NAVAL HEALTH RESEARCH CENTER

AN ANALYSIS OF HOSPITALIZATION LENGTH OF STAY WITHIN A MULTI-ECHELON SYSTEM OF CARE DURING COMBAT OPERATIONS

G. J. Walker

C. G. Blood

Report No. 99-24

NAVAL HEALTH RESEARCH CENTER
P O BOX 85122
SAN DIEGO, CA 92186-5122

BUREAU OF MEDICINE AND SURGERY (MED-02)
2300 E ST. NW
WASHINGTON, DC 20372-5300

AN ANALYSIS OF HOSPITALIZATION LENGTH OF STAY WITHIN A MULTI-ECHELON SYSTEM OF CARE DURING COMBAT OPERATIONS

G. Jay Walker*
Christopher G. Blood

Medical Information Systems and
Operations Research Department
Naval Health Research Center
P.O. Box 85122
San Diego, CA 92186-5122

*GEO-Centers, Inc.

Report No. 99-24, supported by the Office of Naval Research, Arlington, VA, Department of the Navy, under **Work Unit No. 63706N-M0095.005-6704**. The views expressed in this article are those of the authors and do not reflect the official policy of the Department of Defense, or the U.S. Government. Approved for public release; distribution is unlimited.

Summary

Problem

The medical resources needed to support combat operations are dependent upon the time patients spend within the medical care system, as well as on the numbers and types of casualties incurred. Accurate estimates of the lengths of stay for the different types of patients seen at each level of care is an essential component of efficient resource planning.

Objective

To obtain summary length of stay results from a sustained combat operation that could serve as a basis for projecting length of stay for future conflicts.

Approach

Hospitalization records were reviewed for U.S. Marine Corps casualties sustained during the Vietnam War, and lengths of stay were calculated for each level of care. Besides presenting overall results, lengths of stay were contrasted by types of diseases and injuries and for various treatment flows through the echelon system of care.

Results

Wounded-in-action (WIA) casualties had a mean length of stay of 69.9 days compared with 21.2 days for disease and non-battle injury (DNBI) patients. The median lengths of stay were 38 days for WIA and 10 days for DNBI casualties. DNBI patients had slightly longer average lengths of stay at Echelons II and III compared with WIA admissions, but slightly shorter stays at Echelon IV and substantially shorter stays at Echelon V. For the WIA casualties seen at Echelon II, 62.1% stayed 3 days or less, while 17.9% were there for more than 1 week; the figures for WIA casualties at Echelon III were 26.8% staying 3 days or less and 51.7% staying more than 7 days. For DNBI admissions, 24.1% were at Echelon II for over 1 week and 63.1% stayed at Echelon III for more than 1 week. DNBI patients completing treatment at a given echelon stayed almost twice as long on average as those moving on to a higher echelon.

Conclusions

The results presented in this investigation provide a quantitative basis for medical planning models requiring length of stay data to project needed medical resources. While treatment regimens may have changed, these data provide a baseline to which adjustments can be made for medical advances or changes in operational doctrine.

An Analysis of Hospitalization Length of Stay Within a Multi-Echelon System of Care During Combat Operations

Introduction

Allocation of appropriate levels of medical resources to support combat operations requires accurate forecasts of the numbers and types of patients who will be seen at each echelon level of medical care. Additionally, estimated lengths of stay for the various types of patients expected to be seen at each echelon level is needed to properly program the needed resources. Evacuation policies, the maximum length of time a patient will be retained at a particular echelon of care, also have an impact on the medical resource calculations. While evacuation policies governing the lengths of stay at each echelon level are set at the outset of the military operation, in practice, the actual lengths of stay often depend on factors like lifts of opportunity, severity of injury, and how temporally near the casualty is to returning to duty. Moreover, while some casualty evacuation planning presumes that the patient will proceed incrementally through the various echelons of care until they are either returned to duty or evacuated to a continental U.S. (CONUS) facility, patients have often "leap-frogged" over levels of care depending on the severity of the condition and the type of care required.[1,2]

Previous investigations have examined length of stay (1) during peacekeeping operations,[3] (2) aboard aircraft carriers during both combat and peacetime deployments,[4] and (3) during combat operations for specific diagnostic groups.[5] The objective of this investigation was to look at the lengths of stay through a multi-echelon system of care during a protracted conflict. Specifically, the flow of injured and diseased Marines through the five-echelon system of medical care in place during the Vietnam War was examined. Additionally, lengths of stay at each level of care were analyzed by admission type and by treatment disposition.

The Medical Analysis Tool (MAT) is a joint service modeling program being used to help estimate the medical requirements necessary to treat casualties.[6] However, the output of this tool depends heavily on the data underlying its projections. Review of the types of casualties, their lengths of stay, and the levels of care received in prior combat operations (in this instance, Vietnam) can provide important insights into accurately determining the probable medical resources required for future military engagements.

The Echelon System of Care

Historically, medical treatment of casualties has traditionally been provided at five different echelons of care.[7] Echelon I treatment is typically rendered by the first responder at the site of injury or at battalion aid stations. Medical personnel perform first aid and emergency care, control blood loss and shock, and administer antibiotics at these types of facilities. Echelon II facilities have generally been collecting and clearing companies, surgical support companies, and casualty receiving and treatment ships. Services provided at Echelon II facilities include resuscitative treatment, blood and emergency surgical services and holding ward facilities.[7] During the Vietnam War, Echelon II facilities included the 1st and 3rd Medical Battalions and the amphibious landing platform helicopter ships.[8] Echelon III facilities have been represented by hospital ships and combat zone hospitals. These facilities in Vietnam included the Saigon Navy Hospital, the Navy Hospital in Da Nang, and *USS Repose* and *USS Sanctuary* hospital ships.[8] The Echelon III facilities performed more-specialized surgical procedures and offered various clinical capabilities. They provided definitive treatment to those with a reasonable chance of soon returning to duty and immediate, high-level surgical capabilities to those who would require further treatment at yet higher echelons. Hospital admissions for U.S. Marines in the Vietnam War typically began at an Echelon II or Echelon III facility.

Echelon IV treatment centers are overseas medical facilities, usually fully staffed hospitals, designed to give definitive or specialty care to those personnel who could not receive the necessary procedures of care at Echelon II or III facilities that would allow them to return to duty. The principal Echelon IV facilities for the Marines during the Vietnam War were the naval hospitals in Yokosuka, Japan, and the Marianas Islands. Echelon V treatment centers are CONUS facilities, and they are designed to provide convalescent, restorative, or rehabilitative services. The Echelon V facilities for the Marines who served in Vietnam were primarily CONUS naval hospitals which provided convalescent care.

Method

Incidence data for wounded-in-action (WIA) and disease and non-battle injury (DNBI) casualties were extracted from hospitalization records of Marines who served in Vietnam during the 1965 to 1969 time frame. Records were selected that showed an initial treatment at an Echelon II or Echelon III facility in Vietnam, and the movement of each patient was tracked through the various levels of care during the course of that hospitalization.

Because the total actual length of stay cannot accurately be calculated until treatment is finished, records were omitted from this analysis in which it was not specifically documented that treatment was completed. Table 1 indicates that over 70% of the WIA admissions and more than 80% of the DNBI admissions were included for the present study. There were 27,461 WIA admissions and 59,221 DNBI admissions that were followed through completion of treatment.

Table 1. Patient Dispositions for WIA and DNBI Casualties
Vietnam Marines, 1965 to 1969

	WIA	DNBI
Transferred to non-Navy facility for further treatment	18.6%	10.3%
Last record specifically stated "treatment not completed", and no further information recorded	4.9%	3.7%
Died	2.5%	0.1%
Final treatment status couldn't be specifically determined	3.2%	4.2%
Complete record documented	70.8%	81.7%
	100.0%	100.0%

In calculating lengths of stay, patients who were admitted to a particular echelon level and released the same day were counted as having a half-day length of stay (0.5 days). Also, the term "average" length of stay in this report refers to the mean length of stay. Median lengths of stay are also reported for some analyses.

Results

Table 2 shows the percentage of WIA and DNBI patients who were seen at each echelon level and their average length of stay (both means and medians). WIA casualties had longer overall mean lengths of stay than DNBI casualties, 69.9 days versus 21.2 days. While less than 15% of DNBI casualties required treatment at either Echelon IV or Echelon V (11.8% and 13.2%, respectively), a much higher percentage of WIA casualties were sent out of theater for further treatment (26.8% to Echelon IV, 45.0% to Echelon V). The DNBI admissions had slightly longer average lengths of stay than WIA patients at Echelon II (5.7 days vs. 4.5 days) and Echelon III (13.8 days vs. 12.9 days), but shorter mean stay lengths at Echelon IV (25.0 days vs. 29.6 days) and Echelon V (58.8 days vs. 116.6 days) .

Table 2. Average Length of Stay for Marine WIA and DNBI Casualties by Echelon, Vietnam 1965 to 1969

	WIA				Std.	DNBI				Std.
	Freq.	%	Median	Mean	Dev.	Freq.	%	Median	Mean	Dev.
Overall	27,461	100.0%	38.0	69.9	84.7	59,221	100.0%	10.0	21.2	32.8
Echelon II	14,630	53.3%	2.0	4.5	6.5	34,591	58.4%	4.0	5.7	6.5
Echelon III	15,110	55.0%	8.0	12.9	14.8	30,639	51.7%	10.0	13.8	12.6
Echelon IV	7,367	26.8%	24.0	29.6	21.7	7,012	11.8%	19.5	25.0	19.1
Echelon V	12,349	45.0%	90.0	116.6	94.4	7,827	13.2%	44.0	58.8	56.4

Tables 3 and 4 present a more detailed examination of the distribution of lengths of stay. Table 3 shows the percentage frequency distribution for WIA casualties by range of treatment lengths at each echelon level. Overall, fewer than one fifth of the WIA casualties completed treatment within 1 week (18.4%), and less than half completed treatment within 30 days (44.9%). While stays of less than 3 days were the norm at Echelon II (62.1%), stays of more than 1 week were not uncommon (18.0%). Almost half of Echelon III patients stayed a week or less (48.3%), but 10.6% stayed more than 30 days. Two thirds of the casualties who transferred to Echelon V were there over 2 months, while almost 20% stayed more than 6 months.

Table 3. Length of Stay Frequency Distribution for Marine WIA Casualties by Echelon, Vietnam 1965 to 1969

	Length of Stay in Days										
Echelon	0	1-3	4-7	8-14	15-21	22-30	31-60	61-90	91-120	121-180	181+
Overall	0.4%	7.1%	10.9%	11.6%	7.4%	7.5%	17.1%	11.1%	7.5%	9.3%	10.1%
Echelon II	3.9%	58.2%	19.9%	12.1%	3.6%	1.5%	0.7%	0.0%	0.0%	0.0%	0.0%
Echelon III	1.2%	25.6%	21.5%	21.0%	11.4%	8.7%	9.0%	1.3%	0.2%	0.0%	0.0%
Echelon IV	0.0%	1.1%	8.1%	19.4%	15.7%	16.4%	30.1%	7.9%	1.0%	0.1%	0.1%
Echelon V	0.1%	1.0%	1.3%	2.1%	2.0%	4.0%	22.6%	16.9%	12.9%	17.7%	19.2%

Table 4. Length of Stay Frequency Distribution for Marine DNBI Casualties by Echelon, Vietnam 1965 to 1969

	Length of Stay in Days										
Echelon	**0**	**1-3**	**4-7**	**8-14**	**15-21**	**22-30**	**31-60**	**61-90**	**91-120**	**121-180**	**181+**
Overall	0.4%	17.2%	22.8%	21.5%	11.0%	8.3%	10.8%	4.0%	1.8%	1.4%	0.8%
Echelon II	1.4%	43.8%	30.7%	17.3%	4.7%	1.6%	0.6%	0.0%	0.0%	0.0%	0.0%
Echelon III	1.0%	15.5%	20.4%	27.2%	15.5%	11.2%	8.6%	0.6%	0.0%	0.0%	0.0%
Echelon IV	0.0%	1.0%	11.2%	25.9%	16.3%	16.1%	23.2%	5.4%	0.7%	0.1%	0.0%
Echelon V	0.2%	3.2%	5.4%	7.9%	7.6%	10.1%	31.0%	16.3%	7.4%	6.9%	4.0%

Examination of DNBI casualties indicated that approximately two fifths of DNBI casualties (40.4%) completed treatment within 1 week, and four fifths (81.2%) completed treatment within 30 days. Nearly half of the DNBI casualties (45.2%) stayed 3 days or less at Echelon II, while a quarter (24.1%) stayed more than a week at that echelon. At Echelon III, 63.1% of DNBI cases stayed more than 1 week. The percentage staying at Echelon III more than a month was almost the same as for the WIA cases (10.3% vs. 10.6%). In contrast, while only 10.5% of WIA patients were discharged at Echelon V within 1 month, 34.4% of the DNBI patients were released from Echelon V in a month or less.

Length of Stay by Injury Type

Table 5 presents length of stay data for the WIA casualties across all echelons of care according to injury category. Also included in this table are any individual diagnostic codes that represent at least 10% of the admissions within an injury category and 1% of the total number of injuries. Comparison of the median and mean values shows a considerable amount of skewness in length of stay for some types of injuries. For example, for the most prevalent injury category, Open Wound, the median length of stay was 30.0 days while the mean was 57.1 days. For Head/Scalp Wound, the median length of stay was 7.0 days, while the mean was 33.1 days.

Table 5. Average Length of Stay for Marine WIA Casualties by Injury Category, Vietnam 1965-1969

	Freq.	%	Median	Mean	Std. Dev.
Overall	**27461**	**100.0%**	**38.0**	**69.9**	84.7
Fracture	**3657**	**13.3%**	**117.0**	**142.7**	**107.3**
Fracture - radius and ulna	385	1.4%	119.0	146.8	112.3
Fracture - tibia and fibula	572	2.1%	139.5	159.5	108.1
Dislocation	**59**	**0.2%**	**34.0**	**48.5**	**54.7**
Sprain	**340**	**1.2%**	**9.0**	**22.3**	**39.4**
Head/Scalp Wound	**1122**	**4.1%**	**7.0**	**33.1**	**62.1**
Brain concussion	453	1.6%	4.0	11.1	28.4
Intracran injury, inspec. nature	357	1.3%	12.0	51.4	76.6
Injury	**554**	**2.0%**	**92.5**	**120.0**	**99.9**
Open Wound	**20196**	**73.5%**	**30.0**	**57.1**	**71.4**
Open wound - knee, leg, ankle exc. thigh	2110	7.7%	29.0	53.3	66.7
Mult. open wound - trunk, limb	2713	9.9%	45.0	68.8	72.1
Amputation	**605**	**2.2%**	**146.0**	**158.4**	**92.4**
Superficial Injury	**92**	**0.3%**	**5.0**	**18.0**	**35.5**
Contusion	**353**	**1.3%**	**6.0**	**18.5**	**34.8**
Foreign Body	**39**	**0.1%**	**11.0**	**35.9**	**46.9**
Burn	**348**	**1.3%**	**36.0**	**62.9**	**86.4**
Nerve Injury	**51**	**0.2%**	**16.0**	**54.1**	**96.3**
Symptoms and Ill-Defined	**38**	**0.1%**	**5.0**	**24.1**	**39.5**
Other/Not Recorded	**7**	**0.0%**			

Table 6 displays the mean length of stay for various injury categories at each individual echelon level of care. Also included in this table is the percentage of injury types seen at each echelon. For example, the upper left-hand cell in the table shows that 42.8% of casualties with fractures were seen at Echelon II, and that these 42.8% stayed at Echelon II an average of 1.9 days. Similarly, 63.3% of all fractures were seen at Echelon III, staying an average of 9.0 days. The median lengths of stay by injury category and echelon are displayed in Appendix 1.

Table 6. Average Length of Stay by Injury Category and Echelon for WIA Casualties, Vietnam 1965 to 1969

% Admitted at Each Echelon *Avg. Length of Stay in Days*		Ech. II	Ech. III	Ech. IV	Ech. V	Overall
Fracture	*% admitted*	42.8%	63.3%	44.3%	82.5%	100.0%
n=3657	*ALOS*	*1.9*	*9.0*	*25.5*	*151.4*	*142.8*
Dislocation	*% admitted*	49.2%	57.6%	37.3%	32.2%	100.0%
n=59	*ALOS*	*2.5*	*11.8*	*41.5*	*77.7*	*48.5*
Sprain	*% admitted*	49.1%	53.8%	10.0%	15.3%	100.0%
n=340	*ALOS*	*5.5*	*15.0*	*28.0*	*57.2*	*22.3*
Head/Scalp Wound	*% admitted*	32.4%	71.4%	10.1%	23.3%	100.0%
n=1122	*ALOS*	*4.0*	*8.6*	*19.1*	*102.2*	*33.1*
Injury	*% admitted*	26.2%	85.6%	40.6%	77.3%	100.0%
n=554	*ALOS*	*2.3*	*11.2*	*27.9*	*127.5*	*120.1*
Open Wound	*% admitted*	57.8%	51.3%	24.7%	38.4%	100.0%
n=20,196	*ALOS*	*5.0*	*14.5*	*31.7*	*101.3*	*57.1*
Amputation	*% admitted*	46.4%	61.3%	37.5%	92.7%	100.0%
n=605	*ALOS*	*2.2*	*6.8*	*20.5*	*156.9*	*158.4*
Superficial Injury	*% admitted*	34.8%	68.5%	5.4%	8.7%	100.0%
n=92	*ALOS*	*4.8*	*10.3*	*17.2*	*95.9*	*18.0*
Contusion	*% admitted*	52.7%	51.6%	6.8%	13.3%	100.0%
n=353	*ALOS*	*4.7*	*10.0*	*19.4*	*72.0*	*18.5*
Foreign Body	*% admitted*	10.3%	89.7%	23.1%	33.3%	100.0%
n=39	*ALOS*	*3.7*	*9.4*	*10.7*	*73.6*	*35.9*
Burn	*% admitted*	39.9%	70.7%	22.4%	43.7%	100.0%
n=348	*ALOS*	*5.2*	*11.9*	*31.5*	*103.6*	*62.9*
Nerve Injury	*% admitted*	51.0%	64.7%	19.6%	41.2%	100.0%
n=51	*ALOS*	*3.4*	*11.2*	*18.9*	*100.5*	*54.1*
Symptoms/Ill-Defined	*% admitted*	65.8%	39.5%	15.8%	18.4%	100.0%
n=38	*ALOS*	*4.5*	*11.6*	*21.7*	*71.3*	*24.1*
All Diagnoses	*% admitted*	53.3%	55.0%	26.8%	45.0%	100.0%
n=27,461	*ALOS*	*4.5*	*12.9*	*29.6*	*116.6*	*69.9*

Length of Stay by Diagnosis Type

Table 7 shows the average lengths of stay for the DNBI patients according to diagnostic category. Included in the table are those individual diagnostic codes that represent at least 10% of the DNBI category total and at least 1% of the total number of DNBI casualties. The category with the longest mean length of stay was musculoskeletal disorders at 36.7 days, while neoplasms had the longest median length of stay at 23.0 days. Similar to the WIA results, the distribution of many of the disease categories showed considerable skewness. Mean lengths of stay were usually about double median lengths of stay. Many of the categories had a median length of stay in the 7-to-9 day range. These included diseases of the circulatory, respiratory, digestive, and genitourinary systems, and the accidents, poisonings and violence injury category.

Table 8 presents the proportion of all admissions within each DNBI category that were treated at each echelon of care and shows the mean lengths of stay at each echelon. For example, 56.4% of all infective/parasitic admissions were seen at Echelon II, and their mean length of stay was slightly less than 1 week. Within the combat zone, the categories of behavioral/mental disorders, skin diseases and symptoms and ill-defined disorders were more likely to be treated at Echelon II, while neoplasms, nervous system disorders, genitourinary diseases and musculoskeletal disorders were more likely to be seen at Echelon III. Outside the combat zone, neoplasm admissions had the longest lengths of stay at Echelon IV (34 days), while admissions for non-battle injuries (accidents) had the longest stays at Echelon V (80.8 days). The median length of stay times for the DNBI casualties by diagnostic category and echelon are displayed in Appendix 2.

Table 7. Average Length of Stay for Marine DNBI Casualties by Diagnostic Category, Vietnam 1965-1969

	Freq.	%	Median	Mean	Std. Dev.
Overall	**59221**	**100.0%**	**10.0**	**21.2**	**32.8**
Infective and parasitic	**14570**	**24.6%**	**14.0**	**19.7**	**21.9**
Malaria	7975	13.5%	17.0	22.7	19.4
Neoplasms	**891**	**1.5%**	**23.0**	**33.8**	**36.6**
Endocrine, nutritional and metabolic	**518**	**0.9%**	**13.0**	**29.2**	**39.4**
Blood and blood forming organs	**62**	**0.1%**	**17.5**	**27.8**	**27.5**
Behavioral and mental disorders	**2347**	**4.0%**	**14.0**	**28.3**	**36.3**
Neurosis	871	1.5%	13.0	28.0	36.5
Nervous system and sense organs	**1648**	**2.8%**	**17.5**	**32.6**	**40.9**
Circulatory system	**1114**	**1.9%**	**11.0**	**22.0**	**31.7**
Respiratory system	**3107**	**5.2%**	**7.0**	**13.2**	**20.7**
Bronchitis	660	1.1%	8.0	20.1	28.2
Digestive system	**4832**	**8.2%**	**7.0**	**14.3**	**20.8**
Gastroenteritis and colitis exc. ulcer. of noninf. origin	2480	4.2%	4.0	7.3	12.4
Accidents, poisonings and violence	**2149**	**3.6%**	**9.0**	**15.8**	**23.4**
Skin and subcutaneous tissue	**6325**	**10.7%**	**8.0**	**15.3**	**22.3**
Other cellulitis abscess without lymphangitis	3214	5.4%	7.0	13.7	21.8
Other local infection of skin/subcutaneous tissue	1040	1.8%	9.0	15.3	19.3
Musculoskeletal system	**1502**	**2.5%**	**21.5**	**36.7**	**42.2**
Congenital anomalies	**69**	**0.1%**	**21.0**	**31.8**	**29.6**
Symptoms and ill-defined	**7464**	**12.6%**	**7.0**	**13.8**	**21.8**
Symptoms referable to adomen/lower gastro. tract	902	1.5%	6.0	11.3	17.5
Other general symptoms	4339	7.3%	7.0	13.3	19.8
Observation w/o need of further care	1154	1.9%	5.0	13.0	23.5
Accidents, poisonings and violence	**12621**	**21.3%**	**9.0**	**29.7**	**49.5**
Effects of heat and light	1579	2.7%	2.0	7.0	18.3
Other/not recorded	**2**	**0.0%**			

Table 8. Average Length of Stay by Echelon for DNBI Casualties by Diagnostic Category

% Admitted at Each Echelon *Avg. Length of Stay in Days*		Ech. II	Ech. III	Ech. IV	Ech. V	Overall
Infective/parasitic	*% admitted*	56.4%	63.0%	5.8%	6.0%	100.0%
n=14,570	*ALOS*	*6.9*	*17.8*	*26.7*	*51.2*	*19.7*
Neoplasms	*% admitted*	32.3%	73.4%	26.2%	19.5%	100.0%
n=891	*ALOS*	*7.6*	*16.6*	*34.0*	*52.4*	*33.8*
Endocrine/nutritional/metabolic	*% admitted*	45.2%	57.9%	23.9%	35.5%	100.0%
n=518	*ALOS*	*4.2*	*9.2*	*18.5*	*49.5*	*29.2*
Blood/blood forming organs	*% admitted*	71.0%	41.9%	25.8%	22.6%	100.0%
n=62	*ALOS*	*6.3*	*14.7*	*27.4*	*44.9*	*27.8*
Behavioral/mental disorders	*% admitted*	66.6%	37.5%	22.4%	40.7%	100.0%
n=2347	*ALOS*	*4.4*	*12.5*	*17.2*	*41.4*	*28.3*
Nerve system/sense organs	*% admitted*	23.5%	83.2%	34.9%	39.1%	100.0%
n=1648	*ALOS*	*4.5*	*8.9*	*15.9*	*47.6*	*32.6*
Circulatory system	*% admitted*	41.2%	64.5%	13.8%	14.6%	100.0%
n=1114	*ALOS*	*5.7*	*13.1*	*25.2*	*52.7*	*22.0*
Respiratory system	*% admitted*	62.4%	45.2%	7.4%	7.2%	100.0%
n=3107	*ALOS*	*5.2*	*10.9*	*20.1*	*48.3*	*13.2*
Digestive system	*% admitted*	59.6%	47.3%	9.1%	6.0%	100.0%
n=4832	*ALOS*	*4.7*	*13.8*	*26.3*	*43.3*	*14.3*
Genitourinary system	*% admitted*	40.3%	67.9%	5.3%	4.8%	100.0%
n=2149	*ALOS*	*5.4*	*14.1*	*25.0*	*58.0*	*15.8*
Skin/subcutaneous tissue	*% admitted*	66.6%	39.5%	8.1%	6.7%	100.0%
n=6325	*ALOS*	*6.7*	*14.3*	*23.8*	*47.5*	*15.3*
Musculoskeletal system	*% admitted*	33.2%	71.8%	33.7%	32.2%	100.0%
n=1502	*ALOS*	*6.0*	*10.7*	*26.7*	*56.0*	*36.7*
Congenital anomalies	*% admitted*	26.1%	76.8%	31.9%	37.7%	100.0%
n=69	*ALOS*	*4.3*	*11.5*	*20.8*	*40.2*	*31.8*
Symptoms, ill-defined	*% admitted*	72.5%	39.1%	7.7%	8.5%	100.0%
n=7464	*ALOS*	*5.1*	*11.6*	*23.0*	*43.9*	*13.8*
Accidents/poisonings/violence	*% admitted*	60.1%	46.0%	16.9%	20.8%	100.0%
n=12,621	*ALOS*	*5.0*	*11.0*	*28.9*	*80.8*	*29.7*
All diagnoses	*% admitted*	58.4%	51.7%	11.8%	13.2%	100.0%
n=59,219	*ALOS*	*5.7*	*13.8*	*25.0*	*58.8*	*21.2*

Length of Stay by Treatment Disposition

Table 9 displays, for each echelon of care, the specific percentages of WIA admissions who either completed treatment or were evacuated to a higher level of care. As can be seen in Table 9, those admissions who were evacuated to a higher echelon spent a relatively shorter period of time at the "evacuating" echelon.

Table 9. Average Length of Stay by Treatment Disposition by Echelon for WIA Marine Casualties, 1965 to 1969

	Freq.	%	Median	Mean
Overall	**27,461**	**100.0%**	**38.0**	**69.9**
Echelon II Total	**14,630**	**53.3%**	**2.0**	**4.5**
Completed treatment	5,437	19.8%	6.0	7.8
Evacuated to higher echelon	9,193	33.5%	1.0	2.6
Echelon III Total	**15,110**	**55.0%**	**8.0**	**12.9**
Completed treatment	6,628	24.1%	15.0	19.8
Evacuated to higher echelon	8,482	30.9%	5.0	7.6
Echelon IV Total	**7,367**	**26.8%**	**24.0**	**29.6**
Completed treatment	2,953	10.8%	36.0	39.5
Evacuated to higher echelon	4,414	16.1%	18.0	23.0
Echelon V Total	**12,349**	**45.0%**	**90.0**	**116.6**

Median lengths of stay for those completing treatment were 6 times greater at Echelon II (6 days vs. 1 day), 3 times greater at Echelon III (15 days vs. 5 days) and twice as great at Echelon IV (36 days vs. 18 days).

Like their WIA counterparts, DNBI patients who were completing treatment at a given echelon stayed longer than those who were being evacuated to higher echelons. Table 10 compares the mean and median lengths of stay at each echelon for the DNBI patients requiring evacuation and those completing treatment. It can be seen that the median values are consistently less than the means, indicating that the length of stay distributions are skewed.

Table 10. Average Length of Stay by Treatment Disposition by Echelon for DNBI Marine Casualties

	Freq.	%	Median	Mean
Overall	**59,221**	**100.0%**	**10.0**	**21.2**
Echelon II Total	**34,591**	**58.4%**	**4.0**	**5.7**
Treatment completed	24,315	41.1%	5.0	6.5
Evacuated to higher echelon	10,276	17.4%	2.0	3.7
Echelon III Total	**30,639**	**51.7%**	**10.0**	**13.8**
Treatment completed	23,500	39.7%	12.0	15.4
Evacuated to higher echelon	7,139	12.1%	5.0	8.7
Echelon IV Total	**7,012**	**11.8%**	**19.5**	**25.0**
Treatment completed	3,350	5.7%	27.0	30.5
Evacuated to higher echelon	3,662	6.2%	14.0	20.0
Echelon V Total	**7,827**	**13.2%**	**44.0**	**58.8**

Conclusion

The treatment experience of more than 86,000 ill and injured Marines in Vietnam illustrates distinct differences in the lengths of stay between WIA and DNBI casualties, as well as among the various subcategories of injury and illness. The WIA casualties had total lengths of stay 3 to 4 times longer on average than did DNBI casualties. The mean length of stay was 69.9 days for WIA admissions compared with 21.2 days for DNBI admissions; the median length of stay was 38 days for the WIA admissions compared with 10 days for DNBI patients. The DNBI patients had slightly longer average lengths of stay at Echelons II and III than WIA admissions, but slightly shorter stays at Echelon IV and substantially shorter stays when the Echelon V admissions were compared. For the WIA casualties seen at Echelon II, 62.1% stayed 3 days or less, while 17.9% were there for more than 1 week; the figures for WIA casualties at Echelon III were 26.8% staying 3 days or less and 51.7% staying more than 7 days. For DNBI admissions, 24.1% were at Echelon II for over 1 week and 63.1% stayed at Echelon III for more than a week.

These average lengths of stay, however, were greatly influenced by the evacuation policy in place during the Vietnam War. The evacuation policy is set by the Secretary of Defense, upon the recommendation of the theater commander,[9] and establishes the maximum period of noneffectiveness (hospitalization and convalescence) that patients who are expected to return to duty may be held within the theater for treatment. For example, with a combat zone evacuation policy of 10 days, if a patient is expected to be returned to his unit within 10 days, he will be treated in that zone; if his condition is such that he is not expected to be returned for 14 days, then he will be evacuated out of that zone at the earliest opportunity.

The evacuation policies in place during Vietnam were 30 days in the combat zone (Echelons II and III) and 60 days in the communications zone (Echelon IV).[10,11] However, under the new "Joint Vision 2010" doctrine,[12] a major focus is on power projection ashore – a focus that will undoubtedly impact the lengths of stay at the various levels of care. Under JV2010, the old concept of 'definitive' care in the combat theater has been replaced by 'essential' care in the theater combined with 'enhanced aeromedical evacuation'.[13] This doctrinal shift suggests that the extended stays seen at Echelon II and Echelon III in the past are just that – in the past. Nevertheless, while the evacuation policies in place during future conflicts will likely be shorter than those during the war in Southeast Asia, the present investigation is useful in several ways. First, it highlights that it is not unusual for patients to overstay the set evacuation policies – combat medical treatment is contingent upon the needs of the individual patients, and evacuation policies do not always dictate strict battlefield reality. Second, the overall lengths of stay seen in the present study should be valid as a baseline for future operations independent of what individual echelon evacuation policies are set. By using these overall average lengths of stay for various patient conditions, with adjustments for doctrinal changes and/or medical advances, the expected lengths of stay at each echelon can be estimated with greater reliability.

Appendix 1. Median Lengths of Stay by Echelon for WIA Casualties by Injury Category

% Admitted at Each Echelon *Avg. Length of Stay in Days*		Ech. II	Ech. III	Ech. IV	Ech. V	Overall
Fracture	*% admitted*	42.8%	63.3%	44.3%	82.5%	100.0%
n=3657	*ALOS*	*1.0*	*5.0*	*18.0*	*128.0*	*117.0*
Dislocation	*% admitted*	49.2%	57.6%	37.3%	32.2%	100.0%
n=59	*ALOS*	*2.0*	*3.0*	*34.0*	*64.0*	*34.0*
Sprain	*% admitted*	49.1%	53.8%	10.0%	15.3%	100.0%
n=340	*ALOS*	*4.0*	*11.0*	*17.5*	*42.5*	*9.0*
Head/Scalp Wound	*% admitted*	32.4%	71.4%	10.1%	23.3%	100.0%
n=1122	*ALOS*	*3.0*	*6.0*	*13.0*	*91.0*	*7.0*
Injury	*% admitted*	26.2%	85.6%	40.6%	77.3%	100.0%
n=554	*ALOS*	*2.0*	*7.0*	*24.0*	*102.0*	*92.5*
Open Wound	*% admitted*	57.8%	51.3%	24.7%	38.4%	100.0%
n=20,196	*ALOS*	*3.0*	*10.0*	*27.0*	*75.0*	*30.0*
Amputation	*% admitted*	46.4%	61.3%	37.5%	92.7%	100.0%
n=605	*ALOS*	*1.0*	*4.0*	*15.0*	*144.0*	*146.0*
Superficial Injury	*% admitted*	34.8%	68.5%	5.4%	8.7%	100.0%
n=92	*ALOS*	*4.0*	*5.0*	*12.0*	*104.5*	*5.0*
Contusion	*% admitted*	52.7%	51.6%	6.8%	13.3%	100.0%
n=353	*ALOS*	*3.0*	*7.0*	*12.5*	*64.0*	*6.0*
Foreign Body	*% admitted*	10.3%	89.7%	23.1%	33.3%	100.0%
n=39	*ALOS*	*2.5*	*7.0*	*11.0*	*56.0*	*11.0*
Burn	*% admitted*	39.9%	70.7%	22.4%	43.7%	100.0%
n=348	*ALOS*	*2.0*	*6.0*	*31.0*	*61.5*	*36.0*
Nerve Injury	*% admitted*	51.0%	64.7%	19.6%	41.2%	100.0%
n=51	*ALOS*	*2.0*	*7.0*	*13.0*	*63.0*	*16.0*
Ill-Defined Symptoms	*% admitted*	65.8%	39.5%	15.8%	18.4%	100.0%
n=38	*ALOS*	*3.0*	*6.0*	*10.0*	*82.0*	*5.0*
All Diagnoses	*% admitted*	53.3%	55.0%	26.8%	45.0%	100.0%
n=27,461	*ALOS*	*2.0*	*8.0*	*24.0*	*90.0*	*38.0*

Appendix 2. Median Lengths of Stay by Echelon for DNBI Casualties by Diagnostic Category

% Admitted at Each Echelon *Avg. Length of Stay in Days*		Ech. II	Ech. III	Ech. IV	Ech. V	Overall
Infective/parasitic	*% admitted*	56.4%	63.0%	5.8%	6.0%	100.0%
n=14,570	*ALOS*	*5.0*	*15.0*	*21.0*	*43.0*	*14.0*
Neoplasms	*% admitted*	32.3%	73.4%	26.2%	19.5%	100.0%
n=891	*ALOS*	*5.0*	*10.0*	*29.0*	*41.0*	*23.0*
Endocrine/nutritional/metabolic	*% admitted*	45.2%	57.9%	23.9%	35.5%	100.0%
n=518	*ALOS*	*3.0*	*6.0*	*14.5*	*40.0*	*13.0*
Blood/blood forming organs	*% admitted*	71.0%	41.9%	25.8%	22.6%	100.0%
n=62	*ALOS*	*5.0*	*12.5*	*25.0*	*38.5*	*17.5*
Behavioral/mental disorders	*% admitted*	66.6%	37.5%	22.4%	40.7%	100.0%
n=2347	*ALOS*	*3.0*	*10.0*	*13.0*	*31.0*	*14.0*
Nerve system/sense organs	*% admitted*	23.5%	83.2%	34.9%	39.1%	100.0%
n=1648	*ALOS*	*3.0*	*5.0*	*12.0*	*36.0*	*17.5*
Circulatory system	*% admitted*	41.2%	64.5%	13.8%	14.6%	100.0%
n=1114	*ALOS*	*4.0*	*10.0*	*20.5*	*39.0*	*11.0*
Respiratory system	*% admitted*	62.4%	45.2%	7.4%	7.2%	100.0%
n=3107	*ALOS*	*4.0*	*8.0*	*17.0*	*40.0*	*7.0*
Digestive system	*% admitted*	59.6%	47.3%	9.1%	6.0%	100.0%
n=4832	*ALOS*	*4.0*	*10.0*	*23.0*	*34.0*	*7.0*
Genitourinary system	*% admitted*	40.3%	67.9%	5.3%	4.8%	100.0%
n=2149	*ALOS*	*4.0*	*11.0*	*20.0*	*35.0*	*9.0*
Skin/subcutaneous tissue	*% admitted*	66.6%	39.5%	8.1%	6.7%	100.0%
n=6325	*ALOS*	*5.0*	*11.0*	*19.0*	*39.0*	*8.0*
Musculoskeletal system	*% admitted*	33.2%	71.8%	33.7%	32.2%	100.0%
n=1502	*ALOS*	*4.0*	*6.0*	*21.0*	*46.0*	*21.5*
Congenital anomalies	*% admitted*	26.1%	76.8%	31.9%	37.7%	100.0%
n=69	*ALOS*	*3.0*	*4.0*	*17.5*	*37.0*	*21.0*
Symptoms, ill-defined	*% admitted*	72.5%	39.1%	7.7%	8.5%	100.0%
n=7464	*ALOS*	*4.0*	*9.0*	*19.0*	*34.0*	*7.0*
Accidents/poisonings/violence	*% admitted*	60.1%	46.0%	16.9%	20.8%	100.0%
n=12,621	*ALOS*	*3.0*	*6.0*	*24.0*	*62.0*	*9.0*
All diagnoses	*% admitted*	58.4%	51.7%	11.8%	13.2%	100.0%
n=59,219	*ALOS*	*4.0*	*10.0*	*19.5*	*44.0*	*10.0*

References

1. Walker GJ, Blood CG. The Patient Flow of Wounded Marines Within a Multi-Echelon System of Care. 1998. San Diego, CA.: Naval Health Research Center Report No. 98-8.

2. Walker GJ, Blood CG. The Patient Flow of Wounded Marine Disease and Non-Battle Injury Conditions Within a Multi-Echelon System of Care. 1998. San Diego, CA.: Naval Health Research Center Report No. 98-11.

3. Reed RJ, Martino J, Eyestone SM, Pugh WM. The Field Hospital at Zagreb: Tri-Service Medical Care in a Peacekeeping Operation, Military Medicine, 163, 6:413, 1998.

4. Derderian BR, Blood CG. Shipboard Medical Admissions During Peacetime and Combat Support Deployments, 1998. San Diego, CA.: Naval Health Research Center Report No. 98-30.

5. Noy S. Battle Intensity and the Length of Stay on the Battlefield as Determinants of the Type of Evacuation, Military Medicine, 152, 12:601, 1987.

6. Medical Analysis Tool, Version 0.5. Technical Reference Manual, 1998.

7. Department of the Navy, Headquarters United States Marine Corps: Fleet Marine Force Manual 4-50, Health Service Support, Washington, DC, September 1990.

8. McClendon FO. Doctors and Dentists, Nurses and Corpsmen in Vietnam. In Uhlig F (ed.). Vietnam: The Naval Story, pp. 254-268, Annapolis,MD: Naval Institute Press, 1986.

9. Department of the Army, Headquarters: Field Manual 8-55, Washington, DC, September 1994.

10. Neel S. Medical Support of the U.S. Army in Vietnam 1965-1970, Washington, DC.: Department of the Army, 1973.

11. Hardaway RM. Care of the Wounded in Vietnam. Manhattan, KS: Sunflower University Press, 1988.

12. Joint Chiefs of Staff, Concept for Future Joint Operations, Washington, DC, May 1997.

13. Joint Readiness Clinical Advisory Board Tricare Conference. Tricare Northwest Web site. Available at: http://tricarenw.mamc.amedd.army.mil/conf98/r9802/sld010.htm. Accessed September 13, 1999.

REPORT DOCUMENTATION PAGE

Form Approval
OMD No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*

2. REPORT DATE
22 Sept 1999

3. REPORT TYPE AND DATE COVERED
Final Oct 98- Sept 99

4. TITLE AND SUBTITLE
AN ANALYSIS OF HOSPITALIZATION LENGTH OF STAY WITHIN A MULTI-ECHELON SYSTEM OF CARE DURING COMBAT OPERATIONS

5. FUNDING NUMBERS
63706N M0095.005-6704

6. AUTHOR(S)
G. Jay Walker, Christopher G. Blood

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Health Research Center
P.O. Box 85122
San Diego, CA 92186-5122

8. PERFORMING ORGANIZATION
NHRC Report No.99-24

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Office of Naval Research
800 North Quincy St.
Arlington, VA 22217-5600

Chief, Bureau of Medicine and Surgery
Code: BUMED-26
2300 E. Street NW
Washington, DC 20372-5300

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

Hospitalization records were reviewed for Marine Corps casualties sustained during the Vietnam War, and lengths of stay at each level of care were calculated for over 86,000 patients. Wounded in action (WIA) casualties had a total mean length of stay of 69.9 days compared to 21.2 days for disease and non-battle injury (DNBI) admissions. The median lengths of stay were 38 days for WIA and 10 days for DNBI casualties. While approximately 45% of WIA patients completed treatment within 30 days, almost 20% of those who were evacuated to Echelon V facilities stayed over six months. Approximately 40% of DNBI patients completed treatment within a week. Compared to their WIA counterparts, DNBI casualties showed longer lengths of stay at Echelons II and III and were less than half as likely to be sent to Echelon IV or Echelon V facilities.

14. SUBJECT TERMS
medical admissions, length of stay, wounded in action, disease and non-battle injuries, echelons

15. NUMBER OF PAGES
17

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unlimited