informatics, medical imaging, mobile computing and remote monitoring, and simulation and training. TATRC has expanded from its original office at Fort Detrick, Maryland, to a more global presence with offices in Georgia, California, Hawaii, and Europe. TATRC's vision, as an important extension of its legacy, encompasses the creation of opportunities for technology transfer to the public sector as well as the battlefield. TATRC has created partnerships with numerous universities, commercial enterprises, and other federal agencies, supporting approximately 500 ongoing research projects.

Mission: To explore medical science and engineering technologies ahead of programmed research, leveraging other programs to maximize benefits to military medicine.

Historical Highlight: TATRC is the cutting edge of telemedicine and serves as the focal point between industry, the medical community, and the military for cooperation. It has played an important role in championing organizations such as the American Telemedicine Association and has been a leader in areas such as the use of virtual reality tools, biomaterials, and hospital-of-the-future concepts.

The use of advanced technologies to support deployed forces was a common theme as far back as 1993 when a team from Walter Reed Army Medical Center and MATMO deployed to Somalia during Operation Restore Hope. Between 1993 and 1996, tertiary care telemedicine was supported from the Walter Reed Telemedicine Directorate and was deployed for military medical missions in 12 countries.

Congressionally Directed Medical Research Programs

In the early 1990s, Congress began to realize that women's health was becoming a popular public policy issue. Studies were showing discrepancies in the treatment of disease in men and women. Grassroots advocacy organizations such as the National Breast Cancer Coalition were emphasizing the need to fund research in ways that were different from those employed by traditional federal medical research agencies. The National Institutes of Health responded by creating the Women's Health Initiative and mandating women's participation in clinical trials. The Congressionally Directed Medical Research Programs (CDMRP) originated

in 1993 as the result of a second year of additional appropriated funds for breast cancer-related research. (There had been a previous appropriation of $25 million for research on the screening and diagnosis of breast cancer among military medical beneficiaries and their dependents in fiscal year 1992.) The funds from 1993 were part of $29 billion in planned Total Obligation Authority funds remaining from weapons systems programs that were discontinued with the fall of the Soviet Union in 1991. Due to limits of the Budget Enforcement Act of 1990, these funds could only be used within the DoD. The funds were transferred from the Strategic Defense Initiative (President Ronald Reagan's Star Wars Initiative) to a research and development line for the USAMRDC. When the $210 million appropriation was added to the fiscal year 1993 National Defense Appropriations Act for peer-reviewed breast cancer research, the Command made the decision that a separate management structure operating under USAMRMC Headquarters would be necessary to oversee this research.

As a result of the continuing appropriation, the Command commissioned the Institute of Medicine (IOM) to review options for managing the breast cancer program. IOM is a nonprofit organization under the National Academy of Sciences that provides science-based advice on matters of biomedical science, medicine, and health. The IOM's ensuing report titled "Strategies for Managing the Breast Cancer Research Program: A Report to the U.S. Army Medical Research and Development Command," emphasized the importance of a two-tiered peer review and programmatic review process as well as the development of an annual investment strategy. The report also recommended the inclusion of consumer advocates in peer review as well as programmatic review. Both of these recommendations are still integral elements of the CDMRP today. During the peer review process, applications are reviewed for scientific and technical merit, and during the programmatic

review process, proposals are reviewed for program relevance. The IOM also recommended allocating funding among three broad programmatic investment strategies: (1) training and recruitment, such as predoctoral and postdoctoral fellowships and training programs; (2) infrastructure enhancement, such as cancer registries and tumor banks; and (3) investigator-initiated research, such as investigator-initiated grants and innovative developmental and exploratory awards.

CDMRP Programs That Began in the 1990s

- FY92 to FY08 – Breast Cancer Research Program
- FY95 – Defense Women's Health and Osteoporosis
- FY95 to FY08 – Institutionally Based Programs
- FY96 to FY08 – Neurofibromatosis
- FY97 to FY08 – Prostate and Ovarian Cancers
- FY99 to FY06, FY08 – Peer Reviewed Medical Research
- FY99 to FY00 – DoD/VA

Much of CDMRP's funding has been awarded to investigators with innovative ideas for basic research, an area often ignored by other more traditional funding agencies. This funding has contributed to an impressive list of accomplishments across the spectrum of CDMRP programs. Some of CDMRP's critical accomplishments in the 1990s include:

- Supported the early stages of the development of Herceptin® (trastuzumab), a breast cancer therapeutic
- Contributed to the development of sentinel lymph node biopsy as a standard of care for breast cancer
- Developed the Carolina Mammography Registry containing over 1,600,000 records for over 500,000 women
- Contributed to the development of the Margaret Dyson Family Risk Assessment Program at Fox Chase Cancer Center, which offers cancer screening expertise, information, and support for individuals at high risk for breast, ovarian, and colorectal cancers and melanoma
- Supported two natural history studies of the growth of neurofibromatosis 1 plexiform neurofibromas and neurofibromatosis 2 vestibular schwannomas to aid in evaluation of therapeutic efficacy

Congressionally Directed Medical Research Programs (CDMRP)
Fort Detrick, Maryland

History: The 1971 National Cancer Act, which mandated substantial public investment into the U.S. cancer research enterprise, ushered in an era of scientific discovery and medical advances in cancer research. In response to these concerns and the national commitment to end the war on cancer, the U.S. Congress directed the Department of Defense (DoD) to manage intramural and extramural research programs that focus on specific diseases. Beginning in fiscal year 1992, the U.S. Army Medical Research and Materiel Command received a $25 million congressional appropriation for breast cancer research.

In 1993, Congress appropriated $210 million to the DoD for extramural peer-reviewed breast cancer research, marking the beginning of the CDMRP. In the same year, an Institute of Medicine (IOM) report was commissioned to review options for managing this research program. The report emphasized the incorporation of a novel two-tier peer review and programmatic review process and the development of an annual investment strategy. Today, these two recommendations remain an integral part of CDMRP, and along with consumer advocate participation, make the CDMRP a truly unique organization. For the first 3 years, congressional funding supported the Breast Cancer Research Program (BCRP). In 1997, after reviewing the implementation and progress of the BCRP, the IOM recommended the program's continuation.

The success of the BCRP, combined with the ongoing work of consumer advocates and the need for focused biomedical research, led to continuation of the BCRP and the addition of other targeted biomedical research programs in subsequent years, including prostate and ovarian cancers, neurofibromatosis, chronic myelogenous leukemia, tuberous sclerosis, autism spectrum disorders, and a number of military health-related research programs including programs focused on post-traumatic stress disorder, traumatic brain injury, Gulf War illnesses, and amyotrophic lateral sclerosis. Some programs have retained current funding, and others received appropriations for limited time periods. The CDMRP has managed targeted appropriations totaling $4.7 billion and 7,522 research grants, contracts, and cooperative agreements since its inception in fiscal year 1992.

Mission: To provide hope by promoting innovative research, recognizing untapped opportunities, creating partnerships, and guarding the public trust.

Historical Highlight: Original funding for the CDMRP's BCRP evolved from the proactive work of grassroots advocacy organizations. Consumer advocate participation has always been a hallmark of the CDMRP, and consumer advocates serve on both the peer review and programmatic review boards for each of the targeted diseases.

- Funded the development of over 100 mouse models for neurofibromatosis 1 and neurofibromatosis 2 symptoms enabling advanced studies for disease understanding and therapeutic testing
- Contributed to the development of Velcade® (bortezomib), a prostate cancer therapeutic

Summary

The year 1990 marked the beginning of exponential growth and change within USAMRDC. Laboratories and organizational elements were added and deleted in two BRAC cycles. The Command was realigned to its current structure and renamed USAMRMC to reflect its new mission as a full life-cycle command. Additional funds for specific disease threats and women's health issues were added through congressional appropriations. Worldwide, rapid deployment became the norm, and research on related infectious diseases and chemical and biological threats followed suit. The United States faced its first terrorist attack by foreign elements on U.S. soil, one that would be followed by additional attacks on the World Trade Center and the beginning of the Global War on Terror.

Chapter 7

Global War on Terror

On 11 September 2001, the United States experienced the most virulent terrorist attacks in its history when terrorists hijacked four commercial airliners, flying two of them into the World Trade Center and one into the Pentagon. The fourth plane crashed in Somerset County, Pennsylvania, when crew members and passengers attempted to regain control of the plane. A total of 2,998 people died as an immediate result of the incidents. Twenty-four remain listed as missing. The attacks were carried out by members of al-Qaeda, an extremist, fundamentalist Islamic sect led by Osama Bin Laden.

Soldiers look for signs of enemy activity during a patrol in the mountains near the Pakistani border in the Paktika province of Afghanistan in 2007. The Soldiers are from 2nd Battalion, 87th Infantry Regiment, 10th Mountain Division. *(U.S. Army photo by Staff Sgt. Justin Holley.)*

In the aftermath of the attacks, the Bush Administration declared a Global War on Terror. In an attempt to find Bin Laden and bring him to justice, a U.S. military-led coalition entered Afghanistan and overthrew the reign of the Taliban, an Islamic fundamentalist religious sect in control of the country and supporting Bin Laden. The U.S. military has maintained a presence in Afghanistan, assisting the Afghan government in quelling terrorist attacks on its people by extremist Islamic groups, including al-Qaeda.

In the weeks following the September 11th attacks, beginning 18 September 2001, envelopes laced with anthrax were sent through the U.S. Postal Service to two Democratic senators and several news media outlets. Five people died and 17 others were infected as a result. The ensuing investigation by the Federal Bureau of Investigation (FBI) and its partners, code-named "Amerithrax," has been one of the largest and most complex in the history of law enforcement. A total of 9,100 interviews have been conducted and 6,100 subpoenas have been issued. No one has ever been charged with the crime.

On 20 March 2003, the U.S. military began an occupation of Iraq, commonly known as the Iraq War. The main rationale for the war was the allegation that Iraq possessed and was actively developing weapons of mass destruction

Anthrax letters

in violation of United Nations Security Council Resolution 687 established in 1991. There was also a belief that Saddam Hussein, leader of Iraq at the time, was a supporter of Bin Laden.

All of these events have influenced the medical research conducted by USAMRMC since 2001. The increase in terrorist events was an impetus for increased research in biological and chemical countermeasures. Toxic dust from the collapse of the World Trade Center has incapacitated countless emergency responders who worked at the site in the days immediately following the event. The deaths of innocent postal workers from the anthrax incidents precipitated an increase of funding for research on anthrax vaccines and prophylactics.

The war in Iraq is of a different nature than any the U.S. military has encountered in the past. The most common injuries are blast related from improvised explosive devices (IEDs), which are makeshift bombs. The most common injuries from IEDs include traumatic brain injury (TBI), ocular injuries, loss of appendages, and compartment syndrome. Incidents of post-traumatic stress disorder (PTSD) and other mental health illnesses have been exacerbated by repeated deployments to the war zone. Improvements in body armor materials and design have saved the lives of countless Soldiers who would not have survived 20 or even 10 years ago. Advances in burn treatments have resulted in Soldiers surviving with burns greater than 20 percent of total body surface area. This has led to a change in the way the military addresses the treatment and rehabilitation of the wounded Soldier.

Due to a shortage of personnel in today's all-volunteer force and an understanding on the part of military leadership that experience is both time-consuming and expensive to replace, Soldiers are being rehabilitated within the TRICARE health system and returned to active duty whenever possible. Those with injuries too severe to return to duty are discharged to the U.S. Department of Veterans Affairs (VA), but owing to legislation mandating pilot programs and longevity studies, the DoD, in conjunction with the VA, is still responsible for tracking their progress and evaluating their care. Due to its technical superiority and extensive infrastructure for medical research, USAMRMC has been made responsible for organizing the program office that will manage research for blast injuries including TBI and PTSD.

A Soldier looks over a bombed out car after a firefight with insurgents during a 9-day mission in Salah-Ad-Din province, Iraq, in 2006. *(U.S. Army photo by Staff Sgt. Russell Lee Klika.)*

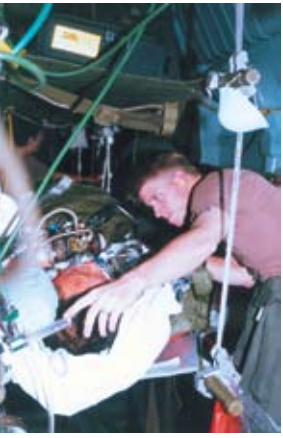
Combat Casualty Care and Treating Burn Wounds

Thermal injury historically constitutes approximately 5 to 20 percent of conventional warfare casualties. USAISR is the premier combat casualty research center for the treatment of burn wounds and trauma. Over 545 burn patients have been treated at USAISR as a result of injuries sustained in the Global War on Terror. USAISR's burn center is part of the trauma unit. It has 16 intensive care and 40 ward patient beds and an outpatient clinic. In a separate burn clinic specifically for service members wounded in Operation Iraqi Freedom and Operation Enduring Freedom, Soldiers, Marines, and Airmen are treated and sent back to duty or Medical Evaluation Board processing is begun.

USAISR also has its own burn flight teams for aeromedical evacuation of patients to the treatment center from combat support hospitals. Between 1952 and 1997, in excess of 4,000 burn patients were transported over a distance of approximately 8 million miles.

These flight teams originated in 1951 with the authorization of the transfer of patients with greater than 10 percent burns to Brooke Army Hospital for treatment. It authorized a "special treatment team" from Brooke for dispatch to any military hospital in the United States for supervision of early treatment to people with burns. In 1962 the mission became "…to furnish burn teams for medical evacuation from points within Continental United States to the U.S. Army Surgical Research Unit…." In 2000, the flight teams were redesignated as the Special Medical Augmentation Response Teams for Burns (SMART-Burns) and, out of necessity, the mission eventually changed from evacuation within the continental United States to worldwide, rapid deployment and evacuation.

Each team consists of a general surgeon, critical care registered nurse, licensed vocational nurse, and respiratory therapist from the burn intensive care unit. According to an article written by USAISR staff in 2005, "The ability to deploy Burn Flight Teams within hours of initial notification



to move critically ill burn patients from Landstuhl [Germany] to Texas represented a paradigm shift toward more rapid Team deployment than was used, for example, during the Vietnam War. Such rapid deployment made it possible to retrieve patients before infectious complications or organ failure ensued..."

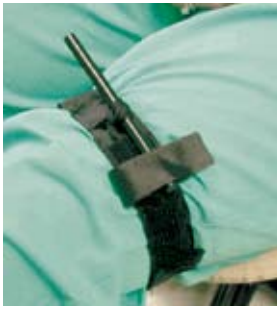
Although burn victims comprise a relatively small number of casualties, the severity and nature of these wounds require a resource-intensive level of patient care and high workload for staff so timely evacuation results in higher survival rates for burn patients and allows staff within combat hospitals to focus on other combat-related casualties.

In April 2003, the USAISR Burn Center and Brooke Army Medical Center's Trauma and Critical Care Service were combined to form the DoD's only Trauma Division under the direction of the Commander, USAISR. Brooke Army Medical Center is designated a Level I Trauma Center by the Texas Department of State Health Services and was verified by the American College of Surgeons Committee on Trauma in 2004 as meeting Level I trauma verification standards. Brooke Army Medical Center treats both civilian and military trauma patients. Since the inception of the Global War on Terror, more than 1,200 trauma patients have been treated by the Trauma Division each year.

The designation of USAISR as both a trauma and burn center also transitioned it to be the primary laboratory for combat casualty care research to address injuries such as TBI and ocular and extremity wound research in addition to burn research. Research for extremity repair has focused on improved fixator pins, wound irrigation, and bone graft substitutes. The clinical research program has also extensively researched extremity blood loss and the use of tourniquets and blood transfusions. Current studies or studies in development are focusing on hemoglobin-based oxygen-carrying capacity resuscitation fluid, an antimicrobial polymer dressing for superficial wounds, coagulation dynamics, monitoring devices such as infrared spectroscopy and their role in treating head injuries, and effective pain management techniques that are applicable for battlefield scenarios.

Products that USAISR has taken to advanced development include the Rapid Wound Cleansing System, Hemoglobin-Based Oxygen Carrier, antimicrobials for orthopedic injuries, Chitosan Hemorrhage Control Dressing, and the Combat Application Tourniquet, which was named one of the Army's 10 Greatest Inventions for 2005. Groundbreaking new burn products and treatments recently developed include the Ventilation Back Ramp and correction formulas for glucometers. The Ventilation Back Ramp is a positioning device that has significantly improved back wound care management by decreasing pressure and humidity on the back burn wound. Mathematical correction formulas were recently developed for widely used point-of-care glucometers to correct for hematocrit effect associated with this technology. This formula has been implemented in the burn intensive care unit and has resulted in decreased incidents of hypoglycemia and improvements in glycemic control, which is associated with proven improved patient outcomes.

The Chitosan Hemorrhage Control Dressing adheres to an injury site to form a clot and stop severe bleeding.



The Combat Application Tourniquet is lightweight and easy to use for controlling hemorrhage in severely bleeding extremities.

The Rapid Wound Cleansing System is used for wound cleaning and is necessary to avoid wound sepsis and achieve optimal healing.

Clinical and Rehabilitative Medicine Research Area Directorate

Researchers seek to develop novel therapies to regenerate fingertips using extracellular matrix material.

In recognition of the need to expand USAMRMC's traditional research focus to include definitive and rehabilitative care innovations required to "reset" the terms of duty performance and quality of life for wounded warriors, USAMRMC has created a new Research Area Directorate. The Clinical and Rehabilitative Medicine Research Area Directorate will provide policy and process oversight for all congressional programs managed by TATRC and CDMRP. It will be the lead for program development and oversight of the Armed Forces Institute of Regenerative Medicine (AFIRM), a multi-institutional, interdisciplinary network. In addition, it will more tightly link the USAMRMC research and development community with the clinical investigations community of the U.S. Army MEDCOM and the Military Health System.

The Congressionals in the Global War on Terror

In response to concerns related to the Global War on Terror, Congress substantially increased its appropriations funding for medical research to the DoD, the Army, and USAMRMC. These additional monies have expanded the mission, reach, and scope of military medical research within the Command. Activities and offices that support the related functions for the Command have had to significantly increase their infrastructure to support the new programs adding staff and additional facilities.

Congressionally Directed Medical Research Programs

Psychological health and TBI interventions have been priorities of the DoD since the initial deployment of U.S. troops to the Persian Gulf. The Psychological Health and Traumatic Brain Injury (PH/TBI) Research Program was established in fiscal year 2007 as one effort to respond to these priorities. The mission of the PH/TBI Research Program is to prevent, mitigate, and treat the effects of traumatic stress and TBI on function, wellness, and overall quality of life for service members as well as their caregivers and families. The PH/TBI Research Program is committed to funding and integrating with individual and multiagency research efforts that will lead to improved prevention, detection, diagnosis, and treatment of psychological health challenges and TBI. All of the programs retain the same basic management structure and two-tier review process. In keeping with its grassroots legacy, consumer advocates serve on both the peer review and programmatic review boards for each of the conditions.

New CDMRP Programs Since 2000

- FY02 – Prion Diseases
- FY02 to FY06 – Chronic Myelogenous Leukemia
- FY02 to FY06, FY08 – Tuberous Sclerosis
- FY04 – Myeloproliferative Disorders
- FY06, FY08 – Gulf War Veterans Illness
- FY07 to FY08 – Autism Spectrum Disorder
- FY07 – Amyotrophic Lateral Sclerosis
- FY07 – Psychological Health and Traumatic Brain Injury

From fiscal year 1992 to fiscal year 2008, CDMRP has awarded 7,522 grants for a total appropriations amount of $4.7 billion. Examples of the innovative research funded since fiscal year 2000 include:

- Funded the development of new mouse and zebrafish models for preclinical testing of new Chronic Myelogenous Leukemia therapeutic agents
- Contributed to the development of OPHID (Online Predicted Human Interaction Database), a computational tool housing 16 million datasets on gene and protein expression patterns in ovarian cancer and other diseases
- Developed NAViGaTor, an OPHID companion tool to study gene and protein interactions
- Supported the discovery of gene fusion as a mechanism of prostate cancer initiation
- Funded the development of a bovine milk immunoglobulin supplement that prevents diarrhea
- Supported the instrumentation development of a portable, noninvasive system to measure tissue perfusion on the battlefield
- Supported the development of a light-based technology for self-treatment of Pseudofolliculitis barbae
- Funded the development of a comprehensive clinical Tuberous Sclerosis Complex natural history database

New Product or Idea Web Site and Database

USAMRAA, under Headquarters USAMRMC's direction, developed a new web-accessible database to collect and manage unsolicited products and ideas from vendors and researchers. Once a vendor submits a proposal, it is forwarded to a USAMRMC staff reviewer. The database provides reviewers with several disposition options including forwarding directions to a vendor to submit a full unsolicited proposal for possible award, proposal rejection, or to schedule a meeting to exchange information. Management oversight reports provide visibility of all submissions, their disposition, and reviewer response times.

Telemedicine and Advanced Technology Research Center

TATRC is a unique organization involved with all aspects of systems integration, demonstration, and evaluation of new communications and information systems technology for the improvement of health care for Soldiers and their beneficiaries. TATRC manages both a general research and development program and various specific congressional interest advanced technology projects in multiple areas extending far beyond traditional telemedicine.

TATRC views the advanced medical technology area as the convergence of a number of disparate fields to include medicine, telecommunications, computer engineering, informatics, artificial intelligence, and robotics. The trademark of this effort is the fusion of all the specialties into a combined effort. One example of this is the Operating Room of the Future. This effort integrates advances in robotics; computer-assisted, minimally invasive surgery; voice recognition and data analysis as well as modeling and simulation. Teleneurosurgery consultation is conducted on a relatively routine basis between Afghanistan and Landstuhl Regional Medical Center in Germany. In Iraq, teledermatology consultation is also conducted on a relatively regular basis.

TATRC has managed more than $250 million annually, primarily through congressional markups, and has expanded from its original office at Fort Detrick, Maryland, to a more global presence with offices in Georgia, California, Hawaii, and Europe. TATRC is charged with managing congressionally mandated projects, connecting extramural capabilities with intramural laboratories and military applications. However, equally important has been TATRC's partnership with numerous universities, commercial enterprises, and other federal agencies, supporting approximately 500 ongoing research projects. TATRC's vision, as an important extension of its legacy, encompasses the creation of opportunities for technology transfer to the public sector as well as the battlefield.

TATRC has organized itself around major research portfolios representing e-medicine advanced technologies of importance to the DoD and not covered in core programs. Major portfolios and core competencies for TATRC include:

- Medical robotics
- Clinical informatics/health information technologies
- Medical imaging technologies
- Advanced prosthetics and human performance
- Computational biology
- Biomonitoring technologies
- Simulation and training technologies

Each of these includes elements of modern medical disciplines such as neurosciences, biomaterials, nanomedicine, and tissue engineering. They are also cross-matrixed with projects representing three disease models, diabetes, breast and gynecological disease, and Parkinson's disease.

The extramural partnerships and TATRC's in-house research have produced numerous usable technologies since the initial demonstration of the telemedicine concept. Key accomplishments include the following:

- Teleradiology (now the PACS [Picture Archiving and Communications System] office)
- Battlefield Medical Information System Tactical (BMIST)
- Wireless Information Carrier (EIC)
- Telepathology (AAMTI [AMEDD Advanced Medical Technology Initiative])
- Medical Robotics (Evacuation) Program
- VIRGIL-Chest Tube Simulator
- ARGUS Biosurveillance System
- Volume Angio-Computed Tomography
- Joslin Vision Network
- Breast Tissue Bank
- CIMIT (Center for Integration of Medicine and Innovative Technology) medical innovation incubator

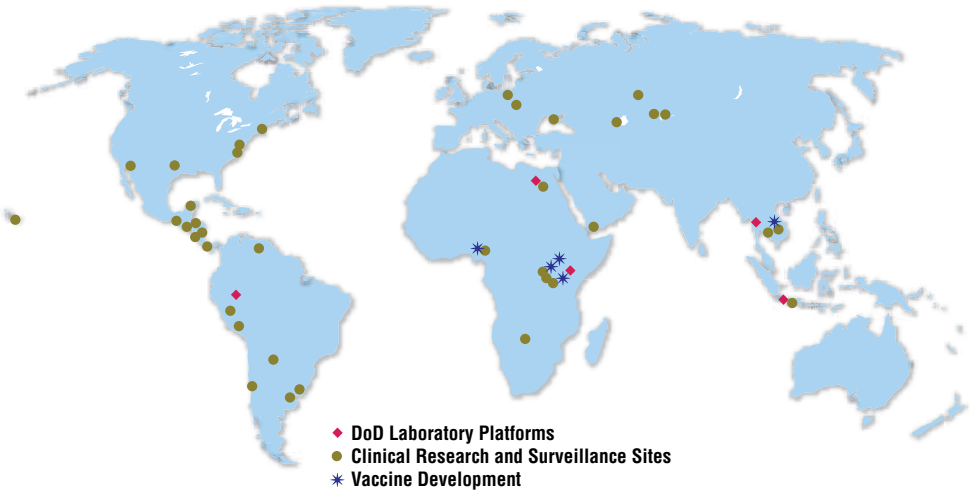
The BMIST, EIC, and VIRGIL-Chest Tube Simulator were all recipients of the prestigious Army's Greatest Invention Award.

Battlefield Medical Information System Tactical (BMIST)

U.S. Military HIV Research Program

The current goals of the USMHRP are to prevent disease in Armed Forces personnel and minimize the cost of HIV infections to the DoD. It is centered at the Division of Retrovirology at WRAIR and partners with the Henry M. Jackson Foundation for the Advancement of Military Medicine. Additional triservice participation includes the Navy and the Uniformed Services University of the Health Sciences.

Over the past decade, the program has expanded through collaboration with U.S. and international agencies to include a unique and effective surveillance network throughout the world.

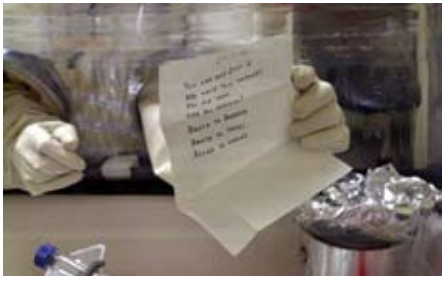


This not only allows the DoD to monitor the emergence of new virologic strains, it also helps to promote political and economic stability and deters conflicts in less stable regions of the globe that would otherwise require troop deployment. In some instances, the Armed Forces of a country, for example Nigeria, are one of the program's collaborators. This leads to better working relationships between the U.S. military and the governments and militaries of participating countries.

USAMRIID's Role in the Global War on Terror

USAMRIID's expertise in the laboratory identification and medical management of biological threat agents was instrumental in the wake of the September 11th terrorist attacks and the anthrax mailings that followed.

The institute provided diagnostic support to the Department of the Army, the DoD, the U.S. Capitol Hill Incident Management Team, the State Department, the FBI, the Centers for Disease Control and Prevention, and other organizations. Between September 2001 and May 2002, over 30,000 samples were received and evaluated and over 260,000 separate assays were performed to determine the presence of biological threat agents. The effort, dubbed Operation Noble Eagle, required USAMRIID to expand its capacity for threat agent identification by nearly 10-fold virtually overnight. Personnel worked 24 hours a day, 7 days a week in support of this effort. Challenges included the fact that the majority of the samples were nonmedical (environmental samples and others, including clothing, furniture, rugs, and office equipment). USAMRIID also provided a three-person team to perform on-site sample collection at the American Media Building in Florida (the site of the first anthrax letter) and advised federal and state officials on how to decontaminate the building. In addition, the widely publicized strategy for antibiotic treatment of anthrax patients with ciprofloxacin (brand name Cipro®) was based on animal research conducted at USAMRIID as were the AVA (Anthrax Vaccine Adsorbed) postexposure treatment guidelines for U.S. postal workers. Despite the enormity of carrying out Operation Noble Eagle, USAMRIID continued to conduct its research mission and transitioned 14 diagnostic assays to the DoD's Critical Reagents Program in 2002.



Anthrax letters were opened and decontaminated by experts at USAMRIID, and then a number of scientific and forensic examinations were conducted by both USAMRIID and the FBI.

In addition to USAMRIID's research capabilities, its deployable teams are available on short notice to assist with establishing diagnostic laboratories in theaters of combat operations. Epidemiological and aeromedical isolation teams specialize in rapid response to investigate disease outbreaks anywhere in the world. Also called Special Medical Augmentation Response Teams (SMART), they deliver a small number of highly skilled specialists within hours to evaluate a situation, provide advice to local authorities, and organize military resources to support a response to a disaster or terrorist act. These teams are organized, equipped, trained, and ready to deploy within 12 hours of notice. USAMRIID responds to emerging infectious disease outbreaks in many ways including providing information, resources, and diagnostic capabilities or by deploying specialized teams.

Institutional Review Boards in Iraq

As mentioned in previous chapters, both the DoD and USAMRMC have a strong commitment to maintaining the highest ethical standards for human subjects research. DoD Directive 3216.02 mandates that all medical research conducted in DoD facilities and supported by the DoD operate under an "Assurance of Compliance Certificate." This certificate is a formal acknowledgement of the DoD's responsibilities for protecting the rights and welfare of human subjects. In addition to operating under an Assurance of Compliance Certificate, the DoD institution sponsoring and/or conducting the research must have an Institutional Review Board to review the research protocols, all researchers must be trained in human subjects protection, and there must be a mechanism in place for ongoing compliance oversight. In 2004, medical personnel supporting Operation Enduring Freedom and Operation Iraqi Freedom recognized the need for retrospective research on patient records and prospective research comparing clinical procedures in respective combat theaters; however, none of the protections listed above were in place.

In 2005, in response to this need, the Commander of USAISR and the Commander of the 44th Medical Brigade established a multipartner memorandum between the Commander Multi-National Corps-Iraq and the Army Surgeon General to create the necessary approval and documentation

process to allow research. Under this memorandum, all protocols must be reviewed by an Institutional Review Board, and all researchers must have proper training in medical research. These research protocols undergo scientific review at USAISR, ethical review at Brooke Army Medical Center, and the Commander of the 44th Medical Brigade serves as the signer of the Assurance of Compliance Certificate. This allows for the same informed consent and protection of human subjects in theater as are in the United States. It also allows deployment of DC2RTs (Deployed Combat Casualty Research Teams) in theater in close proximity to warfighters, which in turn allows for better, more accurate data gathering related to type and severity of wounds, effectiveness or lack thereof of protective equipment, and examination of early onset symptoms for infectious disease. As proven in Vietnam with the WRAIR medical research units, collocating researchers in the field with warfighters allows for a more efficient review of the problem than is possible in the laboratory and often expedites medical research solutions. This will be seen again in terms of medical evacuation platforms and combat service support solutions.

As of early 2008, a number of retrospective studies have been approved and conducted involving the review of military medical records. These studies sought to assess a number of trauma types and compare those injuries to patient outcomes. This has directly and indirectly led to a number of OTSG policy changes related to the treatment of casualties.

Supporting Deployed Forces

Accelerating Research

During the initial period of deployment to Iraq in 2003, USAMMDA sent an IND and Emergency Use Authorization SMART Team to provide medical chemical, biological, radiological/nuclear, and explosive incidents countermeasure support to military and international forces. Specifically, its mission was to provide countermeasures against the threat of botulinum toxin release in the Central Command's area of operations. In support of this effort, the team developed a botulinum response plan, established treatment facilities at 3 combat support hospitals and the U.S. Navy Ship Comfort, and trained 110 Army and Navy medical personnel to ensure the safe utilization of one botulinum IND vaccine.

A second IND team composed of staff from USAMMDA, USAISR, and the U.S. Special Operations Command was also deployed to provide training and oversight for the use of the fibrin hemostatic dressing under an emergency IND. This team, attached to the Special Operations Component, Central

U.S. Army scouts from Headquarters and Headquarters Company, 1st Battalion, 30th Infantry Regiment, 3rd Infantry Division treat simulated injured Soldiers after their humvee was hit by a mock roadside bomb during a mission readiness exercise at Fort Stewart, Georgia, 3 March 2007. *(U.S. Army photo by Spc. Shawn Cassatt)*

Army and Navy personnel train together on how to decontaminate a chemical, biological, nuclear patient at the Third Republic of Korea Army Base during Reception, Staging, Onward Movement, and Integration/Foal Eagle exercises. The annual, multiphase exercise is tailored to train, test, and demonstrate U.S. and Republic of Korea force projection and deployment capabilities. *(DoD photo by Photographer's Mate 2nd Class Sandra M. Palumbo, U.S. Navy)*

Command, obtained prior informed consent from more than 3,000 Special Forces and attached personnel in the theater, trained Special Forces medical personnel on the indications and use of the dressing, and established a medical reporting chain to track the use and outcome of the hemostatic dressing in a combat situation.

USAMMDA was directly involved in developing urgent warfighter needs for the Global War on Terror including the up-armored HMMWV (high-mobility multipurpose wheeled vehicle) casualty evacuation conversion kit (UAH-CCK) and the interior layout of the mine-resistant, ambush-protected (MRAP) ambulance. These efforts came about due to the widespread use of IEDs on the battlefield. Older HMMWV ambulances were not equipped for safe ground evacuation in these circumstances. This limited safe evacuation of the wounded especially in urban areas where air evacuation was unavailable. AMEDD officers serving on the Army Materiel Command FAST (Field Assistance in Science and Technology) team helped to articulate the urgent requirements for UAH-CCKs. Working with the U.S. Central Command and AMEDD Center and School, USAMMDA worked with 2 vendors to produce 16 units in less than a year. This effort led to a contracted delivery order of more than 680 ambulance variants of the MRAP vehicle for service in Iraq and Afghanistan by the end of 2008. This is a particularly notable accomplishment as it involved the collaboration of users, requirements developers, materiel developers, and contracting.

An electronics integrated systems mechanic in the Command, Control and Computers Avionics Directorate performs operational verification of electronic systems on an MRAP vehicle. To meet a critical warfighter need, Tobyhanna Army Depot produced a month's worth of MRAP kits in just 9 days. MRAP vehicles include multimission combat, ambulance variant, and troop transport vehicles. (Photo by Steve Grzezdzinski, www.army.mil)

Another noteworthy collaborative effort is the establishment of the Joint Trauma Analysis and Prevention of Injury in Combat (JTAPIC) program, a partnership of several organizations both within and outside of the U.S. Army. The goal of the JTAPIC program is to improve understanding of vulnerabilities and develop solutions that will prevent or mitigate blast-related injuries. The JTAPIC program has collected and analyzed data to warn commanders of vulnerabilities to probable weapons and to help modify vehicle equipment to better protect Soldiers from blasts. The program has begun to collect damaged personal protective equipment, such as body armor and combat helmets, for analyses that will help developers improve protection systems. USAMRMC remains heavily engaged with the Army and combatant commands to find solutions to current operational problems. The UAH-CCK and the ambulance variant of the MRAP vehicle are two examples.

Medical Logistics Transformation

A significant event in the transformation of medical logistics occurred in June 2004 when USAMRMC initiated a comprehensive strategy to transform Army medical logistics to better support theater requirements for medical force projection and sustainment. The objectives of this strategy were to:

- Integrate and synchronize all theater medical supply chain management activities under a single, end-to-end process management.
- Simplify processes in the theater, accomplishing the most complex processes at the highest level possible, for example, in safe havens.
- Apply best-business processes to provide the right products at the lowest total delivered cost.

Three important initiatives made it possible for USAMRMC to achieve these objectives: Policy Transformation, Organizational Transformation, and Technology Transformation.

Significant policy transformation began when DoD Directive 5101.9 designated the Defense Logistics Agency (DLA) as the DoD executive agent for Medical Materiel, making it the DoD agency responsible for orchestrating end-to-end medical supply chain support to combatant commands. A major element of this initiative has been the formal incorporation of Army medical logistics organizations into the DLA operational architecture as Theater Lead Agent for Medical Materiel (TLAMM). TLAMM manages theater-level distribution for the Health Service Support system on behalf of the executive agent, receiving materiel directly from industry and providing direct support to theater customers. These TLAMM designations build upon a highly successful partnership between the AMEDD and DLA that allows designated AMEDD organizations to operate with the support of the DLA Defense Working Capital Fund. This partnership has existed since 2000 and leverages the capabilities of both the Army and DLA to achieve seamless, end-to-end medical materiel distribution directly from commercial sources to operational customers in the theater. The implementation of an executive agent for Medical Materiel and the designation of TLAMMs formalize this partnership into a policy framework that is now included in joint doctrine for Health Service Support.

The full realization of an enterprise solution will require the establishment of new organizational responsibilities and relationships. Army medical logistics organizations that traditionally have managed independently using stand-alone, legacy systems and servers are being functionally integrated to the enterprise solution. Most of these units currently operate under different commands using their own procedures. Organizational responsibilities for the management of enterprise processes, especially catalog update and new item entry, will have to be established and streamlined to be responsive to theater requirements worldwide. USAMRMC is working with the AMEDD Combat Developer and U.S. Forces Command to develop the necessary operational concepts and organizational alignments to enable separate Army medical logistics units to successfully manage a synchronized, end-to-end supply chain.

Technology transformation is integrated into research and logistics in multiple ways. In recent years, USAMRMC has been developing a theater-level medical logistics solution by leveraging its successful SAP (a business software innovation company)-based Enterprise Resource Planning initiative originally developed in partnership with DLA for the management of medical assemblages. The Theater Enterprise-Wide Logistics System is a

BMMP (Business Management Modernization Program)-approved, phased implementation of a single enterprise solution using commercial off-the-shelf software. It extends TAMMIS automation into the joint arena. It supports the development, production, and ultimate theater sustainment of medical assemblages that are the basic building blocks of operational medical capabilities. In addition, the system supports the operation of all Army organizations serving as a TLAMM and provides materiel management within a single operational instance for tactical Army medical logistics companies. The Theater Enterprise-Wide Logistics System migrated into the Defense Medical Logistics Standard Support program as the theater-level solution for medical supply chain management.

One of the most significant changes in medical logistics between Operations Desert Shield and Desert Storm and the Iraq War is a smaller medical footprint. As an example, 20-person forward surgical teams have replaced the much larger MASH (mobile army surgical hospital) units, and 88-bed combat support hospital modules have created a more deployable increment of the 296-bed base combat support hospital. These smaller life-saving organizations require more flexible and timely supply packages, known as Sets, Kits, and Outfits, and faster line-item resupply to support the same expected patient load. Medical logisticians are delivering such packages today in Operation Iraqi Freedom. The configuration of these packages, according to sound business principles and medical practice, is one of the strategic missions of USAMMA.

Sets, Kits, and Outfits

Grouped medical items in the U.S. military are known by many terms including, assemblies, assemblages, kitting, or Sets, Kits, and Outfits and range in size from small single-person first aid kits to large field hospitals. There are three main types:

Service-Unique (Major) Medical Assemblages – Managed by AMEDD and used primarily for the Army

Multi-Service (Minor) Medical Assemblages – Managed by the Defense Medical Standardization Board and used by multiple services

Deployable Medical Systems (also known as Medical Materiel Sets or hospital modules) – Managed by the Defense Medical Standardization Board and used by multiple services

USAMMA's remarkable innovation in the process of developing and providing assemblies (i.e., Sets, Kits, and Outfits) is known as the USAMMA Revolution in Logistics.

USAMMA Revolution in Logistics

The USAMMA Revolution in Logistics supports the medical mission and enables the optimization of business practices in the form of reduced cost and lead times for medical assemblies.

The USAMMA Revolution in Logistics improves business practices through employment of an enterprise resource planning system based on the same software as the Army's Logistics Modernization Program and the DoD's Business Systems Modernization Program.

- SAP Product with IBM as the integrator
- SAP R/3 with plug-ins for materiel management and financial management
- Incorporated DLA changes into scope (Prime Vendor Contract)

This system employs an integrated business information warehouse capability to provide USAMMA and stakeholders with highly detailed reports to support the dynamic changing medical mission. The system optimized and modernized medical logistics business practices by reducing customer wait time for medical assemblages from 18 months to an average of 2 months.

The Planning and Programming Division of the USAHFPA is responsible for the integration of over $700 million of annual capital investments for the Military Health System. Its analysts and program managers serve as a focal point for the direct coordination with other services, the DoD, the office of the Assistant Secretary of Defense for Health Affairs, and MEDCOM staff for issues related to the planning and programming of requirements in the Medical Military Construction program for the Program Objective Memorandum.

U.S. and Guatemalan Army Soldiers work on the roof of a clinic being constructed in San Marcos, Guatemala, 19 April 2007, during exercise New Horizons-Guatemala 2007. *(U.S. Army photo by Juan Torres-Diaz)*

Bassett Army Community Hospital Replacement Project

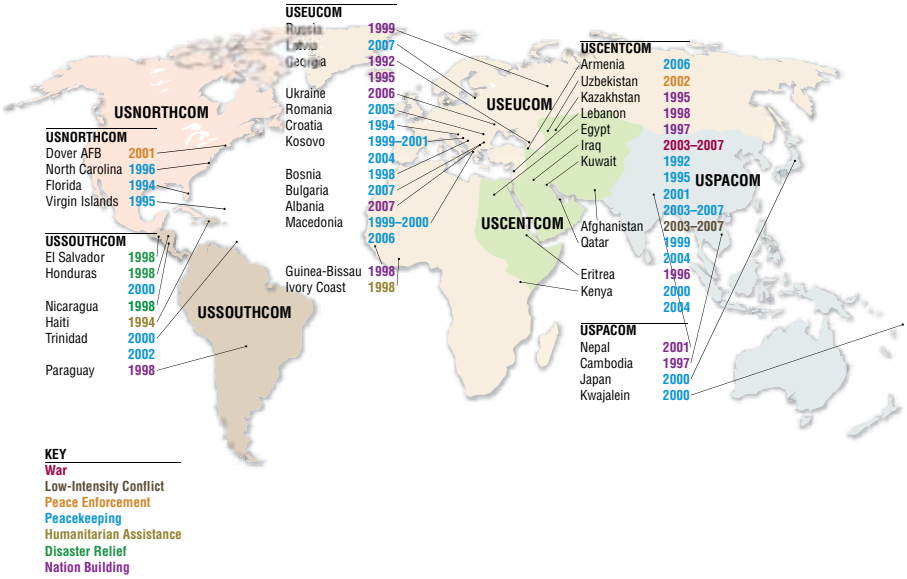
U.S. Army Health Facility Planning Agency Medical Construction Projects for Fiscal Year 2007

Completed: Bassett Army Community Hospital Replacement, Fort Wainwright, Alaska; Military Amputee and Training Center, Walter Reed Army Medical Center, Washington, DC; 121 General Hospital Addition and Alteration, Yongsan, Korea (Phase I completed); Darnall Army Medical Center Emergency Department Addition and Alteration, Fort Hood, Texas; Consolidated Troop Medical Clinic, Fort Benning, Georgia; Health Clinic Addition and Alteration, Wiesbaden, Germany; and Biosafety Level 3 Laboratories, Fort Bragg, North Carolina, and Fort Hood, Texas.

Initiated: U.S. Army Medical Research Institute of Infectious Diseases Phase I, Fort Detrick, Maryland; Consolidated Troop and Family Medical Clinic #10, Fort Hood, Texas; Dental Clinic, Fort Irwin, California; Dental Clinic, Fort Bliss, Texas; Consolidated Health/Dental Clinic, Fort Riley, Kansas; Enhanced Health Service Center, Vicenza, Italy; Battlefield Health and Trauma Center, Fort Sam Houston, Texas; and Hospital Replacement, Fort Belvoir, Virginia.

The U.S. military has found that assisting the governments and humanitarian organizations in less stable regions of the world helps to promote stability and a positive image of the U.S. military. USAHFPA has responded to this need by creating its own deployable teams—SMART-HS (Health Systems). These teams evolved from field medical operations that have supported and continue to support a variety of "real world" missions. As shown in the following map, assigned missions include war and low-intensity conflict, peacekeeping, humanitarian assistance, and disaster relief.

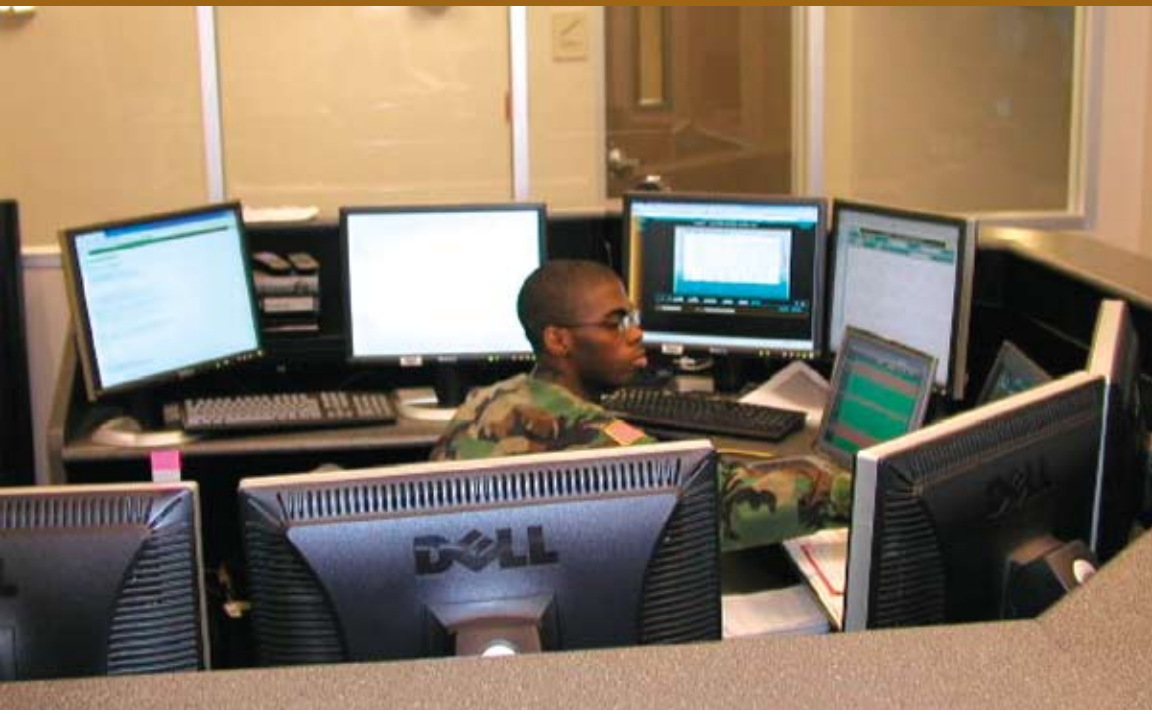
SMART-HS provides the medical commander with a nucleus of subject matter experts drawn from MEDCOM units and medical treatment facilities who are trained to address system-wide and project-specific issues for both U.S. and allied medical resources for host nation or other civilian and military health care systems. Core expertise comprises four members including a health facility planner, a nurse methods analyst, a biomedical equipment specialist, and a clinician. Other medical and nonmedical personnel can be added to this core group to expand the SMART-HS team's capabilities.



SMART-HS Support Missions

As previously noted, USAMISSA was assigned to USAMRMC in 1997 as a result of Task Force Mercury. In 2003, the unit was renamed USAMITC (the U.S. Army Medical Information Technology Center) and reorganized. USAMITC divides its mission requirements into three areas: Enterprise Information Management/Information Technology (IM/IT) Management, IM/IT Customer Solutions, and IM/IT Operations Support.

USAMITC provides the infrastructure for a single worldwide Army medical network operating environment that enables corporate information sharing and centralized management. USAMITC implemented and maintains the Army's medical network operating environment, the AMEDD Active Directory Forest. The Active Directory provides the authentication of and security infrastructure for the MEDCOM's global enterprise. It consists of more than 400 servers, spans 65 sites, and supports more than 80,000 users. The Active Directory is the foundation for key applications such as exchange mail and utilities. It is also a key component to maintaining an Active Directory/Joint Collaboration Forest initiative—an Active Directory infrastructure to facilitate sharing applications across the triservice medical community—and implementing and maintaining MEDCOM Enterprise Management technologies. With MEDCOM's Enterprise Management tools, USAMITC has the ability to distribute software updates and patches to connected MEDCOM units quickly and from a centralized location—a truly worldwide help desk.



USAMITC designs, develops, and sustains medical IM/IT systems. As the systems architect for the AMEDD, USAMITC bridges the gap between the enterprise's business requirements and the IM activities and systems needed to meet those requirements. USAMITC's IT professionals apply the DoD architectural framework to the AMEDD's business processes to design client architectures that reduce system risks and safeguard against mission failures, wasted funds, and dissatisfied customers.

Several examples of customer relations implemented and maintained at USAMITC include the TAMMIS Competency Center housed at USAMITC (helping to push a common data environment); the Armed Forces Health Longitudinal Technology Application (AHLTA; formerly CHCS II) implementation, the DoD's electronic patient health record; and the Surgery Scheduling System.

An important case study is the Pre/Post-Deployment Health Assessment that has enabled a significant increase in captured Post-Deployment Health Questionnaires. Prior to automation, the capture rate for Post-Deployment Health Questionnaires was about 50 percent. Today, this assessment ensures that health problems emerging during deployment are properly documented and addressed. It has provided health care providers with better patient information, and it has reduced errors, inconsistencies, lost records, and delays in tracking symptoms and signs. USAMITC's project management

professionals work within the framework of DoD acquisition regulations and provide the skills to increase project success, reduce project risk, and ensure that quality projects are brought in on time, on budget, and meet requirements and performance goals. They can tailor an acquisition program by negotiating the purchase of a commercially available product, customizing an off-the-shelf product, or building an entirely new product to meet the unique needs of customers.

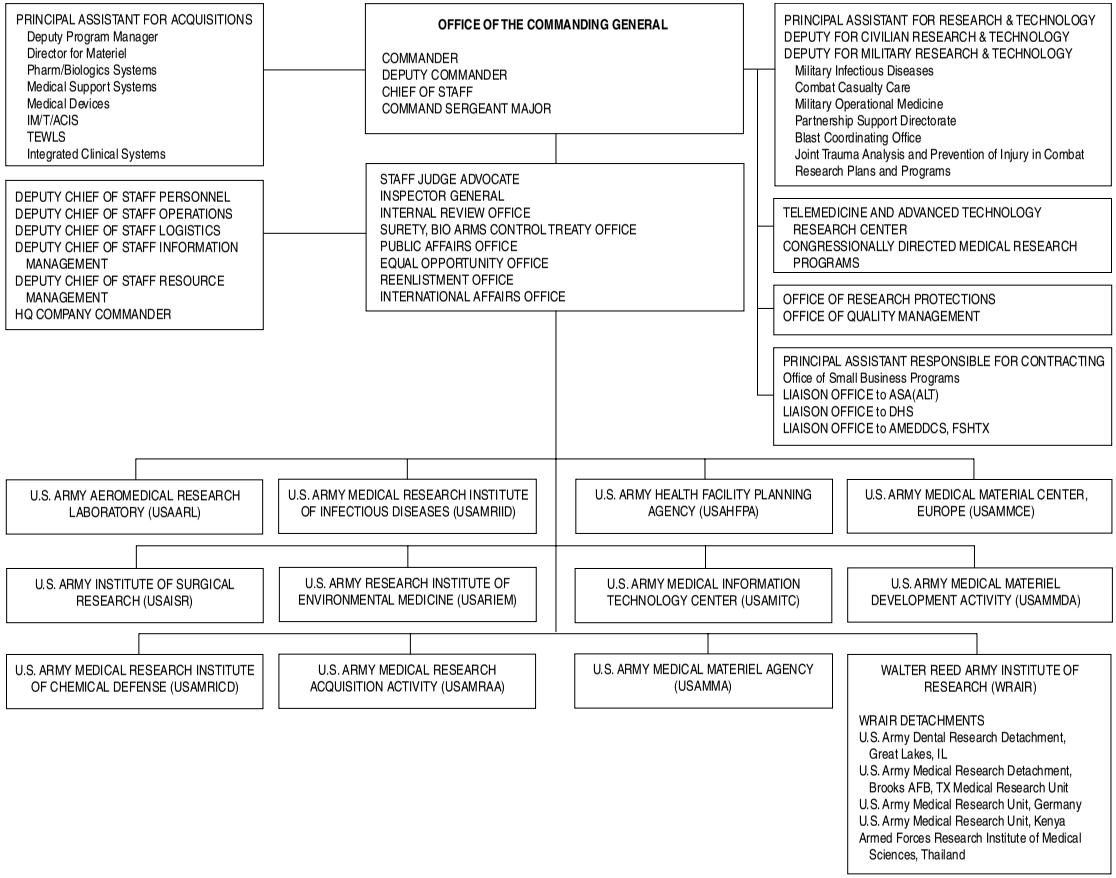
USAMITC ensures the AMEDD's network security and connectivity by monitoring the Army MEDCOM's medical networks 24 hours per day, 7 days per week for any operational vulnerabilities. USAMITC has also maintained the MEDCOM corporate Virtual Private Network architecture and offers security engineering assistance and support to military treatment facilities worldwide.

USAMITC also continues to maintain and enhance the AMEDD electronic messaging system. To put these initiatives into perspective, one should consider that the AMEDD's medical networks and messaging systems consist of over 100 servers centrally managed at 6 global messaging centers. They support users worldwide and provide the secure, reliable transmission of over 2.7 million messages daily.

Summary

The events leading to the Global War on Terror marked a new era for USAMRMC. The increase in terrorist events was an impetus for increased research in biological and chemical countermeasures. The expertise of USAMRIID and USAMRICD in medical biological and chemical defense research was appreciated and utilized by the country in multiple incidents. Progressive care for our wounded resulted in great advances in trauma and burn research and treatment at the Army's premier trauma and burn research institute, USAISR. In addition, USAMRMC recognized the benefits of addressing mental health issues, such as PTSD, and regenerative medicine, which prompted new directions of research within the Command. The following organizational chart illustrates the size and complexity of the Command in 2008.

USAMRMC in 2008



Chapter 8

USAMRMC–Protecting the Future Force

The future face of USAMRMC will be shaped by the transformation and modernization initiatives that the DoD is undergoing today.

Medical BRAC 2005

As BRAC 2005 recommendations are implemented, USAMRMC is in a strategic position to form the backbone of the Joint Center of Excellence for Battlefield Health and Trauma Research at USAISR, Infectious Disease Research at WRAIR, Regulated Medical Project Development and Acquisition at Fort Detrick, Medical Biological Defense Research at USAMRIID, and Chemical Biological Defense Research, Development, and Acquisition at USAMRICD. To expand upon a few, notably USAISR will form the foundation of an entity that integrates all of the Services' combat casualty care research missions and functions into a multifaceted, synergistic research capability with a clinical foundation provided by the trauma center at Brooke Army Medical Center. This will promote translational research that fosters the rapid application of research findings to health care delivery and provides synergistic opportunities to bring clinical insight into bench research through sharing of staff across the research and health care delivery functions.

USAMRIID will be the foundation for the Joint Center of Excellence for Medical Biological Defense. USAMRIID will not only be at the heart of the Joint Center of Excellence for the DoD but through its expansion will also be the cornerstone of the National Interagency Biodefense Campus. The campus will grow in phases as partner facilities are constructed adjacent to existing facilities. USAMRMC will continue to partner with existing organizations at Fort Detrick including the National Cancer Institute and the U.S. Department of Agriculture. In addition to the impressive facilities of these two organizations, notable new facilities will be the National Institute of Allergy and Infectious Diseases' Integrated Research Facility and the Department of Homeland Security's National Biodefense Analysis and Countermeasures Center. In the not too distant future, the National Interagency Biodefense Campus will become a center of gravity for biodefense research and development leveraging the capabilities of joint and interagency programs anchored by USAMRIID.

The Joint Center of Excellence for Battlefield Health and Trauma Research located at Fort Sam Houston at the U.S. Army Institute of Surgical Research on the Brooke Army Medical Center campus.

The National Biodefense Analysis and Countermeasures Center under construction.

The National Institute of Allergy and Infectious Diseases' Integrated Research Facility under construction.

Initiatives Focused on the Wounded Warrior

Regenerative medicine is a promising field for tissue and organ repair and replacement. Regenerative medicine encompasses many novel approaches for the treatment of damaged tissues and/or organs by using therapies that prompt the self-regenerative capacity of the body and by integrating cells with biomaterials for the creation of engineered tissues or organs for therapy. These innovations are possible because of several key advances, including the development of systems that can reliably induce progenitor and stem cell proliferation and differentiation, the discovery of growth factors that control tissue morphogenesis, and derivation of biomaterials and scaffolds that can guide tissue regeneration and reconstruction.

LTG Eric B. Schoomaker describes the regeneration of a human ear.

The concept of AFIRM (the Armed Forces Institute of Regenerative Medicine) is based on the approach that the epidemiology of combat injury is well defined and presents many opportunities for the application of regenerative medicine to improve clinical outcomes after traumatic injury. AFIRM is a collaborative institution composed of USAISR and a consortium of public and private organizations. AFIRM creates cooperative partnerships with industry to ensure that technical innovations emerging from research will transition rapidly into militarily relevant therapies and result in producible technologies, which ultimately will be translated into civilian population applications as well. It is envisioned that integration between basic science research and translational and clinical research will be necessary to bring to practice effective regenerative medicine therapies.

It is also envisioned that this model will establish a viable long-term pipeline with the expectation of having a more "corporate" model applied to AFIRM that closely integrates translational and clinical programs.

Armed Forces Institute of Regenerative Medicine (AFIRM)

AFIRM stresses the following:

- Most near-term payoff for the service member
- Service member wound focus
- Scientific excellence and utilization of technologies at the forefront of regenerative medicine
- Strategic implementation of research (innovative methods for translation of research efforts into clinical practice)
- Integrative effort between different components of the consortium

The research objectives of AFIRM focus on the following conditions resulting from battlefield trauma with clearly defined clinical implementation (e.g., clinical trials and evidence-based change in clinical practice) of one or more therapies within 5 years:

- Compartment syndrome – therapies for repair of sequelae
- Functional limb and digit salvage, reconstruction, regeneration, or transplantation
    - Regenerating large osseous defects
    - Nerve repair
    - Regrowing functional muscles and tendons
    - Revascularization
- Craniofacial reconstruction
- Inflammation control, healing without scarring
- Burn repair

Because the regeneration or replacement of skin is a critical factor in all of the above problems, a development plan for this tissue will be included throughout all research activities. AFIRM brings great promise to the future care of wounded warfighters.

A Culture Change in Medical Science and Technology

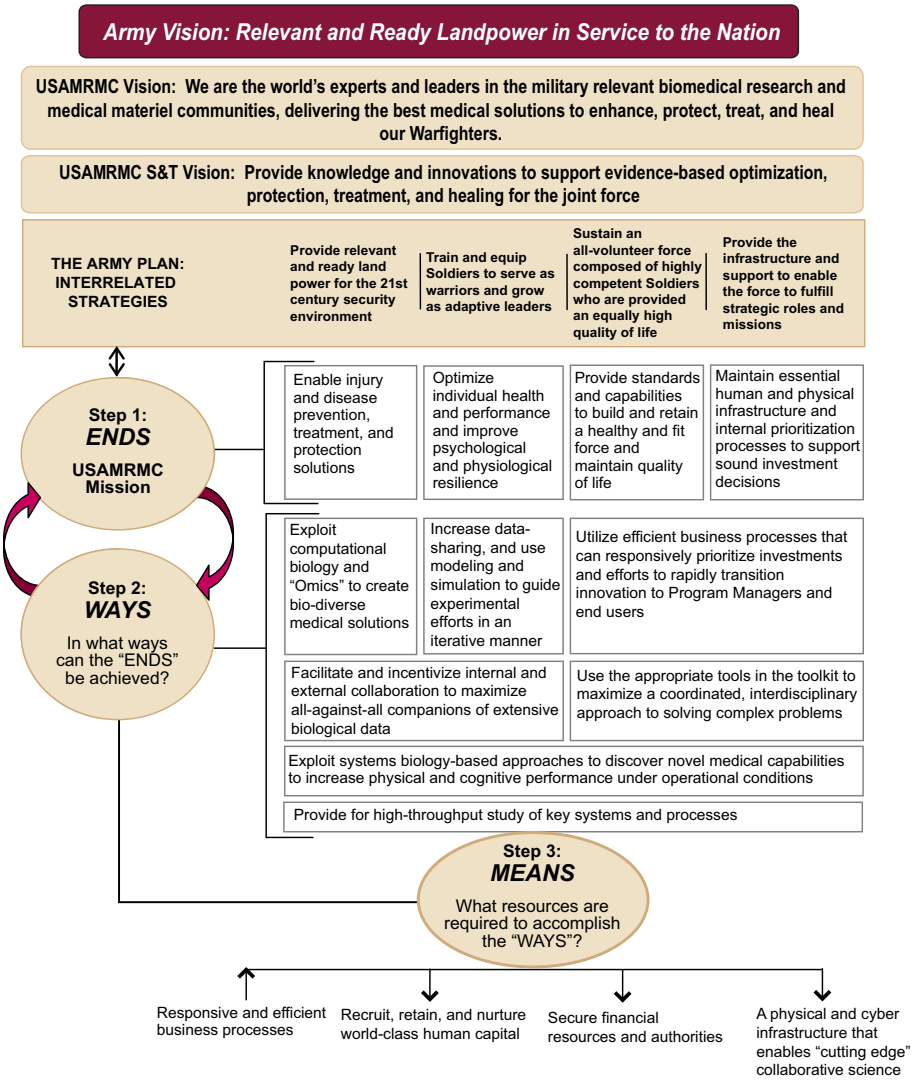
Understanding the extreme scientific complexities that underlie problems encountered in military health and performance across a broad spectrum of operations requires a transformation in biomedical research. The future programs in military biomedical research and development will undergo a culture change enabled by the explosive growth of increasing amounts of biomedical data, interdisciplinary approaches to solving complex problems in military performance, and military-unique diseases and injuries. In developing a strategy to synchronize with Army and joint strategic planning guidance, novel approaches to science and the practice of medicine will be implemented by a true paradigm shift in biomedical and biotechnological research. Such a paradigm shift represents a change in the traditional culture of scientific inquiry. Thus, cultural change includes initiatives that promote a systems approach to understanding the biological complexity manifested in disease, injury, and illness enabled by collaborative interdisciplinary research teaming across the Command's laboratories and research areas.

TATRC is exploring the use of remote-presence robots. The wireless RP-7 robot allows a physician to interact with a patient from another location via a computerized control station.

Mimic Technologies will use advanced technologies in haptics and simulation to improve proficiency and safety in surgical training.

The Command is setting its Science and Technology vision to take advantage of the emergence of information technologies and the robustness of biological data by developing road maps for systems biology, a framework where data and expertise are leveraged, a scientific basis for standardization and quality control of experimentation, generic tools for data integration and data storage that can be implemented Command wide, tools for validation of data generated by participating research areas and laboratories, and an infrastructure for sharing data and information.

The Science and Technology vision embraces the creation of a seamless enterprise with support mechanisms for interdisciplinary collaboration through transparent scientific-community access to data and tools.



The vision strives to facilitate open access to large-scale databases; tools for data-mining, modeling, and simulation; and computing infrastructure. The vision advocates computation, modeling, and simulation as fundamental components of a systems biology research process. The vision is premised on the anticipation that increases in computing performance will result in economies of scale necessary to achieve greater fidelity in modeling and simulation and enable acceleration of drug discovery through compressing the technology-development cycle, more rapidly yielding medical solutions.

Logistics and Acquisition in the Future

The Defense Medical Logistics Center, Fort Detrick, Maryland (Scheduled occupancy, December 2008)

The Defense Medical Logistics Center

The transformation of medical logistics will be enhanced and accelerated by the establishment of the Defense Medical Logistics Center currently under construction and ready for occupancy in December 2008. This central structure will collocate Army, Navy, and Air Force medical logisticians into a single facility with the objectives to achieve maximum efficiency and effectiveness in support of Joint Force Health Protection; improve capabilities for interoperability among the Services; maintain the organizational integrity of tenant agencies; and maximize future opportunities to improve operations, increase operability, and transform organizations through design flexibility. There will be significant opportunities for operational efficiency such as consolidation of administrative functions and current joint medical operations. Moreover, collocation of the Services' medical logisticians will enable better collaboration to address prioritization of requirements and materiel acquisition, enhanced planning for medical logistics support to joint operations across the full range of military operations, and enhanced collaboration on support to Military Health System-wide medical logistics information technology architecture. The center will create a collaborative environment for clinical engineering and medical equipment management, management of equipment allowance standards, materiel acquisition for medical assemblage production, operations planning and requirements determination, medical contracting support, business analysis and development of business process improvements across the Military Health System, technology assessment and acquisition management, management of DoD vaccine programs, and information technology services.

Next-Generation Acquisition Management

Next-generation acquisition management practices are well under way with the recent reorganization of the medical acquisition program. The USAMRMC acquisition organization now parallels a typical Program Executive Office structure found within the office of the ASA(ALT) with Product Managers reporting to Project Managers who in turn report

Medical materiel bound for the Middle East is trans-shipped via USAMMCE. USAMRMC components maintain constant visibility of medical materiel in transit.

Medical logisticians inventory medical supplies.

to a Program Manager and to the Milestone Decision Authority. One feature unique to the medical acquisition enterprise is the inclusion of the appropriate subordinate commanders under the acquisition chain of authority, bringing support structure resources and priorities into the mix. With their involvement, the acquisition function truly encompasses all core functions as well as critical support functions such as materiel fielding, training, regulatory affairs, and severe adverse effect reporting. It is a robust structure to meet unique requirements of medical acquisition. Direct reporting Program Managers are: (1) Program Manager for USAMRMC Enterprise IM/IT who oversees assigned initiatives, shepherds activity through the MEDCOM governance process, provides acquisition life-cycle support to Army/MEDCOM Programs of Record, and supports the USAMRMC Defense Business Transformation activity and technology transfer of IM/IT efforts to established acquisition Programs of Record and (2) Program Manager for Theater Enterprise-Wide Logistics System who manages the Army's initiative to migrate theater-level Class VIII supply chain management to a SAP-based, joint architecture that supports both peacetime and operational environments.

USAMMA-based Project Managers report to the Commander, USAMMA, who reports under the acquisition chain of authority to the Principal Assistant for Acquisition. The USAMMA Project Managers are: (1) Project Manager for Integrated Clinical Systems who centrally manages all imaging, image management, and major clinical systems that integrate with the DoD Electronic Medical Record and operates through three Product Managers to execute the integrated clinical systems mission and (2) Project Manager for Medical Devices who manages all Table of Organization and Equipment medical devices supporting patient and animal care excluding imaging systems; oversees three Product Managers for acute care, ancillary care, and medical scientific matters; and manages major end items and associated unit assemblages in trauma and emergency medical treatment, medical transport, general surgery including surgical subspecialties, recovery, central materiel service, ophthalmology and optometry services, laboratory, dentistry, veterinary services, and general medical care.

USAMMDA-based Project Managers report to the Commander, USAMMDA, who reports under the acquisition chain of authority to the Principal Assistant for Acquisition. The USAMMDA Project Managers are: (1) Project Manager for Pharmaceutical Systems who centrally manages the development and acquisition of drugs, vaccines, diagnostics, repellents, blood products, and resuscitative fluids; operates through several Product Managers with specific disease or technology focus; leverages and partners with USAMRMC laboratories and domestic and foreign pharmaceutical

companies; and works with the Defense Medical Standardization Board on the Joint Formulary and ensures AMEDD unit assemblages include the most up-to-date pharmaceuticals and (2) Project Manager for Medical Support Systems who manages nonmedical products supporting the medical mission, engages non-AMEDD Program Managers and Program Executive Officers to ensure that medical requirements are addressed, oversees a rapid prototyping laboratory, and operates through two Product Managers.

The reorganization strengthens the acquisition–logistics enterprise, promotes communications across multiple organizations, provides for robust life-cycle management, and ultimately transitions the best capabilities to the warfighter in a more timely and cost-effective manner.

USAMRMC is devoted to providing the best medical solutions for today and tomorrow. Diverse, multifunctional teams span the materiel development life cycle from basic research in the laboratory to innovative product acquisition, to the fielding and management of medical equipment and supplies. Many great milestones have been achieved since its inception in 1958 and realignment in 1994 to a full life-cycle manager for all medical systems. Disease and non-battle injury casualty rates have significantly declined. All-time historically high survival rates are being seen in Operation Iraqi Freedom and Operation Enduring Freedom. USAMRMC impacts the Soldier at every step from accession to deployment to demobilization. As the Command moves forward into the next 50 years, it will continue to uphold its vision and purpose: To enhance, protect, treat, and heal our warfighters.

Appendix A

USAMRMC Commanders 1958–2008

Appendix A

USAMRMC Commanders 1958–2008

Robert L. Hullinghorst, COL, MC	Aug 1958 – Oct 1958
Joseph H. McNinch, BG, MC	Oct 1958 – Aug 1960
James H. Forsee, BG, MC	Aug 1960 – May 1962
Robert E. Blount, BG, MC	May 1962 – Feb 1965
Colin F. Vorder Bruegge, BC, MC	Feb 1965 – Jul 1967
Joe M. Blumberg, MG, MC	Jul 1967 – Jul 1969
Irvin C. Plough, COL, MC	Jul 1969 – Sep 1970
Richard R. Taylor, MG, MC	Sep 1970 – Feb 1973
Robert Bernstein, BG, MC	Mar 1973 – May 1973
Kenneth R. Dirks, BG, MC	Aug 1973 – Aug 1976
William S. Augerson, MG, MC	Aug 1976 – Feb 1979
LeeRoy G. Jones, COL, MC	Mar 1979 – Jun 1979
Garrison Rapmund, MG, MC	Jun 1979 – Aug 1986
Philip K. Russell, MG, MC	Aug 1986 – Sep 1990
Garland E. McCarty, COL, MC	Oct 1990 – Dec 1990
Richard T. Travis, MG, MC	Dec 1990 – Jan 1994
Russ Zajtchuk, BG, MC	Mar 1994 – May 1998
John S. Parker, MG, MC	May 1998 – Mar 2002
Lester Martinez-Lopez, MG, MC	Mar 2002 – Apr 2005
James A. Romano, COL, MS	Apr 2005 – July 2005
Eric B. Schoomaker, MG, MC	July 2005 – Mar 2007
Jonathan H. Jaffin, COL, MC	Mar 2007 – Nov 2007
George W. Weightman, MG, MC	Nov 2007 – present

Appendix B

USAMRMC Subordinate Commands 2008

Appendix B

USAMRMC Subordinate Commands 2008

U.S. Army Aeromedical Research Laboratory (USAARL)

USAARL at Fort Rucker, Alabama, is a nationally recognized Center of Excellence for research into Soldier safety, survival, impact tolerance, sustainability, and performance effectiveness in the mounted environment. Its JUH-60A Black Hawk aircraft is a unique aviation medicine resource. Though USAARL's legacy was forged in Army Aviation, its present research program uses equipment such as the multi-axis ride simulator to focus on increased force effectiveness and safety in mounted and dismounted operations with land-based tactical vehicles and weapons platforms. USAARL has state-of-the-art research capabilities in the areas of acoustics, vision, repetitive impact, crash survival, and life support systems, and its full-motion NUH-60FS Black Hawk flight simulator and 8-bed sleep laboratory are unrivaled for investigating management of crew workload, stress, and fatigue.

U.S. Army Institute of Surgical Research (USAISR)

USAISR, located at Brooke Army Medical Center, Fort Sam Houston, Texas, is renowned as the only DoD Burn Center and is recognized worldwide for its advanced level of care to critically burned Soldiers, Sailors, Marines, and Airmen, as well as support to the civilian community. USAISR has an equally important research mission to provide medical solutions and products across the full spectrum of combat casualty care from far-forward self-care and buddy care through evacuation to definitive military medical treatment and return to duty. Focused areas of research include hemorrhage control, resuscitation, orthopedic injuries, and soft tissue injuries including burns, pain management, bone regeneration, clinical trauma, and trauma informatics. USAISR is the future home of the Joint Center of Excellence for Battlefield Health and Trauma Research. The 2005 Base Realignment and Closure commission's decision will consolidate combat casualty care research for the Army and Navy in one location to facilitate the development of joint solutions. The new facility is expected to open in September 2009.

U.S. Army Medical Research Institute of Chemical Defense (USAMRICD)

Located at Aberdeen Proving Ground, Maryland, USAMRICD is the DoD's lead laboratory for development of medical countermeasures against chemical warfare agents. Medical countermeasures developed at USAMRICD protect the warfighter through antidote therapy, topical skin protectant barriers, pretreatment measures, and improved management of casualties through treatment regimens that reverse or reduce the toxicity of

chemical agents. USAMRICD also has responsibility for training health professionals in the medical management of chemical casualties. The Chemical Casualty Care Division conducts classroom courses, field training exercises, satellite broadcasts, and numerous training products for distance learning (see https://ccc.apgea.army.mil).

The U.S. Army Center for Environmental Health Research, Fort Detrick, Maryland, a detachment of USAMRICD, directs and conducts research, development, testing, and validation for the medical aspects of environmental surveillance and environmental health in support of medical force protection.

U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID)

USAMRIID, located at Fort Detrick, Maryland, conducts basic and applied research on biological threats resulting in medical solutions to protect military service members. USAMRIID is the lead medical research laboratory for the U.S. Biological Defense Research Program. The institute plays a key role as the only laboratory in the DoD equipped to safely study highly hazardous infectious agents requiring maximum containment at biosafety level 4. As the Center of Excellence for DoD medical biological defense research, USAMRIID's challenge is to maintain its world-class scientific and technology base while being responsive to its primary customer—the warfighter. While USAMRIID's primary focus is on protecting military service members, its research has applications that benefit the civilian population at large. The institute's unique science and technology base serves not only to address current threats to our Armed Forces but is an essential element in the medical response to any future biological threats that may confront the Nation.

U.S. Army Research Institute of Environmental Medicine (USARIEM)

USARIEM is the DoD's premier institution for environmental and exercise physiology research. Located in Natick, Massachusetts, USARIEM functions as a world-class laboratory for environmental medicine, physiology, performance, and nutrition research to protect, sustain, and enhance warfighter health and performance. The institute performs basic and applied research in environmental physiology and occupational medicine with a focus on human performance optimization. USARIEM conducts research in thermal and mountain medicine, military performance, military nutrition, and biophysics and biomedical modeling. By leveraging its unique capabilities and facilities with industry, academia, and government, USARIEM produces a variety of important products, including performance optimization doctrine, preventive medicine and planning doctrine, materiel development support, physiological monitoring strategies and predictive algorithms, and health hazard assessments.

Walter Reed Army Institute of Research (WRAIR)
WRAIR, Forest Glen, Maryland, is the oldest (1893), largest, and most diverse laboratory of USAMRMC. Its mission is to counter threats from naturally occurring infectious diseases, high energy and trauma, stress and sleep deprivation, and biological and chemical warfare agents. Housed in a new state-of-the-art laboratory facility and collocated with the Naval Medical Research Center, WRAIR provides unique research capabilities, including sleep suites; an insectary to produce vectors of militarily important diseases such as malaria, dengue fever, and leishmaniasis; biosafety level 3 laboratories; a clinical trial facility for conducting human challenge studies; and a Good Manufacturing Practice-grade bioproduction facility.

In addition, WRAIR manages collocated research programs in laser/microwave bioeffects (U.S. Army Medical Research Detachment) and combat dentistry (U.S. Army Dental and Trauma Research Detachment). WRAIR also operates overseas research units in Thailand, Kenya, and Germany.

U.S. Army Health Facility Planning Agency (USAHFPA)
USAHFPA, Falls Church, Virginia, is USAMRMC's operational command that supports planning and execution of AMEDD facility life-cycle management worldwide. As the Army MEDCOM's deployable experts in planning, programming, design, construction, and transition of facilities, USAHFPA assists AMEDD and other customers in assessing and refining their facility requirements and then executes design and construction investments whenever and wherever needed. The agency also deploys its expertise globally as one of the MEDCOM's Special Medical Augmentation Response Teams–Health Systems in support of war, operations other than war, peacekeeping, nation building, and disaster relief.

U.S. Army Medical Information Technology Center (USAMITC)
USAMITC provides IM/IT (information management/information technology) products and services to support the AMEDD, the Military Health System, DoD, and other government clients. USAMITC is also the operational arm for the Army Surgeon General in executing corporate IM/IT strategy and managing corporate IM/IT infrastructure and is the AMEDD's single enterprise IT service provider.

U.S. Army Medical Materiel Agency (USAMMA)
USAMMA has its headquarters at Fort Detrick, Maryland, with forward sites and maintenance operations in various locations in the United States and overseas. USAMMA has myriad, strategic roles involving medical centrally managed logistics programs, materiel acquisition and supporting functions,

Army Supply Class VIII (Medical) set builds and cataloging, command fielder, maintenance planning and operations, and Army Force Generation integration and synchronization. USAMMA's vision is to take full measures that ensure every provider can deliver the health care expected by the nation, joint warfighters, and partners.

U.S. Army Medical Materiel Center–Europe (USAMMCE)

USAMMCE, Pirmasens, Germany, serves as the theater lead agent for medical materiel for the U.S. European Command and provides medical materiel support for the U.S. Central Command. USAMMCE supports more than 1,300 Army, Navy, Air Force, and Department of State hospitals, clinics, embassies, and field units, focusing on acquisition, storage, and distribution of medical materiel, optical fabrication, and medical maintenance. USAMMCE also serves as the executive agent to the Department of State for its medical humanitarian assistance program. USAMMCE is ISO 9001:2000 and 1400 certified.

U.S. Army Medical Materiel Development Activity (USAMMDA)

USAMMDA's mission is to protect and preserve the lives of America's sons and daughters by developing new drugs, vaccines, and medical devices that enhance readiness, ensure the provision of the highest quality medical care to the DoD, and maximize survival of medical casualties on the battlefield. USAMMDA product managers take promising new concepts and technologies developed in our laboratories, guide them through the regulatory maze to obtain FDA certification, and develop plans for fielding in conjunction with USAMMA.

U.S. Army Medical Research Acquisition Activity (USAMRAA)

USAMRAA crafts both Federal Acquisition Regulation-compliant contracts and assistance agreements (grants and cooperative agreements) in support of USAMRMC and its many subordinate activities. These documents are used to obligate funds and acquire services from the commercial market, such as research staff, scientific effort, advance development support, medical products, logistics support, and supplies/equipment in support of the Command's overall mission. This mission encompasses more than $2 billion and over 21,000 transactions annually. Additionally, USAMRAA provides contractual business advice to Command elements and assistance with ISO certification upon request.

Appendix C

Reference List

Reference List

Numerous USAMRMC, Department of the Army, and government resources, including but not limited to web sites, brochures, briefings, and published articles, were used in the writing of this book. Other references are listed below.

Artenstein AW, Opal JM, Opal SM, Tramont EC, Peter G, and Russell PK. History of U.S. Military Contributions to the Study of Vaccines against Infectious Diseases. *Military Medicine.* Vol. 170, April Supplement, 2005.

Baehr G. Albert Lasker Basic Medical Research Award, Overview of 1946 Winners. 2008. http://www.laskerfoundation.org/awards/1946_b_overview.htm. June 2008.

Ballou WR, et al. Update on the clinical development of candidate malaria vaccines. *American Journal of Tropical Medicine and Hygiene*. 2004; 71 (Suppl 2), pages 239–247.

Biological Weapons: Effort to Reduce Former Soviet Threat Offers Benefits, Poses New Risks. *GAO Report to Congressional Requesters*. GAO/ NSIAD-00-138, April 2000.

Boles J. ARFIMS [AFRIMS]: Treating Disease in Southeast Asia for Fifty Years. *Thai-American Business*. Volume 1, 2008.

Brew M and Baker D. The Transformation of Medical Logistics since Operation Desert Storm. *AUSA: Army Magazine*. 1 June 2003.

Britt TW, Adler AB, and Bartone PT. Deriving benefits from stressful events: The role of engagement in meaningful work and hardiness. *Journal of Occupational Health Psychology*. 2001;6(1):53–63.

Brosch LR, Holcomb JB, Thompson JC, and Cordts PR. Establishing a Human Research Protection Program in a Combatant Command. *The Journal of Trauma, Injury, Infection, and Critical Care*. 2008: 64(2): February Supplement.

Brush P. Higher and Higher: Drug Use among U.S. Forces in Vietnam. *Vietnam*. Dec 2002; 15(4).

Byrne P. Defense Medical Logistics and the Army Medical Department. *Military Medical Technology*. 2006; 10(5).

Committee to Advise the Department of Defense on Its Fiscal Year 1993 Breast Cancer Program, Division of Health Sciences Policy. *Strategies for Managing the Breast Cancer Research Program*: A Report to the U.S. Army Medical Research and Development Command. Institute of Medicine, National Academy Press, 1993.

Cordts PR, Brosch LR, and Holcomb JB. Now and Then: Combat Casualty Care Policies for Operation Iraqi Freedom and Operation Enduring Freedom Compared With Those of Vietnam. *The Journal of Trauma, Injury, Infection, and Critical Care*. 2008; 64(2); February Supplement.

Covert N. The Cutting Edge: A History of Fort Detrick, Maryland. 3rd edition. Public Affairs Office, Headquarters, U.S. Army Garrison, Fort Detrick, Maryland. 1997.

Cancio LC, Horvath EE, Barillo DJ, Kopchinski BJ, Charter KR, Montalvo AE, Buescher TM, Brengman ML, Brandt M, and Holcomb JB. Burn Support for Operation Iraqi Freedom and Related Operations, 2003 to 2004. *Journal of Burn Care and Rehabilitation*. March/April 2005, Pages 151–161.

Dasey CF. U.S. Army Medical Research and Development Command in Support of Desert Shield/Storm. *The Journal of the U.S. Army Medical Department*. March/April1992; PB 8-92-3/4.

Delehanty R. *Historic California Posts, Camps, and Stations: Letterman Army Medical Center*. http://www.militarymuseum.org/LettermanAMC.html. May 2008.

Engelman R and Joy R. *Two Hundred Years of Military Medicine*. The Historical Unit, U.S. Army Medical Department, Fort Detrick, Maryland. 1975.

Fransesconi R, Byrom R, and Mager M. United States Army Research Institute of Environmental Medicine: First Quarter Century. *The Physiologist*. Vol. 29, No. 5, Supplement 1986.

Friedl K and Allan J. USARIEM: Physiological Research for the Warfighter. *Army Medical Department Journal*. Oct/Nov/Dec: PB 8-04-10/11/12.

Gabriel RA and Metz KS. *A History of Military Medicine*. Volume. II. New York: Greenwood Press. 1992.

Grabenstein JD, Pittman PR, Greenwood JT and Engler RJM. Immunization to Protect the U.S. Armed Forces: Heritage, Current Practice, and Prospects. *Epidemiologic Reviews*. 2006;28:3-26.

Henchal E and Vander-Linden C. USAMRIID: The Cornerstone for Medical Biodefense. *U.S. Army Medical Department Journal*. October–December 2004.

Hoke CH. History of U.S. military contributions to the study of viral encephalitis. *Military Medicine*. 2005;170(4):92,92–105.

Hoke CH et al. Protection against Japanese encephalitis by inactivated vaccines. *New England Journal of Medicine*. 1988 Sep 8;319(10):608–14.

Kelley PW. Textbooks of Military Medicine: Military Preventive Medicine: Mobilization and Deployment, Volume 1. Office of the Surgeon General, Department of the Army, 2003.

Kitchen LW and Vaughn DW. Role of U.S. military research programs in the development of U.S.-licensed vaccines for naturally occurring infectious diseases. *Vaccine*. 10 Oct 2007:25(41).

Kris B. The search for health: SEATO medical projects in Thailand. South-East Asia Treaty Organization, Washington, DC. 1965.

Lam DM. The U.S. Army Telemedicine and Advanced Technology Research Center is on the cutting edge of telemedicine and serves as focal point between industry, the medical community and the military for cooperation. *Military Medical Technology*. 19 May 2004:8(4).

Ledford FF. From the Surgeon General of the Army: Medical Support for Operation Desert Storm. *The Journal of the U.S. Army Medical Department*. January/February 1992:PB 8-92-1/2.

McGeary M and Hanna K. Committee on Alternative Funding Strategies for DoD's Peer Reviewed Medical Research Programs, Medical Follow-Up Agency and Board on Health Sciences Policy. *Strategies to Leverage Research Funding: Guiding DoD's Peer Reviewed Medical Research Programs*. Institute of Medicine of the National Academies, 2004.

McKaughan J. Warrior Protector: Interview of Lieutenant General James B. Peake, U.S. Army Surgeon General Commander, U.S. Army Medical Command. *Military Medical Technology*. 25 November 2003:7(8).

Miller J, Clement S, Hoskins C, and Schloss H. United States Army Medical Department Reorganization. Volume I: Narrative. Office of the Surgeon General (Army), Falls Church, VA. 1995.

Moran M, Guzman J, Ropars AL, Jorgensen M, McDonald A, Potter S, and Selassie H. *The Malaria Product Pipeline: Planning for the Future*. The George Institute for International Health. 2007.

Mullins WS. *A Decade of Progress, The United States Army Medical Department 1959–1969*. Prepared and published under the direction of Lieutenant General Hal B. Jennings, Jr., The Surgeon General, United States Army, Office of the Surgeon General Department of the Army Washington, DC, 1971.

Neel S. Medical Support of the U.S. Army in Vietnam 1965–1970. *Vietnam Studies*. Department of the Army, Washington, DC, 1991.

New Electromechanical Hand Lifts Egg Intact, *Army Research and Development Newsmagazine*, December, 1966.

Ognibene AJ and Barrett O. Medical Department, United States Army Internal Medicine in Vietnam, Volume 2: General Medicine and Infectious Diseases. Office of the Surgeon General (Army), Falls Church, Virginia. 1982.

Owens BD, Wenke JC, Svoboda SJ, and White DW. Extremity Trauma Research in the United States Army. *Journal of the American Academy of Orthopaedic Surgeons*. September 2006:14(10):S37-S40.

Richelson JT. Operation Desert Storm: Ten Years After. January 17, 2001. http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB39/. May 2008.

Ritchie M. Alfred Gilman: February 5, 1908 – January 13, 1984. Biographical Memoirs. National Academy Press, Washington, DC. Volume 70. 1996. http://www.nap.edu/html/biomems/agilman.pdf. May 2008.

Salisbury LL and Colman AB. A Mechanical Hand with Automatic Proportional Control of Prehension. *Technical Report 6611*. USAMRMC, WRAIR. May 1966.

Schneider BR. Chapter 1: U.S. Bio-defense Readiness: Thoughts after September 11th. *The Gathering Biological Warfare Storm.*

Sidell F, Takafuji E, and Franz D. Textbooks of Military Medicine: Medical Aspects of Chemical and Biological Warfare. Office of the Surgeon General, Department of the Army, 1997.

The Army Medical Research and Development Board. *Science*. 2 November 1945: 102(2653):440–441.

Tucker JB. The Yellow Rain Controversy: Lessons for Arms Control Compliance. *The Non-Proliferation Review*. Spring 2001

United States Department of State. *Case Study: Yellow Rain: Fact Sheet, Bureau of Verification, Compliance, and Implementation*. Washington, DC. October 1, 2005. http://www.state.gov/t/vci/rls/prsrl/57321.htm. May 2008.

USAMRMC Products Portfolio. United States Army Medical Research and Materiel Command. Fort Detrick, Maryland. June 2007.

Vander Linden C. USAMRIID celebrates 50-year research tradition. *Comprint Military Publications Online*. March 2, 2005.

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