

The Golden Hour: American Battlefield Medicine in World War I

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In 1916 the United States Army began to prepare for the possibility of participating in the war in Europe that had been raging since 1914. The army's plan for winning was to wage an aggressive war of movement. Given this it was expected that all units, including their medical ones, be organized, equipped and trained to operate on an ever changing battlefield.¹

This concept, however, was not feasible when the U.S. declared war on Germany in 1917 and began sending troops to France because of the fortified trench lines that stretched from the North Sea to Switzerland. However, the Americans, their allies and the Germans still believed a war of movement was possible if their opponent's line was ruptured which is what happened in 1918 first to the allies and then to the Germans.

In response to army doctrine and the reality of the Western Front in 1917 the army's Medical Department established their treatment and evacuation system so it could operate in both a static and mobile combat environments. Based on their history in the American Civil War and a study of the French and British medical systems the department created a structure and units designed to provide a sequence of managed care from the front line to the rear area for both environments.²

The structure divided the delivery of care into two commands called the Zone of the Armies, which will be the focus of today's talk, and the Services of Supply. It is in the Zone of the Armies that the practice of battlefield medicine is to be found.³

This leads us to ask: What is battlefield medicine and where does the World War I battlefield begin and end?

A short definition for battlefield medicine is it is the treatment of the sick and wounded in or near a combat zone. A more nuanced and contemporary description is it is the treatment of combatants in a combat zone through three phases⁴ and locations, which are:

- Care under fire: which is immediate first aid given under hostile conditions
- Tactical field care: which is physician directed treatment to stabilize the patient
- Tactical evacuation care: which is treatment intended to prepare the patient for evacuation

Today's talk examines how these fundamentals of modern combat casualty care were pioneered by the army's Medical Department in World War I.

The second part of the question was where does the World War I battlefield begin and end? The answer is found in the maximum ranges⁵ for the weapons used by the German army, which are as follows:

- Rifles fired out to 546 yards
- Machine guns fired out to 2 miles (4,811 yards)
- Light field artillery fired out to 11 miles (19,500 yards)
- Heavy field artillery fired out to 13 miles (24,000 yards)
- Railway guns fired out to 35 miles (62,200 yards)

If we map these ranges onto the army's diagram for treatment and evacuation we see that all the medical units operating within the Zone of the Armies were in the combat zone, or battlefield, because they were subject to direct and indirect fire in varying degrees of intensity from the Germans.

This meant that the battlefield environment coupled with medical knowledge, equipment, technique and available personnel shaped how American physicians, nurses and support staff responded to the challenges they faced.

But what did they face?

In the Medical Department's official history we find that over the 13 months of the army's combat operations there were 224,089 admissions for gas and battle injuries and 12,817 for neurasthenia and shell-shock cases. The breakdowns⁶ for these are:

- 70,552 gas injuries
- 153,537 battle injuries
- 8,919 cases of neurasthenia
- 3,898 shell-shock cases

The Medical Department's patient records tell us what the major causes of wounds were and what parts of the body were affected for over 153,000 admissions. The highest wounding agents⁷ were:

- 74,883 gunshot, kind not specified
- 51,226 shell and shrapnel
- 20,420 rifle ball

And the distribution of wounds⁸ on the body was:

- 20 % hit the head and trunk
- 20 % hit the trunk
- 25% hit the upper extremities
- 35% hit the lower extremities

Within the 153,537 battle injuries the five types⁹ most seen were:

- 46,549 lacerated wounds
- 42,374 penetrating wounds

- 25,272 fractures
- 18,292 multiple wounds
- 13,271 perforating wounds

It is the Zone of the Armies that these and other injuries would have occurred, been treated and the patients prepared for evacuation into the Services of Supply area where the large Base Hospitals were located. And it is within this area of battlefield medicine that the concept of the “Golden Hour” comes into play.

But what is the “Golden Hour”?

The term is credited to Dr. R. A. Crowley based on his experience as a trauma surgeon in the mid-1970s and his advocacy for the idea that trauma patients have better outcomes if they receive definitive care within 60 minutes from the time of injury. Today Crowley’s concept is controversial because there is little objective data to support his thesis that emergency care is so time dependent that it affects either the survival rate or eventually the patient’s quality of life.¹⁰

Even though questioned, however, it is self evident that less time between injury and treatment is likely to be better for patients which makes the “Golden Hour” more of a metaphor than a rule. And as a metaphor it suggests that trauma care is time dependent but it discards an arbitrary limit.

The notion of using the “Golden Hour” as a metaphor is especially useful to describe one of the fundamental concerns in military medicine in World War I and in subsequent wars.¹¹ If we return to the Medical Department’s schematic diagram we see in the Zone of the Armies that the army deployed its medical units in a linear sequence from the front to the rear, with each unit having a specific purpose.

The army created in the zone a pyramid in which at the base was the Evacuation Hospitals and the apex was the Battalion Aid Stations, with other units between them. What separated them was distance and of course the time it took to move a patient from one medical unit to the next.

It was apparent to the physicians at each level that time was a constraint that affected their ability to:

- Collect casualties from the battlefield and initiate first aid
- Control hemorrhage, shock and set fractures
- Give a prophylactic injection to prevent tetanus
- Initiate surgical procedures to prevent gas gangrene

The experience of America’s allies reinforced the concept that time from injury to treatment could prevent death or an uncontrollable infection. For example, the British Army observed that the anaerobes that cause gas gangrene could appear within 10 hours

and if untreated by 12 their growth was significant and within 16 hours it caused the death of a limb.¹²

A French Army study in 1918 correlated the time from the treatment for shock to a patient's survival. If treated between 1 to 3 hours the mortality rate was 10 to 12%, at 4 to 6 hours it rose to 33 to 41% and if delayed to 8 to 10 hours it rose to 75%.¹³

These examples are two of the unique and demanding challenges that faced World War I medical personnel. Of course, there others such as gas injuries, shell shock, massive bone and tissue damage and the influenza pandemic.

How officers, nurses and enlisted men were organized to deal with these injuries and disease leads to the focus of today's talk which is an overview of the system, type of treatment and patient management that the Medical Department put into practice to care for its nation's citizens.

The place to begin is the schematic diagram for treatment and evacuation that identifies the medical units and their proximity to each other. We see two levels and within the first one a sub-division of units, which are the:

- Battalion Aid Stations
- Dressing Stations, Ambulances and Field Hospitals

In the second level we see the:

- Evacuation Hospitals and Mobile Hospitals

At each level, of which all are within the battlefield, the Medical Department deployed units that were designed to provide the right type of treatment that progressed from immediate first aid to intermediate care to life saving surgery.

The first medical care began on the battlefield at the point of injury. It was expected that the initial treatment of a man's wound began with his own application of his first-aid dressing to his wound. To do this each man was provided with two gauze bandages, two gauze compresses, two safety pins and was instructed on how to apply the dressing by one of the physicians assigned to his battalion.¹⁴

The purposes of the dressing was to protect the wound from further trauma, prevent loss of blood, and reduce the possibility of secondary infection and to give the man some physical and psychological comfort.

However, he may not have been able to care for himself. If so the dressing would have been applied by a comrade but more likely by the Company Aid Post personnel, who were trained to apply field dressings, control hemorrhage, splint fractures and protect the wounded from gas.¹⁵

There were four of these aid posts, one each for the four companies in the battalion. Two Medical Corps enlisted men manned the post and all eight men were trained and supervised by the physician assigned to the Battalion Aid Station.¹⁶

The Company Aid Post was sited in a sheltered location very near the front line if the unit was garrisoning a trench system. However, if the company was out of its protected position making an assault or in retreat the post would move and establish a succession of posts to provide emergency medical care.¹⁷

The locating, marking, gathering and directing the wounded to this next level would have been an important patient management task performed by the men assigned to the Company Aid Post.

About 40% of the wounded were able to walk to the rear.¹⁸ The remainder needed to be carried by regimental stretcher bearers to the next level of care, the Battalion Aid Station, where they would be seen by the battalion's medical officer.

There were three Battalion Aid Stations that were centrally located at 500 to 1000 yards behind the infantry companies in the open or ideally in a building, dugout or specially constructed shelter. Its location was carefully selected because it had to be easily reached from the front by foot and on a road, if possible, to allow ambulances to pick up the patients for transport to their next level of care.¹⁹

An aid station's site could be anything from a hasty shelter to set of above or below ground rooms constructed over time that could treat from 12 to 30 patients, protect them from further harm, hold them for evacuation, plus store medical supplies for the station and company aid posts.

Each Battalion Aid Station was staffed by one medical officer, four to six medical corps enlisted men, two runners and one or more stretcher bearer squads. This meant that when the three stations were combined into a Regimental Aid Station there were up to 7 officers and 43 enlisted men assigned to each regiment.²⁰

The treatment received was limited to physician directed emergency care²¹ such as:

- Control of hemorrhage
- Application or readjustment of field dressings and splints
- Injection of the anti-tetanus serum and morphine tablets for pain
- Treatment for gas injuries
- Anti-shock treatments such as warmth and hot drinks

The first step in a long process of sorting the sick and wounded began here with the filling out of the patient's field card²² that noted whether he was:

- Very slightly wounded but able to return to the line
- Slightly wounded and requires evacuation

- Seriously wounded
- Patient with fractures
- Severely wounded with attendant shock
- Gassed patient
- Psychoneurotic
- Sick

If the patient was slightly wounded or not seriously sick he would be retained whereas the rest were evacuated. The slightly wounded to be evacuated, seriously wounded and those with fractures were likely to receive the attentions of the physician whose examination led to personal or directed treatments²³ such as:

- Painting around the wound with iodine
- Injection of 500 units of the anti-tetanus serum
- One-fourth grain of morphine for pain to slightly to seriously wounded
- Control of hemorrhage through ligature, hemostats or a tourniquet
- Immobilization of fractures with splints
- Shock treatment such as blankets, hot water bottles, hot drinks

Given that the aid station could not provide definitive surgical procedures; retain patients for any length of time; were subject to enemy fire; and were constantly receiving new patients it was essential to evacuate their patients as soon as possible. This was especially important due to the risk that the wounded could develop a life, or limb, threatening gas-gangrene infection if he did not receive a surgical intervention within 12 hours of his wounding.²⁴

A timely evacuation was a challenge due to the weather, terrain, enemy fire, how to move the patient and their condition. Weather and terrain were variables that could not be controlled. The threat from enemy fire could be mitigated by a night evacuation.

The means of evacuation, by stretcher bearers, wheeled stretcher cart or ambulance and preparing the patient for movement were variables that the station's staff focused on. The physician's treatment was designed to stabilize the man and prepare him for his next level of care at the division dressing station or field hospital. At the same time the stabilizing treatment was given the staff coordinated his evacuation with the personnel of the next level of care which was the ambulance company.

After receiving emergency treatment at the regimental level patients were evacuated to their next phase of physician directed care which was provided by the infantry division's Sanitary Train.²⁵

This was a 950 man medical unit that consisted of a:

- Train Headquarters
- Ambulance Company Section
- Field Hospital Section

- 8 Camp Infirmaries
- Divisional Medical Supply

Their mission was to provide medical care for the entire division through the ambulance company and field hospital sections and the camp infirmaries.

It would have been men of the Ambulance Company Section who transported the Battalion Aid Station's patients to a unit in the Field Hospital Section. The Ambulance Company Section consisted of four identical companies except one had 12 horse drawn ambulances and the other three each had 12 motor ambulances. Each company was divided to perform the tasks of the collection and evacuation of patients from the regiments and the other was to man an intermediate stop called the Dressing Station.²⁶

Due to delays or the self-regulated evacuation by the walking wounded the Medical Department recognized the need for a site where emergency medical care could be continued. They designated this site as the Dressing Station. It was located at up to 3,000 yards from the front line and staffed by up to 5 officers and 25 men. It was sited on a road, if possible, and housed in a dug out, cellar, building or tent.²⁷

The treatment²⁸ provided was identical to the Battalion Aid Station's in that it focused on:

- Arresting hemorrhage
- Inspecting and readjusting the dressings and splints
- Administering morphine and the anti-tetanus serum if not already given
- Treating for shock and gas injuries

The explanation for repeating these fundamentals was because of the need to ensure the patient was not in immediate danger and he continued to be stable enough for further evacuation. However, if the patient load was light it was possible to offer more treatment for shock and gas injuries and even to close aspirating chest wounds and control hemorrhage through ligature or packing the wound.²⁹

Patient management was an important concern for the staff at this phase of care. This is the first evidence of attention given to the design of a continuous system of evacuation by ambulances from the battlefield as performed by half of the Ambulance Company. The second was the continuation of stabilizing the patient at the Dressing Station for further evacuation and the first detailed classification of patients in order to direct them towards their future care.³⁰

The Dressing Station addressed these tasks by organizing itself into departments³¹ so as to efficiently manage their case load which were:

- Receiving and forwarding
- Dressing
- Orthopedics
- Gas

These departments indicate the first step toward placing patients, such as orthopedic and gas cases with a staff that was experienced in treating these types of injuries.

The receiving and forwarding department was assigned to unload, sort and classify the patients. It was supervised by a medical officer who examined them and determined who should be returned to their unit, who needed immediate attention from the dressing, orthopedic or gas departments and who and when should be evacuated to the next level of care which would be the triage operated by one of the Sanitary Train's field hospitals.

Triage was a method used by the French Army to sort, classify and distribute the sick and wounded that arrived from the front. The army's physicians observed its use in 1918 and quickly recognized that it was an effective means for patient management, especially given the limited resources of the Medical Department.³²

The unit assigned to implement it was the Field Hospital Section in the division's Sanitary Train. The section consisted of four identical field hospitals with a combined total of 25 officers and 337 men. Each hospital accommodated 216 patients and was designed to be mobile so it could remain in contact with the forward medical units it supported.³³

In early to mid-1918 the static combat zone allowed these hospitals to be grouped for greater efficiency. They were positioned at 6 to 8 miles from the front on a road network that linked them to the Ambulance Company Section's Dressing Stations and to medical units further to the rear such as the Evacuation Hospitals.³⁴

The concept of deploying four hospitals for same role changed in May 1918 when the 1st Infantry Division's Field Hospital Section at the Battle of Cantigny experimented by assigning patients to a specific hospital³⁵ for their condition which were:

- Wounded and gassed
- Sick
- Skin and venereal diseases

The fourth hospital was to be the medical reserve or a convalescent camp. At the same time the concept of triage was explored by designating its function to the hospital that received the wounded and gassed.

The idea of assigning one type of patient to each field hospital was quickly adopted by the other field hospitals operating at the infantry division level, but in practice each division's sections were free to designate what worked best for them, especially the mission for the triage.

An illustration of how the triage operated with the other field hospitals and the ambulance companies is illustrated in the deployment of the 82nd Infantry Division's Sanitary Train in September 1918 for the St. Mihiel offensive.³⁶

At the start of the operation Field Hospital 328 was designated as the division's triage and was located at Dieulouard. It remained at that location throughout the battle and began receiving casualties eight hours after the start of the offensive on September 12th. At Millery, further south, Field Hospital No. 325 was designated to receive the sick, the 326th the gassed and the 327th the seriously wounded.

This illustration also shows the preferred site for these field hospitals. Although each had tents the preferred location was in a village because the site was likely to have intact buildings that provided better shelter, a water supply, sources of fuel and perhaps electricity.

In the sequence of evacuation that has been outlined the Field Hospital would have been the last point for a man to receive treatment from a division medical unit. However, upon arrival and treatment it did not mean he would be evacuated to the next level of care such as an evacuation or a base hospital. If a patient did not require prolonged care and was likely to recover within 14 days he was retained at one of the hospitals or the convalescent camp.³⁷

This illustrates the value of triage as a method to sort, classify and determine who should be evacuated to the next level of care. If a patient could recover in two weeks his contribution to the infantry division was not lost.

An example that illustrates this was the diagnosis of a man classified as a potential 'war neurosis' case. At the triage he would be examined by the division psychiatrist to determine the cause and severity of his condition. The six categories³⁸ used for diagnosis were:

- Shell fright
- Gas fright
- Hysteria
- Mental and or physical fatigue
- Malingering
- Cowardice

This examination, classification and recommended treatment led to 79% of the cases seen at the division level to be retained and 21% to be evacuated to a neurological hospital.³⁹

The overall sorting, classification and distributing performed at the triage required a skilled team to determine who was transportable and who needed to be retained until they were ready to be moved. Ideally this team had a thorough knowledge of medicine, surgery and human nature. Their evaluations had to be complete and unhurried but quick enough to prevent congestion caused by the arrival of new patients.

The sorting and classifying process focused on identifying which patients were transportable and which were not. A few triages sorted and immediately distributed their

patients to the nearest hospitals. In others there was a continuation of emergency medical care, with the possibly of more sophisticated treatment than received at an ambulance dressing station.

The treatment⁴⁰ for shock was especially a high priority whether given at the triage or the Field Hospital for the wounded and consisted of:

- Removal of wet clothing
- Warming through blankets, stoves and warming chambers
- Hot drinks and food
- Morphine for pain
- Adjustment of splints and bandages to reduce pain
- Intravenous saline solution
- Blood transfusion from matched donors

However, prior to receiving treatment for shock the patient would have been seen in the receiving department of the triage or hospital for the wounded. His condition would determine whether he would be routed to the dressing, shock or operating departments. If treatment for shock was required he would be held there until his condition permitted either evacuation or treatment by the operating department's team.

The operating team's procedures focused on the control of hemorrhage and adjusting fractures and if time permitted the removal of foreign bodies and the debridement of the wound. All surgical work was intended not to be definitive but rather to prepare the patient for transportation to an Evacuation Hospital where more definitive work could be done.⁴¹

At the hospital designated for the treatment of gas injuries the patient's clothes were removed and he was bathed to remove possible contamination followed by an appropriate treatment for the cause of his injury such as a gas designed to irritate the lungs or blister the skin.⁴²

All treatment at this level was constrained by the reality that only essential emergency procedures could be performed. It was imperative that this care be matched by the need to maintain the system for patient management. Therefore, the overall mission for the staff of the Sanitary Train's Ambulance Company Section and Field Hospital Section was to save lives and to prepare their patients for their next level of treatment at the Evacuation Hospital.

At this point in the system if the patient is evacuated he moves from the division level of care in the Zone of the Armies to a more sophisticated level of treatment that is provided by medical units that are assigned to the army level.

The, by now familiar, schematic diagram of hospitalization and evacuation shows that this level is the intersection between the forward area medical units and the rear area of base hospitals that were reached by hospital trains.

This area, which was still within the battlefield, was the most dynamic and complex system for patient care created by the Medical Department. In contrast to the set number of division units and the fixed locations of base hospitals the army level medical units were assembled for the casualties that would result from a major offensive.

An illustration of this is the medical plan prepared by Colonel Alexander Stark, the First Army's Chief Surgeon, for the projected 33,000 casualties from St. Mihiel Operation that was launched on September 12, 1918.⁴³

In addition to the nine Sanitary Trains for each infantry division he assembled, placed and commanded:⁴⁴

- 9 Evacuation Ambulance Companies
- 4 Ambulance Companies
- 4 Field Hospitals
- 3 Medical Supply Depots
- 2 Gas Hospitals
- 1 Contagious Disease Hospital
- 2 Neurological Hospitals
- 5 Mobile Hospitals
- 10 Evacuation Hospitals
- 1 American Red Cross Hospital
- 2 Base Hospitals

This list is instructive in that it we see that Stark has provided for the means to move patients by ambulance from the division's field hospitals to medical units in the second level. It also illustrates that by mid-1918 the emergence of experimentation and specialization.

The Medical Department recognized that by designating hospitals to receive specific patients better medical results were obtained for the treatment of gas casualties, contagious diseases and neurological cases. These specialized hospitals permitted the concentration of scarce specialists who through treating several patients could better assess their results and thus improve on their methods for treatment.⁴⁵

The five Mobile Hospitals are an example of experimentation. These units were based on French *auto-chir* and although small their mobility allowed rapid deployment to where they were needed. However, they were not fully integrated into the medical system and by the end of the war they treated only 1% of the army's wounded. It would be in future wars that this type of unit would come into its own.⁴⁶

What was fully integrated, as shown in the St. Mihiel plan, was the reliance on the ten evacuation hospitals to receive the majority of patients who were evacuated from the field hospitals. These hospitals were so essential and in such short supply that the base

hospital 45 and 51 and the American Red Cross Hospital were designated to temporarily function as evacuation hospitals.

When first envisioned by the Medical Department in 1916 the Evacuation Hospital was conceived as a unit to support the infantry division's field hospitals. Two were to be assigned to a division. The plan was to provide for over 400 beds and a staff of 16 medical officers and 179 men. The hospital's function was to receive the patients from the field hospitals when they were required to move to a new location.⁴⁷

However, this would not be their role as a result of the delivery medical care in France in 1917. Experience forced medical doctrine and unit missions to change in order to provide effective treatment and evacuation. It was recognized that the envisioned role for the division's field hospitals to be the "emergency hospital for the battlefield" was impractical. Experience proved their size, location and the requirement to be mobile transformed them into a "magnified and improved dressing station rather than a hospital."⁴⁸

The implication of this was if the Field Hospital could not be the site for life saving surgery then where could it be delivered? The answer lay with French and British solutions to the problem. The army recognized that what was needed was a unit similar to the British Casualty Clearing Station and so the Evacuation Hospital's purpose was re-defined to solve the problem.

However, it was easier said than done. Although the army had equipment and supplies in 1916 to form 20 hospitals they had no personnel to staff them. To solve this they recruited, re-assigned personnel, enlarged the hospital to 34 officers and 237 men and increased the patient capacity to 1000 beds, similar to the British Casualty Clearing Stations, but in the end only 22 hospitals were deployed instead of the required 48. It was a continuous challenge to staff these hospitals which meant the need to temporarily assign surgical teams from the base hospitals during the peak period of admissions caused by major offensives.⁴⁹

Although an Evacuation Hospital's size varied their function, general layout and location on the battlefield remained consistent. Their purpose to provide "with great rapidity" the best possible surgical care was constrained by the number of casualties received per day.⁵⁰

In order to prevent confusion, congestion and over-loading the army's chief surgeon planned for each offensive by clustering hospitals at 9 to 15 miles from the front in order to support each other. They were sited on roads and rail lines to allow for receiving and evacuating their patients.⁵¹ This meant that these hospitals were relay stations that treated but did not retain patients any longer than necessary.

The hospital's layout was carefully planned to allow for the efficient treatment of a large number of admissions per day. The ground plan for Evacuation Hospitals 6 and 7 at Souilly illustrates this through the placement of its rooms and wards.⁵²

The Receiving Rooms and Evacuation Wards were adjacent to a road and rail lines which facilitated patient arrival and evacuation. In the center were the Operating Rooms, X-Ray rooms, and adjacent to them the hospital wards.

These hospitals were organized into two services which were Administrative and Medical. The former dealt with records, supply, personnel and administrative matters while the Medical provided patient care that was directed by the Chief of Surgical Service and Chief of Medical Service.

The Chief of Surgical Service⁵³ supervised the:

- Receiving Room
- Dressing Room
- X-Ray Room
- Pre-Operative Ward
- Shock Ward
- Operating Room
- Post-Operative Ward
- Evacuation Ward

The Chief of Medical Service supervised the Medical and Gas Wards and assisted the Chief of Surgical Service in the Receiving Ward.

The process of sorting patients began with their examination on arrival at the Receiving Room which determined where the patient should be routed. At this point an important decision would be: Should he receive an operation or could it be delayed until he arrived at a Base Hospital?⁵⁴

For example, a small perforated wound, gutter wound, flesh wound or small bone fracture made one eligible for re-dressing in the Dressing Room and on to the Evacuation Ward to await a Hospital Train. This decision was likely if 1000 casualties were received in a day. These injuries were not deemed as serious as a wound to the head, chest, abdomen or a fractured femur or multiple injuries.⁵⁵

Five wards and three rooms performed the surgical work which was the Pre-operative Ward, X-Ray Room, Shock Ward, Operating Room and Post-Operative Ward. All were aligned to reduce the distance a patient was carried and to efficiently use staff and resources.⁵⁶

The Pre-operative Ward prepared patients for surgery through another examination, undressing, bathing, morphine, shock prevention and sorting them into head, chest, abdominal, shock and fracture cases. If a patient was in shock or on the verge of it he was moved to the Shock Ward for resuscitation and if an X-ray was ordered he was transported to that room.⁵⁷

The Operating Room was staffed by four teams using eight tables. Each team consisted of two surgeons, one anesthetist and two nurses, which if experienced performed 35 to 40 operations per shift. By mid-1918 it was common for teams to be augmented by ones from quiet evacuation and base hospitals which could be up to fourteen teams.⁵⁸

The surgeries addressed the types and severity of injuries. A laparotomy was performed for abdominal wounds. Wounds caused by bullets and shell fragments required the devitalized tissue and foreign bodies be removed through debridement. This method was used to arrest or prevent infection, especially gas gangrene caused by anaerobic bacteria.

The wound, if there was a possibility of infection, was prepared for the Carrel-Dakin system to prevent or control infection.⁵⁹

Fractures were set as well as repairs to the knee or elbow. If a limb was too damaged it was amputated. Upon completion the surgeon recorded his findings, the procedure and whether the patient should be 'detained' or 'evacuated'. Head wounds were a challenge. They required neurosurgical skills and if an operation was performed it would prevent an immediate evacuation. Therefore, the Chief of Surgical Service might recommend a delay and evacuate the patient to a base hospital.⁶⁰

Both categories were moved to the Post-operative Ward for recovery. If a patient was detained he was then moved to an appropriate ward of similar injuries. All cases, however, were not retained any longer than necessary which on average was 10 to 14 days.

If a patient was identified for evacuation upon recovery he was moved to the Evacuation Ward to join those from the Receiving Ward or Dressing Room. Here he was prepared for evacuation by being classified as a sitting or stretcher patient and whether he was a surgical, medical, infectious disease or psychiatric case.⁶¹

It was at this point the soldier passed to the next level which was the rear area of base hospitals via a Hospital Train. The coordination of this transfer was essential for the success of the entire patient management system designed by the Medical Department. It was entrusted to the Chief of Surgical Service who arranged with the army's Regulating Officer a Hospital Train for the evacuation of patients to their final destination in France.⁶²

At this point we end the overview of how the American army in World War I treated and evacuated its sick and wounded in and from the battlefield. It is now time to ask: Just how well did this system and staff perform? The overview of each component suggests a well thought out system that was designed to provide the right type of care for the environments they were expected to operate in. But did they, over the 13 months of combat operations, perform as expected?

The answer is yes and no. The divisional units performed as expected. However, where deficiencies were found adaptations were made such as the Triage or creating a new role

for the evacuation hospital or by creating hospitals for specific patients, adding mobile labs, X-Ray units and Mobile Hospitals.⁶³

But what was never completely solved were the breakdowns caused by an insufficient number of ambulances or the how to manage the large influx of admissions caused by having too few evacuation hospitals.⁶⁴

The solution to these problems would be found in future wars with improved tools for communication and methods for evacuation by ground or air that delivered the wounded in less time from their point of injury to a surgical team.⁶⁵

But what has remained the same is the concept of providing three levels⁶⁶ medical treatment:

- Echelon I (Care under fire) is still the domain of the medic and battalion aid station as it was in World War I.
- Echelon II (Tactical field care) that was provided by the Ambulance Company Dressing Stations, Field Hospitals and Mobile Hospitals is now delivered by the Forward Surgical Team.
- Echelon III (Tactical evacuation care) that was provided by the Evacuation Hospital is now delivered by the Combat Support Hospital.

And perhaps the most enduring legacy that informs these three is the army's philosophy of instilling a "medic-to-surgeon" mentality to its delivery of battlefield medicine.⁶⁷

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