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THE GENERAL BOARD

United States Forces, European Theater

TRENCH FOOT (COLD INJURY, GROUND TYPE)

MISSION: To make a study of the conditions known as "Trench Foot" and other types of cold injury, as they occurred in the European Theater of Operations and to report the procedures which were found to be most effective in the prevention and treatment of the several types of cold injury.

The General Board was established by General Orders 128, Headquarters European Theater of Operations, US Army, dated 17 June 1945, as amended by General Orders 182, dated 7 August 1945 and General Orders 312 dated 20 November 1945, Headquarters United States Forces, European Theater, to prepare a factual analysis of the strategy, tactics, and administration employed by the United States forces in the European Theater.

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TRENCH FOOT (COLD INJURY, GROUND TYPE)

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UNITED STATES FORCES, EUROPEAN THEATER
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TRENCH FOOT (COLD INJURY, GROUND TYPE)

CHAPTER 1

DEFINITION AND DISCUSSION OF TRENCH FOOT AND OTHER SIMILAR CONDITIONS ENCOUNTERED IN THE EUROPEAN THEATER OF OPERATIONS

SECTION 1

DEFINITION OF TRENCH FOOT AND OTHER SIMILAR CONDITIONS ENCOUNTERED IN THE EUROPEAN THEATER OF OPERATIONS

1. "Trench foot" is a diagnostic term used by the United States Army Medical Corps to describe the cold injury resulting from prolonged exposure to cold at just above freezing temperatures.[1]

2. "Frostbite" is the term used to describe the cold injury resulting from exposure to temperatures of freezing and below.[1]

a. "Frostbite, ground type", is a term applied to frostbite occurring in ground forces.[1]

b. "Frostbite, high-altitude type", is the term applied to frostbite occurring in air combat crews while flying at high altitudes.[1]

3. "Immersion Foot" is the term used to designate the cold injury resulting from prolonged exposure of the feet in cold water.[1]

SECTION 2

DISCUSSION OF TRENCH FOOT AND OTHER SIMILAR CONDITIONS ENCOUNTERED IN THE EUROPEAN THEATER OF OPERATIONS

4. During World War I, the French reported trench foot as accounting for three and two hundredths percent (3.02%) of their battle casualties. During the Italian Campaign in 1943 and 1944, the incidence of trench foot in the United States Forces was approximately ten percent (10%) of all casualties.[1 & 2]

5. During the period from October 1944 to April 1945, a total of 46,107 cases of cold injuries of all types were admitted to hospitals from the United States Forces in the European Theater of Operations. This represented the loss of the equivalent

of more than three combat divisions and comprised nine and twenty-five hundredths percent (9.25%) of the total casualties admitted from all causes during the entire campaign.[2]

6. Trench foot occurred, for the most part, in combat soldiers and the highest rates were usually encountered in infantry divisions. The condition usually developed in soldiers who had been living in the wet and cold and who for various reasons had been relatively immobile, had been unable to warm themselves, had not changed their wet socks and shoes and had not received regular meals of warm food and hot drinks. The etiological factor common to all types of cold injury was "cold".[1] Most of the soldiers who developed trench foot not only were exposed to cold but their shoes and socks were wet at the time they developed the condition. It is not known whether or not moisture per se is an etiological factor or whether it contributes toward the development of trench foot by its cooling effect. Factors which contribute to the development of trench foot are:[1 & 2]

a. Impaired peripheral circulation which was caused by inactivity and the constriction of the extremity by clothing and foot gear.

b. General body cooling which resulted from inadequate clothing and exposure to the elements.

c. Lowered metabolic rate of the individual due to fatigue and lack of warm food and hot drinks may have been a factor in certain instances.

7. A study of the pathological changes which take place in cold injury was made in the 108 General Hospital in the winter of 1944 and 1945. As a result of this study it was concluded that the pathological changes in trench foot, frostbite and immersion foot are the same and that these three conditions can be treated identically. From the standpoint of the pathologist and of the physician treating the casualty, it is more desirable to group these three conditions under the heading of "cold injury". When desirable, the term may be modified by the addition of the expressions "high-altitude type" or "ground type" to differentiate the condition occurring in ground troops from that occurring in air combat crews. There are varying degrees of cold injury and it has been recommended that they be classified similar to burns, i.e., first, second and third degree.[1 & 2]

8. Since the pathological changes which take place in trench foot, frostbite and immersion foot are the same, since the same measures are effective in preventing the three conditions and since they are all treated in the same manner, the term "cold injury, ground type" will be used hereafter in this paper in referring to this group of conditions.

9. The award of the Purple Heart to cold injury casualties in the European Theater of Operations was governed by Change number 4 to paragraphs 16 a (1) and (2) of Army Regulations No. 600-45, dated 3 May 1944, which states in effect that the "Purple Heart is awarded to members of the Armed Forces of the United States and to civilians who are citizens of the United States serving with the Army who are wounded in action against the enemy of the United States, or as a direct result of an act of such an enemy provided such wound necessitates treatment by a medical officer. A wound is defined as an injury to any part of

the body from an outside force, element, or agent sustained as the result of a hostile act of the enemy or while in action in the face of the enemy. The word 'element' refers to weather and permits award of the Purple Heart to personnel severely frostbitten while actually engaged in combat. Trench foot will not be considered as meriting the award of the Purple Heart." The difficulty in accurately determining the climatic conditions which caused the cold injury in many specific individuals and of arbitrarily differentiating between frostbite and trench foot when an award was in question resulted in many administrative difficulties. The responsibility for this decision usually rested on the medical officers in the first echelon medical service. In many instances these medical officers were immature and were in a position to be swayed by their personal relationships with the casualty and with their commanding officers. Experience in the European Theater of Operations indicates that it is extremely difficult, if not impossible, to differentiate between frostbite and trench foot in combat. From a practical standpoint it is believed that just and equitable awards of the Purple Heart for injuries due to cold can be made only if the decoration is authorized for all casualties who suffer injuries due to cold while they are actually engaged in combat and provided that the injuries are of sufficient severity to necessitate treatment by a medical officer.[3]

CHAPTER 2

FACTORS WHICH INFLUENCED THE INCIDENCE OF TRENCH FOOT IN THE EUROPEAN THEATER OF OPERATIONS

SECTION 1

INADEQUACY OF CLOTHING AND FOOT GEAR

10. Following the drive across Northern France by the First and Third United States Armies and the advance of the Seventh United States Army from Southern France to the Upper Rhineland, the United States Forces in the European Theater of Operations at the time of the onset of cold, wet weather in November of 1944 were confronted with extended supply lines and inadequate stocks of proper types of winter clothing and foot gear. The nature of the fighting in France did not permit the individual troops to carry with them the types of winter clothing and foot gear necessary for their protection in the fighting that was to occur in the vicinity of the German border. The Transportation Corps was taxed to the utmost in providing the armies with gasoline, ammunition and rations and had not had an opportunity to build up adequate stocks of winter clothing and foot gear in the forward areas.

11. The foot gear in the possession of the troops at the time of the onset of cold, wet weather in the latter part of October and early November of 1944 was of four types, none of which were entirely satisfactory.[6]

a. Many of the troops were equipped with combat boots but these boots had been fitted prior to the onset of cold weather and were too small to permit the wearing of more than one pair of socks without undue constriction of the feet.

b. Some of the troops were equipped with service shoes and these likewise had been fitted over one pair of socks and were not large enough to permit the wearing of more than one pair of socks without impairing the circulation of blood to the feet. It was necessary to wear leggings with the service shoes and when the leggings became wet they caused a certain amount of constriction and interfered with circulation.

c. The combat boots and the service shoes were not waterproof or water-resistant and it was necessary to treat them in an effort to make them water-resistant. Dubbing was used for this purpose but was not satisfactory for several reasons. The troops had not been thoroughly trained in the proper method of applying dubbing. The application of dubbing to the leather interfered with the ventilation of the feet through the leather, increased perspiration and resulted in wet, cold feet. So far as The General Board can determine, no large scale tests were made to determine the relative effectiveness of shoe polish and dubbing in waterproofing leather foot gear. However, numerous individuals who have been interviewed stated that in their personal experiences, a good grade of wax shoe polish such as that obtained from British sources was just as effective for waterproofing shoes as dubbing and had the advantage of permitting ventilation through the leather. Foot gear treated with shoe polish presents a much more attractive appearance than when treated with dubbing and it is easier to gain the cooperation of the troops in the application of shoe polish.[4]

d. Some of the troops who were equipped with combat boots and service shoes had also been equipped with overshoes. During the pursuit through France, the overshoes had either been lost or had been left in storage in rear areas and were not available at the time of the onset of cold, wet weather. Overshoes are not satisfactory because they are an extra pair of shoes that the soldier has to carry, they make long marches difficult and tiresome, they do not provide secure footing when fighting in mountains and they interfere with the ventilation of the feet.[4]

e. A few of the troops had been equipped with shoepacs and although the shoepac is not entirely satisfactory, it was the best form of foot gear for the prevention of cold injury, ground type, available in the European Theater of Operations. Sufficient stocks were never available to equip all combat troops. The shoepac must be fitted carefully to permit the wearing of two or three pairs of socks. The lower part of the shoepac is made of material which interferes with the ventilation of the feet and causes excessive perspiration. Socks and innersoles must be changed at least once in every 24 hours in order to prevent the feet from remaining wet due to perspiration. Early models of the shoepac did not have a heel sufficiently high to provide comfort while marching, and they were not constructed to provide sufficient arch support. The improved model did not arrive in sufficient quantity in time to influence the incidence of cold injury, ground type.[5]

f. The wearing of proper socks while engaged in winter fighting is essential in the prevention of trench foot. In the European Theater of Operations adequate socks were available only in limited numbers and these did not arrive until near the end of the trench foot season. Since adequate socks were not available, emphasis was placed on the daily changing of socks and this seems to have been the best solution possible under the existing circumstances. The experiences of the Swedish Army indicate that three pairs of socks should be worn when fighting in severe winter weather.[2]

SECTION 2

OPERATIONAL CONDITIONS

12. Operational conditions were second in importance to the the inadequacy of clothing and foot gear in effecting the incidence of cold injury, ground type, in the European Theater of Operations.[6]

a. Cold weather was the one etiological factor which was always present. The ground type of cold injury first began to appear when the temperature reached 50 degrees Fahrenheit or lower. The colder the weather the shorter the time of exposure that was necessary to produce the casualty.

b. Rain, mud and melting snow were usually encountered along with the cold weather and soldiers with wet clothing and foot gear had a higher incidence of cold injury, ground type, and the injury developed after shorter periods of exposure than was necessary in dry, cold weather. Troops who had become wet while engaged in river crossings were particularly apt to develop cold injury.

c. In static tactical situations the troops which were in contact with the enemy frequently had their movements restricted by hostile observation and fire and this invariably caused a rise in the incidence of cold injury. This was particularly true when the troops were not afforded an opportunity to partake of warm food and hot drinks and when they were not withdrawn at least once a day to permit the warming and drying of themselves.

d. A considerable number of cases of cold injury, ground type, occurred in Military Police standing for prolonged periods at traffic intersections and among reinforcements who were packed into trucks and railroad cars while being transported to the forward areas.[7]

SECTION 3

DELAY IN INSTITUTING A PROGRAM FOR THE CONTROL OF COLD INJURY, GROUND TYPE

13. As a result of the experience in the Mediterranean Theater of Operations, the War Department issued on 22 July 1944 Circular No. 312 which stressed the importance of a program for the control of trench foot. While measures were instituted in accordance with this directive and other directives which were issued by higher echelons of command in the European Theater of Operations, there was a general laxity among the lower echelons in stressing the importance of the individual measures in the care of the feet.[14] Many individuals seemed to have only a vague idea of the seriousness of the condition and the practical methods of combatting it were not well understood.[5] After the losses from cold injury, ground type, had reached such serious proportions late in 1944, both commanders and medical officers realized the need for greater emphasis on the cold injury control program particularly in the lower echelons and a more intensive program was instituted.[6] This program will be discussed at greater length in Chapter 3.

CHAPTER 3

THE TRENCH FOOT CONTROL PROGRAM IN THE EUROPEAN THEATER OF OPERATIONS

14. The similarity between the several types of cold injury, ground type had not been fully determined when the control program was instituted and as a result it was referred to as "The Trench Foot Control Program".[8]

15. In January 1945 it was realized that the clothing and foot gear available in the European Theater of Operations were not ideal for winter fighting, that the operational conditions then prevailing were likely to continue for several months and that the only solution was to take vigorous action to make the best of the conditions as they existed. It was determined that the responsibility for the control of cold injury, ground type was two-fold; commanders being responsible for measures directed toward the prevention of cold injury and unit surgeons being responsible for the triage and treatment of casualties after the condition occurred.[8]

a. Training directives were published in January 1945 by each of the major subordinate commands relative to the nature and control of trench foot. These were supplemented by posters emphasizing the seriousness of the condition and illustrating preventive measures. Pamphlets were issued so that each individual soldier might carry the instructions in his pocket and be thoroughly familiar with them. Photographs were distributed to a limited degree to illustrate the seriousness of the condition once it developed. Publicity was given to the subject in the "Stars and Stripes" and in "Army Talks". The dissemination of this information was assisted and insured by trench foot control teams within the major commands. New troops arriving in the European Theater of Operations received these instructions and an effective trench foot control program was established. An effort was made to train reinforcements in trench foot control and divisions included this in the program of indoctrination for newly arrived men.[8]

b. Individual control measures which each soldier could follow were included in the instructions. These measures stressed certain routine procedures in the care of the feet and the proper wearing of clothing, including keeping the feet dry, avoiding constriction, stimulating the circulation in the feet, keeping the entire body dry and warm, avoiding prolonged sitting in one position and avoiding standing in mud and water.[8]

c. The responsibility of command was stressed. In order to provide closer supervision of preventive measures, control teams were established in each army, corps and division, and in some cases regiments. Trench foot non-commissioned officers were selected in each unit of company size.[8]

d. The trench foot control teams, composed of one officer from the line and one officer from the Quartermaster Corps or S-4 section of the staff, were designated to work in close cooperation with the unit surgeons to determine the extent and nature of trench foot within the unit, assist in training and supervision in trench foot control methods, advise the commanders on the existing status of trench foot in the command and recommend the necessary corrective measures.

e. Trench foot non-commissioned officers were selected from among men of demonstrated ability and experience in units of company size to supervise and encourage foot discipline in the unit, determine any deficiencies and take the necessary action to acquaint all members of the unit with proper preventive measures.

f. The effectiveness of control measures was found to be directly dependent on the state of discipline in the unit and poor discipline was reflected by a high trench foot rate as it was reflected by a high venereal disease rate, a high court-martial trial rate, and a high absent without leave rate. Failure to carry out proper control measures and a continued high trench foot rate in the unit resulted in several commanders and staff officers being relieved.[6]

g. Every effort was made to supply adequate clothing and equipment to units most vitally needing it and priority was given in the supply of overshoes, shoepacs and winter clothing to front line units, particularly infantry and attached medical troops. Unfortunately sufficient stock levels did not exist in the theater at this time to adequately supply troops. An adequate quantity of socks was made available and the system of sock exchange and supply was established in which each man carried at least one extra pair and received clean ones at the time the ration was issued in exchange for a dirty pair. However, the socks were not of the desired quality and the daily exchange made it impossible to properly fit the socks to the individuals. Instructions were issued on the fitting and wearing of the shoepac and socks, and on the wearing of the clothing so as to provide maximum warmth and wind resistance.[6]

h. Experience in the European Theater of Operations showed that temporary relief of troops in forward positions to permit them to get warm, have a hot meal and carry out proper foot hygiene at least once in every 24 hours is the key to prevention of cold injury, ground type. Such a program was instituted in most units when the tactical situation permitted. It was found that a few men per platoon might be relieved at one time to go to a shelter a short distance in rear of the unit area. Rotation of the entire unit from the line at regular intervals also reduced the trench foot rate by limiting the period of close contact with the enemy during which time individual control measures are most difficult.[5]

i. The results of the trench foot control program as finally instituted could not be completely evaluated as the weather moderated in the early part of March 1945 at the time the program began to take effect and very few cases occurred after this time. However, from the results reported in April 1945 by the Army Trench Foot Control Teams, it was shown that this program was effective in reducing the trench foot rates and not the weather alone was responsible. Also units which had instituted a vigorous control program prior to the general program showed a consistently low rate.

16. As a result of the experiences in the European Theater of Operations it has been learned that an effective program for the prevention and control of cold injury, ground type, must originate in the War Department and should be based on the premise that "a soldier who is properly equipped with clothing and foot gear which is suitable and adequate for fighting in a cold, wet climate, who is afforded regular meals of warm food and hot drinks and who is afforded an opportunity at least once every 24 hours to warm and dry himself will not develop trench foot". Such a program must insure that the necessary supplies are available to the troops at the time when they are needed.

Commanders of all echelons must be aware of the seriousness of cold injury and must take the necessary steps to insure the timely application of the proper preventive measures. Unit surgeons must be as thoroughly trained in the triage and treatment of casualties with the several degrees of cold injury as they are in the triage and treatment of first, second and third degree burns. Indoctrination and training in preventive measures must be instituted in the Zone of the Interior.[13]

CHAPTER 4

MEDICAL ASPECTS OF COLD INJURY, GROUND TYPE

SECTION 1

DEFINITION OF AND PATHOLOGICAL CHANGES OCCURRING IN COLD INJURY, GROUND TYPE

17. Brigadier General (then Colonel) Elliot C. Cutler, et.al., in an undated preliminary report entitled "A Preliminary Report on the Nature and Care of Trench Foot Casualties", submitted to the Surgeon General in the early spring of 1945 has presented a detailed account of the pathological changes which occur in cold injury and has carefully outlined the treatment employed by the medical department in the European Theater of Operations. It is neither necessary nor desirable that The General Board, United States Forces, European Theater, attempt to duplicate this excellent report.

SECTION 2

THE TREATMENT OF COLD INJURY CASUALTIES FORWARD OF THE ARMY REAR BOUNDARY IN THE EUROPEAN THEATER OF OPERATIONS

18. The battalion surgeon is usually the first medical officer to see a cold injury casualty. Experience in the European Theater of Operations has shown the importance of the battalion surgeon being able to differentiate between mild cases of cold injury which can be returned to duty from battalion level and the moderate and severe cases which require evacuation to the rear of the battalion. When the tactical situation permits the battalion surgeon should have a warming room or tent in the vicinity of the battalion aid station. Here cases of cold injury can have their foot gear removed in order to permit efficient triage by the battalion surgeon. Mild cases can be given warm food and hot drinks and afforded an opportunity to dry their clothing and foot gear and after a few hours they can be returned to duty. Moderate and severe cases require evacuation to the rear.[4]

19. At times the tactical situation does not permit the establishment of a triage and warming tent at the battalion level. Under such conditions it has been found that the regimental surgeon can prevent the unnecessary evacuation of mild cases by the establishment of such facilities at the regimental level. This interposes the regimental aid station as a link in the chain of evacuation but under certain conditions this has been possible and desirable. It must be emphasized at both the battalion and regimental level that casualties with cold injury to the foot must be treated as litter cases and that

every effort must be made to prevent the injury from progressing while the casualty is being processed through medical channels of evacuation.[4 & 8]

20. Most of the divisions in the European Theater of Operations have found it necessary and desirable to establish a center for the triage and treatment of cold injury casualties in the vicinity of the division clearing station. Here more careful triage can be performed and the mild cases which may have been evacuated by the battalion or regimental surgeons can be restored to duty. If the tactical situation permits, moderate cases may be treated and restored to duty from the division level.[4 & 13]

21. The several armies in the European Theater of Operations established centers for the triage and treatment of cold injury casualties occurring among army troops as well as those which were evacuated from corps and divisions. The establishment of such centers was found to be effective in promoting a standard form of triage and treatment throughout the theater. When the tactical situation permitted all of the mild cases and most of the moderate cases could be returned to duty at the army level. In such centers the severe cases could be more easily and efficiently prepared for evacuation to the Communications Zone.[10]

SECTION 3

THE TREATMENT OF COLD INJURY CASUALTIES IN THE COMMUNICATIONS ZONE, EUROPEAN THEATER OF OPERATIONS

22. The treatment of cold injury casualties in the Communications Zone has been adequately reported upon by Brigadier General Cutler, et.al., as the result of the experiences in the 108 General Hospital in Paris.[1]

CHAPTER 5

EXPERIENCES RELATIVE TO COLD INJURY IN THE ARMIES OF ALLIED AND ENEMY NATIONS IN THE EUROPEAN THEATER OF OPERATIONS

23. The incidence of cold injury, ground type, in the French forces was comparable to that among the United States troops. A high rate occurred among French troops in the Sixth Army Group who were fighting in the Vosges mountain area. These troops were equipped with United States Army leggings, socks and shoes. Control measures were similar to those among United States forces.[10]

24. The British forces recognized the nature of cold injury, ground type, and instituted a program of individual foot hygiene essentially the same as that eventually proposed and effected by the United States forces. The available information on the incidence of cold injury in the British forces indicates that it was much lower than that of the American forces. This is attributed to better socks and shoes, a well-established combat rotation policy, strict command supervision and the carrying out of individual preventive measures.[6]

25. The Russian Army considered trench foot, frostbite and similar foot disorders as preventable conditions and placed the responsibility on the individual, the smaller unit commander and the medical officer. The individual and his immediate superiors were accountable for the occurrence of such disability and punishment was administered according to the neglect involved. In severe cases such disability was looked upon as sabotage since it deprived the army of man hours from combat. Preventive measures included providing proper foot gear, rigid foot inspection and the wearing of non-constricting boots over a wrapped woolen bandage rather than a sock. Emphasis was on proper foot gear, personal education and responsibility in the care of the feet. It was claimed that the Soviet rate of disability from foot disorders was very low.[11]

26. Many cases of cold injury, ground type, were seen among German prisoners of war and interrogation revealed an incidence in the German army equal to or greater than in the American forces. While good foot hygiene was recognized as instrumental in prevention, the lack of proper foot gear and training was evident and made control difficult. Penalties were established on the basis that cold injury can be prevented and that acquiring it involved neglect. However, this was based on the belief that some troops were acquiring the injury to avoid hazardous duty.[12]

CHAPTER 6

CONCLUSIONS

27. The terms "trench foot", "frostbite" and "immersion foot" refer to conditions which result from exposure to cold and the development of which is aggravated by moisture, impaired peripheral circulation, general body cooling and possibly by lowered metabolic rates due to fatigue and the lack of warm food and hot drinks.

28. The term "cold injury" is more descriptive of the etiology and the pathological changes of the conditions known in the European Theater of Operations as trench foot, frostbite and immersion foot, and should be adopted. Cold injury should be considered as analogous to burns and the term "cold injury" should be modified by the addition of such qualifying words as mild, moderate and severe or first, second and third degree. It may be desirable to further qualify the term by the addition of the phrases "high-altitude type" or "ground type" to distinguish between the injury occurring in combat air crews and that found in the army ground forces.

29. Cold injury, ground type, is to a great extent preventable.

30. The relatively high incidence of cold injury (9.25% of all casualties) in the European Theater of Operations was due to inadequacy of clothing and foot gear of types suitable for winter operation, unfavorable operational conditions and to the delay of many units in instituting a program with emphasis on and close supervision of the measures to be taken by the individual soldier.

CHAPTER 7

RECOMMENDATIONS

31. As a result of experiences in the European Theater of Operations, it is recommended that a combat boot be devised for winter fighting. Such a boot should embody the following characteristics.

a. It should be made entirely of leather.

b. It should be relatively waterproof when treated frequently with a wax base shoe polish.

c. It should provide arch support, should have a normal heel and the toe should be sufficiently roomy to permit free movement of the toes inside the shoe.

d. The sole of the shoe should be designed on the Munson last but the uppers should be so constructed as to permit the adjustment necessary when one, two or three pairs of socks are worn.

e. The quarters of the boot should be so large that they come together over the tongue after the foot encased in heavy socks is inserted in the shoe or boot. Thus tight lacing over the instep would be impossible.

f. The boot should be loose around the ankles so as to avoid constriction.

g. It should be easily removable so as to encourage the soldier to remove it daily to care for his feet.

32. It is recommended that a study of socks be made to develop ones which are adequate for winter weather and adaptable for wear with the combat boot recommended above. Three pairs of socks should be provided for the coldest weather, to include a light inner sock, a medium sock, and a heavy outer sock, which are of graduated sizes to allow for a proper fit and avoid wrinkling.

33. The policy regarding the award of the Purple Heart for cold injury should be reviewed with the idea that the award should be made for trench foot as well as for frostbite or in neither case. Consideration should be given to the conditions of combat and weather, whether or not the injury is due to negligence, deliberate intent or was unavoidable, and the degree to which such an injury is attributable to enemy action.

34. Medical Corps officers should receive the same training in the management of cold injury casualties as is given them in the management of burns.

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