

NAVAL HEALTH RESEARCH CENTER

***THE PATIENT FLOW OF MARINE DISEASE
AND NON-BATTLE INJURY CONDITIONS
WITHIN A MULTI-ECHELON SYSTEM OF CARE***

G. J. Walker

C. G. Blood

Report No. 98-11

DTIC QUALITY INSPECTED

Approved for public release: distribution unlimited.

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

NAVAL MEDICAL RESEARCH AND DEVELOPMENT COMMAND
BETHESDA, MARYLAND



19980831 032

**THE PATIENT FLOW OF MARINE DISEASE AND NON-BATTLE INJURY
CONDITIONS WITHIN A MULTI-ECHELON SYSTEM OF CARE**

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. 98-11, 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

Disease and non-battle injuries (DNBI) rates have exceeded combat-related injuries in every major U.S. military operation. Medical resource planning for combat operations, therefore, requires reliable projections of the expected DNBI patient flow from the initial treatment facility on the battlefield, through intermediate care facilities, to hospitals in the continental United States.

Objective

The present investigation seeks to examine the flow of hospitalized DNBI Marines through the multi-echelon system of medical care in place during the Vietnam War.

Approach

DNBI hospitalization data from 1965 through 1969 was extracted for Marines in Vietnam. For those patients hospitalized at an Echelon II or III facility, the inter-echelon movement was tracked until treatment was completed. Inter-echelon movement patterns were also contrasted by different disease types.

Results

More than two thirds of the DNBI admissions to Echelon II facilities and over three fourths of the DNBI admissions to Echelon III facilities showed no further treatment at higher echelons of care. Fewer than one eighth of hospitalized DNBI Marines were seen at an Echelon IV or Echelon V facility. Patients with infective and parasitic diseases were most likely to be seen at an Echelon III facility, while injured patients were about twice as likely as those with diseases to eventually be treated at an Echelon IV or Echelon V facility.

Conclusions

Differences in the inter-echelon patient flows were observed among the various DNBI hospitalization categories during the last sustained military conflict with U.S. involvement. Medical planning for future military operations requires anticipating the percentages and types of DNBI patients who will need treatment at each echelon of care and allocating resources accordingly.

THE PATIENT FLOW OF MARINE DISEASE AND NON-BATTLE INJURY INCIDENCE WITHIN A MULTI-ECHELON SYSTEM OF CARE

Introduction

Forecasting of wartime medical requirements depends on the reliable estimates of both the casualty rate and the percentage of hospitalized patients who will require subsequent movement to and treatment at facilities offering advanced levels of care. While the main focus of medical commands during conflict is typically on the care and treatment of patients wounded in battle, records indicate that the occurrence of disease and non-battle injuries (DNBI) has always exceeded combat-related injuries in every major U.S. military operation.^{1,2} Moreover, DNBI casualties will occur regardless of the tempo of military operations. Thus, accurate projections of the DNBI rates becomes a key component of proper resource planning. In addition, determining the specific types of injuries and diseases expected to be seen at the various levels of care and ascertaining the required personnel and medical resources associated with each disease or injury category is essential to placing the appropriate medical resources to best meet operational demands.

Recent studies have examined the rates of wounded in action (WIA) and DNBI occurrence for previous combat operations.³⁻⁶ Forecasting tools have been developed to estimate medical admissions under scenarios with different adversaries and under varying geographical conditions.⁷ The objective of this paper is to analyze the rates and types of DNBI seen through a multi-echelon care system during a protracted conflict. Specifically, the flow of U.S. Marine Corps DNBI will be examined through the system of medical care in place during the Vietnam War. The number of hospital admissions to facilities in the combat theater will be computed. Then, the percentages of admissions that required treatment at each higher echelon will be ascertained to determine the inter-echelon flow rates. Differences in the patient flow for the leading categories of DNBI conditions will also be examined.

The Echelon System of Care

Medical treatment of casualties among combat and support personnel has traditionally been provided at five different levels or echelons of care. Echelon I facilities typically have been unit corpsmen or battalion aid stations. Medical personnel perform first aid and emergency care, control blood loss and shock, and administer antibiotics at these types of facilities.⁸

Echelon II facilities in the past were typically collecting and clearing companies, surgical support companies and casualty receiving ships. For the Marines in the Vietnam War, Echelon II facilities included the 1st and 3rd Medical Battalions and the amphibious LPH (landing platform helicopter) ships. Services provided at Echelon II facilities include resuscitative treatment, blood and emergency surgical services and holding ward facilities.⁸

Echelon III facilities are represented by hospital ships and combat zone hospitals. These facilities in Vietnam included the Saigon Navy Hospital (later taken over by the Army), the Navy Hospital in Da Nang, and the *USS Repose* and *USS Sanctuary* hospital ships.⁹ 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 higher echelons. Treatment of U.S. Marines hospitalized during the Vietnam War typically began at an Echelon II or Echelon III facility.

Echelon IV treatment centers are overseas medical facilities, usually a fully staffed hospital, designed to give definitive or specialty care to those 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 facilities are in the continental United States and are designed to provide convalescent, restorative, or rehabilitative services. The Echelon V facilities for the Marines who served in Vietnam were primarily naval hospitals.

It is noted that current Marine Corps doctrine has led to the creation of smaller, more mobile Echelon II treatment facilities. While in the Vietnam era, hospital admissions encompassed all

individuals admitted and treated at an Echelon II facility or higher, current doctrine views “admissions” as those treatments that occur at Echelon III and higher. Future echelon II facilities will most likely function as “flow through” facilities where the minimally injured are returned to duty, and those with more severe wounds/illnesses are soon thereafter transported for admission to higher echelon facilities.

Method

DNBI incidence data were extracted for combat and support troops from hospitalization records of Marines who served in Vietnam from 1965 through 1969. Records were selected that showed an initial treatment at an Echelon II or Echelon III facility in Vietnam. The movement of each patient was then tracked through the various levels of echelon care during the course of the hospitalization. Hospitalization records showing movement to a facility whose echelon level could not be determined were removed (0.68%), as were those with questionable movement patterns between echelons (0.10%).

During this time frame there were 60,847 individuals representing 73,100 DNBI hospitalizations and 127,942 diagnoses. The majority of Marines, and consequently the bulk of Navy medical resources, were in the northern (I Corps) part of South Vietnam, and initial treatment and evacuation of the most seriously sick or injured Marines from other parts of the country were often provided by Army and Air Force units.⁹ Transfers from non-Navy facilities represented 4.1% of the DNBI hospitalizations entering the Navy treatment system at the Echelon II or III level. The levels of treatment required of all patients who reached a Navy Echelon II or III facility (n=73,100) and the contrasting levels of care needed by patients with different types of DNBI injuries are the major focus of this study.

Results

Inter-Echelon Patient Flow

Tables 1 and 2 summarize the inter-echelon patient flow for Marines with DNBI whose initial hospitalization occurred at an Echelon II and III facility, respectively. Table 1 shows the flow of the 43,076 DNBI hospitalizations, out of a total of 73,100, that were initially hospitalized at an

Echelon II facility. This table presents the number of patients that were seen at each echelon of care during their course of treatment, and the echelon level to which they were subsequently moved.

Table 1. Inter-Echelon Movement of Marine DNBI Admissions Initially Hospitalized at Echelon II, Vietnam 1965-1969

<u>Level of Care</u>	<u># of Patients</u>	No Further Treatment Recorded	<u>Subsequent Level of Care</u>			
			<u>Echelon 2</u>	<u>Echelon 3</u>	<u>Echelon 4</u>	<u>Echelon 5</u>
Echelon II	43,076	71.8%	-----	17.8%	6.1%	4.3%
Echelon III	7,623	82.3%	2.2%	-----	9.6%	5.9%
Echelon IV	3,366	57.2%	-----	-----	-----	42.8%
Echelon V	3,723	100.0%				

Of the total 43,076 DNBI hospitalizations that commenced at an Echelon II facility, 3,366 of the patients were received at an Echelon IV facility. Of these 3,366 patients, more than half did not have a recorded treatment beyond Echelon IV, with the remainder of these patients (42.8%) were seen at an Echelon V facility. Of the initial 43,076 Echelon II hospitalizations, 71.8% of the patients had no further treatment recorded beyond Echelon II, while 8.6% were eventually seen at an Echelon V facility.

Similar in format to Table 1, Table 2 depicts the DNBI hospitalizations that began at an Echelon III facility. More than 75% of these admissions recorded no further treatment at any other echelons.

Table 2. Inter-echelon Movement of Marine DNBI Admissions Initially Hospitalized at Echelon III, Vietnam 1965-1969

<u>Level of Care</u>	<u># of Patients</u>	No Further Treatment Recorded	<u>Subsequent Level of Care</u>			
			<u>Echelon 2</u>	<u>Echelon 3</u>	<u>Echelon 4</u>	<u>Echelon 5</u>
Echelon III	30,024	76.1%	1.3%	-----	15.5%	7.0%
Echelon II	396	68.4%	-----	10.4%	12.6%	8.6%
Echelon IV	4,710	48.3%	-----	-----	-----	51.7%
Echelon V	4,575	100.0%				

Of those patients initiating at an Echelon III facility, 4,575 (15.2%) were eventually seen at an Echelon V facility.

Table 3 summarizes the information from Tables 1 and 2. It presents the percentage of DNBI patients who were received at each echelon of care, both for those who began their hospitalization at an Echelon II facility and those who began at Echelon III. For example, 7.8% of those patients initiating treatment at an Echelon II facility were seen at some point at an Echelon IV facility, while 11.0% of all DNBI hospitalizations were seen at an Echelon IV facility.

Table 3. Percentage of Overall Hospitalizations Treated at Each Echelon for Marine DNBI Admissions in Vietnam, 1965-1969

	<u>Initial Treatment at Echelon II</u>	<u>Initial Echelon at Echelon III</u>	<u>Total</u>
Echelon II	(100.0%)	1.3%	59.5%
Echelon III	17.7%	(100.0%)	51.5%
Echelon IV	7.8%	15.7%	11.0%
Echelon V	8.6%	15.2%	11.4%
Total Hospitalizations	43,076	30,024	73,100

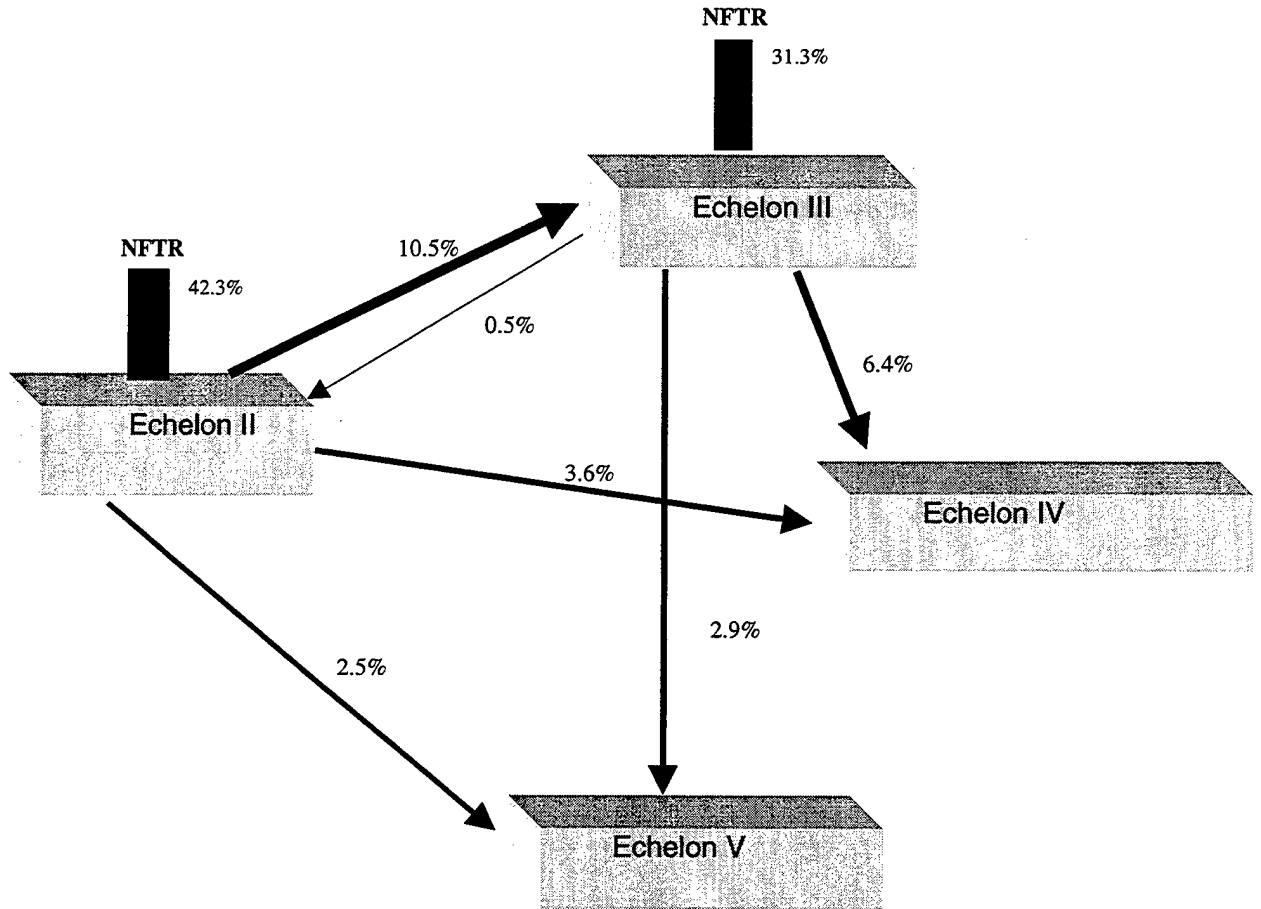
A more detailed description of the various patient flows for all 73,100 DNBI hospitalizations is displayed in Table 4. The most frequently occurring patient flow was being seen at an Echelon II facility without any additional treatment recorded at higher echelons, while being seen at Echelon III with no further treatment recorded was the next most frequent patient flow. These two were followed by the patient flow of initial admission at Echelon II and subsequent movement to an Echelon III facility with no record of any further treatment. Only 17.1% of all the DNBI hospitalizations required treatment at Echelon IV or Echelon V.

Table 4. Inter-Echelon Patient Flows of Marine DNBI Admissions -- All Diagnoses

Patient Treatment Flow				Patient Treatment Flow		
Rank	by Echelon	N	%	by Echelon	N	%
1	2	30,945	42.3%	For Initial Hospitalization at Echelon II		
2	3	22,863	31.3%	2	30,945	42.3%
3	2-3	6,275	8.6%	2-3	6,275	8.6%
4	3-4-5	2,409	3.3%	2-4	1,527	2.1%
5	3-4	2,251	3.1%	2-5	1,836	2.5%
6	3-5	2,105	2.9%	2-3-2	171	0.2%
7	2-5	1,836	2.5%	2-3-4	399	0.5%
8	2-4	1,527	2.1%	2-3-5	447	0.6%
9	2-4-5	1,109	1.5%	2-4-5	1,109	1.5%
10	2-3-5	447	0.6%	2-3-2-3	36	
11	2-3-4	399	0.5%	2-3-4-5	331	0.5%
12	2-3-4-5	331	0.5%	For Initial Hospitalization at Echelon III		
13	3-2	271	0.4%	3	22,863	31.3%
14	2-3-2	171	0.2%	3-2	271	0.4%
15	3-2-3	41	0.1%	3-4	2,251	3.1%
16	2-3-2-3	36	0.0%	3-5	2,105	2.9%
17	3-2-5	34	0.0%	3-2-3	41	0.1%
18	3-2-4-5	27	0.0%	3-2-5	34	0.0%
19	3-2-4	23	0.0%	3-2-4	23	0.0%
				3-4-5	2,409	3.3%
				3-2-4-5	27	0.0%
	Total	73,100	100.0%			

Figure 1 portrays the initial movement for the 73,100 DNBI hospitalizations. Only the first movement, if any, after the initial Echelon II or III hospitalization is displayed in this graph. Figure 2 shows the percentages corresponding to each type of inter-echelon movement for the 19,292 initial Echelon II or III admissions that required further treatment. Since patients often move more than once, Figure 2 portrays both the initial and subsequent movements between echelon levels.

Figure 1. Secondary Treatment Level Following Initial Entry to Echelon II or Echelon III Medical Facilities; U.S. Marine DNBI Admissions in Vietnam, 1965-1969

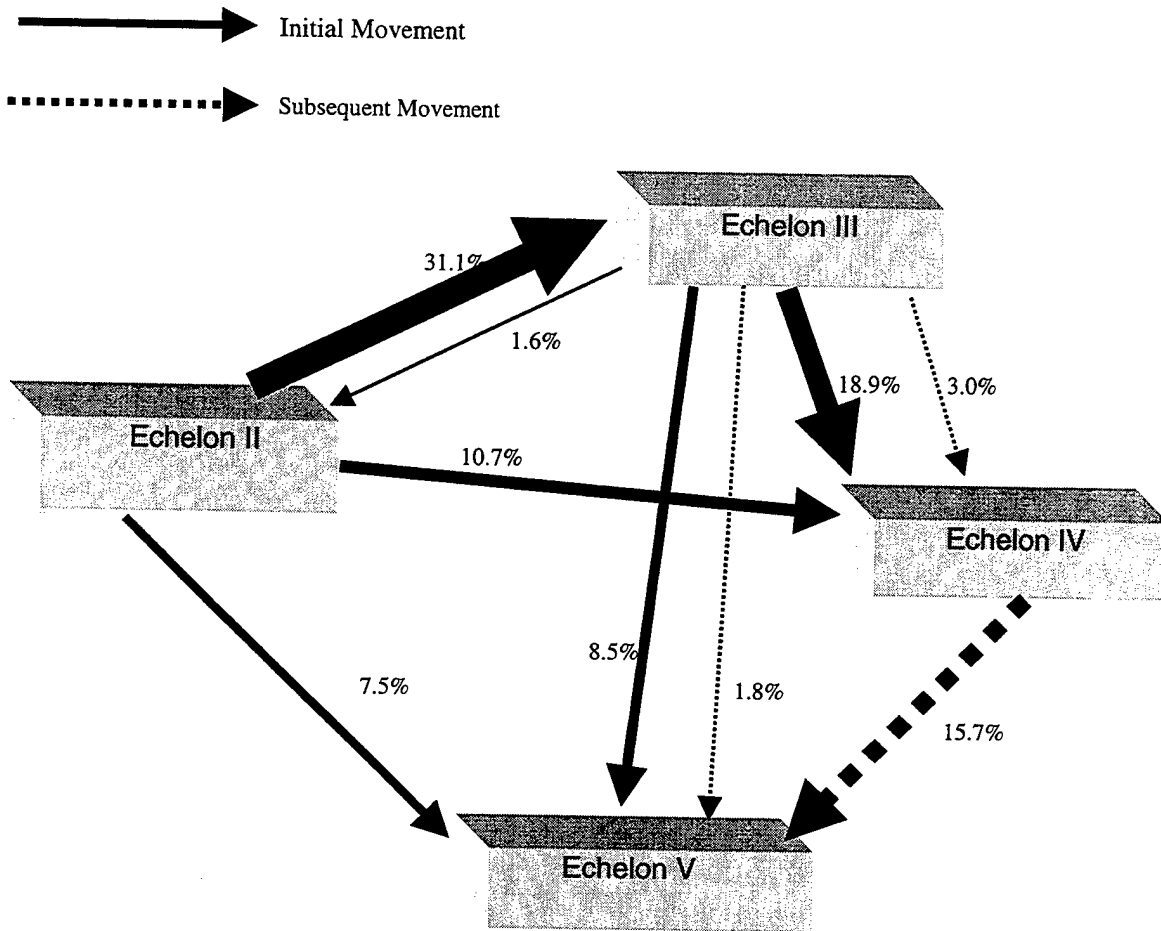


NFTR - no further treatment recorded

Note A - the percentages are based on 73,100 DNBI hospitalizations during this period. For example, there were 10.5% x 73,100 or 7,659 hospitalizations that started at Echelon II and moved to Echelon III.

Note B - the percentages do not reflect intra-echelon movement, or the movement from one facility to a different facility at the same echelon level.

Figure 2. Initial and Subsequent Inter-Echelon Flow of U.S. Marine DNBI Admissions in Vietnam, 1965-69



Echelon flows representing less than 1% of the total hospitalizations are omitted.

Note A - the percentages are based on 19,292 DNBI hospitalizations with 24,641 inter-echelon movements during this period. For example, there were 31.1% x 24,641 or 7,659 cases of initial patient movement from Echelon II to Echelon III, and 15.7% x 24,641 or 3,876 cases of initial patient movement from Echelon IV to Echelon V.

Note B - the percentages do not reflect intra-echelon movement, or the movement from one facility to a different facility at the same echelon level.

Intra-Echelon Patient Movement

The intra-echelon flow, or movement between facilities at the same echelon level of care, is summarized in Table 5. For instance, 412 DNBI patients were moved one time from an Echelon II facility to another Echelon II facility without any intervening movement to another echelon level. There were 33 cases of two such movements between Echelon II facilities.

Table 5. Summary of Intra-Echelon Flows of Marine DNBI Admissions

<u>Echelon Level</u>	<u>Transferred Once</u>	<u>Transferred Twice</u>	<u>Transferred 3+ Times</u>	<u>Total</u>
Echelon II	412	33	4	449
Echelon III	1,692	46	5	1,743
Echelon IV	32	0	0	32
Echelon V	150	5	1	156
Total	2,286	84	10	2,380

Of the 73,100 total DNBI hospitalizations, 2,380 cases (3.3%) showed intra-echelon movement. The vast majority of these cases involved only one move at the same echelon level before moving to another echelon level or returning to duty. However, an additional 94 cases of patients had two or more moves at the same echelon level before they were discharged or moved to another level of care. Altogether, there were a total of 2,484 intra-echelon movements, with most of these occurring at Echelon III (72.4%), followed by Echelon II (19.7%).

Results by Diagnostic Category

Certain types of diseases and injuries are more resource-intensive than others and may require a higher level of care. One key question for planners is how closely a projected mix of DNBI diagnoses will match the experience in Vietnam. The remainder of this report will present the distribution of the primary diagnostic categories for the DNBI casualties and display the patient flows for the most prominent categories for the Marines in Vietnam.

Table 6 presents the primary diagnoses for all 73,100 DNBI hospitalizations, as well as secondary diagnoses recorded within 10 days of the initial admission.

Table 6. Frequency of Occurrence of Disease and Non-Battle Injuries

<u>Diagnostic Category</u>	<u>Primary Diagnosis at Admission</u>		<u>Secondary Diagnosis Within 10 Days of Admission</u>	
	<u>#</u>	<u>%</u>	<u>#</u>	<u>%</u>
Infective and parasitic	16,201	22.2%	4,407	20.3%
Neoplasms	1,074	1.5%	245	1.1%
Endocrine, nutritional and metabolic	699	1.0%	723	3.3%
Blood and blood forming organs	88	0.1%	683	3.1%
Behavioral and mental disorders	2,919	4.0%	1,382	6.4%
Nervous system and sense organs	2,172	3.0%	919	4.2%
Circulatory system	1,326	1.8%	678	3.1%
Respiratory system	3,396	4.6%	1,418	6.5%
Digestive system	5,606	7.7%	1,429	6.6%
Genitourinary system	2,445	3.3%	922	4.2%
Pregnancy, maternal	2	0.0%	1	0.0%
Skin and subcutaneous tissue	7,298	10.0%	1,872	8.6%
Musculoskeletal system	1,960	2.7%	1,052	4.8%
Congenital anomalies	113	0.2%	241	1.1%
Symptoms and ill-defined	12,574	17.2%	4,619	21.3%
Accidents, poisonings and violence	15,227	20.8%	1,104	5.1%
Total	73,100	100.0	21,695	100.0

There was a fairly wide dispersion of diseases and injuries over the various diagnostic classifications. The most common diagnosis was infective and parasitic diseases at 22.2%, closely followed by accidents, poisonings and violence at 20.8%. Symptoms and ill-defined diagnoses came next, followed by skin and subcutaneous tissue diseases and digestive system disorders. Behavioral and mental disorders accounted for 4.0% of the DNBI hospitalizations. The most common secondary diagnostic types were symptoms and ill-defined conditions along with infective and parasitic diseases.

Table 7 shows the most frequently occurring patient flows for those in the five most common primary diagnostic categories.

Table 7. Patient Flow Comparisons for the Most Common Disease and Non-Battle Injury Categories

<u>Echelon Course of Treatment</u>	<u>Accidents, Poisonings and Violence</u>	<u>Infective, Parasitic</u>	<u>Ill-Defined Symptoms</u>	<u>Skin, Sub- cutaneous Tissue</u>	<u>Digestive</u>
2	41.9%	38.0%	47.6%	57.9%	50.8%
2-3	3.4%	8.7%	25.0%	4.8%	4.7%
2-4	4.0%	1.1%	1.3%	1.5%	1.7%
2-5	5.0%	0.9%	2.0%	0.6%	0.6%
2-3-5	0.9%	0.4%	1.0%	0.2%	0.4%
2-4-5	3.0%	0.6%	1.1%	0.6%	0.6%
3	27.8%	44.4%	15.8%	26.1%	32.3%
3-4	3.6%	1.5%	1.3%	2.5%	3.8%
3-5	4.6%	1.6%	0.7%	1.9%	1.2%
3-4-5	3.6%	1.3%	1.4%	2.3%	2.5%
Others	2.2%	1.5%	2.8%	1.6%	1.4%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

All five categories show a substantial number of patients recording no further treatment beyond their initial echelon level of admission. In fact, the only one of the five categories with fewer than 69% of such patients is the ill-defined symptoms category, and this was due in part to one quarter of the ill-defined symptoms group moving from an Echelon II to an Echelon III facility before treatment was completed. The diagnostic group most likely to move to an Echelon IV or Echelon V facility was accidents, poisonings and violence.

Table 8 further summarizes the patient flows for the five primary diagnostic categories. Specifically, for each category, the table shows the percentage of patients who were seen at each echelon level.

Table 8. Percentage of DNBI Marines Treated at Each Echelon, by Disease Category

Accidents, Poisonings and Violence		Infective, Parasitic		Ill-Defined Symptoms		Skin, Subcutaneous Tissue		Digestive	
<u>Echelon</u>		<u>Echelon</u>		<u>Echelon</u>		<u>Echelon</u>		<u>Echelon</u>	
II	60.3%	II	48.9%	II	80.9%	II	67.3%	II	60.2%
III	46.2%	III	61.0%	III	47.8%	III	39.3%	III	46.2%
IV	15.6%	IV	4.9%	IV	6.7%	IV	8.1%	IV	9.5%
V	17.9%	V	4.9%	V	6.9%	V	6.1%	V	5.8%

Of the patients with a primary diagnosis of accidents, poisonings and violence, 60.3% were seen at some point at Echelon II facilities, 46.2% at Echelon III facilities, 15.6% at Echelon IV, and 17.9% at Echelon V facilities. The percentages in each group add up to over 100% since many patients were seen at more than one echelon.

The ill-defined symptoms group was most likely to have been treated at an Echelon II facility, while the infective and parasitic group was most likely to have been seen at an Echelon III facility during the course of treatment. Outside of the category of accidents, poisonings and violence, fewer than 10% of the patients in these prominent DNBI diagnostic groups were seen at an Echelon IV facility, and fewer than 8% were seen at an Echelon V facility.

Table 9 presents the distribution of diagnostic categories for the patients seen at each echelon level. Distinct differences can be seen among the echelons. The table shows that 21.1% of the patients seen at Echelon II facilities had a primary diagnosis of accidents, poisonings or violence, while 19.1% of Echelon II patients had a primary diagnosis of infective and parasitic diseases. Of the patients seen at Echelon V facilities, 32.9% had injuries due to accidents, poisonings or violence. More than one third of the patients seen at either Echelon IV and V facilities were in the "Others" category. The most common diagnostic categories for patients in the "Others" group for both Echelons IV and V were nervous system and sense organ diseases and disorders, mental and behavioral disorders and musculoskeletal system diseases.

Table 9. Percentage of Marine DNBI Admissions Treated at Each Echelon, by Diagnostic Type

<u>Diagnostic Category</u>	<u>Echelon II</u>	<u>Echelon III</u>	<u>Echelon IV</u>	<u>Echelon V</u>
Accidents, Poisonings and Violence	21.1%	18.7%	29.5%	32.9%
Infective and Parasitic	19.1%	25.5%	10.1%	9.8%
Symptoms and Ill-defined	23.4%	16.0%	10.4%	10.5%
Skin and Subcutaneous Tissue	11.3%	7.6%	7.3%	5.3%
Digestive System	7.8%	6.9%	6.6%	3.9%
Other	17.3%	25.3%	36.0%	37.6%
Total	100.0%	100.0%	100.0%	100.0%
	(43,472)	(37,647)	(8,076)	(8,298)

Contrast With WIA Patient Flow

The present report documented the inter-echelon patient flow of Marine DNBI hospitalizations in a combat scenario. This study supplements a recently published report on the WIA patient flow for the same population of Marines who served in Vietnam during the 1965-1969 time period.¹⁰ Comparisons of these patient flows, as shown in Table 10, indicate that a much higher percentage of the WIA patients received treatment at Echelon IV and V facilities than did their DNBI counterparts.

As seen in Table 10, approximately as many Marine patients were treated at Echelon II facilities as at Echelon III facilities, and this held true for both WIA and DNBI patients. However, WIA patients were more than twice as likely to need treatment at facilities outside of Vietnam, particularly at the Echelon V level. A total of 45.7% of the WIA patients eventually left Vietnam for treatment. In contrast, 17.1% of DNBI patients eventually required treatment outside of Vietnam. WIA patients also had more intra-echelon trips (4.9% of the total hospitalizations vs. 3.3% for the DNBI patients) and were more likely to require further treatment beyond the initial echelon of hospitalized care (50.3% vs. 26.4% for the DNBI group).

Table 10. Comparison of the Percentage of Total Hospitalizations Treated at Each Echelon Level for Wounded in Action and Disease and Non-Battle Injuries

	<u>WIA</u>	<u>DNBI</u>
Echelon II	53.3%	59.5%
Echelon III	54.9%	51.5%
Echelon IV	23.1%	11.0%
Echelon V	35.4%	11.4%
Total Hospitalizations	39,175	73,100

Conclusion

Reliable projections of the types and numbers of diseases and non-battle injuries likely to be sustained in a military operation is essential to determining the medical resources needed to support that combat operation. The present investigation provided information on the extent and movement of the DNBI hospital admissions sustained during the Vietnam conflict, and it examined the patient flow to different echelons of care, both overall and for the most prevalent diagnostic groupings.

Approximately three fourths of all DNBI patients had no further treatment recorded beyond their initial echelon of hospitalized care. This held both for those who began their hospitalization at an Echelon II facility (71.8%) and for those initially admitted to an Echelon III facility (76.1%). Almost one ninth of DNBI admissions were eventually seen at Echelon IV facilities (11.0%), while a similar percentage were eventually seen at Echelon V facilities (11.4%).

Using empirical data from previous combat operations will allow medical planners to more accurately access the medical needs of future military operations. By combining data detailing expected patient flow during a combat scenario with evacuation policies and anticipated treatment lengths, the volume and optimal placement of medical personnel and equipment may be most reliably projected.

References

1. Hoeffler DF, Melton LJ. Changes in the Distribution of Navy and Marine Corps Casualties from World War I Through the Vietnam Conflict, Military Medicine, 146, 11: 776-779, 1981.
2. Department of the Navy, Bureau of Medicine and Surgery. Statistical Report of the Surgeon General, U.S. Navy, 1890-1972, Washington, DC., 1978.
3. Blood CG, Gauker ED, Jolly RT, Pugh WM. Comparisons of Casualty Presentation and Admission Rates during Various Combat Operations, Military Medicine, 159, 6: 457-461, 1994.
4. Blood CG, Jolly RT. Comparisons of Disease and Nonbattle Injury Incidence Across Various Military Operations, Military Medicine, 160, 5: 258-263, 1995.
5. Blood CG, Anderson ME. The Battle for Hue: Casualty and Disease Rates during Urban Warfare, Military Medicine, 159, 9: 590-595, 1994.
6. Blood CG, Gauker ED, Anderson ME, Odowick MS, O'Donnell ER. Projections of Battlefield Medical Casualties among U.S. Marine Forces for Various Theaters of Operations. 1993. San Diego, CA.: Naval Health Research Center Report No. 93-35.
7. Blood CG, Zouris JM, Rotblatt D. Using the Ground Forces Casualty Forecasting System (FORECAS) to Project Casualty Sustainment, 1997. San Diego, CA.: Naval Health Research Center Report No. 97-39.
8. Department of the Navy, Headquarters United States Marine Corps. Fleet Marine Force Manual 4-50, Health Service Support, Washington, DC.; September 1990.
9. 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.
10. 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.

REPORT DOCUMENTATION PAGE		Form Approval OMD No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for receiving instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA. 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.			
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE 12 June 1998	3. REPORT TYPE AND DATE COVERED Final Oct 96- June 98	
4. TITLE AND SUBTITLE THE PATIENT FLOW OF MARINE DISEASE AND NON-BATTLE INJURY CONDITIONS WITHIN A MULTI-ECHLEON SYSTEM OF CARE		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. 98-11	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		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 data were extracted for Marines who incurred disease and non-battle injuries in Vietnam from 1965 through 1969, and the echelon flow of treatment care for different types of injuries was examined. The inter-echelon movement of each patient who was hospitalized at an Echelon II or III facility was tracked until the treatment was completed or until the patient was moved to a continental U.S. facility. Results showed that approximately three-fourths of the admissions to Echelon II or III facilities had no further treatment recorded at a higher echelon of care. Less than one-fifth of the patients required treatment at an Echelon IV facility or Echelon V facility.			
14. SUBJECT TERMS casualty projections, Marines, echelon flow, interechelon movement, wounded		15. NUMBER OF PAGES 17	16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT Unlimited