

**Study of Yugoslav Guerrilla Forces of WWII to Inform Modern U.S. Army Strategy During A
Near-Peer Military Conflict**

M. Tyler Colesar, MD
Captain, Medical Corps, U.S. Army
Uniformed Services University of Health Sciences

Table of Contents

Table of Figures	3
Abstract.....	4
Background	4
Foreign Surgeons in Yugoslavia	5
Dr. Lindsay Rogers: Guerrilla Surgeon	5
Dr. Colin Dafoe: The Parachute Ward.....	5
Methodology	5
Partisan Guerrilla Hospital System.....	6
Battlefield Conditions	6
Hospital Design.....	6
Underground Bunkers	10
Mt. Rog Hospitals	12
Hospital Operations	13
Hospital Staffing.....	14
Logistics.....	14
Injury Care	15
Patient Evacuation	16
Contingency Planning.....	17
U.S. Army Hospital Doctrine.....	18
Battlefield Conditions	18
Geneva Conventions	18
Hospital Design.....	19
Hospital Staffing.....	20
Logistics.....	23
Patient Evacuation	23
Possible U.S. Army Medical System Structure in an Isolated and Non-Conventional Posture.....	25
Hospital Design.....	25
Hospital Operations	26
Hospital Staffing.....	27
Patient Evacuation	27
Contingency Planning.....	29
Conclusions.....	29
References.....	31

Table of Figures

Figure 1: Partisan Hospital Types ¹	7
Figure 2: Central Partisan Hospital on Petrova Gora, 1944 ¹⁴	8
Figure 3: Possible Partisan hospital bunker dimensions inspired by Phorje hospitals.....	11
Figure 4: Remnants of an underground bunker entrance near the hospital at Petrova Gora.....	12
Figure 5: Partisans evacuating patients from Petrova Gora on horseback.	16
Figure 6: U.S. Army medical facility construction classifications.	20
Figure 7: Medical Platoon Organization.....	21
Figure 8: Medical Company Organization.....	21
Figure 9. Class 8 Intra-theater Distribution ³²	23
Figure 10. Conventional Medical Evacuation System.....	24
Figure 11. Possible Medical Treatment Facility Configuration During Isolated and Non-Conventional Operations.....	26
Figure 12: Evacuation distances by air from hospital sites utilized by Dr. Rogers and Dr. Dafoe demonstrating feasibility of rotary evacuation if this conflict occurred in modern day.	28

Abstract

Introduction:

Yugoslavian Partisans of WWII faced extreme medical and logistical challenges that spurred innovation while waging guerrilla war against the Nazis. Their innovations can be incorporated into U.S. Army strategy to better combat near-peer adversaries.

Methods:

WWII records pertaining to Yugoslavian guerrilla medicine, including biographies of British surgeons Dr. Dafoe and Dr. Rogers who served in Yugoslavia were obtained via internet search and documents referenced by subject matter experts. U.S. Army doctrine was identified via a search of official publications regarding Doctrine and Training from the Army Publishing Directorate.

Results:

Partisans used concealed hospitals ranging between 25 to 215 beds throughout the country. Wards were often subterranean and held 30 patients on average. A prototypical underground ward was approx. 3.5 x 10.5 m with 2 levels of bunks, storage space, and ventilation. Concealment and secrecy prevented discovery of many wards. Backup storage and treatment facilities proved crucial redundancy. Partisans relied on Allied fixed wing aircraft for inter-theater evacuation whereas pack animals and litter bearers were used intra-theater.

International law should protect medical personnel and patients from attack when facing a near-peer adversary, but cannot be guaranteed. Guiding Army Medical Department (AMEDD) principles provide a good doctrinal foundation for medical tactics during non-conventional warfare. There is minimal guidance within Army doctrine on conducting non-conventional medical operations. Deficiencies were found in logistics, evacuation, hospital design and staffing. The current guidance is too reliant on rapid evacuation and not prepared for prolonged field care.

Conclusions:

It is recommended doctrine be established that educates on makeshift ward construction, how a Battalion Aid Station (BAS) can convert to hold and care for over 40 patients while executing split operations, and how an Forward Surgical and Resuscitation Team (FRST) may utilize split operations to assist multiple entrenched BASs. Rotary aircraft will likely still play a vital patient evacuation role given operational flexibility. Redundant supply and treatment facilities should be used in a non-conventional military posture.

Background

April 6th, 1941 Axis forces invaded Yugoslavia and quickly subdued Yugoslav forces. A guerrilla resistance began to fight for liberation. Various guerrilla factions developed with some eventually capitulating and other continuing to fight the occupying powers. The Yugoslav Partisans emerged as a robust and credible fighting force led by Josip Tito. Despite difficult fighting conditions they were able to mount a successful guerrilla resistance with material and personnel assistance from the Allied powers.

Partisans began as shock brigades spread across the country, followed by the creation of division and corps to complete more complex tasks. The initial phase of operations was to destroy and disrupt the enemy whenever favorable. These groups would then assist the front by operating behind enemy lines providing intelligence, harassing the enemy and establishing landing sites for airlifts. German reliance on transportation and communication technologies made them vulnerable to guerrilla attack at their convenience.¹

The rugged and mountainous terrain made Yugoslavia ideal for mounding a guerrilla defense and were 80,000 strong by the end of 1941.² The Partisans eventually gained control of the entire country as the Axis powers were forced to withdraw and consolidate forces.³ Yugoslav military and civilian casualties have been estimated to be upwards of 1 million.⁴ Medical infrastructure and supply was very limited because of the ongoing occupation. Medical personnel were forced to adapt to these constraints and develop strategies to handle large patient loads in austere environments.

The medical system of WWII Yugoslavia has been written about in multiple firsthand accounts. These include Guerilla Surgeon by Dr. Lindsay Rogers,⁵ The Parachute Ward by Brian Street² and Partisan

Hospitals in Yugoslavia 1941-1945 by Colonel Doctor Djorde Dragic.¹ These books describe the strategies used to run austere, long term hospitals in hostile territory.

Former Secretary of the Army, Dr. Mark Esper, in his Initial Message to the Force stated readiness is his number 1 priority “...with immediate focus on preparing for a high-end fight against a near-peer adversary.”⁶ The U.S. Army has been focused on combating insurgencies, but is now shifting to confront near-peer adversaries such as Russia, China, North Korea and Iran.⁷ Combat with these adversaries does not guarantee air superiority or freedom of movement. This will adversely impact the modern U.S. Army’s rapid patient treatment and evacuation system. The Army needs to be prepared to assume a more non-conventional posture in the event a large conventional unit becomes overwhelmed. The medical system will also need to be prepared for longer evacuation times, treatment in hostile territory, lack of supplies, etc. Similar challenges were faced by Yugoslav guerrilla fighters. Their experiences may shed light on strategies that could be implemented on a modern battlefield to improve care and patient outcomes.

Foreign Surgeons in Yugoslavia

Two surgeons as members of the British Mission in Yugoslavia covertly entered the country after serving in North Africa from the outset of WWII. Both captured their experiences in detailed accounts and provide a Western account of the Yugoslavian medical system during the struggle to overthrow the occupying Germans.

Dr. Lindsay Rogers: Guerrilla Surgeon

Dr. Rogers was a New Zealand surgeon educated at Otago University. He joined the Royal Army Medical Corps (RAMC) in 1940. He first served in North Africa, then joined the secret Special Operations Executive. In operation codenamed “Vaseline” he was sent by submarine to Yugoslavia to assist the Partisans. He first arrived on the island of Vis off the western Yugoslavian coast before being inserted onto the mainland. The Partisans were skeptical of him at first and he was faced with severe supply shortages. He worked in various locations to include Dalmatia, Croatia, and Bosnia in the secret hospital network treating Partisans, downed Allied pilots, and civilians. He also briefly ran a medical school for 25 Yugoslavian students. He returned to Italy to acquire more supplies for his mission and then parachuted into Slovenia with 2 assistants. Here, he continued to treat patients in a network of secret hospitals constantly hiding from the Germans until the end of the occupation.

Dr. Colin Dafoe: The Parachute Ward

Dr. Dafoe was a Canadian surgeon who served with Dr. Rogers in North Africa and later followed his example and was dropped into Yugoslavia. He attended medical school at Queen’s University and was accepted to study Obstetrics and Gynecology at McGill University in Montreal, but instead ran a remote 8 bed mining hospital for 5 months. He then finished his internship and moved with this wife to England. Shortly thereafter he was commissioned into the RAMC and sent to north Africa with the British 8th Army, where he worked with Dr. Rogers.

He then was inserted into Yugoslavia by parachute to set up a field hospital. There he treated a wide variety of war injuries and directed the construction of a ward made of parachutes and wood, for which the book is named. This site was overrun by Chetnik’s cooperating with the Germans and the medical unit spent months on the move with the corp they were attached to. In 1944 he traveled to Italy to acquire supplies for a hospital in the newly liberated Tuzla but was unable to return to Yugoslavia because of health problems and suspected communist sympathy.

After the war he completed a surgical Fellowship in England, returned to Canada and mysteriously disappeared in the Waterton Lakes National Park in 1969.

Methodology

Modern U.S. Army doctrine was identified via a search of official publications regarding Doctrine and Training from the Army Publishing Directorate.⁸ Documents were selected for review if the title includes terms associated with medicine, evacuation, medical logistics, medical leadership, medical tactics,

hospital operations, health support, special operations, survival, evasion, and concealment. Relevant sections within these documents were summarized and distilled into lists of strategies and techniques that would be applicable to a guerrilla medical posture.

Literature regarding the Partisan guerrilla medical system was gathered by evaluating Dr. Farr's relevant publications and citations,⁹ discussion with subject matter experts, to include Dr. Dale Smith, and a literature search of the USUHS Learning Resource Center (LRC) materials with the assistance from a LRC search expert. Guerrilla medical strategies were identified and compared to strategies in modern military doctrine.

Partisan Guerrilla Hospital System

“Care of the wounded in partisan warfare is one of the most difficult problems for the rear, wherein the presence of wounded, as distinct from the regular army, often has a decisive effect on the planning and development of military operations.” – Partisan Lieutenant General Dr. Gojko Nikolis¹⁰

Battlefield Conditions

The former Yugoslavia region has a very diverse topography and climate. To the west was Adriatic Sea which provided access to the Mediterranean and moderate weather. The northern portion of the country received the eastern edge of the Alps, resulting in tall peaks, deep gorges and vast forests that were used to the Partisan's advantage. The central portion of Yugoslavia, now Bosnia, consists of fertile agricultural land, modest mountains and large forests. The predominant bedrock was limestone, resulting extensive creation of caves and depressions as the minerals were dissolved over millennia. This terrain made movement difficult for the Germans, who's superior mechanized elements were slowed and left vulnerable in the mountain passes. This geography allowed the Partisans to hide deep in difficult to reach forests to mount a successful resistance.

Communications were fragmented between supporting Allied forces and the Partisans. They often relied on physical messengers because radio communications were often not available. This difficulty combined with the baseline skepticism of the Partisans caused Dr. Rogers to be mistaken for the enemy and be taken prisoner upon arrival to mainland Yugoslavia.⁵

The Partisans operated primarily at night to evade the enemy, who did not have sophisticated radar technology and primarily relied on direct observation. Germans had dedicated teams of 50-200 soldiers for hospital hunting aided by dogs. Some would disguise themselves as local shepherds in an attempt to catch hospital security off guard.¹ The Germans were brutal in their methods and would often resort to torture to extract information from Partisans and civilians. In one instance, a peasant was coerced into giving away the location of 50 patients and nurses in a hidden underground bunker. The patients were systematically killed and the nurses were stripped and raped.² This required the Partisans to use upmost secrecy and conduct air evacuations, supply drops and personnel insertions at night.

Diets among the soldiers were generally poor. The occupying German forces gathered as much food and supplies from the local population as they could to minimize their own supply chain and to reduce the Partisans access to food. Dr. Rogers recalled that during a long march they had only been eating meat for some time and he had developed scurvy. To augment his vitamin C intake he would create a stew of grass and spruce tips.⁵

Hospital Design

“No area must be too inaccessible, no sacrifice too great, no information too detailed, no strategical retreat unnecessary if the security of the wounded is in question.” – Dr. Edvard Pohar¹¹

The Partisan medical system followed a general pattern but was regionally adapted based on the tactical environment. Large numbers of smaller hospitals were used to minimize transport times and reduce

the individual hospital target value. The medical unit was an asset for the fighting force because they were often in close proximity and would take wounded off infantry's hands, improving maneuverability.¹

Principles for the organization of hospitals by Partisan doctor, Gojko Nikolis:¹²

1. A heavy concentration of casualties in one place must not be permitted.
2. Parallel with the use of the free territory for stationary hospitals, it is necessary to make all preparations for the moving to another territory. Large-scale enemy offensives soon place the forest hospitals in jeopardy, in spite of their inaccessibility. No place is inaccessible to the enemy.
3. For the purpose of ensuring the medical and military protection of the wounded the hospital system should be organized as follows:
 - a. The selection and clearing centre and surgical hospital should be located on or at least near a good communication line, if possible in a sheltered spot which is not visible from the air;
 - b. After receiving surgical assistance the wounded should be sent to the hospital wards for treatment. The wards should be located at a distance from the communication lines, in places which are not vulnerable to air raids or tanks;
 - c. Reserve cabins should be placed deep in the forest, where the wounded will be concealed in case the enemy should penetrate along the communication line;
 - d. Secret hideouts should be built near the reserve cabins in case the enemy should gain control of the communications and begin infiltration into the forests for the purpose of searching it.

Partisan hospitals were broken down into several types shown in Figure 1. Open (public) hospitals were located in schools, cooperatives, hotels etc. and were within unoccupied friendly territory. Secret hospitals were more likely to have purpose-built structures than open hospitals. Additionally, tents, caves and in the open were used temporarily.¹

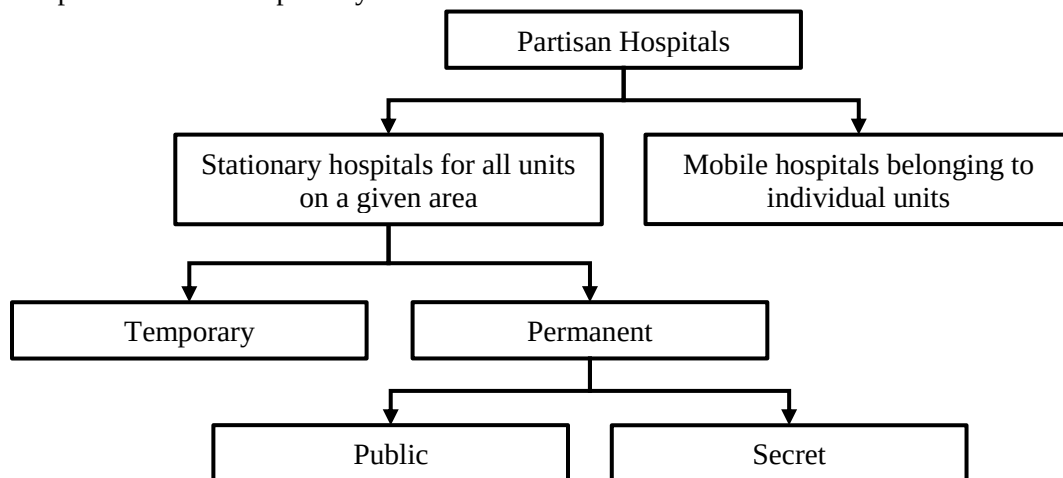


Figure 1: Partisan Hospital Types¹

Buildings of opportunity such as barns and homes were often used as temporary hospitals before purpose-built structure could be assembled. Hospitals were constructed out of any materials available. Towards the end of his tour Dr. Dafoe was transferred to a divisional hospital built of parachutes with an operating room table made of saddles, planks and rubber sheeting. He was also called upon multiple times to set up makeshift forest surgical wards.²

Major construction considerations for purpose-built structures were open vs secret, location, capacity, and anticipated occupation time. Hospitals were constructed with local materials. Best constructed in a deep glade, sheltered by forest. Forests with a large concentration of evergreen trees was preferred. Ground should be suitable for digging underground shelters and a water source should be accessible. Local peasants were used to help establish the best location for the hospital but were not be told the purpose.¹³ Construction teams were not shared across hospitals to prevent leak of the location. Often timber was cut hours away and transported at night. Wood was often chopped and cut in a special dugout only at night reduce the odds that Germans would discover the operation. Sentries would guard the craftsmen and laborers at all times as the processed wood and constructed the hospitals.¹ An example of a secret cabin hospital built in the mountain Petrova Gora is pictured below in Figure 7.¹⁴



Figure 2: Central Partisan Hospital on Petrova Gora, 1944¹⁴

When Dr. Dafoe arrived by parachute with his 2 assistants and intended to construct a 200 person bed hospital 100 kilometers from the front. The partisans did not believe this was feasible and suggested using the woods and caves to hide patients and equipment. They believed that a large hospital would not give them the mobility to quickly strike and evade the enemy.²

Hospitals came in various sizes and degrees of concealment throughout the country as demonstrated in Table 1. Secret hospitals were not surprisingly less well documented than their public counterparts. The average number of beds was 87.3, average number of building were 3.8 and the average construction time was 26.7 days. The average number of patients per building was 22. These calculations only represent Partisan hospitals for which data was available and is omitting hospitals that did not have quantitative data.

Table 1: Partisan Hospital Features

Hospital Location	Beds	# of Buildings	Build Time (d)	Construction Features	Building specialization	Style
Mt. Grmec near Dobra Voda ¹⁵	100	7	45	Roughhewn logs, hardboard panels, 2 stories	3 wounded, 1 surgical, 1 dressing station, 1 pharmacy 1 kitchen	Cabin
Mt. Grmec near Lastva	200	1			1 wounded wing 1support wing	Cabin
Central Hospital near Borci	215	5	21		Surgical, Internal med, 1 infectious 1 TB/venereal	Cabin
Mt. Plješivica near Bijeli Potoci	120	1		Insulated walls	N/A	Cabin
Hosp. No. 3, Slavonija	150	20				Bunker
Hosp. No. 2, Ravna Gora				Brick pavilions and bunkers		Bunker/ Pavilions
Hosp. No. 5, Mt. Papuk				Located in deep gorge, well concealed, difficult to access		Bunker
Tisovac	35	1		Single tier of beds		Cabin
Mt. Boriya	60					
Petrovo Polje	25					
Demici	150					
Hospitals of Phorje (6x)	35	1		8-12 m x 3 m	Well hidden, no backup shelters	Bunker
Mt. Rog	35	2	14			Cabin
Greater Croatian Area		One main hospitals, satellites		Camouflaged by trees, painted green, black, or brown		
Yelen Dol		1		800 yards from main German transport line		
Trnava Hospitals		Variable			Limited surgery	Bunker
Kosta	150	3		One ward built of wood and parachute hammocks	Surgery, light wounded, infectious	Cabin
Petrova Gora ¹⁴	Large	Variable		Combination of cabins/bunkers. Served as a central hospital	Multiple ORs	Cabin
Franja Hospital near Cerkn ¹⁶	120	13		Located in deep gorge and accessed by walking upstream		Cabin
Average	85.3	3.8	26.7			

Hospitals often had elaborate anti-tracking strategies to include suspending walkways in the trees, using stepping stones instead of trails. One hospital used soldier's amputated limbs scattered in the forest to throw German search dogs off the trail. An example of a well-hidden hospital was Yelen Dol, which was within 800 yards of a main forest track frequented by Germans.⁵ In contrast to traditional field armies, medical aid stations were placed much closer to conflict zones.¹

Regional hospital systems would often have specialized wards. These included infectious disease, lightly injured, critical care, femur fractures and even a maternity ward.⁵ The less seriously wounded were often billeted in villagers homes, 3-4 per house with a hidden underground shelter in the event of an attack.¹ Hospital decentralization forced specialized healthcare providers to travel for hours at a time between each smaller hospital. Dr. Rodgers lamented about how he cannot properly follow up on his patients because he was forced to travel long distances.⁵

Relay stations served as waypoints between hospitals that were far apart and would treat lightly wounded. Staff were light infantry with hospital orderly training who would provide basic treatment and casualty transport. Soldiers would move patients to the next outpost or hospital. These stations had a 10-15 bed capacity and usually located in a limestone hollow for concealment. Locations were kept secret and reportedly none were found during the war. Patient safety was maintained because these units were independent of the main force and had high mobility.

The Slavonia hospital system initially used loyal families who hid wounded in stables, barns or purpose-built bunkers. These scattered wounded were eventually focused in secret forest hospitals with their own management and quartermaster service. Hospitals would be open or use tents in the summers with dugouts and cabins constructed in the autumn. A total of 25 hospitals accommodating 1,000 wounded were operating in Slavonia by 1943. The greater Croatian area was organized with one main hospital and several satellites per territory.¹

Underground Bunkers

These structures were a vital component of hospital design and were used to conceal supplies and patients from the enemy if the hospital was threatened. They were built near hospitals and maintained in absolute secrecy. Sites were well drained, usually covered in grass or brush. Typically, 1.8 meters high with 2 levels of bunks and ventilation holes bored to the surface. Shelters started simple but became more elaborate throughout the war. More advanced designs involved digging a hole the size of the bunker, building a cabin-like structure inside the cavity with double walls for dryness and then covering it. These "open cast" style bunkers were typically 2.7 meters wide and 2.4 meters high to facilitate 2 tiers of bunks. They were equipped with a sewage canal and air holes every 3 meters. Water seepage during the rainy season was a problem, so some of the bunkers were lined with tar paper. Smaller bunkers were easier to camouflage and quicker to build and predominated over larger bunkers. Bunker construction crews would stay with the sick and wounded or be transferred to distant units to preserve secrecy. The natural limestone caves that were common across Yugoslavia were also used extensively to hide patients. Effort was made to never use the same shelter twice. Wounded could stay in these bunkers for several weeks if necessary.

Figure 3 shows an author generated possible bunker configuration based on the dimensions of Phorje hospitals, supplemented by features of other Partisan subterranean structures. It features three rows of bunks, 2 rows high with storage underneath for personal effects. The drawing also shows potential placement of an access hatch and placement of ventilation holes. These components would be heavily camouflaged to render the structure undetectable.

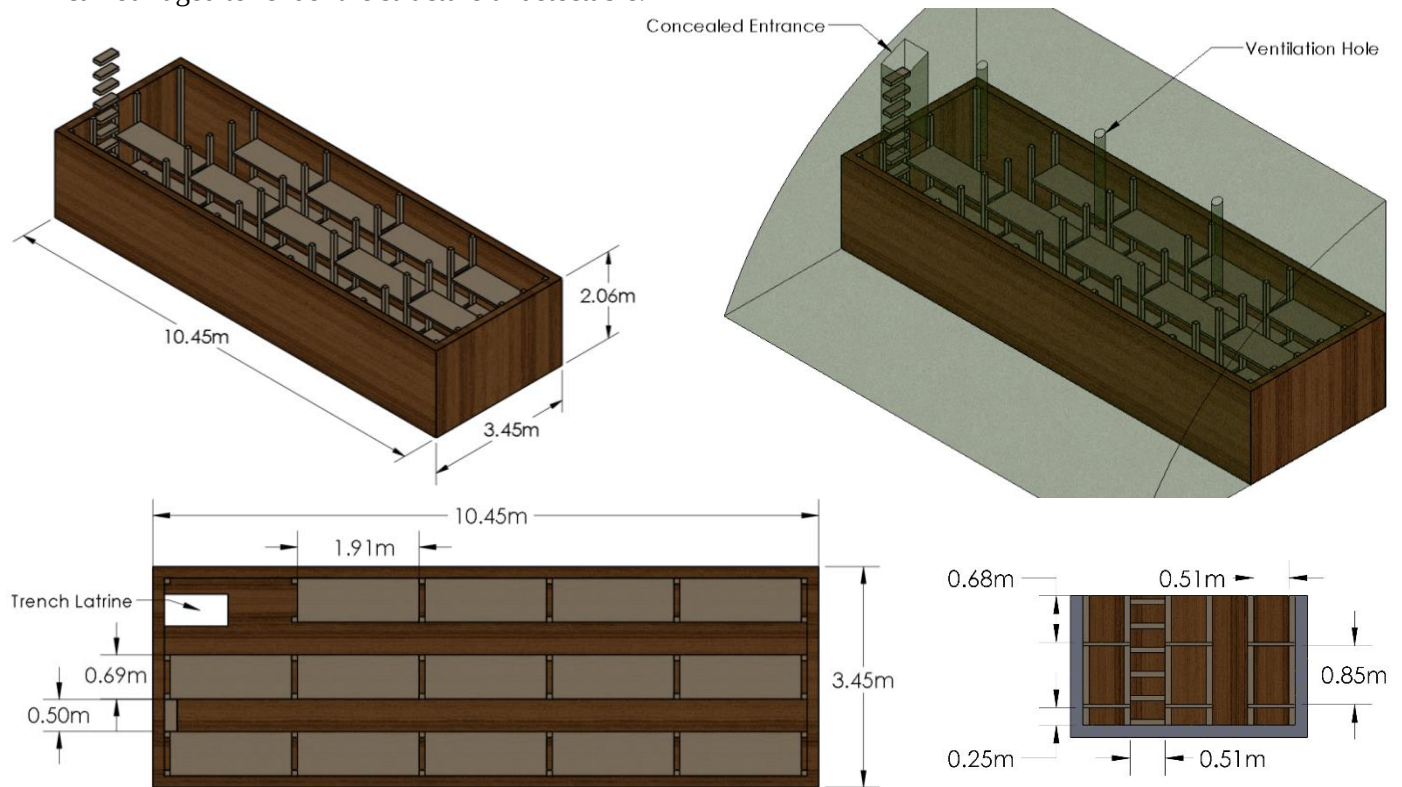


Figure 3: Possible Partisan hospital bunker dimensions inspired by Phorje hospitals.

One hidden supply bunker servicing Dr. Dafoe's hospital in Kosta was 6x8 meter dug out cavity lined with blackened planks. Water seeped through the walls and appeared to be below the water table. The trap door was covered by leaves. Peasants in the area would use similar chambers to hide from enemy offensives.²

The Trnava hospital hid 1,000 casualties during the 6th offensive in mostly underground bunkers. Tools were taken from units or nearby villages. Medical care while in a bunker was limited to wound dressings and medication administration. Surgery was only done if absolutely necessary. Chief disadvantages were low standards of hygiene and health, low moral and greater mortality.¹ Strict rules were instituted to maintain order in the shelters. "The male or female orderly in charge is entitled to prevent the

opening of the bunker and exit of the patients by all possible means.”¹⁷ Figure 4 shows remnants of an underground bunker entrance used at Petrova Gora.¹⁴



Figure 4: Remnants of an underground bunker entrance near the hospital at Petrova Gora

Mt. Rog Hospitals

The detailed account of Mt. Rog Hospital illustrates how a hospital system would evolve over time while under constant threat of enemy attack. The hospital founded in a repurposed hunting lodge deep in the woods away from town and commanded by Dr. Lunacek. It utilized a separate casualty clearing station 1 hour away by foot in the nearby villa. Here patients would be initially brought, triaged, and packaged for transport to the hidden hospital. It was common in Yugoslavia to have patient clearing, immediate surgery and treatment of non-transportable casualties near communications lines and more long term treatment would be done in more remote and hidden hospitals.¹

Shortly after converting the hunting lodge to a hospital an additional cabin for the staff quarters was built. The hospital was guarded by a Partisan company stationed nearby. Numerous underground bunkers were built for food, equipment and medical stores in the vicinity that also operated as air raid shelters.

Italians attacked and destroyed the casualty clearing station but did not locate the hospital. When news reached the hospital of the attack non-ambulatory patients were evacuated to a nearby glade and makeshift shelters were constructed. The casualty clearing station was rebuilt in the same location as a decoy and a heavily camouflaged cabin 15 minutes away was constructed as the real casualty clearing station. This minor innovation showed how camouflage, facility separation and fall back systems resulted in few hospital casualties and minimal disruption to care.

Unfortunately, later another enemy offensive found the hospital. It and the adjacent cabin were subsequently burned. An intense search was conducted in a 10 minute walk radius, but no patients or equipment were found. The glade where they were hidden after the first attack was strewn with pepper to throw off dogs. As the Italians drew closer patients were moved to limestone depression that was concealed using felled trees, tarp, moss, ferns, etc. They remained in this concealed location for a month until a new hospital could be constructed. A 20-bed purpose-built log cabin that was erected in 14 days because winter was approaching. By this time patient load was increasing so a second hospital was built 45 minutes away. During the winter, staff and patients were not allowed to exit the hospital because they would leave tracks in the snow. Litter bearers used round-about paths and brushed tracks behind them.

With likely influx of more patients and a water shortage at the current facility, additional hospital cabins were constructed at Mt. Rog with some improvements to include raised bunks and wider passageways. A convalescent ward was built out of an old barn that was less secure and could serve as a

decoy. If this structure was threatened, the ambulatory patients within it could easily escape. An additional two cabins built 10 minutes away served as a reserve in the event the hospital needed to take on more patients. Measures were taken to mask the location of the various cabins from the new construction crew members to reduce the likelihood of hospital discovery the event the crew was captured by the enemy.

Patrols would communicate between cabins the enemy movements, which were now 5 hours away at their greatest distance. Weekly reports were given to a central command and specialized providers would visit the facilities as needed. An air raid alarm would prompt rapid camouflage of all cabins and huts. Cooking smoke was directed underground, but eventually replaced by smokeless charcoal. All hospital cabins had caves or smaller huts ready to disperse patients to minimize losses in the event of an enemy attack. The Partisan guards would act as decoys and draw away enemy patrols from the hospitals when they were threatened.

The distance of hospital facilities reduced the number of checkups and added burden to the medical staff. Two doctors oversaw one half of the growing Mt. Rog hospital system each and a surgery team would travel to each ward. Wounded would be met at a single point and then carried by specialized soldiers who would disperse them to hospitals and cover tracks. Unlike modern patient evacuation systems, transport times from the casualty clearing station to the hospital could take several hours. This was acceptable because patients were not often transferred between hospitals and would spend the duration of their recovery there. Casualty transport was a small period of time compared to the total length of stay.

Hospital Operations

When the British surgeons both entered Yugoslavia they encountered hospitals that had appalling sanitary conditions. Many were dirty, overcrowded, damp, lacked clean water and supplies. Dr. Dafoe "... was dismayed to see [the ceiling] was covered in a grimy jaconet. Two windows shed some light to reveal the mud and filth in semi-darkness."² This led to poor patient outcomes and in one example, a patient with an intact neurovascular bundle was subjected to an amputation simply because the wound could not be kept clean in the hospital.⁵ An interesting consequence of poor sanitary conditions was many of the wounds would become infested with maggots who would clean away necrotic tissue.² One of the first orders given by the British surgeons were to have all of the facilities rigorously cleaned and operating rooms disinfected to the best of their abilities. In Dr. Dafoe's Kosta hospital he required patients be "disinfected" on arrival by shaving heads, sanitizing clothes and given baths in a separate facility. It was standard practice to also delouse incoming patients.¹

Maintaining secrecy was paramount and "As a rule, no hospital knew the location of the others."¹ Hospital staff were carefully selected from the most loyal Partisans. To maintain secrecy patients were only admitted or discharged at night. Hospitals and paths were well camouflaged. Code names were used for hospitals, nearby villages and landmarks among the staff and on communications to minimize the odds of discovery if a patient or staff member was captured. Cooking was primarily done at night to minimize smoke. Dry food was issued during the day when necessary. Staff and patients were not allowed to leave the hospital without permission from the senior officer. In the winter moving in and out of hospitals was only permitted during heavy snowfall in order to cover tracks.¹

Because of the volatile nature of the war, it was common for hospitals to need to rapidly move or hide patients and for staff to become mobile. Both British surgeons encountered long periods of marching with their unit and treating patients out of a backpack became a necessity.² Medical mobility maximizes effectiveness and keeps the treatment staff relevant on the battlefield.¹

The close tie between troop morale and care of the wounded necessitates close communication between the commanders and the medical corps.¹ Per Partisan statutes, the medical officer is a member of the staff and should be informed of forthcoming operations. Medical units transfer should be mutually agreed upon by the commander and medical officer. Medical service also has location priority when a unit arrives to a new location.¹⁸ The Partisans were very dedicated to their wounded and this would often influence the actions of the unit as discussed by Tito, "... Besides this, as in Foca for example, our operations were closely linked with our wounded, who were always numerous, so that it was not possible to avoid encirclement, although the Supreme Headquarters were fully aware of the enemy's intentions."¹⁹

Hospital Staffing

The medical skill of the Partisans was highly variable. Dr. Dafoe considered his first assistants to be inefficient, whereas Dr. Rogers remarked that the untrained peasant nurses in the Partisan hospitals were comparably skilled to British nurses he worked with in North Africa.⁵ This shows training up personnel in times of desperation can be a valuable strategy to improve patient care. A 2-month course were held at the hospitals to train up local girls as nurses. There was also an advanced medical course in Vojvodina that was 2-3 months for exemplary nurses.¹ Recovered patients often built the hospitals and assisted staff.¹

Working with the Partisans was often a challenge for the British surgeons. Not only were the supply chains undisciplined, but early in their tours they found it difficult getting Partisans to clean hospitals, build new facilities or listen to medical advice.² Having a local population for support can be an asset, but cultural differences and limited command over them may hinder combined efforts. Hospitals would have up to 30 light infantry for sentries and security.¹

The hospital doctors were very valuable to the Germans and in communications regarding Dr. Rogers they stated “He must be taken alive if possible.”⁵ This is likely because he knew the locations of all of the hospitals, backup bunkers and supply caches in his hospital network. Extracting that intelligence from him would have allowed the Germans to strike a fatal blow to that region’s medical system.⁵

There is limited information on the number of personnel at each hospital but most accounts indicate they were very understaffed, especially when patients were taken into hiding. Staffing levels were highly variable because hospitals ranged in size from 20 to 150 beds. Smaller hospitals would often only have a single nurse or physician that split his time between multiple hospitals.

Logistics

Partisans would supply themselves through many different channels to include the local population, enemy units, occupied hospitals, manufacturing supplies themselves, Allied air drops, scavenging, and improvisation. During the conflict Partisan forces prioritized adequate supplies and personnel for the medical system over the line units because they believed a strong medical system would boost morale.²⁰

In the early stages of the war an important source of supplies was on the free market. The local population was generally loyal and supplied a large fraction of medical supplies. Furniture would be obtained locally or by attached hospital craftsmen.¹

The enemy was used as a medical supply source through either war spoils or by smuggling supplies out of occupied zones. Medical staff who were loyal to the resistance would assemble supply packages and often pass them to couriers to take the packages across German lines to Partisans, usually under the cover of darkness.⁵ Partisans would conduct purposeful raids on hospitals in occupied territory and in some instances without firing a shot. Additionally, medical staff would prepare to seize supplies ahead of a major offensive. After capture, medical facilities would be placed under guard and medical staff would prioritize what supplies were transported away. Highest priority items were: “... bandages, surgical instruments, thermometers, serums (especially anti-tetanus vaccine), syringes, cardiac drops, analeptics, narcotics, disinfectants etc...”¹ Remainder of supplies were left for the civilians. Medicines for internal use would only be used if they were found in original containers because of the risk of accidental or intentional mislabeling by the enemy.

Partisans would also manufacture supplies to include stretchers, splints, dressings, bandages etc. “... made various types of instruments, such as shears, pincers, tongs from high-grade steel taken from disabled enemy tanks.”¹ Drugs manufactured included morphine, novocaine, strophanthine, saline, and glucose solutions. While serving in a remote hospital Dr. Rogers ran out of Steinmann pins for fractures, and instead had to resort to using nails. Ligatures were created from parachute cord. Procedures were performed without gowns or gloves. During a brief stay in Italy to gather more supplies he became frustrated that the store officers did not appreciate what “was necessary for a surgeon’s work.” He considered the clothes, soap, candles, lamps they would airdrop to be luxuries and not critical to the mission.⁵

Dropping supplies by parachute was a necessary but inefficient method of delivery. Challenges included poor communication, limited landing areas, difficult terrain, supply collection and drop zone security.¹ It was estimated that up to 65% of supplies were unable to be recovered by friendly forces for various reasons. The Partisans who recovered the supplies would often take what they needed before sending the supplies to the appropriate unit.² Supplies were also shipped from Italy to the Partisan stronghold on the island of Vis and then to the mainland.¹ Supply requests from the Partisans were often unreasonable, forcing the Allied forces to guess and ration what they thought was appropriate to send over.⁵ Discipline from the unit surgeons and the soldiers in the supply chain is critical to ensure the precious supplies are exactly what is needed and that they get to their intended location. The British and Allies forces provided medical supplies to the Partisans at a rate of 3,000 air drops per month.²

The Partisans were very resourceful and would recover supplies from any source available. At Dr. Dafoe's hospital in Kosta a B17 "Flying Fortress" crashed in the vicinity and it was quickly harvested for raw materials. Windows for a new surgical theater were made using the acrylic windows and parachute silk used to cover the ceiling and walls. Hot showers were built using various piping and nozzles recovered from the aircraft. The tubing, sheet metal, and other components were put to good use.²

Some regional hospital systems had a dedicated quartermaster service for the region. This service helped keep remote, secret hospitals supplied with food through coordination with central hospital's robust food acquisition network. Almost all food was obtained locally.¹ Food depots were widely dispersed in the region and ideally 2-3 months of food was kept in reserve. Mt. Rog hospital bunkers contained 15,000 kg potatoes, 800 kg sugar, 10,000 kg wheat, 1,000 kg salt, 400 kg of smoked meat.¹

Injury Care

The injuries suffered by the Partisans included the expected traumatic war wounds of the era and disease nonbattle injuries (DNBI) secondary to harsh living conditions. The austerity and limited surgical capability resulted in many future complications in patient who did not die immediately from wounds.

Gunshot wounds (GSW), fractures, and blast injuries were the most common injuries, but since prehospital treatment was limited, only the patients that survived the initial injury would make it to the hospital. Wounds were often badly infected once they made it to a surgeon as described by Dr. Dafoe, "The cases came on one after the other, GSW limbs, with and without fractures. Most of them severe and running with pus. I never believed that there was so much pus in the world... literally buckets of it."² Osteomyelitis was common and many fractures could not be properly cast at the time because of infection. Rampant infections combined with sparse antibiotics and poor patient nutrition complicated and prolonged patient recovery. Long term complications of inadequately treated traumatic injuries included enteric fistulas, amputations, AV fistulas and need for revision plastic surgery. Less common injuries included eye trauma and injuries secondary to enemy torture. Dr. Rogers was forced to complete an emergency bladder reconstruction after a Partisan's bladder burst because of positional torture technique performed by the Germans. Although they were able to perform amazing surgical feats in austere hospitals Dr. Rogers remarked many injuries "no mortal man could ever replace."⁵

DNBIs likely represented the majority of casualties in the Partisan army, as was usually the case in armies of any period.²¹ Poor lodging, lack of blankets, poor nutrition, and bedridden patients contributed to frostbite in addition to other traumatic wounds. It was not uncommon for the patient to survive an extremity GSW, only to lose the limb secondary to transport to frostbite because of vascular compromise.⁵ Psychiatric injuries to include "shell shock" were encountered by Dr. Dafoe.² American airmen treated by Dr. Rogers who were shot down over Yugoslavia primarily suffered from communicable diseases to include dysentery, typhus, and STIs.⁵ Special wards were established to house patients suffering from typhus and TB. Many wounded had pressure ulcers and a shortage of bandages forced the Partisans to reuse bandages 10-12 times.⁵ In modern warfare it would be unthinkable to re-use medical supplies between patients, but if a unit is logistically cut off for more than a week it may be necessary to find means to fabricate new supplies or clean/sterilize existing supplies.

Surgeons were spread thin and patients would travel for up to weeks at a time to reach surgical services. Dr. Dafoe had about 15 cases a day with a hospital census of 150 at Kosta. Periodically he would

also be confronted with mass casualties. One day 100 injured Partisans arrived to his hospital and as the sole physician he was forced to triage patients and disperse the less injured to other hospitals or treat them.²

Civilians were often treated in Partisan hospitals because they represented an important source of support for the Partisans. They were often the primary source of medical supplies and food for the hospital in the region. Unfortunately, they could compromise the secrecy of the operations and on one occasion Dr. Rodger's hospital was threatened because civilians had been spotted moving a casualty to the hospital by the Germans during the day in their bright clothes.⁵

Compared to British medicine the Partisans methods were more crude, with less regard for patient comfort and long term outcomes. Dr. Rogers remarked that patients were often left in the cold, I.V. lines were not delicately placed, and bandages were removed aggressively. Guillotine amputations were common, even though they usually had poorer outcomes than a flap based technique.⁵ The seeming lack of regard for patient comfort likely in part due to difficult working conditions where efficiency was more important. After some time in country Dr. Rogers was forced to compromise and many operations under brutal conditions. In one instance he would use half a cup of the local fruit brandy, named rakija, and ~50 mg of morphine as anesthetic for shrapnel removal, abscess drainage, and fracture reduction among other procedures.⁵ Dr. Rogers found himself later in his tour confronted with the decision to amputate versus conservative therapy because he was unsure if and when he could return to the patient to address any complications.⁵ Tito identified that there was a gap in the medical knowledge among Partisan doctors and instructed Dr. Rogers to start a medical school in a Guerrilla hospital in order to train up about 25 medical students to support the war effort.⁵

Despite difficult conditions, surgeons were impressed with how quickly they could recover. Dr. Dafoe remarked, "Patients recovered completely even when enduring the continual transport and uncertain diet." He also claimed to have never lost a patient who had undergone abdominal surgery and "We were among amazing people in an amazing country."²

Patient Evacuation

Patients were moved intra-theater based on their injury category. Litter bound and those patients requiring long term recovery would be moved to the most remote hospitals to minimize the possibility of enemy attack and additional movement. Ambulatory patients were inversely treated at the more vulnerable locations close to communication lines because they could more easily evacuate if the enemy was encroaching.⁵ Figure 5 shows Partisans of the Petrova Gora hospital evacuating wounded via horseback.¹⁴



Figure 5: Partisans evacuating patients from Petrova Gora on horseback.

Civilians were invaluable to the medical units, particularly during long movements. The Partisan resistance was a national effort captured by this quote from the medical officer Dr. Irina Kovanjko Knežević regarding the villagers of Tepci, “For five full days and nights these people worked in shifts, up to their knees in water, transporting our wounded, hospital staff and Italian stretcher-bearers. The Tara river was streaming in the frost, an icy film covered the banks, and yet these people, numb with cold and fatigue, drive their carts on and on, their only thought being that there might not be enough time to save all the families in case of sudden German breakthrough.”²²

Partisans relied heavily on air evacuation provided by Allied fixed wing assets to move patients out of theater. Enemy forces mandated that evacuations occur only at night because of enemy air patrols and ground spotters. Partisans needed to build and then defend makeshift mountain runways in order to have patient evacuation capabilities. Evacuations were mostly done in waves on improvised airfields. Allied aircraft would fly in the vicinity of the evacuation zone and then be signaled to land using coordinated signal fires. Mistakes in this communication process often led to the aircraft turning back for fear that the signal fires were decoys set by the enemy. Dr. Dafoe had difficulty evacuating all of his patients to Italy because the number of aircraft sent was insufficient. One night only capacity for 200 wounded was sent, but the Partisans had brought 600 to the airfield. They managed to evacuate 300 that night while the remainder waited for a future pickup. Overcrowding aircraft was a dangerous strategy because there was at least one plane rumored to have crashed because of the extra weight.² Casualties were also evacuated by sea when they made it to the island of Vis.⁵ This was hindered by frequent patrols by German fast attack ships, known to the allies as E-boats.

Contingency Planning

The Partisans were experts at evading the enemy and their hospital system was designed to minimize losses in the event the Germans threatened the hospital safety. The general strategy was to have designated fall back hospitals and bunkers if the enemy encroached. The small security force protecting the hospital would harass and misdirect enemy forces while the hospital evacuated. Ambulatory patients would be sent to distant hospitals or temporary forest shelters with medical staff and supplies. Litter bound patients would be moved to secret underground bunkers pre-stocked with supplies with a nurse. There they would stay until the enemy moved on or was cleared from the area. Sometimes patients would remain hidden for months at a time.

When one of Dr. Rodger's hospitals was bombed they immediately began preparing the hospital to move patients. This started with Dr. Rogers taking down fractures suspended on Balkan beams and casting them. Ambulatory patients were given food and water and left the hospital first for forest hiding places. Litter bound patients were then evacuated by carrying parties and a medical provider to prepositioned shelters that were pre-stocked with supplies. The remaining supplies at the hospital were also cached in hidden underground bunkers. One lapse of planning was poor communication regarding the location of the patients after the evacuation. Dr. Rogers had difficulty finding many of them. In total 200 patients were dispersed from the hospital.⁵

The frequent movement of patients to worse accommodations often resulted in complications such as shock and gangrene, but Dr. Rogers concluded “... for the sake of those who lived we had to adopt this method of concealment.”⁵ Traditional, fixed hospitals did not have to balance the need of a patient to rest and heal versus the need to move them to safer location.¹ In other cases it was observed the constant movement did not seem to worsen injury outcomes, but in fact the Partisans demonstrated remarkable resiliency and high morale.²³

The pre-insertion survival and evasion training proved useful for Dr. Rogers when upon arriving on mainland Yugoslavia when the village he was staying in was rapidly taken by the Germans. He was separated from all of his equipment and was forced to conceal himself under a bridge and evacuate up a creek overnight.⁵ This demonstrates that all personnel should have basic Survival, Evasion, Resistance, and Escape (SERE) training before deploying against a near-peer adversary.

U.S. Army Hospital Doctrine

AMEDD Battlefield Rules:

“These Battlefield Rules in order of precedence are to-

- Maintain a presence with the soldier (being there).
- Maintain the health of the command.
- Save lives
- Clear the battlefield
- Provide state-of-the-art care.
- Ensure the early return to duty of sick, injured, or wounded soldiers.”²⁴

These guiding values provide the foundation for much of the U.S. Army military medical doctrine that is reviewed in this section. These principles alone can serve a unit well in a dire, isolated situation by simplifying the mission and providing direction during adversity. The line “Provide state-of-the-art care” is seemingly not compatible with a resource limited environment as isolated, non-conventional warfare. It can be interpreted to mean medical providers should be competent in austere medical principles to provide the most state-of-the-art care possible in resource limited situations.

Battlefield Conditions

The modern battlefield is vastly different today than what was encountered in WWII. Today’s armies rely heavily on the gains brought about by the information age. The rules of war, such as the Geneva Conventions, place protections on patients and medical staff that were non-existent during the Partisan’s struggle. Considering what technologies exist today that would hinder evasion and evacuation techniques used by the Partisans will inform if those techniques can be used by a modern army.

Operating at night has been made much easier with the advent of night vision devices (NVDs) and thermal imaging technologies. It is clear current U.S. Army doctrine understands this new capability greatly impacts medical unit concealment and has outlined many strategies to use and defeat it. Commanders should consider appropriating civilian buildings to minimize light/thermal signals, light proofing shelters, communication with night vision devices and noise reduction. Heat signatures from generators and other equipment should be minimized using natural features or sandbags.²⁵ Planning should consider having the best IR defeating uniform possible.²⁶ Unit surgeons should understand how to use both near and far infrared (IR) devices and how they can be used to in combat health support. These devices include the combat identification panel (CIP), BUDD light and the Phoenix light. Chemical lights degrade light discipline any should be used cautiously.²⁷ Medical personnel are expected to be able to support night operations to include treatment and medivac. Standard procedures should be communicated to establish light discipline. Units should be proficient in erecting structures at night and understand which facilities can block visible light and which will glow under night vision goggles. Vehicles may need to be used for patient treatment in mobile scenarios to block visible light.²⁷

Air evacuations can be hindered by modern radar and infrared detection systems, which are likely capabilities of a near peer adversary. Operating only at night may not be sufficient to evade the enemy. Stealth technology for both fixed wing and rotary aircraft will be critical for patient evacuation while in an isolated, non-conventional posture.

Geneva Conventions

Many of the techniques used by the Partisans will theoretically unnecessary when in combat with a near-peer adversary who adheres to the Geneva Conventions. Under the Conventions from the moment a soldier is wounded or is sick, they are protected. Regardless of allegiance, combatants must be given the same care regardless of which side is treating them.

The Axis powers actively pursued the wounded in hospitals to drive down morale. They had specialized teams and reconnaissance aircraft to seek out and kill as many healthcare workers and

wounded as possible. Partisan and Allied doctors were not shielded from enemy attacks and direct fire. When captured Partisan doctors were executed like their infantry comrades. Both Dr. Rodger and Dr. Dafoe were engaged in small arms combat, aerial attack, and indirect fire.⁵ This fierce pursuit forced the Partisans to innovate and develop guerilla medical strategies. These strategies will only be useful to a conventional Army if the enemy does not adhere to the Geneva Conventions, but instead sees the medical system as a target.

The Army Health System Field Manual interprets Article 12 as any combatant who lays down arms because of a common-sense definition of sick and wounded gains protection. "It is unlawful to harm in any way a fallen and unarmed enemy soldier." In addition, Article 12 imposes an obligation to give aid as needed. Only medical urgency should be used to distinguish which patients are treated first. Aid should be rendered irrespective of distinctions such as nationality, race, sex, etc. "Wounded and sick shall not willfully be left without medical assistance..." If the treating unit needs to leave the wounded combatant behind, then doctrine indicates that that at a minimum they should be provided with medical supplies and personnel if possible.²⁸

The Conventions also explicitly protect healthcare facilities provided they are only used for a medical purpose and are adequately indicated with Geneva emblem; a red cross on a white background. NATO STANAG 2931 states that a medical unit may temporarily camouflage the distinctive Geneva emblem if it poses a risk to the operational unit.²⁹ It would be logical to conclude that a medical unit in hiding from an enemy that does not comply with the Conventions, they should employ all camouflage possible, to include the Geneva emblem.

Hospital Design

The current NATO medical evacuation classification system used by the U.S. Army sorts medical facilities into Roles 1 through 4 based on proximity to injury, size, and medical capabilities.³⁰ Generally injuries will be first initially managed in the field by a combat lifesaver trained soldier or medic. The casualty would then be moved to a Role 1 facility, triaged and treated, then sent up the chain to a Role 2 for more advanced/definitive management. This escalation in care will continue until the casualty comes to a Role 4 fixed facility, usually within the home country.³¹

The Army's Role 1 facility is a Battalion Aid Station (BAS). Care is provided by a PA and/or physician with no surgical or patient holding capability. Care may be provided out of a building of opportunity, a tent, or simply on a tailgate. This facility has 4 treatment beds but no holding capacity. A Role 2 provides basic primary care, some ancillary services and damage control surgical capabilities if augmented with a Forward Surgical Team (FST). This is a company sized element servicing a battalion or cavalry regiment. A Role 2 with an FST will have approximately 10-15 beds.³¹ These systems are inherently designed to treat and quickly evacuate any casualty that cannot return to duty within a matter of days. While an FST is theoretically capable of 30 life saving operations in 72 hours, it is only expected to provide post-op ICU level care to eight patients for up to 6 hours.

Construction of improvised hospitals was a critical element of the Partisan system and the U.S. Army Survival Manual²⁶ describes a number of different types of improvised shelters. These include a simple poncho lean-to to more elaborate parachute tepees. These tepees utilized an improvised wooden frame covered in the parachute fabric. The section describes many ways to use a parachute canopy to include a hammock. This construction system was not unlike Dr. Dafoe's Parachute Ward, which also relied on a wooden frame covered by parachutes and parachute hammocks. This style helped shield patients from the elements while providing good ventilation and comfortable accommodations. The Survival Manual also discusses how to use natural formations including caves, rocky crevices, clumps of bushes can be used for shelter. Natural formations were used frequently by Partisans if they needed to hide patients from the enemy during a raid. As expected, the Survival Manual does not discuss building larger, more semi-permanent structures out of limited or natural materials because it mainly focuses on survival of a single soldier for a limited period.

Army medical logistics doctrine³² does not describe specific austere construction methodologies, but does appreciate that temporary medical facilities should have certain characteristics. The term most

applicable to isolated and non-conventional warfare discussed is Organic Construction. These facilities are expediently set up and can be used up to 90 days, but up to 6 months if needed and do not have external engineering support. Organic Construction can be compared to other facility classifications below in Figure 6.³² The initial facility standard is characterized by minimum or austere facilities that require minimal engineer efforts and simplify material transport and availability. The use of local construction materials is encouraged but they will likely include tents and ISO containers. If a unit's treatment facility has to be sustained for greater than 6 months, then U.S. Army doctrine directs units to upgrade facilities to permanent structures as was done in many of the long-standing Partisan hospitals. Hospital sites should have good drainage, facilitate heavy traffic flow, be free of major obstacles, and be able to expand if needed. It is recommended that at least 4 acres of land be available for treatment and administration, not including helipads or motor pool.²⁵ This large footprint would not be compatible with a guerrilla posture in contested territory because it could be easily sighted from air or space by the enemy.

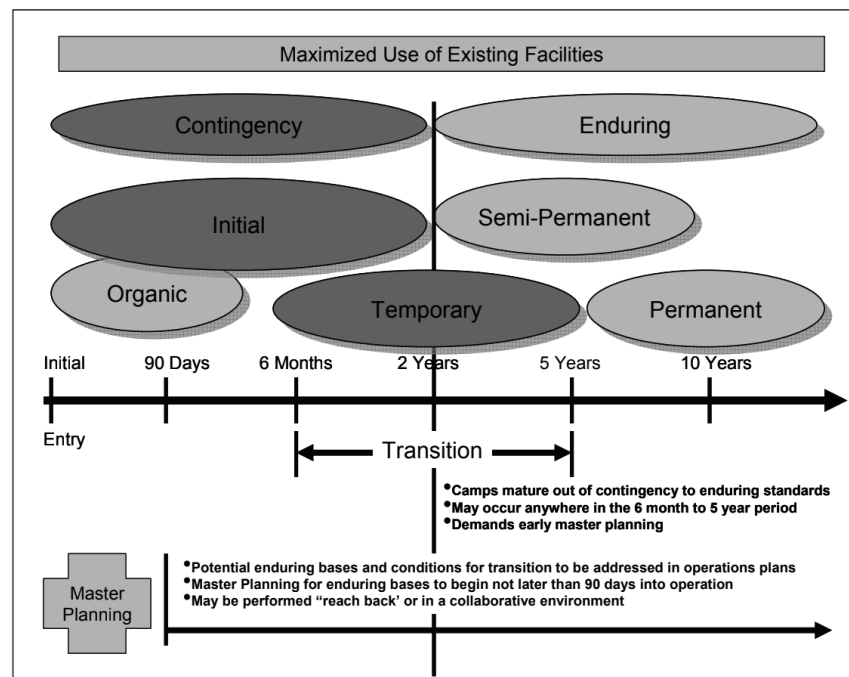


Figure 6: U.S. Army medical facility construction classifications.

Medical treatment facilities should be in areas that are accessible by main roads, networks, and air corridors to facilitate rapid evacuation. They should not be near likely enemy targets such as bridges, ammunition storage facilities, motor pools, etc. The hospital site should have maximum cover and concealment without degrading the mission or communications. It should also not be too secluded for ambulances to locate. The site should also be able to facilitate air ambulance landing, be defensible, and consider efficient placement of all necessary equipment.²⁵

Hospital Staffing

The modern conventional unit that is most similar in size and staffing level to what was found in the partisan hospitals is the Battalion Aid Station (BAS). The BAS is part of a Medical Platoon within a combat battalion and provides Role 1 care for that unit. The BAS consists of a headquarters section, treatment squad, evacuation section and combat medic section. The combat medics are integrated into the

supported unit and range from 12 to 16 based on the type of support unit. Infantry battalions will have 16 integrated combat medics, Stryker units 12, and Armored 13. An organizational chart showing the different elements of a medical platoon can be found below in Figure 7.²⁷

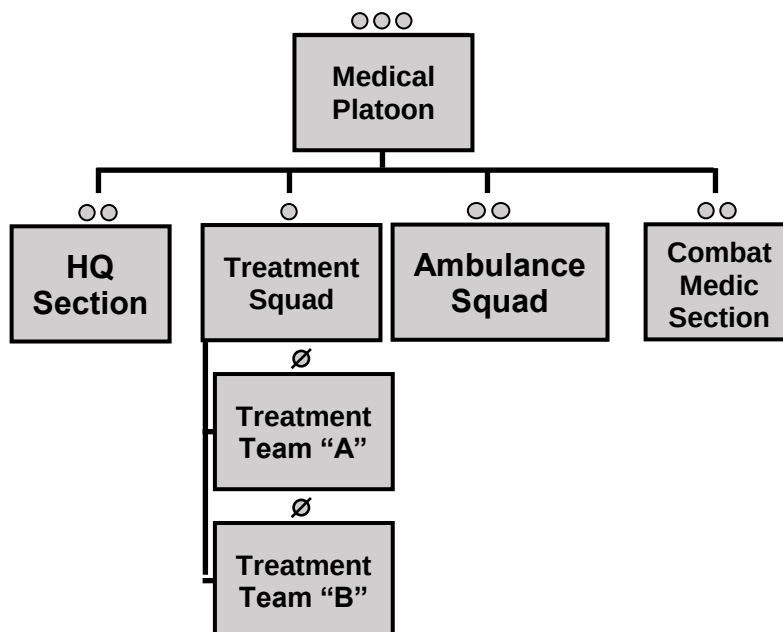


Figure 7: Medical Platoon Organization

The treatment squad is led by the battalion surgeon who leads one of the two treatment teams. The other team is led by an Assistant Battalion Surgeon, often a physician assistant. The HQ section has one field medical assistant and one platoon sergeant. The ambulance squad has between 6 and 4 vehicles based on unit type staffed with medics to provide transport from casualty collection points to the BAS.

The next echelon of care, a Role 2 facility, is run by a Medical Company and is much larger than a BAS, has additional staff and additional services. It is the first unit in the care chain that has dedicated patient holding staff and facilities.³³ It is a brigade level asset and be contained within the Brigade Support Battalion or Multifunctional Medical Battalion. Its organizational structure can be found in Figure 8 and a breakdown of number of personnel per section is found in Table 2.

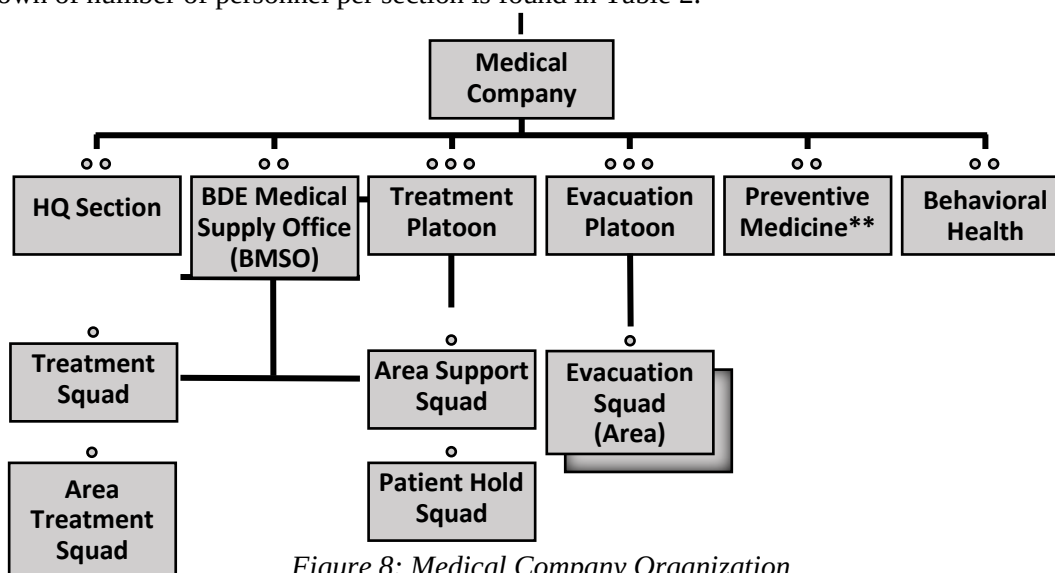


Figure 8: Medical Company Organization

Table 2: Medical Company Staff

Section	Medical Staff	Total Personnel
HQ and BDE Medical Supply	None	7-19
Treatment Squads (x2)	2 Physicians, 2 PAs, Medics	~30
Area Support Squad	Dentist, Physical Therapist, Various Techs	8
Patient Hold Squad	RN, Medics	5
Evacuation Squad	Medics	14
Behavioral Health and Prev. Med	Behavioral Health and Environmental Science Officers	6
	Total	~70-82

An FST can augment a Role 2 facility's capabilities by providing surgical services. Its functions include perioperative resuscitation, initial stabilizing surgery, and postoperative nursing care for up to 30 critically wounded for up to 72 hours. This 20-person team brings no ancillary support services and is wholly dependent on its host Role 2 facility for logistics, lodging, etc.³³ The team consists of 4 surgeons, 3 RNs, 2 CRNAs and 11 other supporting staff. These units are designed to be highly mobile and able to have a functioning OR within 1.5 hours of being on scene and be capable of being packed up to move within 2 hours.

The Army is currently transitioning its FSTs model to a Forward Resuscitation and Surgical Team (FRST) model. This change will preserve the 20 person, highly mobile unit, but also include 2 ER physicians and 2 ER nurses provide a resuscitation component. The FRSTs are also designed to conduct split operations to move surgical capabilities further forward on the battlefield.³⁴

Logistics

Medical supplies are distributed from stockpiles in the rear through each distribution echelon until they reach their end destination. Supplies are requested by the subordinate unit and fulfilled by the parent unit. Medical supplies are referred by the designation 'Class 8' within the U.S. Military. During initial entry supplies are pre-configured packages based on what is expected to be needed and then distributed to the Supplies go from the Brigade Support Medical Company (BSMC) or the Area Support Medical Company (ASMC). The Battalion Aid Station (BAS) request supplies from the BSMC or ASMC and medics in turn will request supplies from the BAS. Supplies are to be sent with ambulances returning to the forward unit after casualties have been offloaded at the parent facility. The flow of material into the theater and out to the various medical units is depicted below in Figure 9.³²

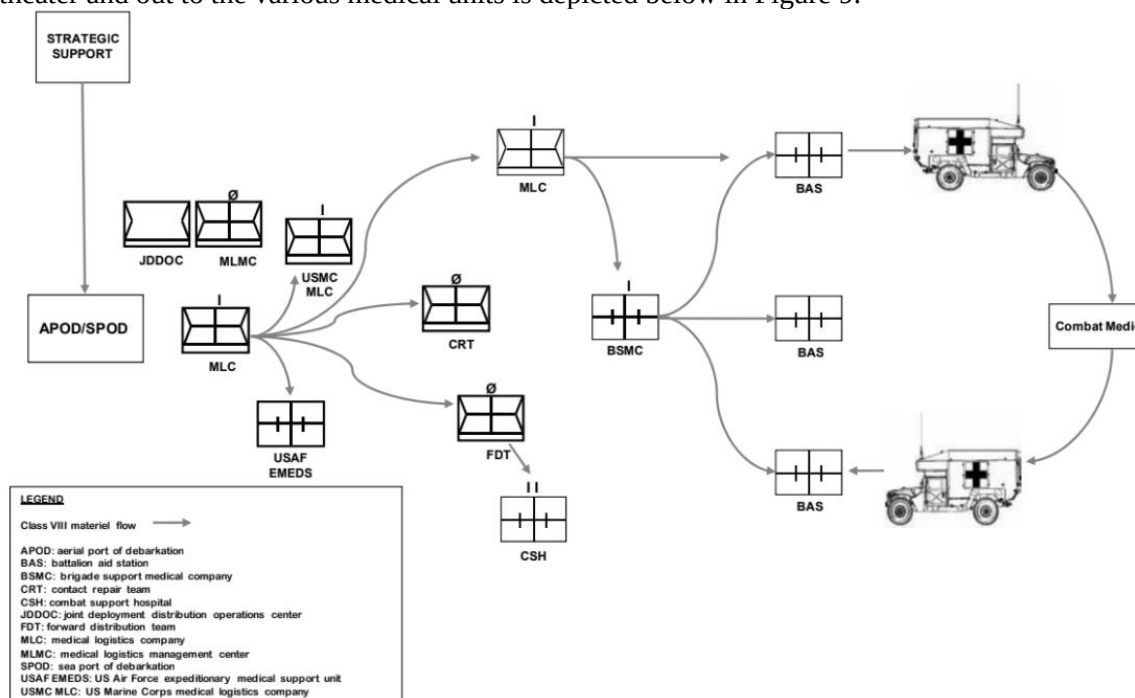


Figure 9. Class 8 Intra-theater Distribution³²

The U.S. Army medical logistics system aims to be lean and to "... minimize, to the extent possible, the number of layers of inventory storage and materiel management." This agile infrastructure allows the most forward operating units to have rapid access to commercial inventories as needed. Medical Resupply Sets are prepackaged sets maintained by Army War Reserve Sustainment stocks. During the initial engagement the brigade level medical units will receive pre-determined Class 8 push packages until item requisition processes are established. The Defense Health Information Management System is the current electronic medical record and combination medical logistics software used in theater. This system theoretically gives any soldier with a laptop the ability to generate Class 8 requests when communications are available.³²

Patient Evacuation

The current evacuation model relies on transportation of casualties from point of injury through escalating Roles of Care until the casualty is out of theater and recovering at a Role 4 facility and entering rehabilitation if necessary. At the point of injury initial Tactical Combat Casualty Care will be provided by soldiers and medics organic to the unit and the casualty will be moved to a Casualty Collection Point (CCP) manned by a medic. From here they will be transported to the BAS by ground ambulance or other means where the soldier will undergo additional stabilization and wound dressing. From here the casualty will be evacuated by ground ambulance or rotary aircraft to the Role 2 facility where further stabilization

and possibly initial damage control surgery will take place. From the Role 2 facility the casualty will be moved to a Role 3 by either ground, rotary or fixed wing aircraft for additional surgery and care. Finally, the casualty will be transported to a fixed Role 4 facility for definitive surgical and medical care. Below Figure 10 depicts the conventional roles of care and how patients are moved between them.³⁵

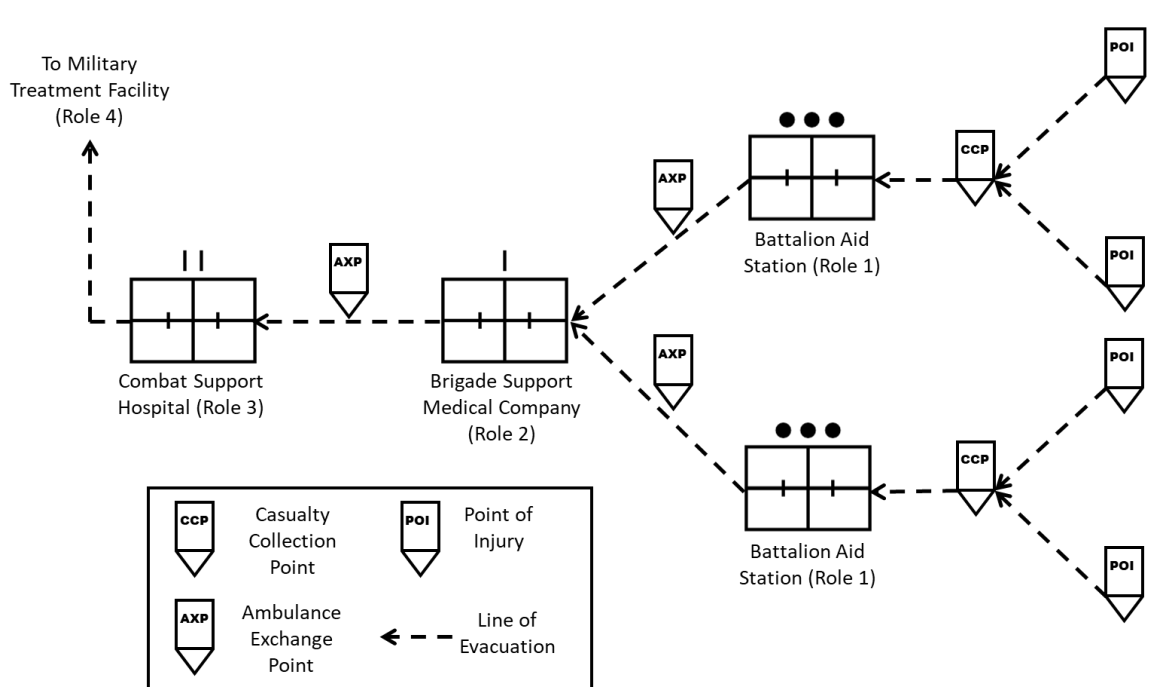


Figure 10. Conventional Medical Evacuation System

Medical evacuation requests can be used to summon both ground or air evacuation assets in real time from the next echelon of care. Casualties are classified as Urgent, Urgent-Surgical, Priority, Routine and Convenience based on the estimated amount of time the patient needs definitive management for their wound or illness. These categories do not consider if the injury can be temporarily managed for an extended period of time if evacuation assets are not able to reach the wounded rapidly. The most senior military or medical person determines evacuation precedence. “Ground evacuation is the principal means of evacuation for patients injured in the forward areas.” Evacuation routes should be minimized by placing clearing stations near supported forces.²⁵ Both air and ground evacuation assets often stay on standby until a medical evacuation request is received. Limited range, high profile, and need for ground security may hinder the use of helicopters in an isolated, non-conventional combat scenario whereas speed, no need for a runway and maneuverability will be an asset.

The current air evacuation system is well suited to a battlefield where we have air superiority and can rapidly evacuate small numbers of injured. In an isolated and non-conventional posture, patients will likely need to be evacuated in large groups all at once because battlefield conditions permitting evacuation may be few and far between. Equipping large rotary aircraft with medical capabilities, not unlike the Air Force’s Critical Care Air Transport Teams (CCATT), will be valuable when large groups of wounded in various degrees of stability need to evacuate at once from an entrenched unit. As it stands, conventional medical evacuation assets are not normally used within hostile territory.³⁵

Litter bearers as an evacuation method are also discussed within Army doctrine. This system can permits patient movement over very inhospitable terrain such as mountains or jungles and are more difficult to detect than a vehicle-based transport system. A 4-person litter squad is expected to cover 900 m and return in 1 hour over relatively easy to cover ground. Mountain operations call for a 6-person litter

team capable of covering 350 m in one hour and returning.³⁶ Litter bearer relay stations are also suggested if multiple casualties need to be transported via litter.

If conventional units are in an isolated, non-conventional posture it may be just as pressing to evacuate all the forces from the unfavorable tactical environment as evacuating the wounded. When evacuation resources are limited, commanders will have to decide if greater losses will be realized if wounded are left behind, versus the able-bodied force. Some guidance for what to do regarding patient evacuation in a isolated situation in modern Army doctrine comes from the Retrograde Movement operations of the Medical Evacuation Manual.³⁵ Relevant points to consider from this section include:

- Requirement for maximum security and secrecy in movement
- Movements at night or during periods of limited visibility
- Medical evacuation routes will also be required for movement of troops and materiel. This causes patient evacuation in retrograde movement to be more difficult than in any other type of operation.
- Command, control and communications may be disrupted by the enemy.
- Providing for the transportation of the slightly wounded in cargo vehicles...
- When the patient load exceeds the means to move them, the tactical commander must make the decision as to whether patients are to be left behind... Medical personnel and supplies must be left with the patients who cannot be evacuated.

Doctrine does acknowledge Special Forces often have prolonged evacuation times, so are aided by enhanced medical training for their medics.³³ They can also train the local population on medical tasks, which would magnify the ability to treat large number of patients for long periods of time.

Possible U.S. Army Medical System Structure in an Isolated and Non-Conventional Posture

The lessons learned by the Yugoslavian guerrilla medical system can be used to speculate strategies that may be useful to modern conventional armies in the event they are overrun by enemy forces and isolated from the main force. The following sections will examine how Partisan methods could manifest themselves in the U.S. Army.

Hospital Design

Hospitals should be built with any readily available materials or use any suitable building of opportunity if a conventional unit is overrun and must resort to sheltering in place. Medical units will likely have organic shelter materials, but if it is expected they will engage in prolonged field care within hostile territory it will be necessary to expand facilities. Construction or building modification techniques to create a rudimentary medical treatment facility are not routinely taught medical personnel. Having basic field construction and engineering knowledge sufficient to build a concealed shelter similar to many of the Partisan structures would be invaluable if a small medical unit needed to become entrenched for a prolonged period of time in a remote location. Modern battlefield conditions suggest that a bunker or subterranean system will likely be the most effective improvised structure because it provides more concealment from modern aerial imaging and infrared detection systems. Native buildings of opportunity in urban locations would also provide a similar degree of concealment. As was done in the Mt. Rog hospitals, buildings of opportunity could be used as initial treatment facilities as hidden hospitals were being constructed.

Facility location is a critical element of design and one of the most important factors in an isolated, non-conventional operation. U.S. Army doctrine specifies hospitals should be located near communication lines, but this makes units more accessible to the enemy. The Partisan forces prioritized inaccessibility because it gave them security, while the U.S. Army doctrine assumes a degree of superiority over the enemy, such that medical facilities do not have to be located behind enemy lines. Modern forces should locate hospitals such that they can be reached easily by rotary aircraft for resupply and patient evacuation, but not be so exposed to allow for large scale enemy air assault or airborne operations nearby that could surprise the facility's defenses. While Partisan hospitals were rarely accessible by road, it would be useful for modern hidden medical facilities to be in relative proximity to roads because it provides a rapid means of egress and conventional BASs use motorized vehicles to

transport staff and supplies. The hospital itself may be located several hundred meters from a rudimentary road with patients and supplies moved by litter bearer from vehicles to the hospital. Sentries responsible for coordinating new casualty transport to the hidden hospital could be responsible for concealing and guarding vehicles near roadways.

Multiple small buildings would be the easiest to construct and were used extensively by Partisans, but require frequent movement of personnel between structures, increasing the risk of detection by infrared and other systems on the modern battlefield. The U.S. Army would be best served by using the number and size of medical treatment facility that best fit the tactical situation at that time. Partisan facilities averaged over 22 beds per structure. BASs may have to adapt to holding upwards of 40 patients total at one time, possibly split geographically between medical providers. Redundant separated facilities were also used extensively by Partisans and should be used by modern units in the event their primary facility is discovered or attacked. This strategy is even more important on the modern battlefield because of enhanced detection capabilities.

One possible medical facility configuration for conventional unit in an isolated and non-conventional posture is depicted below in Figure 11. Instead of all medical operations occurring within friendly territory, medical assets that become overrun and entrenched. Role 1 and stabilizing surgery provided by a skeleton FST or FRST detachment would probably be the most robust medical system that could be successfully used in an isolated and non-conventional posture. Conventional Role 2 and Role 3 facilities should be located in friendly territory because they lack the maneuverability and concealability available to smaller units.

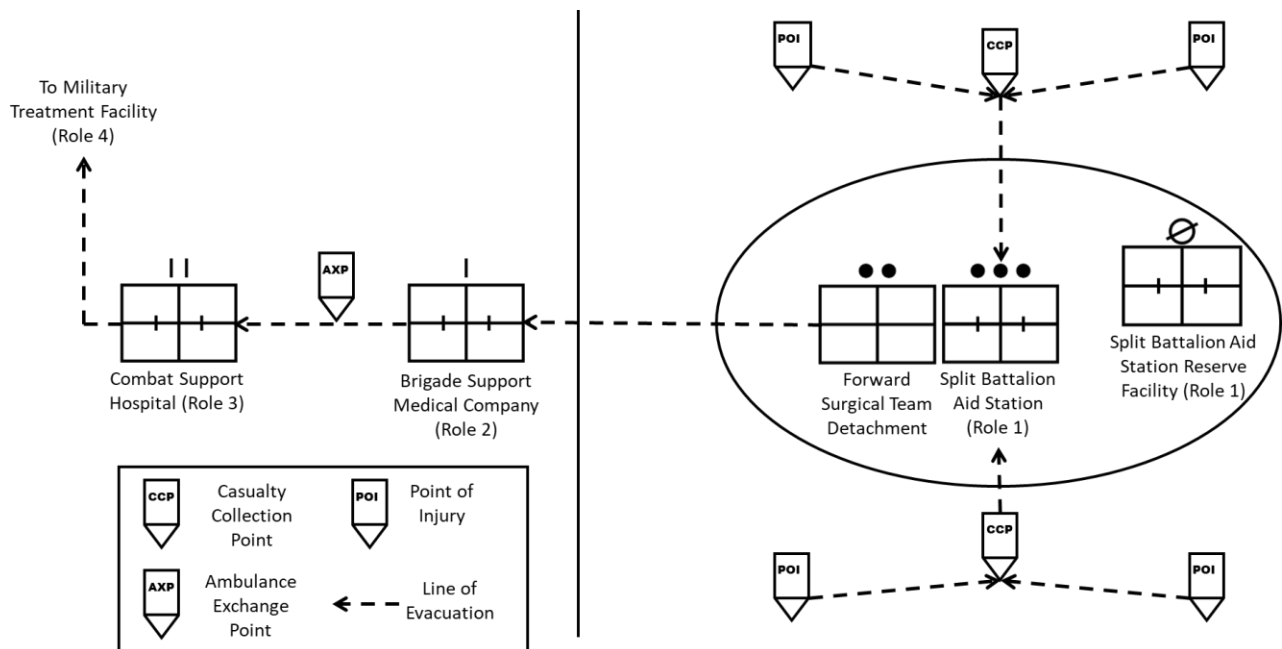


Figure 11. Possible Medical Treatment Facility Configuration During Isolated and Non-Conventional Operations.

Hospital Operations

The most glaring departure from established BAS doctrine would be the need to convert these short-term, rapid stabilization treatment units without patient holding capacity to prolonged field care wards. When receiving casualties the BAS is focused on providing tactical combat casualty care and quickly transporting the wounded to Role 2 or Role 3 with surgical capability. When in an isolated and non-conventional posture the BAS will need to shift its focus to stabilizing in place and managing wounds without definitive treatment for days to weeks.

Isolation from the main force also emphasizes the need to push small surgical teams forward to reach casualties that are unable to be evacuated and require life-saving surgical intervention. Mt. Rog had a small roving surgical team that would visit the scattered facilities. Using a small, traveling surgical team versus transporting patients to a fixed surgical facility would reduce the number of personnel exposed to the enemy and reduce the likelihood of facility discovery. The smaller, 10 person detachments from an FRST would likely fit this role well. This strategy does put the valuable surgical providers at substantially increased risk of being killed or captured because they will need to be frequently moving from facility to facility. Surgical outcomes and productivity would also likely be worse because they would need to operate in several different, sub-optimal facilities and a significant portion of time would be spent traveling.

Feeding casualties in the modern era would be assisted by advances food storage and transport technologies. Use of the Department of Defense Meal Ready to Eat (MRE) or Unitized Group Rations Express (UGR-E) would eliminate the need to cook. This is advantageous because it reduces the likelihood of facility detection secondary to smoke or large thermal signatures and does not require a fuel source. These meals are waterproof and the MRE is shelf stable for 3 years at 80°F, which would be more than adequate for unit in a prolonged field care scenario. If these supplies are not available to the treatment facility then efforts should be made to establish sustainment through a friendly local population if necessary. Standard military chemical water purification systems are generally non-cumbersome, shelf stable, highly effective, easy to use and would be a significant improvement in water quality over methods used by Partisans.

Hospital Staffing

The Partisans were chronically short of staff members for the number of wounded and there is no reason to think if in a similar tactical environment that American forces would also have a sub-optimal number of medical personnel per patient. Partisans often found themselves with one nurse per wards at a ratio often exceeding 30 to 1. As discussed in earlier sections, the BAS should be divided into two, with the treatment teams separated. Each treatment team has either one PA or MD/DO and each could reasonably manage up to 20 stable patients if they were fully augmented with a few medics and ancillary staff. The provider may need to be split between 2 or more hidden wards, but it can be reasonably expected that medics could adequately perform many prolonged field care tasks such as dressing wounds, serial examinations, administering medications etc. The provider would stay focused on complicated cases and perform necessary field procedures. Ideally remaining combat arm forces or the lightly wounded could provide needed sentry services since the BAS does not have organic security, but if needed medics could also adequately take this role.

As done by Dr. Rogers in his area of operation,⁵ surgical teams would likely need move between each hidden ward to provide lifesaving or stabilizing surgery across multiple BAS treatment teams. Surgeons would likely be in very short supply given they are traditionally somewhat distant from the point of injury. As the Army evolves to further push surgical capabilities close to the front lines, future conflicts may see surgeons trapped behind enemy lines with these makeshift prolonged field care wards.

Medical teams would also benefit from attached engineering units to facilitate construction of well concealed and secure wards. Much like the surgical teams these units could travel from site to site rapidly building pre-designed structures ideally out of local materials. A major component of the Partisan success was the ability to rapidly build well concealed hospitals. As it stands BAS are not equipped or trained to retrofit buildings of opportunity or construct fixed structures in austere environments. While small medical units do organically have tents and other temporary structures, they are not adequate for holding large numbers of patients and additional facilities will need to be improvised.

Patient Evacuation

Modern reliance on air superiority necessitates change in evacuation strategy if waging war against a near-peer adversary. Use of ground vehicles, litter bearers and even pack animals may need to be incorporated into the patient evacuation system while isolated. U.S. forces are unlikely to have the

flexibility to mobilize an evacuation platform for every casualty and rapidly transport them to an appropriate next role of care. Evacuations are more likely to occur in burst when the tactical situation permits evacuation platforms to reach patients unhindered.

Rotary aircraft will certainly provide more evacuation flexibility because forces will not be required to develop and hold an easily detectable runway. The evacuation distance for the Partisans was less than 250 miles by air, which would be within the effective range of many rotary aircraft. Shown below in Figure 12 are distances from the two hospital sites that Dr. Dafoe and Dr. Rodgers had permanent hospital operations and the distances of those sites to Bari and the rebel stronghold of Vis.³⁷ Bari served as a major base of operations for allied air assets and frequently was where air dropped supplies would come from and where wounded would be evacuated to.

Ground ambulance units would still serve a vital role if air evacuation is unavailable because there will be increased need to perform en-route care and transport times will likely be greatly increased.



Figure 12: Evacuation distances by air from hospital sites utilized by Dr. Rogers and Dr. Dafoe demonstrating feasibility of rotary evacuation if this conflict occurred in modern day.

If air superiority cannot be maintained and medical units are forced to engage in prolonged field care, there will be increased reliance on manpower-intensive patient transportation. Depending on the degree of medical facility concealment, litter bearers may be needed to carry patients long distances from casualty collection points or the nearest road access. They could also be converted to highly mobile medic teams that could man relay stations between casualty collection points. These dedicated litter/transport teams could provide en-route care and minimize the traffic going to and from hospitals.

Contingency Planning

Army doctrine also does not address contingency planning in the event that a BAS or other smaller medical element is overrun while unable to rapidly evacuate patients to safety. Partisans used backup hideouts, bunkers, and natural structures with great success when the hospital was compromised. When a BAS is isolated and in a non-conventional posture becomes established in a fixed location, a secondary location that could facilitate continued operations should be identified. This location should be able to be reached rapidly with the use of vehicles or litter bearers with the escape route not readily apparent to the encroaching enemy forces. The Practice of hidden supply caches was also an effective strategy and the medical unit should consider what supplies can be stashed and recovered later if the primary treatment location is compromised.

Splitting the BAS most of the time will provide redundancy in the event one of the halves is killed or captured. When the force is initially overrun Treatment Team A could serve as the primary receiving team while Team B maneuvers to a geographically distinct location to establish prolonged field care ward. As the situation matures Team A can stabilize and transport more critically injured to Team B and retain the ambulatory or lightly injured casualties. This maintains one team with high mobility that can quickly react to changing battlefield conditions. These units should be able to evacuate quickly and have vehicles pre-staged and evacuation routes pre-planned.

Both teams should establish secondary fall back locations that consider the present tactical environment. Early on this may just be identifying a nearby natural formation that provides concealment, whereas if the medical unit is entrenched for a long period of time, the backup facility may be a purpose-built bunker. The Partisan bunker design discussed earlier was a highly effective structure that would provide great visual and infrared concealment. It should be used as a model for a modern prolonged field care ward. Advancements in modern building materials could provide improved heating, structural integrity, speed of construction and waterproofing.

Conclusions

Partisans faced many challenges to include difficult geography, a superiorly equipped occupying force, food shortages, and brutal enemy tactics. They used concealed hospitals ranging between 25 to 215 beds throughout the country. Hospital organizational principles included, preventing casualty concentration, redundancy, mobility, and concealment. Wards were often subterranean and held 30 patients on average. A prototypical underground ward was approx. 3.5 x 10.5 m with 2 levels of bunks, storage space, and ventilation. The Partisans had few medical providers, but through battlefield experience, local and British expertise were able to produce many competent wartime medical personnel. Concealment and secrecy prevented discovery of many wards. Backup storage and treatment facilities proved crucial redundancy. DNBIs represented a majority of casualties and trauma was often complicated by infection and poor nutrition. Partisans relied on Allied fixed wing aircraft for intra-theater evacuation whereas pack animals and litter bearers were used intra-theater.

International law should protect medical personnel and patients from attack when facing a near-peer adversary, but cannot be guaranteed. Guiding AMEDD principles provide a good doctrinal foundation for a conventional unit forced into an isolated and non-conventional posture. Modern battlefield ground and air detection systems will make the excellent evasion tactics of the Partisans more difficult to execute. There is minimal guidance within Army doctrine on conducting isolated medical operations. The smallest medical provider treatment element is the BAS, and realistically the largest element that could maintain enough maneuverability and concealment to operate behind enemy lines. New FRSTs provide greater capability, flexibility and autonomy than current FSTs. Deficiencies were found in logistics, evacuation, hospital design and staffing. Modern evacuation doctrine focuses on stabilization of casualties and a rapid evacuation sequence from Role 1 to Role 4 with more definitive injury management occurring along the way. This system has a heavy reliance on air superiority because of the widespread use of rotary aircraft.

Many tactics used by Partisan guerrillas should be used to shore up deficiencies in modern Army doctrine. Doctrine does not adequately address how to incorporate readily available local building materials

or how to establish medical treatment facilities within buildings of opportunity. The Army would benefit from basic guidance on how to establish a concealed treatment ward such that it is appropriately distant from communication lines, yet within a reasonable distance from ground or air evacuation pick up sites. Attached engineering personnel to medical units would mitigate this shortcoming. Based on Partisan wards, a reasonable facility size should be approximately 20 patients with at least one medical provider per facility. This suggests a BAS holding capacity in an isolated and non-conventional posture of 40 patients if necessary. BASs entrenched behind enemy lines are likely the largest medical unit that could still provide most of their intended services while maintaining maneuverability. As done by the Partisans, a small surgical team such as a split FST or FRST could move between established BAS wards providing life-saving and temporizing surgical services. A greater focus on prolonged field care and austere medicine is needed to ensure they have the skills to treat patients if conventional units are isolated. Use of pre-cooked and shelf stable rations like the MRE and UGR-E would improve modern patient nutrition over their Partisan counterparts and reduce the operational footprint associated with food procurement/preparation. Rotary aircraft should continue to be used when the tactical situation allows because they require minimal landing zone set up and whose range would have been adequate to support the guerrilla operations of the Yugoslavians. When flying risk is too great medical personnel should be prepared to utilize ground vehicles, pack animals and litter bearers for prolonged concealed movements. Ground ambulances will be a very valuable asset because they are more easily concealed and provide a platform for prolonged en-route care. The Army should prepare at least one backup facility and supply cache for each remote treatment facility to allow for rapid evacuation and redundancy in the event the site is compromised. BASs, FSTs/FRSTs should generally perform split operations to provide additional redundancy and minimize the operational footprint.

References

1. Dragić VA. *Partisan Hospitals in Yugoslavia: 1941-1945*. Beograd: Vojnoizdavački zavod; 1965.
2. Street BJ. *The Parachute Ward*. Toronto, Ontario: T.H. Best Printing Company Limited; 1987.
3. BBC News. Balkans war: a brief guide. <http://www.bbc.com/news/world-europe-17632399>. Published 2018. Accessed March 2, 2018.
4. Cohen PJ. *Serbia's Secret War: Propaganda and the Deceit of History*. College Station, TX: University Press; 1996.
5. Rogers L. *Guerrilla Surgeon*. Garden City: Doubleday; 1957.
6. Esper M. Initial Message to the Force from the 23rd Secretary of the Army. 2017.
7. Mattis JN. Guidance from Secretary Jim Mattis. 2017.
8. Army Publishing Directorate. <https://armypubs.army.mil/>.
9. Farr W. Guerrilla Warfare Medicine - A Review of the Literature and the Problem. *J Spec Oper Med*. 2006;6:18-32.
10. Nikolis G. The Medical Service in the Fourth Offensive. *Mil Med Pharm Rev*. 1946;(4):207.
11. Pohar E. Chronicle Reg. No. 490. In: *Department for the History of the Military Medical Service*. Military Medical Academy; :4.
12. Nikolis G. Development of the Medical Service in the Yugoslav Army. 1947:31.
13. Zarkovic G. *Materials for the History of the Medical Service during the People's Liberation War in Croatia and Slavonia No 688*. Military Medical Academy
14. The Central Partisan Hospital. Balkan War History. <http://www.balkanwarhistory.com/2017/12/astonishing-partisan-hospital-that.html>. Published 2017. Accessed January 4, 2018.
15. Barila K. Partisan Hospitals in the Region of Podgrmec in 1942. *Belgrade Rev Mil Hist*. 1951.
16. Anpi L, Franja B. L'ANPI di Cividale del Friuli in visita al Museo della Bolnica Franja in Slovenia. 2011.
17. Documents of the medical service in the People's Liberation war, Vol. 2. :335-336.
18. *Almanac Anthology of Documents and Materials and Other Data on the Yugoslav People's Liberation War, Vol II (Book 6)*.; 1957.
19. Tito J. *The Creation and Development of the Yugoslav Army*. Belgrade: Central Political Department of the Yugoslav Army; 1949.
20. *Almanac Anthology of Documents and Materials and Other Data on the Yugoslav People's Liberation War, Vol. II (Book One)*. Belgrade; 1949.
21. Guze SB, Joellenbeck LM, Russell PK, ebrary I. *Strategies to Protect the Health of Deployed U.S. Forces [Electronic Resource] : Medical Surveillance, Record Keeping, and Risk Reduction*.; 1999. <http://site.ebrary.com/lib/aberdeenuniv/Doc?id=10056931>.
22. Knežević DIK. *Diary*. Department for History of the Army Medical Service; 1943.
23. Hirst CJW. An Account of the Medical Services of the National Liberation Army of Yugoslavia and of the R. A. M. C. assistance given to it. *J R Army Med Corps*. 1945;3.
24. FM 8-42 Combat Health Support in Stability Operations and Support Operations. 1997.
25. FM 4-02.6 The Medical Company. 2002.
26. FM 30-05.70 Survival. 2002.
27. FM 4-02.4 Medical Platoon Leaders' Handbook. 2003.
28. Army Health System and the Effects if the Law of Land Warfare and Medical Ethics. In: *FM 4-02 Army Health System*. ; 2013.
29. FM 4-02.21 Division and Brigade Surgeons' Handbook. 2000.
30. Chapter 16: Medical Support. In: *NATO Logistics Handbook*. ; 1997:1610-1614.
31. Borden Institute. *Emergency War Surgery*: Fourth Uni. Fort Sam Houston: Office of Surgeon General, United States Army; 2013.
32. FM 4-02.1 Army Medical Logistics. 2009.
33. ATP 4-02.3 Army Health System Support to Maneuver Forces. In: ; 2014.
34. Crown E. Army upgrades frontline surgical teams.

https://www.army.mil/article/200699/army_upgrades_frontline_surgical_teams. Published 2018.
Accessed October 10, 1BC.

35. FM 4-02.2 Medical Evacuation. 2007.
36. FM 8-55 Planning for Health Service Support. 1994.
37. Map of Former Yugoslavia. 2003.
<http://www.un.org/Depts/Cartographic/map/profile/fmryugo.pdf>.