

OTOLARYNGOLOGY/HEAD AND NECK SURGERY COMBAT CASUALTY CARE IN OPERATION IRAQI FREEDOM AND OPERATION ENDURING FREEDOM

Section II: Principles and Demographics



View of ear-nose-throat clinic tent, Balad Air Base, Iraq (2004).

Photograph: Courtesy of Colonel Joseph A. Brennan.

Chapter 5

EVACUATION AND ROLES OF CARE

G. RICHARD HOLT, MD, FACS,* AND TIMOTHY K. JONES, DDS[†]

INTRODUCTION

EVOLUTION OF THE US MILITARY MEDICAL EVACUATION SYSTEM

US Civil War

World War I

World War II

The Korean Conflict

The Vietnam Conflict

OPERATION IRAQI FREEDOM AND OPERATION ENDURING FREEDOM

Roles of Care

Evacuation Terminology

Evacuation Platforms and Medical Facilities

SUMMARY

**Colonel, Medical Corps, US Army Reserve; Professor Emeritus, Department of Otolaryngology–Head and Neck Surgery, University of Texas Health Science Center at San Antonio, Medical Arts and Research Center at San Antonio, 7.702, 8300 Floyd Curl Drive, San Antonio, Texas 78229; Professor of Surgery, San Antonio Military Medical Center*

[†]Colonel (Retired), Dental Corps, US Army; Assistant Director, Borden Institute, 2478 Stanley Road, Building 2268, Fort Sam Houston, Texas 78234-6120

INTRODUCTION

At the very heart of successful military action is the effective and efficient medical support of service members engaged in combat, both so that recovered patients can return to the battlefield and for the important factor of morale. Caring for the combat casualty is a moral imperative for US military medical services and, as reported in this textbook, has been carried out with the highest level of professionalism and capability in recent decades. Fundamental to this medical mission is the process of medical evacuation, or MEDEVAC, which begins with point of injury care by trained medics and corpsmen and continues through the roles of medical care to the final recovery phase of the wounded service member, usually in a continental United States (CONUS) medical facility.

Throughout Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) providers have used the most advanced technology in medical evacuation and surgical care of combat casualties.

However, fundamental to this care have been the skills and compassion of highly dedicated medical personnel from the US Army, Navy, and Air Force, including deployed active duty, Reserve, and National Guard members. The care of wounded service members, both American and allied, has resulted in the highest survival rate seen in any large scale military conflict in the course of modern conflict. This is directly attributable to the training and dedication of all medical assets, including individual personnel and combat casualty care units of all sizes. Critical to the high rate of survival of the combat wounded is the conjoint medical evacuation system employed in these operations. The coordination between the triservice evacuation systems has been refined over the course of a decade of conflict in the Middle East, with resulting enhancement of patient flow, reduced time from injury to critical care, and out-of-country evacuation to Germany.

EVOLUTION OF THE US MILITARY MEDICAL EVACUATION SYSTEM

US Civil War

While it is common to think of modern military medical evacuation as originating in the 20th century, in fact it had its beginnings during the US Civil War. Major Jonathan Letterman, MD, medical director of the Army of the Potomac, when faced with the expectation of overwhelming casualties in forthcoming battles, developed a prospective medical plan to handle the wounded soldiers (Figure 5-1). The plan, and its future refinements in the Civil War, is felt to be the predecessor of modern medical evacuation and casualty care:

Beginning at Antietam, Letterman . . . developed an orderly and efficient system for the treatment of wounded soldiers. This began right on the firing lines, where regimental surgeons were the first responders. From the front, the wounded were moved by ambulance along pre-determined evacuation routes to division field hospitals, most of which had been set prior to the battle. At each field hospital, “dressers” performed basic triage, sorting patients for treatment by priority rather than order of arrival. After being stabilized, most patients were transported to long-term recovery hospitals in Frederick or sometimes to Baltimore, Washington, and Philadelphia. Letterman also created two long-term hospitals on the battlefield—the first of their kind—at Smoketown and Keedysville. This kind of evacuation and treatment in stages remains fundamental in handling battlefield casualties today.¹

World War I

The “Letterman system”—rapid evacuation of the battlefield wounded and initial treatment taking place as close to the battlefield as possible—would prove

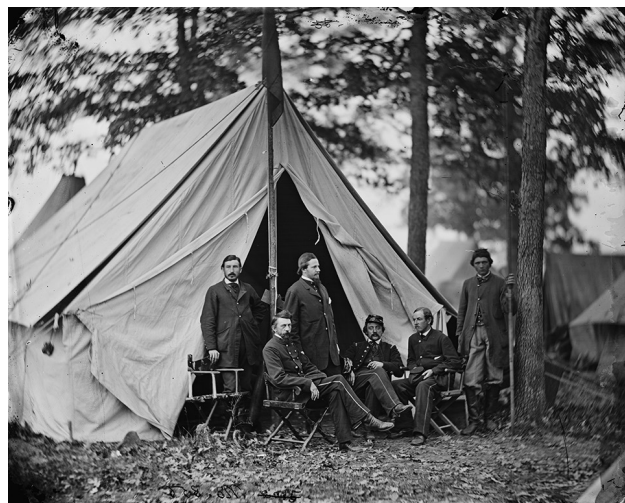


Figure 5-1. “Warrenton, Va. Dr Jonathan Letterman, medical director of the Army of the Potomac and staff, 1862.” Major Letterman was an early pioneer of the care of wounded soldiers in the Civil War.

Reproduced from Library of Congress Prints and Photographs Division, image LC-DIG-cwpb-03769.

both prescient and challenging during World War I. "During the world's first industrialized war, the army medical department refined the Civil War-era division hospital by establishing more specific levels of care, including collection stations, field hospitals, and evacuation hospitals that often were permanently built near rail lines."²

During the First World War, the primary modes of casualty evacuation were horse-drawn or early gasoline-powered ambulances, and weather conditions such as snow and mud regularly made evacuation difficult (Figure 5-2). The US Army Ambulance Service was formed in 1917, with a combination of military and volunteer civilian drivers. Because of the mostly static positions of the opposing forces, a more stable level of care could often be established in the vicinity of the combat zone:

Medical support in the zone of the advance was the responsibility of the medical elements within the divisions, including the medical support organic to the maneuver units and the division sanitary train. Two enlisted medical soldiers were customarily attached to each rifle company where they established a company aid post. Wounded soldiers were brought there for first aid treatment, carried from the front line by company bearers. Most divisions detailed soldiers from the line companies to supplement the number of litter bearers. The battalion aid station was nor-



Figure 5-2. "Ambulance Co. No. 13; field hospital division on the move, showing ruins of town in distance and soldiers in caves [tents] on hillside; Very, Meuse, France; 3 October 1918." Sgt. Marshall, Signal Corps, photographer. Medical evacuation transportation in World War I. Note attempt to camouflage ambulances with tree branches. Reproduced from National Archives and Records Administration, Record Group 111.

mally 250 to 500 yards to the rear of the front line, close enough to be able to render prompt treatment. It was staffed by one or two physicians, a dentist (if available), four to six medics, plus two runners and one or more litter squads supplied by the supporting ambulance company. Battalion aid stations with two medical officers could split into two sections that leapfrogged to keep pace. Litter squads consisted of four bearers.³

From these aid posts, the equivalent of the modern medical battalion provided ambulances for evacuation to one of four field hospitals, which were located less than 10 miles from the front. Each field hospital contained a maximum of 162 beds. The responsibility of the field hospitals was to return to duty the minimally wounded, and to evacuate as quickly as possible those with more serious injuries. The next level of care was the evacuation hospital (which existed in the US Army through the Persian Gulf War), which could expand to 1,000 beds as needed. The evacuation hospital was the first level of definitive surgical care for the severely wounded.^{3(pp42-45)}

Early in the war, patients with injuries to their jaws and lower face were often quickly loaded into the back of an ambulance in a supine position and rushed to the nearest facility for emergent care. Too many of these patients were lost in transit because of aspiration and loss of the upper airway. Two techniques were utilized in an attempt to better secure the airway in facially wounded patients: interdental fixation and the Barton's head-jaw dressing, as described at the time in the *Journal of American Surgery*:

November 10, 1918. Maj. Bruggeman. Wounded November 10, 11 a.m. . . . mandible, left side. Incision under local anesthetic to left side of jaw to release tension. Loss of teeth between cuspid and molar region. Temporary open bite splint applied with Barton Bandage. Mouth very clean at time of evacuation.⁴

These measures, in addition to placing the patient on his side, saved countless lives. Many seriously injured service members spent a good deal of their primary recuperation at fixed allied medical facilities in Europe or Australia. Evacuation by air to the United States was not yet available, so their return to the United States was primarily by hospital ship.

World War II

Over the course of 20 years between World War I and World War II, tremendous advances in industrial and medical technology caused significant changes in the conduct of medical evacuation. Among the advances were expanded aircraft capabilities and

increased knowledge of aviation medicine; improved ground transportation vehicles, including the ground ambulance and the versatile jeep; new drug developments (sulfa and penicillin); and more rapid movement of forward surgical units, due to improved transportation and transportable equipment and operating rooms. In both the European and Pacific theaters of operation, medical care of combat casualties began with embedded Army medics and Navy corpsmen with the Marines. From this initial treatment, which was primarily lifesaving care on the battlefield—control of bleeding and circulation (airway control, under the circumstances, was of necessity and training limited to positioning)—the next level of care depended upon the battle's location. Most infantrymen carried both compressive dressings and sulfa powder and tablets, so medics and corpsmen had additional supplies readily at hand with each casualty.

In the Pacific theater, where island combat was common, clearing stations and battalion aid stations were placed close to the battle, possibly on the beachhead, and evacuation to a higher level of care was by boat to off-shore medical facilities on a hospital ship or other large ship. In the European theater, a more systematic form of medical evacuation was utilized. After the initial care given by the unit medics, the casualty was brought by litter, ambulance, or jeep to a battalion or regimental aid station, where primary resuscitation was carried out and the patient stabilized for further evacuation. The third level of care was either an evacuation hospital, which varied in size and was semimobile, or a field hospital, which was placed as close to the battlefield as tactically possible. The field hospital could be segmented into smaller units, whose function contributed to the formation of mobile Army surgical hospitals (MASHs) in the Korean conflict. Also, surgical augmentation teams were utilized functionally for the first time, including a maxillofacial trauma team.⁵

Weather and geographic conditions gave rise to tremendous variations in the medical evacuation schema during World War II. In the African theater, with wide open desert spaces that made for fast-moving offenses and troop movement, it was a challenge for medical assets to stay in proximity to the battlefield. Some units utilized "surgical trucks" for stabilization of casualties; these trucks could be moved quickly and positioned close to the combat action (Figure 5-3). Ambulances or other outfitted trucks were then used to evacuate wounded to the next level of care.

In the European theater the terrain was quite different, ranging from dense forests to hills and mountains. Here, the experience and capabilities of medics in providing lifesaving aid gave the wounded a reasonable chance for survival until they were evacuated to a



Figure 5-3. "March 1945. Fifth Army, Italy. Medical battalion surgical unit working in support of the 1st Armored Division after setting up the tents which are carried on cab of the surgical truck, the fly with Red Cross markings is placed on tent. All necessary articles are carried inside truck for immediate use." Photo by Mason, 196th Sig Photo Co. Reproduced from National Archives and Records Administration, Record Group 111.

clearing station or battalion aid station. Evacuation was often accomplished by jeep, which, with its four-wheel drivetrain, could navigate the often difficult trails and roads to the next level of care (Figure 5-4).

Evacuation of casualties from the Pacific islands or from one theater to another fell to the US Army Air Corps, which primarily utilized the C-46 and C-47 aircraft. These aircraft could be outfitted for litters as well as ambulatory wounded:

The U.S. armed forces had their first large-scale experience with aeromedical evacuation during World War II, in which 672,000 Americans were wounded—almost four times the number in World War I. Because incapacitating wounds or illnesses frequently occurred in areas remote from modern medical facilities, providing care to soldiers and airmen often required aeromedical evacuation. Even in Western Europe, aeromedical evacuation offered both medical and logistical advantages. More than one million patients were successfully moved by air during World War II. Although most patients in the war still traveled by ground and water transport, aeromedical evacuation clearly showed a potential for expansion in future wars.⁶

Helicopter evacuation of combat casualties was not yet part of the medical evacuation system during World War II. There were, however, isolated instances of utilizing utility helicopters in an emergency when



Figure 5-4. Medics of the 100th Infantry Battalion using a jeep as an ambulance vehicle.
Reproduced from National Archives and Records Administration, Record Group 112.

no other means of evacuation were available. The first medical evacuation by helicopter in the war is described below:

The China-Burma-India “Hump” airlift operation was the theater for what was probably the first use of a helicopter in a combat rescue. In April 1944, TSgt Ed “Murphy” Hladovcak of the 1st Air Commandos, piloting a Stinson L-1 Vigilant with three wounded British soldiers on board, was forced down over 100 miles (160 km) behind Japanese lines, 15 miles (25 km) west of Mawlu, Burma. Deep in the jungle where an airplane could not land, unable to hike out because of the injured passengers, and with ground-rescue forces days away, the downed men hid from nearby Japanese soldiers. A newly-delivered Army Sikorsky YR-4B helicopter, piloted by Lt. Carter Harmon, with a 175-horsepower engine, was dispatched to try a rescue. In the heat and humidity of Burma, the YR-4B could carry only one passenger at a time, straining its engine past the redline just to lift off. Despite these difficulties, over the two day period 25–26 April 1944, four trips were made in and out to a secure location where the men could safely transfer to a Stinson

L-5 Sentinel. The final hasty liftoff was accomplished just as shouting soldiers burst from the jungle. As Lt. Harmon learned later, the soldiers were not Japanese, but an Allied land rescue party that had finally reached the crash site. The great success of the mission encouraged the advocates of helicopters, but few other missions actually took place during WW II.⁷

Because of the longer distances required for a patient’s return to CONUS, hospital ships were used for the most part. The use of a helicopter for search and rescue, as well as for casualty evacuation, began to become a viable concept by the end of World War II, but was not studied as doctrine until the 1950s, just before the Korean conflict.⁸

Additional information on the US Army Medical Department hospitalization and evacuation, zone of interior, in World War II, is available at the Medical Department’s Office of Medical History.⁹ A 1945 interview with Colonel Paul H Streit, who was surgeon of the Central Pacific Base Command, can be found on the Office of Medical History website and provides further descriptions of the care of casualties in the Pacific theater.¹⁰ Colonel Streit was an otolaryngologist and later became commanding general of Walter Reed Army Medical Center in Washington, DC.

The Korean Conflict

Korea became the primary testing ground for the concept of helicopter evacuation of the wounded. At the start of the hostilities in 1950, an ill-equipped delaying force was sent from Japan to Korea on a short-term notification. This force, called “Task Force Smith” after its commanding officer, had only two medical officers to provide casualty care. The senior medical officer, Captain Edwin L Overholt, had just finished training in internal medicine and faced significant medical logistical challenges for which he had not been specifically trained. In an interview for the Office of Medical History, then Colonel Overholt had these observations:

Of utmost importance is stopping the bleeding, preferably by pressure, if necessary by tourniquet well marked and released every 15–20 minutes for a matter of seconds, immobilizing the extremity, giving plasma at forward levels to prevent irreversible shock, and starting penicillin, streptomycin, and tetanus antitoxin. Speedy evacuation is the one key factor paramount to all wounds. If at all possible, all men were evacuated by ambulance from the battalion level inasmuch as all available litter jeeps were used forward of the battalion aid station, as close the company as possible to cut down on the terrifically back-breaking litter-bearer’s job.¹¹

Colonel Overholt was awarded the Silver Star for valor in his medical care of the wounded in this action and subsequently had a distinguished career in military medicine.

Given the challenges to rapid evacuation of wounded in World War II owing to terrain and location of the battlefield, considerable thought was given to using air assets in this capacity. With the rapid expansion of the newly formed US Air Force in 1947, long-distance aircraft were being outfitted for medical evacuation. Most importantly, the concept of helicopter evacuation of casualties, which had been utilized only episodically during World War II, had come to the forefront of the military medical establishment's evolving plans for an improved system of care for wounded service members. Central to this evolving concept were the challenges of battlefield evacuation in the Korean conflict: "On 5 August 1950 one of the helicopters responded to an emergency call from an Army unit and picked up Pfc. Claude C. Crest, Jr. It was the first recorded MEDEVAC mission of the conflict [actually CASEVAC because there was no en route medical care]." ^{11(p12)}

Although evacuation helicopters would routinely be used in Korea, aviation technology had not advanced sufficiently to allow for large, enclosed crew compartments in which medical personnel could attend to patients during transport. The Army helicopter pilot—who was initially a Medical Service Corps officer trained in rotary wing aircraft—was usually the only individual in the cockpit, and one or two casualties were strapped inside the exterior canopies for short distance transport (Figure 5-5). Sea rescues by the US Air Force rescue service often included an air medic flying with the pilot in case a winch was needed. The Navy and Marine Corps included medics in helicopter evacuations of the wounded or in air search-and-rescues of downed pilots, although the Army did not.

In his book on air evacuation in Korea, pilot Richard Kirkland, flying as a member of the US Air Force Air Rescue Service, modestly discussed the risks that these air rescue pilots might undertake: "I believe the helicopter pilots who flew in Korea strived to apply common sense and professionalism in evaluating the risk of their missions. But I have to admit that sometimes we would stretch a little when we knew the stakes were high and someone would live or die by our judgment."¹² A World War II fighter pilot in the Pacific Theater, Kirkland was the first MASH MEDEVAC pilot to evacuate a combat casualty on a nighttime mission (Figure 5-6). The bravery and competence demonstrated by these special pilots has been emulated years by their successors for 60 years.

The five echelons of care used in Korea relied heavily on the unit medics, corpsmen, or aidmen for initial lifesaving care, and the infantry or battalion aid sta-



Figure 5-5. MASH medical personnel and medical evacuation pilots at a Bell H-13 helicopter. "Personnel and equipment needed to save a man's life are assembled at headquarters of the 8225th Mobile Army Surgical Hospital, Korea. October 14, 1951." Photographer: Cpl Charles Abrahamson. Reproduced from Army photo HD-SN-00-03116; National Archives and Records Administration file: 111-SC-382662.

tions (first echelon), which were collocated very close to the fighting positions. The aid station was staffed by two Medical Corps officers in the Navy / Marine system and one Medical Corps and one Medical Service Corps officer in the Army system. Stabilization capabilities at the infantry aid station included controlling bleeding, replacing blood volume (including vascular access through venous cut-down), immobilizing fractures,



Figure 5-6. R.C. Kirkland Night Mission Picking Up Wounded Soldier – Korean War, by Richard Kirkland, watercolor, circa 2002. Photograph courtesy of Richard Kirkland, Vienna, Virginia.

applying compressive dressings, initiating antibiotics, maintaining the airway (including tracheotomy), decompressing pneumothoraxes, and relieving pain.¹³ Requests for evacuation were initiated at the aid station, usually for transport (ground ambulance, jeep, or helicopter) to the second echelon of care, which included division clearing stations (US Army), Navy clearing hospitals, and MASH units. These facilities were generally located 4 to 15 miles from the front.

The concept for the MASH unit evolved from the success of the World War II field hospital individual units, which were semimobile and conditionally capable of moving with the front to support the troops in contact with the enemy. Colonel Michael DeBakey, MD, a pioneering surgeon, was one of the originators of the forward surgical hospital (later called MASH) concept. Ten MASH units supported four Army divisions at positions throughout Korea.¹⁴ US Navy medical officers also staffed MASH units in Korea, which supported the US Marines. Following initial stabilization at the infantry aid or clearing station and evacuation, definitive surgical care, with in-hospital recuperation, was performed at the MASH.

Surgeons at the Korean MASH units were often a combination of experienced World War II veterans and newly trained surgeons, either fresh from residency or taken out of residency. In the acclaimed narrative of his experiences as a MASH surgeon, Dr Otto F Apel Jr described the importance of knowledgeable triage when casualties were considered for helicopter evacuation from the battlefield: "The maximum efficiency of use resulted in an unexpected advantage on the front end of the evacuation. Helicopter evacuation required a much closer selection of evacuees than did evacuation by field ambulance or litter. The battalion surgeon or the medic on the scene decided quickly who was to be evacuated, based on several criteria: the extent of the wound itself, the availability of aircraft, the number of casualties, and other means of evacuation available."¹⁵ As in World War II, combat surgeons eventually returned to the United States as highly experienced trauma surgeons who contributed to advances in trauma management and trauma research.

MASH units typically contained 200 beds, and due to the exigencies of combat, cared for ill patients as well as surgical casualties (Figures 5-7 and 5-8). To keep patients flowing efficiently through the hospital so that beds were available for incoming wounded and sick service members, rapid evacuation to the next echelon of care was carried out, usually by ground ambulance but also by helicopter when needed.

The third echelon of care was provided by evacuation hospitals,¹⁶ which were fairly large facilities located within about 100 miles of the front and capable



Figure 5-7. MASH hospital operating room in Korean War demonstrating multiple procedures underway. "An operation is performed on a wounded soldier at the 8209th Mobile Army Surgical Hospital, twenty miles from the front lines. August 4, 1952." Photographer: Feldman, US Army. Reproduced from US Army photo HD-SN-99-03117; National Archives and Records Administration Record Group 111, file 080-SC-409689.

of providing more definitive surgery, wound care, and recuperation. The 121st Evacuation Hospital existed as a fixed facility within the US Army Garrison Yong-san, in Seoul, Korea, from the Korean War era until it was renamed the Brian Allgood Army Community Hospital in 2008.



Figure 5-8. Dr. Sam Gilfand, alias "Hawkeye" and Assistants, Operating on a Wounded Soldier at the 8055 MASH During the Korean War – 1953, by Richard C. Kirkland, watercolor, circa 2002.

Photograph courtesy of Richard Kirkland, Vienna, Virginia.

From the evacuation hospitals, the wounded and sick were transported by ground, ship, or air carrier to the fourth echelon of care: Army station hospitals in South Korea and Japan, Navy hospital ships, and Army and Navy general hospitals in Japan. Here, longer recuperation was possible for patients awaiting transfer to the fifth echelon of care, a military medical center in Hawaii or CONUS.

The Vietnam Conflict

In Vietnam the principles and practice of medical evacuation began to mature into today's versions. One military medical leader who played a prominent role in the development of the modern US Army medical evacuation system by helicopter was Major General Spurgeon Neel Jr. Having commanded a medical company in World War II, Neel was appointed to chair a review board assessing the potential use of rotary wing aircraft as a platform for medical evacuation. Subsequently, he commanded a medical group in Korea, where he established the Eighth Army Aviation Medical Program, which served as the prototype of the US Army Aviation Medicine program. In 1947 the US Air Force School of Aviation Medicine had been established in San Antonio, Texas, training aviation medicine experts to support Air Force missions; Neel was the first Army graduate of this program. He went on to help select the Bell UH-1 helicopter as the platform for US Army medical evacuations. Neel was designated as the first US Army aviation medical office and considered the "father of Army aviation medicine," establishing the protocols for rapid evacuation of casualties to the highest possible echelon of care as determined by each person's injuries (Figure 5-9). The period of time from injury to definitive treatment became known as the "golden hour," and the survival rate of wounded service members in Vietnam rose to an all-time high. Neel also succeeded in placing control of medical evacuations with medical teams.

In addition to the US Army medical evacuation UH-1 "Huey" helicopters, the US Air Force Combat Rescue Forces (including a few US Coast Guard pilots,) flying as the Aerospace Rescue and Recovery Service, utilized the larger Sikorsky HH-3E "Jolly Green Giant" in many sea and land rescues, especially for downed Air Force pilots. The US Navy's Vietnam Combat Search and Rescue service, deployed primarily on off-shore ships, provided similar search-and-rescue services using Huey helicopters as well as other rotary wing platforms for their missions.

The bulk of medical evacuation during Vietnam was handled by the Army ambulance medical companies and other Army helicopters. Flown by brave



Figure 5-9. "Major General Spurgeon Neel, Command General of the Health Services Command (HSC), urges the 30 officers attending the first in a series of meetings designed to define relationships between HSC and army organizations responsible for reserve training 'to pick the best approaches for a better program' in both reserve support and readiness training. 14 August 1973." Neel is considered the "father of Army aviation medicine."

Reproduced from US Army photograph 41-133-4816-2/AL-73, Central Photo Facility, Ft Sam Houston, Texas. Courtesy of the Army Medical Department Center of History and Heritage.

and competent pilots and crewed by dedicated medics and crew chiefs, these medical evacuation helicopters were known by their call signal, "Dustoff." Some believe the call sign represents the spirit of the effort as "Dedicated, Unhesitating Service to Our Fighting Forces"; however, the DUSTOFF Association explains the origin of the name as follows:

The Association derives its name, DUSTOFF, from the radio call sign given to the first aeromedical helicopter evacuation unit in Vietnam, the 57th Medical Detachment (Hel Amb), which arrived in-country in 1962. The 57th initially communicated internally on any vacant frequency it could find. In Saigon, the Navy Support Activity, which controlled all call words used in call signs in South Vietnam, allowed the 57th to adopt the call sign "DUSTOFF." This call sign epitomized the 57th's medical evacuation missions. Since the countryside was then dry and dusty, helicopter pickups in the fields often blew dust, dirt, blankets, and shelter halves all over the men on the ground. Throughout Vietnam all evacuation helicopters assumed the call sign "DUSTOFF" followed by a numerical designation (the exception being the air ambulances of the 1st Cavalry Division which used the call sign Medevac) and no one ever attempted to change this during the remainder of the conflict. Though other call signs regularly changed, both ground and aviation units refused to refer to these

evacuation helicopters by any other call sign. By adopting “DUSTOFF,” in those early stages of the Vietnam War, the legend was born. The call sign “DUSTOFF,” now synonymous with life-saving aeromedical evacuation, has taken on added meaning with the application of the Association’s motto: Dedicated Unhesitating Service To Our Fighting Forces.¹⁷

Although loss of Dustoff pilots and crew members was unfortunately high, due to their bravery in the face of often extreme danger, their efforts helped save thousands of lives (Figure 5-10). The proper evacuation destination for Dustoff flights was determined through a separate medical radio net, which facilitated the efficient transfer of important information on the casualty’s condition. A thorough history of medical evacuation in Vietnam was published by the Center of Military History in 1982.¹⁸

Upon returning from Vietnam, Major General Neel compiled a landmark book on the medical support of forces in that conflict, *Medical Support of the US Army in Vietnam (1969–1973)*, which became the basis for subsequent development of medical evacuation.¹⁹ This book has been a tremendous resource to all involved with aviation medicine and medical evacuation of casualties since its first printing, and is especially applicable to helicopter operations in challenging terrain such as mountainous regions.



Figure 5-10. “Members of the 4th Battalion, 173rd Airborne Brigade, load the wounded aboard a UH-1D helicopter for evacuation after the assault on Hill 875, located 15 miles southwest of Dak To. 23 November 1967.” US Army photograph. Reproduced from National Archives and Records Administration, Record Group 111.

The echelons of care for medical evacuation in Vietnam were very similar to those established in Korea. Battalion aid stations and division assets such as clearing stations were utilized extensively for stabilizing patients for passage to the next level. However, it was common for critically wounded service members to be evacuated by helicopter over the first and second echelons directly to the most definitive care facility available within the critical time period for the casualty. Located throughout the country were both MASH-type surgical hospitals and evacuation hospitals, each with its own mission and capabilities for managing casualties. These hospitals were assets of the active duty military, Reserve, and National Guard units. The first medical unit, self-contained, transportable (MUST) hospital was in place in Vietnam in 1966 (Figure 5-11). This hospital was air-conditioned—an important medical comfort in that country—and was in use through the Persian Gulf War.

In Vietnam, field hospitals could be reached by helicopter or by in-country Air Force medical transportation assets. Convalescent centers were also located in-country for those who could be expected to return to duty. In fact, almost 40% of the wounded and 70% of the non-wounded were returned to their units. The Air Force transported those who could not return to duty first to Clark Air Force Base in the Philippines, followed by flights to hospitals in Japan, Hawaii, or CONUS, during which they were cared for in transit. The wounded sent to CONUS were cared for by the military medical center closest to their homes.



Figure 5-11. Aerial view of US Army MUST hospital facility in Vietnam. Reproduced from National Archives and Records Administration, record group unknown.

The Vietnam conflict also provided major operational experience for the aviation medical officers (flight surgeons) of the Army, Navy, and Air Force. This period of growth and development for the flight surgeon specialty greatly impacted not only military, but also civilian, air evacuations. Concurrently, all of the services experienced the need for trained medics on the aircraft during rescue and casualty evacuation missions, leading to the recognition of a special type of service member, the flight or aviation medic. Training and experience for the Army flight medic is as follows:

Before deploying to Vietnam, medical aidmen received the basic 14-week medical aidman training at the Army Medical Training Center, Fort Sam Hous-

ton, Texas. Once they arrived in Vietnam, the new medics were either assigned to or volunteered for flight medic duty. Medical skills were reinforced, but it was the intensity of casualties that quickly forced the learning of new skills. The new skills included the basics of trauma medicine, caring for a patient in the aviation environment, operating the on-board high-performance hoist, and the numerous crew-chief maintenance tasks that are part and parcel of being an aircrew member.²⁰

The principles and practices of aeromedical evacuation followed in Vietnam were further refined in the Persian Gulf War. However, the next major leap in capabilities began in 2001, with the conflict in Afghanistan and subsequently in Iraq.

OPERATION IRAQI FREEDOM AND OPERATION ENDURING FREEDOM

As shown by the evolution of the medical evacuation system over nearly 150 years, advances in technology, experience in medical logistics and system organization, and expanded training of aeromedical personnel in all branches of the military forces coalesced to bring the finest capabilities to the Middle East area of operations in the 21st century. Army, Navy, and Air Force medical aviation units and medical facilities became a cohesive, coordinated system for the rapid and effective evacuation of wounded and seriously ill American and allied service members to medical facilities staffed by experienced and capable professionals. Command and control and communications for medical evacuation and medical care for OIF and OEF have been tremendously successful. The utilization of resources has been a joint service process from the beginning and continues to be refined through evaluation of outcomes and revision of protocols and procedures.

After the initial invasion of Afghanistan, medical assets in that country were minimal and primarily intrinsic to the units deployed, with some augmentation. The conflict in Iraq produced a cascade of deployed combat and combat support units that required extensive medical support. Very quickly the bulk of US medical assets were deployed to Iraq, including active duty, Reserve, and National Guard resources. In fact, much of the US military medical assets were positioned in the Reserve units. Medical evacuation assets of the Army, Air Force, and Navy were coordinated and cross-supported one another as needed.

The combat environment in Iraq has been dramatically different than Vietnam in many respects: dry, dusty, and harsh, with sand storms that can be very treacherous; increasing use of improvised explosive devices that target military vehicles; weapons in the

hands of insurgents that can bring down a helicopter; and vast areas of enemy encounter far from medical facilities. These adverse conditions, and more, led to a high evacuation rate out of theater, as recently reported:

From January, 2003, to December, 2011, over 50,000 service members were medically evacuated from OIF/Operation New Dawn theater of combat operations to medical treatment facilities outside of theater . . . There were nearly five times as many medical evacuations for disease and non-battle injury than for battle-related injuries.²¹

Roles of Care

The preface of *Emergency War Surgery, Third United States Revision*, which was the guidebook for medical care during most of OIF and OEF, states: "Military doctrine supports an integrated health services support system to triage, treat, evacuate, and return soldiers to duty in the most time efficient manner. It begins with the soldier on the battlefield and ends in hospitals located in the continental United States (CONUS)."²² In January 2014 a new edition (the *Fourth United States Revision*) of this publication was released, completely rewritten and updated.²³ This edition includes the current Army MEDEVAC terminology: formerly known as "echelons" or "levels" of care, there are now four "roles of medical care" for the US armed forces in support of the OIF/OEF areas of operations.²³

The four roles refer to distribution of medical resources and capabilities to facilities at various levels of command, diverse locations, and progressive capabilities, a basic characteristic of organizing modern health services support. As a general rule, no role is bypassed except on grounds of medical urgency, ef-

iciency, or expediency. The rationale for this rule is to ensure the patient's stabilization and best chances for survival through advanced trauma management and far forward resuscitative surgery prior to movement between medical treatment facilities (MTFs). Different roles denote differences in capability of care. Each higher role has the capability of the role forward of it and in addition expands on that capability. The current *Emergency War Surgery* edition²³ describes each role as follows:

Role 1

- Role 1 is point of injury care.
 - First responder care: first-aid and immediate lifesaving measures provided by self-aid, buddy aid, or a combat lifesaver (nonmedical team/squad member trained in enhanced first-aid).
 - Care by the combat medic or corpsman trained in Tactical Combat Casualty Care (TCCC). Additional battlefield providers, with various levels of training, include the Special Forces medical sergeant, special operations combat medic, SEAL (SEa, Air, Land) independent duty corpsman, special boat corpsman, pararescueman, and special operations medical technician.
- Role 1 care—Army
 - Battalion aid station
 - Includes triage, treatment, and evacuation.
 - Care is provided by physician, physician assistant, and/or medic.
 - Goals are return to duty, or to stabilize and evacuate to the next higher role MTF.
 - No surgical or patient holding capability.
- Role 1 care—US Marine Corps
 - Battalion aid station
 - Includes triage, treatment, and evacuation.
 - Care is provided by physician, physician assistant, and/or corpsman.
 - Goals are return to duty, or to stabilize and evacuate to the higher taxonomy of care.
 - No surgical or patient holding capability.
 - Shock trauma platoon
 - Small emergency medical unit that supports the Marine Expeditionary Force.
 - Includes stabilization and evacuation sections.
 - Staff consists of two emergency medicine physicians and supporting staff (total staff of 25 personnel).
 - No surgical capability.
 - Patient holding time limited to 48 hours.

Role 2

- Includes basic primary care. May also include optometry; combat and operational stress control and behavioral health; and dental, laboratory, radiographic, and surgical capabilities (when augmented).
- Has increased medical capability over Role 1 but limited inpatient bed space.
- 100% mobile.
- Each service has slightly different units at this role.
- Role 2 care—Army
 - Role 2 Army medical assets are located in the:
 - Medical company (brigade support battalion), assigned to modular brigades, which include the heavy brigade combat team, infantry brigade combat team, Stryker brigade combat team, and the medical troop in the armored cavalry regiment.
 - Medical company (area support), which provides direct support to the modular division and support to echelons above brigade units.
 - Role 2 MTFs are located in the treatment platoons of medical companies/troops.
 - Includes basic/emergency treatment (advanced trauma management).
 - Has capability to deliver packed red blood cells (liquid).
 - Limited x-ray, clinical laboratory, dental support, combat and operational stress control, and preventive medicine.
 - Those patients who can return to duty within 72 hours are held for treatment.
 - The forward surgical team (FST) is assigned to the medical command or medical brigade and attached to the combat support hospital (CSH) when not operationally employed forward with a medical company. The FST provides a rapidly deployable immediate surgical capability, enabling patients to withstand further evacuation. It provides surgical support in the brigade combat team. The team provides damage control surgery for those critically injured patients who cannot be transported over great distances without surgical intervention and stabilization.
 - Provides lifesaving resuscitative surgery, including general, orthopedic, and limited neurosurgical procedures.
 - Consists of a 20-person team with one orthopedic surgeon, three general surgeons,

two nurse anesthetists, and critical care nurses and technicians.

- Transportable by ground, fixed wing, or helicopter; some FSTs are airborne deployable. Operational within 1 hour of arrival at the supported company.
- Can provide continuous operations for up to 72 hours.
- Has a ~1,000 sq ft surgical area.
- Includes two operating tables for a maximum of 10 cases per day and a total of 30 operations within 72 hours.
- Can provide postoperative intensive care for up to eight patients for up to 6 hours.
- The supporting medical company must provide logistical support and security.
- X-ray, laboratory, and patient administrative support are provided by the supporting medical company.
- Requires additional electricity, water, and fuel from the support.
- Bating medical company.
- The FST is not designed, staffed, or equipped for stand-alone operations or for conducting sick-call operations. FSTs have been split to create two teams during OIF and OEF.

Note: The Role 2 definition used by NATO forces (Allied Joint Publication-4.10(A)) includes terms and descriptions not used by US Army forces. US Army forces subscribe to the basic definition of a Role 2 MTF as providing greater resuscitative capability than is available at Role 1. Surgical capability is not mandatory at Role 2 according to US Army doctrine. The NATO description of Role 2 care, however, includes damage control surgery.

- Role 2 care—Air Force
 - Mobile field surgical team (MFST)
 - Consists of five-person team (general surgeon, orthopedist, anesthetist, emergency medicine physician, and operating room nurse or technician).
 - Can provide ten life- or limb-saving procedures in 24 to 48 hours from five backpacks (350-lb total gear).
 - Designed to augment an aid station or flight line clinic; no holding capacity.
 - Cannot stand-alone; requires water, shelter of opportunity, communications, etc.
 - Integral to remainder of Air Force Theater Hospital System.
 - Small portable expeditionary aeromedical rapid response (SPEAR) team

- Consists of ten-person team: five-person MFST, three-person critical care air transportation team (CCATT), and a two-person preventive medicine team (flight surgeon and public health officer).
- Includes a 600 sq ft tent; stand-alone capable for 7 days.
- Can provide ten lifesaving or limb-saving procedures in 24 to 48 hours.
- Designed to provide surgical support, basic primary care, postoperative critical care, and preventive medicine for the early phase of deployment.
- Highly mobile, with all equipment fitting in a one pallet-sized trailer.
- Expeditionary medical support (EMEDS), basic
 - Provides medical and surgical support for an airbase, providing 24-hour sick-call capability, resuscitative surgery, dental care, and limited laboratory and x-ray capability.
 - The 25-member staff includes a SPEARR team.
 - Can provide ten life- or limb-saving procedures in 24 to 48 hours.
 - Has four holding beds, two operating room tables, and three climate-controlled tents transportable on three pallets.

Total size is ~2,000 sq ft.

- EMEDS + 10
 - Adds six beds to EMEDS basic, for total of ten beds.
 - No additional surgical capability.
 - Has 56-person staff.
 - Consists of six tents transported on 14 pallets.
- Role 2 care—Navy
 - Casualty receiving and treatment ship (CRTS). CRTSs are part of an amphibious ready group (ARG) and usually comprise of one Marine amphibious assault ship (Tarawa class) or landing helicopter deck Wasp-class ship, whose primary mission is the transport and deployment of marines and secondary mission to function as casualty-receiving platforms. An ARG typically comprises three ships with surgical capability only on the CRTS.
 - Ships have 45 ward beds, four operating rooms, and 17 intensive care beds.
 - A 17-person fleet surgical team consists of one surgeon, one certified registered nurse anesthetist, one critical care nurse, one

- operating room nurse, one general medical officer, and 12 support staff.
- The CRTS and fleet surgical team can be augmented with 84 additional personnel to increase capability from one operating room to four, as well as provide the following specialties: two orthopedic surgeons and one oral and maxillofacial surgeon.
- Ships have laboratory, x-ray, and frozen blood capability.
- Designed for receipt and flow of casualties from helicopter flight deck and also landing craft well deck.
- Have triage areas for 50 casualties.
- Doctrinal holding capability is limited to 3 days.
- Aircraft carrier battle group
 - Includes one operating room, 52 ward beds, and three intensive care beds.
 - Staff includes one surgeon and five additional medical officers.
 - Medical assets aboard aircraft carriers are intended for use by the aircraft carrier and its task force. Aircraft carriers are not casualty-receiving ships and are not included in medical assets for support to ground forces.
- Role 2 care—US Marine Corps
 - Surgical company
 - Provides surgical care for the Marine expeditionary force. Basis of allocation is one per infantry regiment.
 - Provides stabilizing surgical procedures (damage control surgery).
 - Doctrinally consists of four forward resuscitative surgical systems, four shock trauma platoons, and four en-route care teams.
 - Has 20-bed capability.
 - Portable digital x-ray and minimal laboratory and blood banking capabilities.
 - Patient holding capability up to 72 hours.
 - Forward resuscitative surgical system
 - Basic surgical capability module.
 - Rapid assembly, highly mobile.
 - Can provide resuscitative surgery for 18 patients within 48 hours without resupply.
 - The eight-person team includes two surgeons, one anesthesiologist, one critical care nurse, two operating room technicians, and two corpsmen.
 - Holding capability of 4 hours.
 - No intrinsic evacuation capability.
- Not a stand-alone organization.
- En-route care team
 - Two-person team consisting of a critical care registered nurse and a corpsman.
 - Provides transport of two critically injured/ill but stabilized postoperative casualties.
 - Has own equipment package.
 - Capable of transporting two patients, one ventilated.
 - Dependent on opportune lift.

Role 3

- At Role 3, the patient is treated in an MTF staffed and equipped to provide care to all categories of patients, including resuscitation, initial wound surgery, damage control surgery, and postoperative treatment. This role of care expands the support provided at Role 2. Patients who are unable to tolerate and survive movement over long distances receive surgical care in a hospital as close to the supported unit as the tactical situation allows. This role includes provisions for:
 - Evacuating patients from supported units.
 - Providing care for all categories of patients in an MTF with the proper staff and equipment.
 - Providing support on an area basis to units without organic medical assets.
- Role 3 care—Army
 - CSH (248-bed). Provides hospitalization and outpatient services for all categories of patients within the theater.
 - Can provide hospitalization for up to 248 patients. The hospital includes a headquarters and headquarters detachment and two completely functional hospital companies, one 84-bed and one 164-bed. Collectively, the hospital has four wards providing intensive nursing care for up to 48 patients and ten wards providing intermediate nursing care for up to 200 patients.
 - Provides emergency treatment to receive, triage, and prepare incoming patients for surgery.
 - Has surgical capability, including general, orthopedic, thoracic, urological, gynecological, and oral and maxillofacial, based on six operating room tables staffed for 96 operating table hours per day.
 - Consultation services for inpatients and outpatients include area support for units without organic medical services.

- Also provides pharmacy, psychiatry, public health nursing, physical therapy, clinical laboratory, blood banking, radiology, and nutrition care services.
- The early entry hospitalization element (44-bed) provides up to 72 hours stand-alone operations, without resupply. Can provide hospitalization for up to 44 patients, with two wards providing intensive care nursing for up to 24 patients total and one ward providing intermediate care nursing for up to 20 patients. The hospitalization augmentation element (40-bed) augments the early entry hospitalization element. Provides outpatient specialty clinic services and intermediate care hospital beds. The two elements together comprise an 84-bed company.
- The hospital company (164-bed) consists of two wards that provide intensive care nursing for up to 24 patients total, and seven wards that together provide intermediate care nursing for up to 140 patients.

Note: Based upon the experiences of a decade of theater operations, an Army force design update has been approved that will dramatically change the structure of the CSH and augmentation teams to enhance future medical capabilities in theater and further improve modularity. The first new hospital designs are expected to be fielded in fiscal year 2017.

- Role 3 care—Air Force
 - EMEDS + 25
 - 25-bed version of EMEDS basic.
 - Has 84 personnel, two operating room tables, nine 600 sq ft tents, and 20 pallets.
 - Can provide 20 operations in 48 hours.
 - Additional specialty modules can be added, including vascular/cardiothoracic, neurosurgery, obstetrics/gynecology, ear-nose-throat, and ophthalmology teams; each comes with its own personnel and equipment modules.
 - Air Force theater hospital
 - Structures and staffing are capabilities-based and modular.
 - Represents the largest Air Force critical care and surgically capable MTF in the theater of operations.
 - Can function as a theater aeromedical evacuation hub.
 - Ground forces.

- Role 3 care—Navy
 - Expeditionary medical facility
 - Standard configuration has 150 beds, including 40 intensive care beds, and four operating rooms.
 - Provides emergency treatment to receive, triage, and prepare incoming patients for surgery.
 - Has surgical capability, including general, orthopedic, thoracic, urological, gynecological, and oral and maxillofacial, based on four operating room tables staffed for 96 operating table hours per day.
 - Consultation services for inpatients and outpatients include area support for units without organic medical services.
 - Also provides pharmacy, psychiatry, public health nursing, physical therapy, clinical laboratory, blood banking, radiology, and nutrition care services.
 - Stand-alone; full ancillary services.
 - Complete base operating support available.
 - Includes class VIII support “until the theater is mature” or approximately C+60.
 - Large holding capability.

Note: Based upon the experiences of a decade of evolutionary operations, Navy Expeditionary Health Service Support is considering a dramatic change to the structure of expeditionary medical facilities. Determinations will be made regarding scalability, modularity, mobility, and deployable capability to enhance future medical support that will improve Navy Medicine’s flexibility in providing medical support across the full range of military operations.

- **Hospital ships (currently the USNS *Mercy* and USNS *Comfort*)**
 - Each ship has 999 beds consisting of 88 intensive care unit beds (which includes 68-general intensive care beds and 20 postsurgical recovery beds. All 88 beds are equipped with piped-in oxygen and suction, and cardiac monitoring capability). One ward is configured with 11 respiratory isolation beds.
 - Inpatient ward capability includes: 400 intermediate care and 500 minimal care/convalescence beds. The 500 minimal care beds are upper bunks, and not suitable for injury patterns related to fractures. Most upper bunks are typically used by escorts and patients ready to return to full duty.
 - Each ship has support services for up to 12 operating rooms.

- Each ship has 1,215 medical staff (273 officers and 943 enlisted).
- Extensive laboratory and x-ray capabilities, including computerized tomography scan.
- Large blood bank with frozen blood capability.
- Patients are allowed a 5-day average stay in accordance with a baseline 7-day evacuation policy.

Role 4

Role 4 medical care is found in CONUS-based hospitals and other safe havens. Mobilization requires expansion of military hospital capacities and the inclusion of the Department of Veterans Affairs (VA) and civilian hospital beds in the National Disaster Medical System to meet the increased demands created by the evacuation of patients from the area of operations.

Evacuation Terminology

There is now a differentiation between casualty evacuation and medical evacuation in the larger context of aeromedical evacuation:

- **Casualty evacuation** (CASEVAC) is the movement of a casualty from the point of injury to medical treatment by nonmedical personnel. Casualties transported under these circumstances might not receive en-route medical care. Typically, this involves a helicopter returning from the battlefield.
- **Medical evacuation** (MEDEVAC) is the timely, efficient movement and en-route care provided by medical personnel to the wounded being evacuated from the battlefield to MTFs using medically equipped vehicles or aircraft. Examples include civilian aeromedical helicopter services and Army air ambulances. This term also covers the transfer of patients from the battlefield to an MTF or from one MTF to another by medical personnel, such as from ship to shore.
- **Aeromedical evacuation** generally utilizes Air Force fixed-wing aircraft to move sick or injured personnel within the theater of operations (intra-theater) or between two theaters (inter-theater), such as moving a casualty from Afghanistan to Germany. This is a regulated system in which care is provided by aeromedical evacuation crewmembers, who may be augmented with CCATTs to provide intensive care.

- **En-route care** is the maintenance of treatment initiated prior to evacuation and sustainment of the patient's medical condition during evacuation.^{23(pp2.1–2.12)}

It is clear from these descriptions that “casualty evacuation” is not an appropriate term to apply to helicopter evacuation from the battlefield or point of injury when medical personnel and equipment are present in the aircraft to support and treat the victim. The primary treatment personnel are “aeromedical or flight medics” who are specially trained for emergency medical treatment in the environment of the evacuation helicopter. Additional medical personnel who may accompany the flight, depending on the circumstances and severity of the injuries, maybe a flight nurse, aeromedical physician assistant, or a flight surgeon. In OIF and OEF, medical evacuation elements were either intrinsic to or directly associated with a parent combat unit, or a separate air ambulance company attached to a general aviation unit.

Evacuation Platforms and Medical Facilities

Because of the dangers of ground ambulance transportation in Iraq and Afghanistan, medical evacuation of injured and wounded service members has been almost exclusively by air ambulance (MEDEVAC helicopters). Ground ambulances have utility in transporting patients within fixed facilities, such as a major airbase or large joint facility. The workhorses of medical evacuation in OIF and OEF have been the Army's UH-60 Black Hawk helicopter (Figure 5-12) and the Air Force's HH-60G Pave Hawk helicopter. During the design phase, the Black Hawk was prospectively evaluated for its potential capabilities as a medical evacuation platform, and its performance has been very positive in this task. In addition to the medical evacuation configuration, the troop carrier version has also been used, when no other medical evacuation helicopter is available, as an emergency aircraft for casualty transportation. This version would be aptly considered to be “casualty evacuation” unless a combat medic accompanied the casualty and could provide advanced lifesaving measures en route to the MTF.

Because of the enemy's use of improvised explosive devices and rocket propelled grenades, as well as conventional weapons, the battlefield has taken a somewhat different form than in Vietnam in many regards, and certainly different than Korea. Typically in Iraq and Afghanistan, after emergency first aid at the site of injury, the casualty was flown as quickly as possible by medical evacuation helicopter to the nearest FST or, more likely, the nearest CSH. There,



Figure 5-12. “A UH-60 Black Hawk helicopter lands for an emergency medical evacuation of casualties, Helmand Province, Afghanistan, 13 February 2010.” US Marine Corps photo by Lance Cpl. James Clark. Reproduced from: <http://www.defense.gov/PhotoEssays/PhotoEssaySS.aspx?ID=1573>.

casualties not only received surgical care to stabilize them, but might also undergo procedures previously felt to be too extensive for this role of care. In particular, the CSH now has the surgical capabilities and surgical specialists (as described in this textbook) to perform high-level trauma care and definitive surgical repair



Figure 5-14. Aeromedical evacuation of patients via C-17 aircraft from Iraq, to Ramstein Air Base, Germany, for transport to Landstuhl Regional Medical Center. “2nd Lt. David Herndon gathers patient information on an aeromedical evacuation mission from Balad Air Base, Iraq, to Ramstein Air Base, Germany, Feb 25, 2007. Lieutenant Herndon is a public affairs officer with the 59th Medical wing, Lackland Air Force Base, Texas.” Photographer: Msgt Scott Reed, HQ AFRS. Reproduced from US Air Force photo 070225-F-4884R-002.



Figure 5-13. Air Force theater hospital at Joint Base Balad, Iraq; September 2004. Photograph courtesy of Colonel Joseph Brennan, MC, US Air Force.

of extensive injuries. Role 3 MTFs such as the CSHs located in Mosul and Baghdad, Iraq, had tremendous capabilities owing to the intrinsic technology and breadth and depth of the medical and nursing staff. The survival rate for casualties in OIF and OEF has been the highest in the history of American combat. For the complete publication on US Army medical evacuation, see ATP 4-02.2, *Medical Evacuation*, published in August 2014.²⁴



Figure 5-15. Landstuhl Regional Medical Center, Germany. Note bus for transportation of casualties between the Ramstein Air Base and the medical center. Photograph courtesy of Landstuhl Regional Medical Center Public Affairs Office.

The highest capability MTFs in-country were the Joint Base Balad Air Force Theater Hospital in Iraq (Figure 5-13) and the Craig Joint Theater Hospital at Bagram Air Base, Afghanistan. Army, Air Force, and Navy medical and nursing personnel worked effectively together at these treatment facilities, which were equivalent to level I trauma centers in the United States. At the Kandahar airfield in Afghanistan, the NATO Role 3 Multinational Medical Unit was also a sophisticated trauma care center, with primarily Navy professionals providing care alongside providers from other nations. Typically, medical evacuation helicopters were the transportation sources for the severely injured patients brought to theater and NATO hospitals. Joint theater hospitals also included a head and neck surgical team with an otolaryngologist/head and neck surgeon.

While some patients presenting to the joint theater hospitals might be returned to duty in-country, the more seriously ill or wounded were air evacuated by Air Force aircraft to Germany (Figure 5-14). Aeromedical evacuation out of Iraq was carried out by the US Air Force Contingency Aeromedical Staging Facility (CASF), the only such facility in the country, and from Afghanistan by the CASF at the Bagram Airfield, both collocated with Air Force theater hospitals. The aeromedical evacuation aircraft utilized in this effort included the C-17 Globemaster III, the C-130 Hercules, the C-141 Starlifter, and the KC-135 (the latter three reconfigured for medical evacuation). Upon arrival at Ramstein Air Base in Germany, the patients were transported by medical bus to Landstuhl Regional Medical Center, where more definitive and follow-up care was delivered (Figure 5-15). Family members of critically wounded casualties were able to travel to Germany to be with patients and accompany them back to CONUS facilities.

Once back in the United States, many casualties, especially those with major amputations or traumatic brain injuries, were eventually rehabilitated in a Center for the Intrepid (at Bethesda, Maryland, or San Antonio, Texas) or a VA Center for Traumatic Brain Injuries. Figure 5-16 shows the new Brooke Army Medical



Figure 5-16. Brooke Army Medical Center, Fort Sam Houston, Texas. Note the circular Center for the Intrepid in the mid-foreground.

Photograph courtesy of Brooke Army Medical Center Public Affairs Office.

Center campus in San Antonio with the circular Center for the Intrepid in view. As subsequent chapters will demonstrate, facially wounded patients from OIF and OEF have received staged reconstructive surgery at military MTFs by otolaryngologist/head and neck surgeon contributors to this textbook.

SUMMARY

US military medical evacuation has been evolving since the Civil War, when Jonathan Letterman established an ambulance system under medical command and control. In addition, he developed a system of forward care, triage, and priority of evacuation based upon severity of injury and transfer to a hospital system of tiered capabilities. This allowed the efficient application of limited medical resources to care for large numbers of casualties. In subsequent

conflicts, numerous improvements were developed, including rotary and fixed wing air medical evacuation, increased knowledge of aviation medicine, and continuous improvement of ground evacuation vehicles with en-route care. This evolution of military medical evacuation has today resulted in a truly integrated system of US Army, Navy, and Air Force assets, composed of active duty, Reserve, and National Guard members. The coordination between

the triservice evacuation systems has been refined over the course of the last decade of conflict in the Middle East, with resulting enhancement of patient flow and reduced time from injury to critical care. Additional capabilities such as critical care air transport teams have allowed the provision of critical care medicine,

ventilation, and advanced patient monitoring during evacuation. Today's casualty care has resulted in the highest survival rate seen in the history of modern conflict, and a critical key to this high rate of survival of combat casualties has been the evolution to today's conjoint medical evacuation system.

Acknowledgments

The authors would like to thank Carlos Alvarado, archivist, and Dr. Sanders Marble, senior historian, of the AMEDD Center of History and Heritage for providing historical photographs for this chapter. Major General Neel was the aviation medicine mentor for one of the authors (GRH), who continues to have the utmost respect for his accomplishments and his integrity. GRH also had the privilege of personally discussing the medical evacuation and casualty care with Colonel Overholt before his death in 2006. It is quite rewarding for a head and neck surgeon or facial plastic and reconstructive surgeon to be able to continue reconstructive care that began in Iraq and Afghanistan after a wounded service member was evacuated to a military trauma center for care. We owe a real debt of gratitude to the military professionals—from the battlefield medic to the head and neck surgeon, and all in between—for their dedication, compassion, and excellence in their care of the wounded service member.

REFERENCES

1. Wichtendahl K. Dr Jonathan Letterman: father of modern emergency medicine. National Museum of Civil War Medicine website. <http://www.civilwarmed.org/letterman-dinner/letterman-father-of-battlefield-medicine/>. Accessed 12 June 2013.
2. McGaugh S. An enduring legacy. In: *Surgeon in Blue: Jonathan Letterman, the Civil War Doctor Who Pioneered Battlefield Medicine*. New York, NY: Arcade Publishing; 2013. New York, NY: Chap 12.
3. Ginn RVN. World War I: the ambulance service. In: *The History of the U.S. Army Medical Service Corps*. Washington, DC: US Army Medical Department Office of Medical History; 1997: Chap 2.
4. Shipley A, Dillon JF. The treatment of maxillofacial injuries in the zone of the advance. *Amer J Surg*. 1918;33:259–264. http://books.google.com/books?id=AukAAAAAYAAJ&pg=PA263&lpg=PA263&dq=Barton%27s+head+dressing+for+jaw+support&source=bl&ots=1Hf7yMpsNA&sig=L1j8LSFWzgv7_TBz22yJN3RqbwA&hl=en&sa=X&ei=5WVDUp7JL-SI2wX2goHoCw&ved=0CEIQ6AEwBA#v=onepage&q=Barton%27s%20head%20dressing%20for%20jaw%20support&f=false. Accessed 22 July 2013.
5. Olive-Drab.com LLC. Echelon III medical treatment WWII. http://olivedrab.com/od_medical_treatment_ww2_echelon3.php. Accessed 4 June 2013.
6. Nanney JS. *Army Air Forces Medical Services in World War II*. Washington DC: Air Force History and Museums Program; 1998: 10. <http://www.afhso.af.mil/shared/media/document/AFD-100923-014.pdf>. Accessed 25 June 2013.
7. Olive-Drab.com LLC. WWII helicopter evacuation. http://olive-drab.com/od_medical_evac_helio_ww2.php. Accessed 22 June 2013.
8. Whitcomb D. *Call Sign DUSTOFF: A History of US Army Aeromedical Evacuation From Conception to Hurricane Katrina*. Fort Detrick, MD: Borden Institute; 2011: Chap 2. https://ke.army.mil/bordeninstitute/other_pub/dustoff/Dustoffch2.pdf. Accessed 22 October 2014.
9. Smith CM. The Medical Department: hospitalization and evacuation, zone of the interior. In: *The United States Army in World War II*. Washington, DC: Center of Military History; 1989. http://www.history.army.mil/html/books/010/10-7/CMH_Pub_10-7.pdf. Accessed 25 June 2013.

10. US Army Medical Department Office of Medical History website. Report of the 61st Medical Battalion, annual report for the 1944 Medical Department activities in Pacific Ocean areas. Interview with Colonel Paul H. Streit, Surgeon, Central Pacific Base Command, 21 May 2945. <http://history.amedd.army.mil/booksdocs/wwii/StreitCenPacrev.htm>. Accessed 26 June 2013.
11. US Army Medical Department Office of Medical History website. The Army Medical Department in the Korean War: interviews and reminiscences. Colonel Edwin L. Overholt, Medical Corps. Task Force Smith and the medical company in combat in Korea, 28 January 1966. <http://history.amedd.army.mil/booksdocs/korea/TaskForceSmith/Overholt.html>. Accessed 28 June 2013.
12. Kirkland RC. *MASH Angel. Tales of an Evac Helicopter Pilot in the Korean War*. Short Hills, NJ: Buford Books; 2009: 187.
13. Scott R Jr. Care of the battle casualty in advance of the aid station. In: *Recent Advances in Medicine and Surgery (19–30 April 1954) Based on Professional Medical Experience in Korea and Japan 1950–1953*. Washington, DC; US Army Medical Service Graduate School, Walter Reed Army Medical Center: April 1954. Medical Science Publication No. 4, Vol I. <http://history.amedd.army.mil/booksdocs/korea/recad1/ch1-4.html>. Accessed 28 June 2013.
14. King B, Jatoi I. The Mobile Army Surgical Hospital (MASH): a military and surgical legacy. *J Natl Med Assoc*. 2005;5:648–656.
15. Apel O F Jr, Apel P. *MASH. An Army Surgeon in Korea*. Lexington, KY: University of Kentucky Press; 1998.
16. Hawk A. Hospitals of the Korean Conflict. Academia.edu website. http://www.academia.edu/2203438/Hospitals_of_the_Korean_Conflict#2. Accessed 14 August 2013.
17. DUSTOFF Association website. DUSTOFF Association history. <http://www.dustoff.org/history/history.htm>. Accessed 21 October 2014.
18. Dorland P, Nanney J. *DUST OFF: Army Aeromedical Evacuation in Vietnam*. Washington, DC: Center of Military History; 1982.
19. Neel S Jr. *Vietnam Studies. Medical Support of the US Army in Vietnam, 1969–1973*. Washington, DC: US Army Medical Department; 1991: 59–79. <http://www.history.army.mil/books/Vietnam/MedSpt/chpt4.htm>. Accessed 11 August 2013.
20. US Army Medical Department Center and School website. Flight medics. <http://www.cs.amedd.army.mil/FileDownloadpublic.aspx?docid=68a4cb29-c9f9-4c8d-8c18-c0bb19fb726d>. Accessed 11 August 2013.
21. Armed Forces Health Surveillance Center. Medical evacuations from Operation Iraqi Freedom/Operation New Dawn, active and reserve components, US Armed Forces, 2003–2011. *MSWR*. 2012;19:18–21.
22. *Emergency War Surgery. Third United States Revision*. Washington, DC: Borden Institute; 2004: 2.1.
23. *Emergency War Surgery. Fourth United States Revision*. Fort Sam Houston, TX: Borden Institute; 2013: 2.1–2.12.
24. Headquarters, Department of the Army. *Medical Evacuation*. Washington, DC: HQDA; 2014. ATP 4-02.2.

