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CASUALTY ESTIMATION SUB-STUDY: DISEASE AND NONBATTLE INJURY RATES

Phase I - Final Report

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All available data and reports on Disease and Nonbattle Injury (DNBI) rates for American forces during war and peace are reviewed and comparative rates by source are provided in tabular form. Comparative data based on the age/race adjusted general US population are also presented. The Army Medical Department Theater Casualty Treatment/Evacuation simulation model is also described and it is proposed that DNBI planning rates be derived from this model. The full reasons for this are discussed within the full report; the primary argument

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered) offered is that dynamic rates based on current professional judgement/ experience , force structure and potential scenarios are preferrable to static historical ones.

It is recommended that:

a. For the Central Europe scenario the DNBI rates projected by the AMEDD Theater Casualty Treatment/Evacuation Model be adopted (overall DNBI = 30.1/ 1000 active duty/day, hospital admissions DNBI - 7.12/1000/day, held for treatment DNBI = 8.4/1000/day, and returned to duty (ambulatory) DNBI = 14.6/ 1000 day.

b. For other scenarios, the hospitalized DNBI rates now listed in Army Force Planning Data and Assumptions FY 1981-1990 (U) continued to be used, pending generation of new scenario-specific rates through the AMEDD modeling process. For overall DNBI rates the Central Europe figure should be used pending scenario-specific revision.

c. Prospective data continue to be collected and incorporated in the modeling process. A specific AMEDD agency (such as the Health Care Studies Division, Directorate of Combat Developments, US Army Academy of Health Sciences) be tasked with: (1) conducting prospective morbidity studies as required, and (2) interfacing with other AMEDD agencies for the purposes of facilitating data exchange, coordinating data gathering activities, insuring uniformity in data gathering instruments, and providing collated data from all AMEDD sources for model input.

Though the percentage actually
on the sick list never got
above twenty, there was less
than fifty percent who were
fit for any kind of work.

Col. Theodore Roosevelt[11]
Battle of Santiago, 1898

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The number of individuals and agencies contributing to this report is much too large to enable acknowledging each. However, whether mentioned or not, all contributions were necessary elements to completion of the whole and were greatly appreciated. Specific thanks are due the Patient Administration Systems and Biostatistics Agency and staff for the provision of required medical data, Major General Frank H. Schober, Jr., and the personnel of the 40th Medical Battalion, 40th Division, California National Guard, for their support and assistance in morbidity data collection, and the professional, technical, and secretarial personnel of the Directorate of Combat Developments and Health Care Studies, Academy of Health Sciences, US Army, for continual assistance throughout all phases of the study from inception to completion of the final report.

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Disease and Nonbattle Injury Rates

1. INTRODUCTION.

a. General.

The devastating impact of diseases on the effectiveness of military units of all sizes has been well documented by many authors from ancient times through the recent past.[11,12,24,28] Specific examples will not be documented here, but the interested reader is referred to the works of Zinsser,[28] Major,[11] and McNeill[12] for detailed and perceptive accounts of the internecine relationship that has existed between war and disease over the centuries. What should be noted, for purposes of this paper, are the changes over time as to the relative contribution of diseases and direct battle casualties to the overall medical experience during times of conflict.

Table 1 shows the relative number of deaths attributable directly to battle versus other causes for the US Army from the Revolutionary War through the Vietnam Conflict.[25] World War II was the first war in which the number of battle deaths exceeded those due to other causes and this relative ratio was seen to increase with Korea and again with Vietnam. However, morbidity, and not mortality, is the primary determinant of medical workload in a theater of operations, and, for purposes of medical force-structure planning for future conflicts, the actual and relative numbers of wounded in action versus disease and nonbattle injury incidents must be estimated. And the relative importance of the disease and nonbattle injury component of overall morbidity can be demonstrated by the fact that this group of conditions accounted for over 80 percent of all hospital admissions in Vietnam.[13]

Although at first glance the definition of a disease and nonbattle injury (DNBI) casualty would seem to be obvious, this is unfortunately not

Table 1

US Army Battle Deaths vs Deaths From Other Causes - Revolutionary War Through Vietnam[25]

War	Number Serving	Battle Deaths	Other Deaths	Battle Deaths to Other Deaths
Revolutionary War**	NA*	4,044	NA*	NA*
War of 1812**	286,730	2,260	NA*	NA*
Mexican War**	78,718	1,721	11,550	0.15
Civil War (Union)**	2,128,948	138,154	221,374	0.62
Spanish American War**	280,564	369	2,061	0.18
World War I	4,057,101	50,510	55,860	0.90
World War II	11,260,000	234,874	83,400	2.82
Korea	2,834,000	27,704	9,429	2.94
Vietnam	4,368,000	30,593	7,146	4.28

* Data not available.

**Data based on incomplete records.

the case. The current version of AR 310-25 (Dictionary of US Army terms)[27] lists: "nonbattle sick and injured (A) - Personnel whose illnesses or injuries were not sustained in action and who are admitted to a hospital or who are evacuated from their units for admission to a medical treatment facility outside the division, ship, or similar area." If not inaccurate, this definition, as detailed below, is at least misleading in that it addresses only a fraction of the true overall incidence of DNBI events. This limited definition is carried over into FM 101-10-1[26] in which nonbattle casualties are only addressed in terms of "losses" (reduction in unit assigned strength) as a result of DNBI hospital admissions.

The obvious shortfall in the above definitions is that overall medical workload/impact is not addressed but only that sub-portion of patients entered on the rolls of a medical treatment facility which is organized and designated as a hospital. This, of course, ignores all of those DNBI incidents either not presenting for treatment, presenting for treatment and not placed in an excused-from-duty status or presenting and held-for-treatment past 2400 hours of the same day but subsequently returned to duty without being hospitalized. And as shall be detailed below, these latter patient classes account for a significant and important component of the overall DNBI rate.

These distinctions become particularly important given the full spectrum of implications that derive from the actual overall DNBI experience. Looking only at the hospitalized DNBI component might suffice for personnel replacement requirements, but, in order to validly determine overall medical force structure requirements and assess unit force-effectiveness under varying conditions in disparate locations, the overall DNBI impact must be taken into account. Unfortunately, although the need for valid and reliable overall DNBI planning rates can be readily appreciated, the nature and determinants of the many disease/injury entities and conditions that combine to produce the overall rate mitigate against the delineation of precise figures which are stable over time.

b. DNBI Determinants[7]

For planning purposes, the Disease and Nonbattle Injury (DNBI) classification can be broken down into four major sub-groups: (1) nonbattle injury (including thermal and environmental injuries), (2) disease (acute and chronic, infectious and non-infectious), (3) female specific, and (4) psychiatric (including battle fatigue); the logic for this breakout is detailed later. However, at a more finite level there are literally thousands of disease/injury entities that fall under the DNBI rubric and the overall number and mix of component conditions will vary with many factors. These factors are termed "disease determinants" and an appreciation of them is required in order to fully appreciate the limitations inherent in generating general and/or specific DNBI rates.

In general, disease/injury determinants can be described in terms of an epidemiological triangle consisting of an overlapping interrelationship of agent, host and environmental factors, all of which are necessary to result in a given condition. Agent factors include changes in virulence of micro-organisms over time (such as has been documented for smallpox), inherent periodicity of biological agents (type A influenza epidemics which are usually separated by 2 to 3 years versus 3 to 6 years for type B), changes in technology and equipment (proliferation of helicopters and mechanized vehicles resulting in a different number and mix of injuries), and availability (of drugs, alcohol, tobacco). Host factors must be thought of in terms of individuals and units and include the basic demographics of age, race and sex as well as level of immunity (natural and acquired), physiological/nutritional condition, and training. Environmental factors closely interrelate with the above and include geographic location, climate, general hygienic condition, and the specific environment created by the type and intensity of ongoing conflict.

Given the above, the generation of specific, precise DNBI rates that could be used as valid and reliable planning factors for future events under largely unknown conditions would be a specious exercise. However, this observation in no way diminishes the very real need to be as prepared as possible to meet whatever contingencies may arise, and this requires the adoption and use of some set of reasonable DNBI planning factors. What must be realized in that these factors are, at best, imprecise estimates that must continually be reviewed and adjusted to reflect what reasonable individuals can rationally expect based on which is known at a given point in time.

c. Present Study

On 23 December 1980, Headquarters, Department of the Army, directed that a comprehensive Casualty Estimation Study (CES) be conducted to develop a reliable and analytically rigorous methodology for estimating Army wartime casualties under varying conventional scenarios. One of the casualty categories identified was Disease and Nonbattle Injury (DNBI) and a specific DNBI substudy was directed under the sponsorship of The Surgeon General, US Army. The Health Care Studies Division at the US Army Academy of Health Sciences was subsequently identified as the study agent. The specific elements of analysis identified were: (1) should different rates be used for different parts of the world and different climatic conditions, and (2) should there be different rates for different intensities and exposure to new epidemiological areas?

2. STUDY CONCEPT.

After a preliminary review of available data a combined retrospective/prospective study design was decided upon. The retrospective portion was to include: (1) a review and analysis of DNBI data available from WW II, Korea and Vietnam, and currently used DNBI planning factors resulting from these experiences[26] as listed in FM 101-10-1, (2) a review of other efforts in the DNBI area, most notably the Disease Rate Prediction Sub-Study of the Theater of Operations Medical Support System (TOMSS) study[20] and the resulting AMEDD Theater Casualty Treatment/Evacuation Analysis Model[3] currently used, and (3) an evaluation of available medical use data for the peacetime active duty Army (ADA) population and for a comparative segment of the US civilian population for a calendar year in terms of approximate DNBI experience. The prospective approach was to consist of: (1) an examination of available data from studies specifically designed to collect morbidity data from US Army battalion-sized units or larger engaged in training exercises in different geographical areas under varying climatic conditions, and (2) a specially designed study to capture DNBI morbidity data from the 1st and 2nd Brigades of the 40th Division of the California National Guard during their two week field training exercise at Fort Irwin, CA (this effort was intended to serve as a prototype for further prospective DNBI studies as required). The relevant discussion, as applicable, will be presented along with the findings for each of the specific efforts noted above. Unless otherwise noted all rates will reflect incidents per 1000 active duty Army strength per day.

3. FINDINGS AND DISCUSSION.

a. <u>World War II</u>[6]

Data available from WW II refer only to disease and nonbattle injury "admissions." This classification included all excused-from-duty patients and thus included personnel held at battalion aid stations, clearing stations, and in quarters as well as those actually hospitalized. Further detracting from the usefulness of these data is the fact that cases carded for record only (CRO), of which about 90 percent represented venereal disease, were counted as admissions even though they were treated on an outpatient basis. Overall, it has been estimated that only 4.7 percent of the 17 million DNBI admissions for WW II represent carded for record only.

Of 17,664,641 admissions recorded over the course of the war for the Army worldwide, 16, 941,081 (95%) resulted from disease and nonbattle injury, an average rate of 1.83/1000/day. Of these, diseases of the respiratory system represented 25 percent of admissions, other infectious and parasitic diseases 20 percent, and nonbattle injury 13 percent; psychiatric cases accounted for 37 admissions per thousand Army personnel per year. Table 2 presents WW II DNBI rates by theater of admission and relative breakout by disease and nonbattle injury. The lowest recorded overall rate (1.5) was for the European Theater and the highest (2.82) was recorded for Africa-Middle East. Available admissions data are also broken out by sex and rank (Table 3). For WW II as a whole the respective DNBI rates for male vs. female officers and male vs. female enlisted were 1.39 vs. 1.94 and 1.86 vs. 3.12. These observations are of special significance and will be returned to again.

Further analyses of the WW II data are possible, but, because of inherent limitations, resulting conclusions would be tenuous. Without gross and/or specific data on the outpatient experience of Army personnel during this war, the overall impacts of disease and nonbattle injury on either force effectiveness or on overall medical workload cannot be addressed.

b. Korea[21]

Table 2

DNBI Admission* Rates (per 1,000 average strength per day),

By Type and Theater of Admission, US Army, 1942-45** [6]

Area of admission	All nonbattle causes	Disease	Nonbattle injury
Total Army	1.83	1.62	0.21
Continental United States	1.82	1.64	0.18
All overseas areas	1.85	1.60	0.25
European theater	1.50	1.27	0.23
Mediterranean theater	2.27	1.98	0.29
Africa-Middle East	2.82	2.51	0.31
China-Burma-India	2.35	2.12	0.23
Southwest Pacific	2.51	2.21	0.30
Pacific Ocean areas	1.68	1.43	0.25
North America	1.67	1.35	0.32
Latin America	1.95	1.70	0.25

* Includes cases carded for record only.

** Includes December 1941; excludes data for first Philippine campaign.

Table 3

DNBI Admission* Rates (per 1,000 average strength perday),

By Area of Admission, Rank, and Sex, US Army, 1942-45**[6]

Cause of admission and area of admission	Total Army	Officers		Enlisted Personnel	
		Male	Female	Male	Female
Nonbattle admissions, all areas	1.83	1.39	1.94	1.86	3.12
Continental United States	1.82	1.32	1.93	1.85	3.04
All overseas theaters	1.85	1.52	2.44	1.87	3.79
Disease admissions	1.62	1.24	1.99	1.65	2.87
Continental United States	1.64	1.19	1.81	1.67	2.79
All overseas theaters	1.60	1.34	2.25	1.61	3.53
Nonbattle injury admissions	0.21	0.14	0.15	0.22	0.25
Continental United States	0.18	0.13	0.12	0.18	0.25
All overseas theaters	0.25	0.18	0.19	0.26	0.27

* Includes cases carded for record only.

** Includes December 1941.

Data from the Korean War, although somewhat more complete than those for WW II, still suffer from the same gross inadequacies in that specific hospital vs. non-hospital "admission" rates and truly accurate outpatient counts cannot be identified. Another problem is that some of the reported data cover the time period from July 1950 through July 1953 while others extended through December 1953. Unlike WW II, carded for record only (CRO) incidents were not counted as admissions. Finally, available data are not broken out by sex, race and/or age thus limiting potential analyses.

For Korea the average US Army mean strength was 207,851 with total admissions (again including all excused-from-duty as well as hospitalized) numbering 443,163 of which 365,375 (82.4%) represented DNBI. The overall DNBI admission rate averaged 1.56 per 1000 per day for the entire conflict of which disease incidents accounted for 80 percent. Among all disease admissions, respiratory disease again accounted for the largest single diagnostic category at 20 percent followed by infective and parasitic disorders at 10 percent. Psychiatric admissions averaged 30/1000/year.

For outpatient care, 128,790 patients were carded for record only (CRO) of which approximately two-thirds (85,000) represented DNBI conditions. An Outpatient Report was subsequently established that covered the period from June 1951 through December 1953. From data resulting from this report, it can be estimated that in addition to all admissions and CRO patients the adjusted outpatient DNBI rate for US Army personnel in Korea was 19.05 per 1000 per day. The Korean DNBI data are presented in Table 4 which is a summary table, by source, for the DNBI rates presented in this paper.

c. <u>Vietnam</u>[9,13]

Available data from Vietnam show an overall DNBI rate of 1.15 with a disease to nonbattle injury ratio of approximately 5:1. Again, unfortunately,

Table 4

Summary Table of DNBI Rates (1000/day)

by Source and Sub-component

Source	Hospital Admission	Held for Treatment	Out-Patient	DNBI Rate	Disease to Injury Ratio	Female Hospital	Other
World War II[6]	(— 1.83 —)***		NA*	NA	8	3.12	NA
Range	(1.50 → 2.82)		NA	NA	4→9	NA	NA
Korea[21]	(— 1.56 —)		19.05	20.61	4	NA	NA
Vietnam[13]	0.55	0.60	NA	NA	5	NA	NA
FM 101-10-1[26]	(0.25 → 6.88) $\bar{X}$=2.03		NA	NA	1→10	NA	NA
TOMSS[22]	1.4	7.6	19.24	28.24	5	NA	NA
AMEDD Model[3]	7.12	8.4	14.6	30.1	4	9.16	40.10
US - 1977[15]	0.43	NA	12.54	12.97	NA	0.60	14
Total Army - 1979[19]	0.41	NA	31.48	31.89	5	0.90	NA
Army in Europe - 1979[19]	0.30	NA	22.62	22.92	4	0.66	NA
Reforger - 79[1]	2.35	9.04	23.82	35.22**	NA	(— 53.09 —)	
Empire Glacier - 80[23]	NA	NA	NA	23.89**	NA	(— 47.86 —)	
Empire Glacier - 78[23]	NA	NA	NA	16.71**	NA	(— 68.21 —)	
CAX 8-80[10]	5.69	(— 9.70 —)		15.39**	2	NA	NA
40th Div[4] - I	0.24	0.40	14.40	15.04**	1.5	0	22.2
40th Div[4] - II	0.26	(—16.84—)		17.10**	.7	0	25.0
40th Div[4] - Combined	0.25	(—15.94—)		16.19**	1.0	0	23.7

* NA = not available or not applicable

** Includes dental conditions, other overall DNBI rates do not

*** (— —) denotes combined figure not broken out data on outpatient DNBI conditions are not recorded, and overall impacts on the medical system and troop/unit effectiveness cannot be assessed. However, available statistics do permit a breakout of admissions between hospitals (48.2%) and others (aid stations, clearing stations, home quarters, etc.). Thus the overall hospital admission DNBI rate was 0.55.

Data on specific disease conditions are sketchy and are not tabulated by age, race and/or sex. Of total disease admissions, malaria accounted for 7.6 percent, and respiratory infections approximately 10 percent. Psychiatric admission rates were quite variable and ranged from a low of 9.8 per 1000 per year in 1968 to a high of 24.0 per year in 1970. Also, unlike rates in previous wars, the incidence of psychiatric events in Vietnam did not vary directly with that of combat injury, but was felt to be more a reflection of illicit drug use.

d. FM 101-10-1 DNBI Rates[26]

The Staff Officers' Field Manual lists DNBI admission rates per thousand average strength for US Army divisional and non-divisional troops for World War II, Korea and Vietnam broken out by type of division, type of operation, climate, terrain and geographical area. These rates range from a low of 0.25 for non-divisional troops in WW II in a cold plains environment during inactive operations to a high of 6.88 for infantry troops in WW II during river-crossing operations in a hot mountainous environment. The overall average rate is 2.03 with a standard deviation of 1.46 as compared to the overall average of 2.27 and standard deviation of 3.14 for wounded in action rates. These numbers clearly illustrate the great variability inherent in DNBI rates and, to an even greater degree, in WIA rates. Those factors generally associated with relatively high DNBI rates are infantry units, offensive, river crossing and defensive operations, and cold mountainous or plains environments.

e. Other Historical Data.

Nowosiwsky[14] thoroughly reviewed all available data relating to DNBI rates for the Middle East region including a detailed analysis of the medical aspects of the US experience during the 1958 Lebanon crisis.[5] He found that the 1.96 DNBI planning factor listed in FM 101-10-1 was unrealistically low, and a revised figure of 2.56 per 1000 per day was recommended.

Data[2] from the opening phases of the 1973 Israeli-Arab War regarding psychiatric stress reaction casualties indicate that this component of the overall DNBI rate (and hence the rate itself) should be increased. This contention is further supported by the fact that current rates are based on incomplete data from previous wars and have not been adjusted to reflect on-going changes in the definition, classification, and treatment of psychiatric casualties. The Israeli fugures showed that of 1500 early casualties, 900 were stress reactions many of which required further management or evacuation. Estimates from the data indicate that up to 7.5 percent of divisional personnel will become stress reactions per 24-hour period on a modern battlefield.

f. Theater of Operations Medical Support System (TOMSS) Sub-Study[20]

The disease Rate Prediction sub-study of the TOMSS was an analytical approach to delineating accurate disease rates within the framework of a Central European mid-intensity conflict involving 25 US NATO Divisions. A list of all conditions resulting in the hospitalization of US Army personnel in the European theater during 1944 was compiled. A similar list for US Army soldiers stationed in Europe in 1975 was also constructed. The two lists were then compared and consolidated to produce a single list of over

100 disease conditions that served as the basis for the predictory rate flow-model that was subsequently developed.

Allowances were made for changes in disease classification between the two periods, and for other factors (such as vaccine developments, etc) that might account for differences in rates over time. The resulting individual disease rates were then summed to produce the predicted disease hospitalization rate. Estimates on outpatient data were constructed from Out-Patient Reports (DA Form 3537) submitted by US AMEDD facilities in Germany for 1972 (the last full year this document was used) which recorded all visits under 13 broad categories.

The initial disease estimates from this study were 0.93 admissions to hospitals and 24.1 total patient visits per 1000 troops per day. These figures were later refined by Ross[22] to include the addition of a nonbattle injury estimate, and the final result was a DNBI rate of 27.84 of which disease incidents accounted for 83 percent of the total. It was further determined that five percent would be hospitalized (hospitalized DNBI = 1.4) and another 26 percent (7.2/1000/day) would be held for treatment past 2400 hours of the day presenting, but not hospitalized. Although specific data enabling generation of overall rates by sex and race are not available from the study the overall pregnancy rate for female soldiers was estimated to be nine percent per year, and, historically, the DNBI rate for black soldiers was noted to be 20 percent higher than that for whites.

Unfortunately, from a purely methodological perspective the TOMSS DNBI estimates are subject to multiple and substantive criticisms. The data sets used in constructing the predictatory model are, at best, incomplete. They represent different periods in time, are based on different classification systems, and are constructed against varying definitional criteria.

Assumption and estimation are too prevalent to allow for rigid credibility, and, most significantly, no allowance is made for the natural variation in disease/injury rates and patterns over time and the resulting large variance that is to be expected in summary figures as a result. It must be stressed, however, that the original authors of the TOMSS Sub-Study realized these limitations, but could not overcome them because the necessary data to do so were not, and are not now, available. The estimates developed represent the best judgments of experienced and knowledgeable individuals based on the information available to them.

g. AMEDD Theater Casualty Treatment/Evacuation Model[3]

As an outgrowth of the overall TOMSS study, an ongoing effort in computer simulation modeling of aptient-flow parameters in the combat environment has been undertaken within the Army Medical Department (AMEDD). The model simulates the projected flow of overall casualties through the field medical system, and is used as the basic planning tool for generating overall AMEDD personnel and materiel requirements in a given scenario as driven by overall combat arms doctrine and projections. To date, the modeling effort has been confined to a Central Europe conventional war scenario, but it is capable of being modified to meet other threat/theater requirements.

The model is currently built around 202 clinical conditions for which a percentage distribution (based on a review of actual clinical data from past wars refined by professional input from panels of specialty consultants) has been established by specific condition for: (1) single and multiple battle casualties, (2) nonbattle casualties, (3) diseases, (4) female specific disorders, and (5) battle stress reactions. Female specific and and battle stress disorders are categorized separately from disease because of the projected substantial increases in these condition sets as both the percentage of females in the Army and battlefield intensity increase. Psychiatric casualties other than battle stress reactions are categorized under the disease heading.

It should be stressed that the percentage distributions are prevalence constructs that give only the relative mix of conditions. In order to determine the overall number of casualties, specific incidence estimates. The overall DNBI rate currently used in the European simulation model is 30.1/1000/day of which the disease component is 20, injuries six, female 1.24, and battle stress 2.86. The overall hospitalization DNBI figure used is 7.12/1000/day. This apparently high estimate is primarily based on the determination that the increased intensity and mobility projected for a war in Europe would necessitate admitting many patients who would be returned to duty or held for treatment without admission in a less intense, more stable environment. Thus, although the overall DNBI rate projected by the AMEDD model is within the range of other estimates (Table 4) there is a significant impact on medical force structure planning in that a greater number of hospital beds and accompanying support resources will be required to handle the higher proportion of hospital admissions.

h. Comparative Data

As noted above, available descriptive data detailing the true impacts of disease and nonbattle injury on military operations are limited, incomplete, and non-specific regarding disease categories and breakouts by such basic disease/injury determinants as age, sex, and race. To help compensate for these deficiencies, other large data sets such as those for the age-adjusted US civilian population and the active duty Army population in peacetime can be analyzed as proxy measures of DNBI. However, it must be stressed that such populations are not truly comparable. Not only are there significant differences between the populations and their respective health care systems, but, in the end analysis, peacetime conditions and experiences are being compared to a dramatically different wartime environment.

Not only will the mix and number of presenting conditions vary, but criteria for the reporting, diagnosis and disposition of patients will be significantly different. For a condition such as the common cold, the soldier in combat may be far less likely (or able) to present for medical treatment than while in garrison, and medical personnel would certainly be more likely to return the soldier to duty as opposed to either holding him for treatment or hospitalizing him. Thus, even if the actual medical experience were to be similar for the combat and garrison environments (a highly unlikely event), the reported experiences would still tend to be substantially different. This is not to say that an analyses of peacetime data bases would not be useful, only to caution against adopting them without qualification as planning tools for combat applications.

(1) Civilian Data, US Population - 1977[15]

The last year for which a complete set of health usage data was available is 1977. The breakout of that data enables a tabulation of hospital and non-hospital medical visits per 1000 population per day for the 15 to 44 year old segment of the US population by sex and race (white and black only - all others are included in the summary totals). The overall hospital disposition rate was 0.43, and the respective rates for males and females were 0.27 and 0.60. Outpatient data are tabulated for 17 to 44 year olds. The overall rate during 1977 was 12.54, with dental care accounting for an additional 4.19 visits per 1000 per day. Females accounted for 25 percent more visits as compared to males, and whites exceeded blacks by seven percent. Upper respiratory infection accounted for the highest number of outpatient visits by males (7%) whereas prenatal care was the foremost diagnosis among females (13%). For hospital dispositions deliveries accounted for 31 percent of all female dispositions whereas for males the leading conditions were psychiatric (7%) and fracture (7%).

(2) Active Duty Army - 1979[18,19]

Army data for 1979 were selected because special summary reports for that year were available for both inpatient and outpatient data. Unfortunately, data permitting specific breakouts by sex and race were not always collected and/or tabulated. For the US Army worldwide with an estimated average active duty strength of 756,000 (of which approximately 60,000 or 8% were female), the disease and injury hospital disposition rate was 0.41 per 1000 per day, and the ratio of disease to injury conditions was 5:1. The relative male and female rates were 0.36 and 0.90 (150% greater) respectively and enlisted rates were twice those for officers. Total clinic visits numbered 8,686,266 which translate to a daily rate of 31.48 per 1000 (no breakout by sex was possible). Hospital admissions therefore represented only about 1.3 percent of all patient contacts. Data on specific conditions were not collected for outpatient visits.

For the Army in Europe with an estimated average active duty strength of 219,000 (of which approximately 17,000 or 8% were female), the daily overall disease and injury hospital disposition rate was 0.30 per thousand with disease incidents outnumbering injuries by a ratio of 4:1. Hospitalization rates for males and females were 0.27 and 0.66 (144% greater) respectively. Throughout the year, Army personnel registered

1,791,695 outpatient visits or 8.18 per soldier per year. The daily outpatient rate per 1000 active duty was therefore 22.62 and hospital admissions again accounted for 1.3 percent of all patient contacts.

Hospital dispositions are sub-classified into 83 disease/illness conditions. For Europe, excluding female specific disorders, the leading hospital condition accounting for seven percent of all dispositions was alcoholism, followed by fractures (6.7%), hepatitis (4.9%), and lacerations (4.5%) in 1979. The single largest adjusted condition-set was that covering female specific disorders (31.9 incidents per 1000 females per year) which accounted for 2.1 percent of overall hospital dispositions even though females only represented eight percent of the force. An attempt was made to correlate the 83 hospital conditions with the 202 used in the AMEDD planning model described above, but gross differences in patient categories prevented a meaningful comparison.

i. Prospective Data

As noted throughout the preceding paragraphs there are definite and significant limitations in using historical or retrospective data to generate DNBI planning factors. Definitional inconsistency coupled with changes in disease/injury patterns (agent), population demographics and relative susceptibilities (host), and the nature and geo-climatic location of combat (environment) diminish the credibility of resulting figures. The use of comparative or cross-sectional data also presents some critical problems both in terms of comparability of populations and definitional inconsistency. Also, both the retrospective and cross-sectional approaches utilize data bases designed for purposes other than developing valid DNBI rates and this in itself is seriously delimiting. One methodological approach to addressing such deficiencies is the use of prospectively designed studies that measure morbidity in representative troops/units in real time in environments that simulate combat. Several such studies will be described.

(1) Reforger - 1979[1]

A pilot study to evaluate overall gynecological health needs within a division was conducted during the annual Reforger Exercise in 1979. In order to determine relative medical care requirements by sex, data were collected on a group of patients seen at the clearing station of the 1st Medical Battalion of the 1st Infantry Division from 25 January through 5 February 1979. The study population consisted of 885 individuals of which 135 (15%) were female. Of 374 patient visits (35.22 per 1000 per day), 86 (53.09/1000 females/day) were by females, a rate 66 percent higher than that for males. Upper respiratory infection accounted for 31 percent of all patient visits and dental conditions represented three percent. For all patients, 253 (68%) were returned to duty, 25 (7%) were evacuated (hospitalized) and 96 (26%) were held for treatment.

(2) Empire Glacier - 1980[23]

This cold weather exercise was held at Fort Drum, New York, in January of 1980. Morbidity data were collected by a special team out of the US Army Research Institute of Environmental Medicine (USARIEM) for an 18-day period during which the average troop strength was 8.737 of which 376 (4.3%) were female. The overall DNBI rate recorded was 23.89, whereas those for males and females were 22.81 and 47.86 respectively. Upper respiratory infection accounted for the largest number of cases (24%), and dental conditions represented three percent. Gynecological cases represented six percent of cases among female personnel (2.81/1000 females/day). Data from a previous exercise (Empire Glacier 1978) were also presented for comparison. Those figures showed an overall DNBI rate of 16.71 (males =

16.05 and females = 68.21) with orthopedic, upper respiratory, and ENT conditions reported most frequently (approximately 20% each) and dental accounting for 1.3 percent. Gynecological complaints represented nine percent of all female conditions (6.43/1000 females/day).

(3) CAX 8-80[10]

From 2 - 16 August 1980 another USARIEM team collected morbidity data on 6010 US Marine personnel involved in a desert training exercise at 29 Palms, California. Overall, there were 1387 sick call visits (15.39/1000/day). Of these, 110 (10%) were defined as heat exhaustion and another 176 (16%) as heat related. Trauma accounted for 36 percent of all incidents, ENT (including respiratory complaints) 14 percent and dental, seven percent. Four hundred and six (37%) were treated at the field hospital level. The report on the exercise stressed that "a much larger number of acute heat disorders were not documented since they were treated by company corpsmen or their buddies." This is an important observation and one that needs better documentation especially in terms of defining force effectiveness. Because a disease/injury is not reported and/or documented does not, in any way, diminish its impact on the individual(s) affected.

(4) 40th Division, California National Guard[4]

A pilot study was conducted by the Health Care Studies Division, Academy of Health Sciences, US Army, to collect morbidity data on two training periods of the 40th Division of the California National Guard during active duty for training exercises at Fort Irwin, California, 3-16 May 81 (Irwin I) and 24 May - 5 June 81 (Irwin II). Morbidity and demographic data were collected for a continuous ten-day period during each exercise. These were subsequently broken out by sex, race, rank and age in terms of DNBI incidents per thousand at risk per day. The overall and specific rates are presented in Table 5 for the two groups, individually and combined. The breakout of incidents by care facility is depicted in Table 6. It is significant to note that most cases (96% for Irwin I and 98% for Irwin II) were treated as outpatients and returned to duty. Also, in Irwin I, of all cases seen 28 (15%) were dental and all of these were referred to the hospital for definitive evaluation and care. The daily DNBI rates for dental and other specific conditions are shown in Table 7. The respective disease to trauma ratios were 1.5:1, 1:1.5, and 1:1 for Irwin I, Irwin II and overall. Also of note, there was a greater than threefold increase in heat-related injuries correlated with a 10.5°F increase in average peak temperature (86°F Irwin I to 96.5°F Irwin II).

(5) Prospective Study Limitations

There are important deficiencies in the prospective suty approach that should be identified and addressed. The most important is that although field exercises attempt to simulate combat conditions, one cannot seriously directly equate one with the other, and this disparity would be even more marked in the context of an integrated battlefield. A second, methodological problem, is the affect of the inherent variance when measuring rates on the order of 1.6 per 1000 in finite samples. This is demonstrated in Table 8 which assumes a true DNBI hospital admissions rate of 1.6 and gives the 95 percent confidence interval for the range of values we might expect to find by chance alone at varying sample sizes. Obviously, in order to validly quantify such rates with any degree of precision, studies incorporating much larger sample sizes than those already described are required. Still, the definition of DNBI planning factors remains a necessary requirement, and, short of participating in an actual war, the prospective approach coupled with sound professional judgment offers the best alternative to generating reasonable rates. To better enhance this process, a uniform data gathering effort is absolutely essential in order to amass a sufficient amount of comparative data.

Table 5

DNBI Rates: Incident/1000/day (Irwin I and II)

Group (Incid / TotPop)	Total	SEX		ETHNIC				RANK				AGE			
		M	F	White	Black	Span	Other	All Officer	E7-9	E4-6	E1-3	< 25	26-35	36-45	> 46
Irwin I ($\frac{188}{1250}$)	15.04	14.61	22.22	13.17	19.01	15.05	23.68	3.57	6.06	16.73	18.94	17.14	13.29	12.12	6.58
Irwin II ($\frac{265}{1550}$)	17.10	16.76	25.00	14.88	17.45	23.05	23.19	6.79	8.47	17.31	24.76	22.15	13.82	12.60	12.66
Combined ($\frac{453}{2800}$)	16.19	15.80	23.71	14.16	18.28	19.25	23.36	5.30	7.37	17.06	22.09	19.89	13.59	12.37	9.68

Table 6.

Incident Breakout in Whole Numbers by Care Facility

	Irwin I N = 188	Irwin II N = 265	Combined N = 453
BAS*Only	58	139	197
BAS + Clearing St.	8	56	64
BAS + Hosp	3	10	13
BAS + Clear.+ Hospital	7	4	11
Total Seen BAS	76	204	180
Care Completed	76.3%	68.1%	70.3%
Clear.Only	78	51	129
Clear.+ Hosp.	29	0	29
Total Clear.	122	112	234
Care Completed	70.5%	96.4%	82.5%
Hosp Only	5	4	9
Hosp Referral	39	14	53
Total Field Treatment	76.6%	93.2%	86.3%
Total Hosp Admissions	3	4	7

* BAS = Battalion Aid Station

Table 7

Condition Specific DNBI Rates: Incident/1000/day

	Irwin I	Irwin II	Combined
Total Injury	6.16	9.87	8.21
Back Injury	1.12	1.94	1.57
Hand Injury	.88	1.94	1.46
Lower Extremities	1.84	1.74	1.79
Heat Related	.40	1.35	.93
Total Illness	8.80	6.90	7.75
Dermatology	1.52	1.55	1.54
URI	2.40	1.55	1.93
Dental	2.24	.65	1.36
Admissions	.24	.26	.25
Held $\bar{p}$ 2400 Hrs	.40	-	-

Table 8

Ninety-Five Percent Confidence Intervals
for a "True" DNBI Admission Rate of 1.6
When Measured in Samples of Size N*

True DNBI Rate	Sample Size of N	Standard Error	Confidence Interval
1.6**	100	4.000	0 → 9.44
1.6	1000	1.264	0 → 4.08
1.6	10,000	0.400	0.816 → 2.384
1.6	100,000	0.126	1.35 → 1.85
1.6	1,000,000	0.040	1.52 → 1.68

* Based on binomial approximation of the normal distribution.
*** The hospital admission rates subsequently recommended based on the TOMSS study*

4. DISCUSSION.

One consistent thread that is apparent from all of the data and findings presented above is the marked variation that is characteristic of DNBI rates. On reflection, this should be expected. The number of factors that affect the incidence of a given disease/injury condition, and therefore the overall morbidity experience, makes the definition of such rates difficult. Given the unpredictability of many of the factors that must be considered makes such definition futile in terms of precision and validity. This observation can be underscored by noting the variability in the data presented in Table 9 which portrays annual disease rates among the relatively stable US civilian population for selected years.

The relative demographic instability of the Army population must be stressed, because, in most instances, the shifts that have occurred are consistent with increased requirements for medical services. Foremost among the demographic changes has been the increasing percentage of females in the active force. In both the civilian and military systems, young adult females have been shown to account for at least twice the number of clinic visits and hospitalizations as males. This translates into an increased workload approximating 50 percent for a sexually balanced vs. an all-male force (Table 10). Also of note is the increasing percentage of minorities within the force with an attendant increasing requirement for medical care on the order of 10 percent or more.[16,20] Independent of race and sex, other factors that have characterized the all-volunteer Army have also been correlated with increased medical care requirements. Recent work has shown that enlistees who have not finished high school have twice the dental care requirements compared to those who have.[17]

Table 9

Disease Rates Among the US Civilian Population for Selected Years (15)

Disease	Year							
	1950	1955	1960	1965	1970	1975	1976	1977
	Number of cases per 100,000 population							
Chickenpox	[1]	[1]	[1]	[1]	[1]	78.11	96.06	97.63
Diphtheria	3.83	1.21	0.51	0.08	0.21	0.14	0.06	0.04
Hepatitis A [2]	[1]	19.45	23.15	17.49	27.87	16.82	15.51	14.40
Hepatitis B					4.08	6.30	7.14	7.78
Measles	211.01	337.88	245.42	135.33	23.23	11.44	19.16	26.51
Mumps	[1]	[1]	[1]	[1]	55.55	27.99	17.93	10.02
Pertussis	79.82	38.21	8.23	3.51	2.08	0.82	0.47	1.02
Poliomyelitis, total	22.02	17.64	1.77	0.04	0.02	0.00	0.01	0.01
Paralytic		8.43	1.40	0.03	0.02	0.00	0.01	0.01
Rubella	[1]	[1]	[1]	[1]	27.75	7.81	5.82	9.43
Salmonellosis, excluding typhoid fever	[1]	3.32	3.85	8.87	10.84	10.61	10.74	12.87
Shigellosis	15.45	8.47	6.94	5.70	6.79	7.78	6.15	7.42
Tuberculosis	80.50	46.60	30.83	25.33	18.22	15.95	19.96	13.93
Venereal diseases:								
Syphilis	146.02	76.15	68.78	58.81	45.46	38.00	33.69	30.10
Gonorrhea	192.45	146.96	145.33	169.36	298.52	472.91	470.47	466.83
Chancroid	3.34	1.65	0.94	0.51	0.70	0.33	0.29	0.21
Granuloma inguinale	1.19	0.30	0.17	0.08	0.06	0.03	0.03	0.03
Lymphogranuloma venereum	0.95	0.47	0.47	0.46	0.30	0.17	0.17	0.16

[1] Not reported nationally.

[2] Hepatitis A and B reported as single disease for 1965 and earlier years

Table 10

Relative Annual Medical Workloads For a Division of 20,000 for Varying Ratios of Male:Female With Respective DNBI Rates of 30 and 60/1000/day

# Male	# Female	(%)	Yearly Medical Incidents
20,000	0	(0)	219,000
18,000	2000	(10)	240,900
16,000	4000	(20)	262,800
14,000	6000	(30)	284,700
12,000	8000	(40)	306,600
10,000	10,000	(50)	328,500

The combination of the inherent variation in disease/injury rates over time, the inconsistencies, omissions and definitional shifts that have marked disease/injury statistical tabulations, and the marked demographic shifts in the Army population severely limits the credibility of historical data as a basis for determining DNBI planning factors. These deficiencies are further aggravated when the p: jected battlefield environment of the future is contrasted to its historical counterparts. Increased battle intensity and duration, the potential introduction of nuclear, chemical and/or biological munitions, use of restrictive personal protection garments, increasing dependence on mechanized forces, and the introduction of complex new equipment will result not only in different numbers and mixes of disease/injury conditions but, just as importantly, will necessitate changes in patient treatment/disposition criteria. As a result, a greater percentage of casualties will require hospitalization because other alternatives such as hold-for-treatment will not be feasible and/or available.

Still, all of these considerations do not lessen the requirement for DNBI planning factors. As noted earlier, these morbidity measures are necessary to better assess not only the overall medical force structure, but also personnel replacement requirements and force effectiveness. How, then, can the necessary factors be generated? For force effectiveness, an overall measure of disease incidence, and not just disease reported, would be required and there are no suitable data of this nature available. Reported data are sufficient to address the replacement and medical force structure planning requirements, and emphasis must be placed on standardizing collection efforts and integrating them with current combat doctrine through a continuous analytical review process to insure compatibility of the AMEDD to overall force requirements.

This necessitates a continuous collection of specific data on both hospitalized and ambulatory patients Army-wide, supplemented by prospective efforts designed to provide answers to questions such as the specific impacts of geo-environmental extremes, individual disease/injury conditions, demographic characteristics, and other factors that might have a unique impact at a given time and place. The resulting morbidity data can then be married to currently projected scenario-specific combat estimates, and, through a process of computer simulation guided by informed professional evaluations, a reasonable DNBI projection can be developed based on patient generation and flow in the combat environment. This will enable not only a determination of overall medical resource requirements, but will help to assure a more optimum mix of personnel/materiel, and will provide a sound basis for projecting replacement needs.

It should, however, be stressed that this is a dynamic, complex and multifaceted approach requiring specialized inputs from varied explicit individuals/agencies best suited in terms of knowledge and experience to provide the necessary data on a recurring basis. Two specific areas that require further definition, analysis, and delineation of impacts involve psychiatric and dental conditions. Annexes 2 and 3, respectively, are preliminary efforts at addressing and evaluating some of the key issues affecting these condition sets and their relative DNBI weighting. Similar efforts have been initiated in other areas involving heat and cold injuries, performance at high altitude, burns and the geo-epidemiology of specific infectious diseases. As data become available from these pursuits they should be incorporated into the ongoing modeling process, as required, for the generation of scenario-specific DNBI rates. Other significant condition-sets in need of additional investigative efforts should be identified, and the necessary data collected.

Accomplishing this would enable expanding the current AMEDD Theater Casualty Treatment/Evacuation Model, and, given all of the considerations presented herein, this represents the most appropriate mechanism available to generate useful and credible scenario-specific DNBI planning rates under a wide variety of conditions for both the conventional and the integrated battlefield. In adopting this approach, however, the user must be prepared to confront and defend projected estimates that are significantly different than, and cannot be supported by, historical figures. This is evidenced in the daily DNBI hospitalization rate of 7.12 per 1000 currently predicted for the Central European scenario, a rate some four times higher than those recorded in past conflicts. But then the goal of the planning exercise should not be to validate and reconfirm past events; it should be to better estimate those yet to come.

As noted earlier, the specific elements of analysis identified for this sub-study were: (1) should different rates be used for different parts of the world and different climatic conditions, and (2) should there be different rates for different intensities and exposure to new epidemiological areas? The general answer to these questions is, of course, yes, but before the specific answers (actual DNBI rates) can be given several other questions must first be answered: (1) what comprises the DNBI rate? - present planning factors only address hospital admissions and if overall medical impact is to be assessed, significantly higher estimates will result, (2) how precise must the planning factors be? - as noted above, just the natural variation in these rates over time makes it mathematically impossible to define any figure within a narrow confidence range, (3) how specific must geographic and climatic factors be defined? - given the wide variation in disease/injury determinants for relatively slight changes in the geo-physical environment coupled with the inability to accurately predict the levels and mix of these factors, then as a given DNBI figure is made more specific its validity and credibility decrease, and (4) how is intensity defined in terms of time? - during periods of high-intensity conflict DNBI rates will certainly increase, but planning factors must focus, not on peak loads, but on averages over time and therefore relative intensities over given time-spans must be determined for conventional, non-conventional and mixed scenarios.

5. CONCLUSIONS.

a. Historical DNBI rates are of limited value as planning factors for determining either medical force structure parameters, personnel replacement requirements or force effectiveness levels.

b. DNBI rates should measure the overall medical impact of disease/injury conditions, and should reflect the relative numbers hospitalized, held-for-treatment, treated and returned to duty, and, if force effectiveness is to be addressed, not-treated.

c. The natural variation in disease/injury rates over time, and the inability to precisely predict the overall number and mix of disease/injury conditions and their determinants for a specific area and time make it impossible to generate statistically valid, precise DNBI planning rates.

d. Currently used DNBI rates (on the order of 1.6) are inappropriate and unrealistically low on several accounts.

(1) They only reflect hospitalization rates, and, therefore, only address a small portion of the overall morbidity.

(2) They do not take into account important changes in either demographic structure of the force (race, sex, etc) or the projected battlefield of the future (increased intensity, etc) both of which will result in higher DNBI rates.

(3) They do not reflect the greater percentage of the total DNBI incidents that will require hospitalization because of changes in patient disposition criteria necessitated by current combat doctrine.

e. The most analytically sound alternative to producing reasonable and useful DNBI rates is through the simulation modeling of a finite number of patient conditions with specific incidence rates and patient dispositions based on prospective morbidity studies, and experienced professional input, and as constrained by current combat doctrine. Scenario-specific rates can be generated by altering the number and mix of specific patient conditions.

6. RECOMMENDATIONS.

a. For the Central Europe scenario the DNBI rates projected by the AMEDD Theater Casualty Treatment/Evacuation Model be adopted (overall DNBI = 30.1/1000 active duty/day, hospital admissions DNBI = 7.12/1000/day, held for treatment DNBI = 8.4/1000/day, and returned to duty (ambulatory) DNBI = 14.6/1000/day.

b. For other scenarios, the hospitalized DNBI rates now listed in Army Force Planning Data and Assumptions FY 1981-1990 (U) continue to be used, pending generation of new scenario-specific rates through the AMEDD modeling process. For overall DNBI rates the Central Europe figure should be used pending scenario-specific revision.

c. Prospective data continue to be collected and incorporated in the modeling process. A specific AMEDD agency (such as the Health Care Studies Division, Directorate of Combat Developments, US Army Academy of Health Sciences) be tasked with: (1) conducting prospective morbidity studies as required, and (2) interfacing with other AMEDD agencies for the purposes of facilitating data exchange, coordinating data gathering activities, insuring uniformity in data gathering instruments, and providing collated data from all AMEDD sources for model input.

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Appendix A

FM 101-10-1 Patient Admission Rates

Table 5–28. Patient Admission Rates

f. Southwest Pacific, WW II

Terrain and Climate	INFANTRY				MECHANIZED				ARMORED				NONDIVISIONAL			
	WIA	NBI	DIS	Total	WIA	NBI	DIS	Total	WIA	NBI	DIS	Total	WIA	NBI	DIS	Total
DEFENSIVE OPERATIONS																
Mt-Cold	4.13	.42	5.21	9.76									1.36	.31	3.20	4.87
Mt-Hot	2.68	.49	4.64	7.81									.78	.38	4.00	5.18
Plains-Hot	3.65	.40	4.23	8.28									1.20	.30	2.60	4.10
Mt-Jungle	1.61	.56	3.70	5.87									.53	.41	2.27	3.21
Plains-Jungle	4.16	2.05	2.29	8.50									1.37	1.52	1.41	4.30
RESERVE OPERATIONS																
Plains-Cold	0	.55	5.46	6.01									0	.41	3.35	3.76
AIRBORNE OPERATIONS																
Mt-Hot	17.75	.61	2.50	20.86									5.84	.35	1.54	7.73
INACTIVE OPERATIONS																
Plains-Cold	0	.67	5.47	6.14									0	.50	3.36	3.86

Table 5–28. Patient Admission Rates

g. Korean Conflict

Terrain and Climate	INFANTRY				MECHANIZED				ARMORED				NONDIVISIONAL			
	WIA	NBI	DIS	Total	WIA	NBI	DIS	Total	WIA	NBI	DIS	Total	WIA	NBI	DIS	Total
OFFENSIVE OPERATIONS																
Mt-Cold	3.54	1.40	1.67	6.61	3.27	1.22	1.24	5.72	2.98	1.08	.79	4.80	.19	.34	1.48	2.01
Plains-Cold	1.46	1.37	2.12	4.95	1.35	1.20	1.57	4.12	1.23	1.01	1.01	3.25	.48	1.01	1.30	2.79
Mt-Hot	2.42	.75	1.58	4.75	2.24	.66	1.17	4.06	2.04	.55	.75	3.34	.07	.29	1.02	1.38
DEFENSIVE OPERATIONS																
Mt-Cold	4.75	3.51	1.35	9.61	4.38	3.06	1.00	8.44	4.00	2.59	.64	7.23	.43	.41	1.62	2.16
Plains-Cold	.70	3.31	1.41	5.42	.65	2.88	1.05	4.48	.59	2.44	.67	3.70	.23	2.45	.87	3.55
Plains-Hot	8.03	.70	2.51	11.24	7.40	.62	1.86	9.88	6.76	.52	1.19	8.47	2.64	.52	1.54	4.70
Mt-Hot	2.99	.86	2.28	6.13	2.76	.75	1.69	5.20	2.52	.63	1.09	4.24	1.47	.55	2.54	4.56
RESERVE OPERATIONS																
Mt-Cold	.05	.56	1.18	1.79	.05	.49	.88	1.42	.04	.41	.56	1.01	.02	.41	.72	1.15
Plains-Cold	.29	1.11	1.40	2.80	.27	.97	1.04	2.28	.24	.82	.67	1.73	.10	.82	.86	1.78
Plains-Hot	.04	.38	.94	1.36	.04	.34	.70	1.08	.03	.28	.45	.76	.01	.28	.58	.87
Mt-Hot	.07	.45	.92	1.44	.07	.40	.69	1.15	.06	.33	.44	.83	.02	.33	.56	.91
PURSUIT OPERATIONS																
Mt-Cold	.64	1.85	1.33	3.82	.60	1.62	.99	3.20	.54	1.37	.63	2.54	.21	1.37	.82	2.40
Plains-Cold	.39	1.23	.89	2.51	.27	.84	.66	1.77	.13	.44	.42	.99	0	0	0	0
Mt-Hot	1.40	.56	1.27	3.23	1.30	.49	.94	2.73	1.18	.41	.60	2.19	.60	.44	1.28	2.32
INACTIVE OPERATIONS																
Mt-Cold	.15	.60	.89	1.64	.15	.53	.66	1.33	.13	.44	.42	.99	.01	.25	1.27	1.53
Plains-Cold	.07	.23	.46	.76	.07	.21	.35	.62	.06	.17	.22	.45	.02	.17	.28	.47
Plains-Hot	.14	.18	.32	.64	.14	.16	.24	.54	.12	.13	.15	.40	.05	.13	.20	.38
Mt-Hot	.14	.24	.54	.92	.14	.22	.41	.76	.12	.18	.26	.56	.05	.13	.33	.56
AMPHIBIOUS OPERATIONS																
Plains-Hot	1.83	.18	.26	2.27	1.69	.16	.20	2.05	1.54	.13	.12	1.79	.60	.13	.16	.89
RIVER-CROSSING OPERATIONS																
Mt-Cold	6.94	1.37	2.62	10.93	6.40	1.20	1.94	9.53	5.84	1.01	1.25	8.10	2.28	1.01	1.61	4.90
Plains-Cold	7.20	1.19	1.22	9.61	6.64	1.04	.91	8.58	6.08	.88	.58	7.52	2.37	.88	.75	4.00
Plains-Hot	3.32	.55	1.46	5.33	3.07	.48	1.08	4.63	2.80	.41	.69	3.90	1.09	.41	.90	2.40

Table 5–28. Patient Admission Rates

h. Vietnamese Conflict

Terrain and Climate	INFANTRY				MECHANIZED				ARMORED				NONDIVISIONAL			
	WIA	NBI	DIS	Total	WIA	NBI	DIS	Total	WIA	NBI	DIS	Total	WIA	NBI	DIS	Total
ALL OPERATIONS																
Jungle Mt-Hot	.42	.15	.74	1.31	.39	.14	.55	1.08	.35	.11	.35	.81	.14	.15	.77	1.06

Table 5–28. Patient Admission Rates

c. Italy, WW II

Terrain and Climate	INFANTRY				MECHANIZED				ARMORED				NONDIVISIONAL			
	WIA	NBI	DIS	Total	WIA	NBI	DIS	Total	WIA	NBI	DIS	Total	WIA	NBI	DIS	Total
OFFENSIVE OPERATIONS																
Mt-Cold	4.68	.82	4.69	10.19	4.32	.72	3.47	8.50	3.94	.61	2.23	6.78	.07	.14	1.54	1.75
Plains-Cold	15.60	.71	4.79	21.10	14.38	.62	3.54	18.54	13.14	.52	2.28	15.94	5.13	.53	2.94	8.60
Plains-Hot	12.51	.71	2.18	15.40	11.53	.62	1.62	13.76	10.53	.52	1.04	12.09	.58	.32	1.39	2.29
Mt-Hot	4.26	.62	3.61	8.49	4.44	.61	2.83	7.87	4.60	.58	2.04	7.22	.69	.41	1.45	2.55
DEFENSIVE OPERATIONS																
Mt-Cold	.26	.25	1.49	2.00	.25	.22	1.11	1.57	.22	.18	.71	1.11	.19	.25	1.74	2.15
Plains-Cold	2.18	.55	4.57	7.30	2.02	.49	3.38	5.88	1.84	.41	2.18	4.43	.72	.41	2.81	3.94
Plains-Hot	.75	.58	2.64	3.97	.70	.51	1.96	3.16	.63	.43	1.26	2.32	.25	.43	1.62	2.30
RESERVE OPERATIONS																
Mt-Hot	.45	.49	1.48	2.42	.42	.43	1.10	1.95	.38	.36	.70	1.44	.15	.36	.91	1.42
Plains-Cold	.19	.49	3.09	3.77	.18	.43	2.29	2.90	.16	.36	1.47	1.99	.06	.36	1.90	2.32
Plains-Hot	.14	.61	3.93	4.68	.08	.56	2.83	3.47	.01	.50	1.71	2.22	.05	.45	2.41	2.91
PURSUIT OPERATIONS																
Mt-Hot	3.61	.62	2.51	6.74	3.33	.55	1.86	5.73	3.04	.46	1.19	4.69	1.19	.46	1.54	3.19
Plains-Cold	.63	.66	1.03	2.32	.59	.58	.77	1.93	.53	.49	.49	1.51	.21	.49	.63	1.33
Plains-Hot	1.28	.54	1.46	3.28	1.46	.48	1.14	3.08	1.62	.41	.81	2.84	.42	.40	.90	1.72
INACTIVE OPERATIONS																
Plains-Cold	.52	.43	4.29	5.24	.81	.38	3.17	4.36	1.08	.32	2.04	3.44	.17	.32	2.63	3.12
Plains-Hot	1.15	.34	2.19	3.68	1.07	.30	1.62	2.99	.97	.25	1.04	2.26	.38	.25	1.34	1.97
AMPHIBIOUS OPERATIONS																
Plains-Cold	6.06	.27	1.30	7.63	5.59	.24	.97	6.79	5.10	.20	.62	5.92	1.99	.20	.80	2.99
Plains-Hot	16.05	1.36	6.30	23.71	14.79	1.19	4.66	20.63	13.51	1.00	3.00	17.51	5.38	1.01	3.87	10.26
RIVER-CROSSING OPERATIONS																
Mt-Cold	1.78	.32	4.32	6.42	1.65	.29	3.20	5.13	1.50	.24	2.06	3.80	.59	.24	2.65	3.48
Plains-Cold	2.68	.71	4.39	7.78	2.48	.62	3.25	6.34	2.26	.52	2.09	4.87	.88	.53	2.70	4.11
Plains-Hot	5.64	.57	2.16	8.37	5.20	.50	1.60	7.30	4.75	.42	1.03	6.20	1.86	.42	1.33	3.61
Mt-Hot	1.08	.33	2.88	4.29	1.00	.29	2.13	3.42	.91	.24	1.37	2.52	.36	.24	1.77	2.37

Table 5–28. Patient Admission Rates

d. Mideast Wars (Between Opposing Non-US Forces)

Terrain and Climate	INFANTRY				MECHANIZED				ARMORED				NONDIVISIONAL			
	WIA	NBI	DIS	Total	WIA	NBI	DIS	Total	WIA	NBI	DIS	Total	WIA	NBI	DIS	Total
ALL OPERATIONS																
Desert-Hot	2.29	.38	1.58	4.25	2.30	.39	1.59	4.27	2.29	.38	1.58	4.25	.40	.35	1.25	2.00

Table 5–28. Patient Admission Rates

e. Central and South Pacific, WW II

Terrain and Climate	INFANTRY				MECHANIZED				ARMORED				NONDIVISIONAL			
	WIA	NBI	DIS	Total	WIA	NBI	DIS	Total	WIA	NBI	DIS	Total	WIA	NBI	DIS	Total
OFFENSIVE OPERATIONS																
Mt-Hot	9.12	.46	2.20	11.78									3.00	.34	1.35	4.69
RESERVE OPERATIONS																
Plains Cold	.45	.26	3.93	4.64									.15	.19	2.41	2.75
INACTIVE OPERATIONS																
Mt-Hot	0	.27	.72	.99									0	.20	.44	64
Plains Cold	0	.07	.33	.40									0	.05	.20	.25
AMPHIBIOUS OPERATIONS																
Mt-Jungle	4.48	.43	.76	5.67									1.47	.32	.47	2.26
Plains-Jungle	5.64	.64	.64	6.92									1.86	.47	.39	2.72
Plains-Hot	12.78	.49	.72	3.99									4.20	.36	.44	5.00

Table 5—28. Patient Admission Rates

a. Overall in WW II, Korean Conflict, and Vietnamese Conflict

INFANTRY WIA	INFANTRY NBI	INFANTRY DIS	INFANTRY Total	MECHANIZED WIA	MECHANIZED NBI	MECHANIZED DIS	MECHANIZED Total	ARMORED WIA	ARMORED NBI	ARMORED DIS	ARMORED Total	NONDIVISIONAL WIA	NONDIVISIONAL NBI	NONDIVISIONAL DIS	NONDIVISIONAL Total
WW II—Europe (See Table 5—28b)															
3.04	.54	2.07	5.65	2.17	.43	1.61	4.21	1.29	.30	1.14	2.73	.39	.34	.99	1.72
WW II—Italy (See Table 5—28c)															
1.97	.53	3.62	6.12	2.46	.52	2.60	5.57	2.93	.49	1.57	4.99	.40	.29	1.72	2.41
WW II—Mideast (See Table 5—28d)															
2.29	.38	1.58	4.25	2.30	.39	1.59	4.27	2.29	.38	1.58	4.25	.40	.35	1.25	2.00
WW II—Central and South Pacific (See Table 5—28e)															
1.91	.28	.89	3.08	1.77	.25	.66	2.68	1.16	.21	.42	2.24	.63	.21	.55	1.39
WW II—Southwest Pacific (See Table 5—28f)															
2.08	.61	5.12	7.81	1.92	.54	3.79	6.24	1.75	.45	2.44	4.64	.99	.35	3.71	5.05
Korean Conflict (See Table 5—28g)															
.82	.62	1.05	2.49	.76	.55	.78	2.09	.69	.46	.50	1.65	.54	.40	1.74	2.68
Vietnamese Conflict (See Table 5—28h)															
.42	.15	.74	1.31	.39	.14	.55	1.08	.35	.11	.35	.81	.14	.15	.77	1.06

Table 5—28. Patient Admission Rates

b. Europe, WW II

Terrain and Climate	INFANTRY WIA	INFANTRY NBI	INFANTRY DIS	INFANTRY Total	MECHANIZED WIA	MECHANIZED NBI	MECHANIZED DIS	MECHANIZED Total	ARMORED WIA	ARMORED NBI	ARMORED DIS	ARMORED Total	NONDIVISIONAL WIA	NONDIVISIONAL NBI	NONDIVISIONAL DIS	NONDIVISIONAL Total
OFFENSIVE OPERATIONS																
Mt-Cold	9.74	.96	4.85	15.55	6.86	.83	4.25	11.94	3.97	.68	3.64	8.29	.56	.26	1.01	1.83
Plains-Cold	5.31	.73	4.24	10.28	4.37	.57	3.52	8.46	3.41	.39	2.79	6.59	.38	.22	1.01	1.61
Plains-Hot	8.82	1.15	2.32	12.29	6.32	.75	2.59	9.66	3.80	.34	2.85	6.99	.49	.55	.90	1.94
DEFENSIVE OPERATIONS																
Mt-Cold	7.48	1.92	2.24	11.64	5.55	1.38	2.12	9.04	3.61	.82	1.98	6.41	2.46	1.42	1.38	5.26
Plains-Cold	1.79	.64	2.35	4.78	1.54	.45	1.96	3.94	1.28	.24	1.55	3.07	.20	.33	1.11	1.64
Plains-Hot	4.58	.50	1.70	6.78	3.06	.41	1.64	5.10	1.52	.31	1.56	3.39	.12	.16	.48	.76
RESERVE OPERATIONS																
Mt-Cold	.30	.51	1.49	2.30	.28	.45	1.11	1.84	.25	.38	.71	1.34	.13	.38	.91	1.42
Plains-Cold	.86	.52	2.43	3.81	.79	.44	1.81	3.03	.70	.34	1.18	2.22	.28	.38	1.49	2.15
Plains-Hot	1.74	.34	1.82	3.90	1.46	.31	1.38	3.15	1.17	.27	.93	2.37	.57	.25	1.12	1.94
PURSUIT OPERATIONS																
Mt-Cold	3.62	1.75	1.99	7.36	3.57	1.06	1.70	6.32	3.50	.36	1.39	5.25	1.19	1.30	1.22	3.71
Plains-Cold	2.71	.60	1.67	4.98	2.46	.49	1.36	4.30	2.19	.36	1.03	3.58	.89	.44	1.03	2.36-
Plains-Hot	1.47	.44	.73	2.64	2.28	.45	.67	3.40	3.08	.44	.60	4.12	.48	.33	.45	1.26
INACTIVE OPERATIONS																
Plains-Cold	.16	.32	1.15	1.63	.08	.27	.88	1.23	.01	.20	.59	.80	.05	.24	.71	1.00
Plains-Hot	.42	.25	.50	1.17	.54	.20	.45	1.19	.65	.14	.38	1.17	.14	.19	.31	.64
AIRBORNE OPERATIONS																
Plains-Cold	10.47	2.33	.66	13.46	0	0	0	0	0	0	0	0	3.44	1.72	.41	5.57
Plains-Hot	9.20	.25	1.02	10.47	0	0	0	0	0	0	0	0	3.03	.19	.63	3.85
AMPHIBIOUS OPERATIONS																
Plains-Hot	10.45	.28	.53	11.26	9.63	.25	.40	10.28	8.80	.21	.25	9.26	3.44	.21	.33	3.98
RIVER-CROSSING OPERATIONS																
Mt-Cold	4.84	.83	3.17	8.84	6.58	.76	3.67	11.01	8.31	.68	4.15	13.14	1.59	.61	1.96	4.15
Plains-Cold	5.57	.52	3.02	9.11	5.14	.46	2.23	7.83	4.69	.38	1.44	6.51	1.83	.38	1.85	4.06
Plains-Hot	5.46	.51	2.32	8.29	3.80	.35	1.35	5.49	2.12	.18	.36	2.66	1.60	.38	1.42	3.60
Mt-Hot	10.22	.64	6.24	17.10	9.42	.56	4.61	14.59	8.61	.47	2.97	12.05	3.36	.47	3.83	2.66

Appendix B

Psychiatric Conditions

Psychiatric Annex

The term psychiatric casualty refers to a collection of conditions of ineffectiveness with varying organic, psychological, social, cognitive, motivational, and political components (Rath, 1980). A soldier who is a psychiatric casualty is one who becomes ineffective in his combat role for reasons other than wounds, organic disease, or ineptitude.

It becomes difficult to make comparisons between different wars for rates of psychiatric casualties due to differences in definitions of psychiatric conditions, differences in treatment offered, and differences in medical statistics recorded. The current terms for the psychiatric casualties are transient battle reaction and battle fatigue reactions (Jones, 1980). Since the 1950s, there have been significant changes in the administration of psychiatric services to include: the widespread use of psychoative drugs, an emphasis on brief rather than long term psychotherapies, and a shift in emphasis from inpatient admissions to outpatient clinic visits.

Certain trends affecting casualty estimation can be discerned. Historical data from World War I, World War II, the conflicts in Korea and Vietnam, and the 1973 war between Israel and the Arab Nations indicate an average, predictable ratio of one psychiatric casualty for every three wounded-in-action over the duration of the conflict (Mangelsdorff, 1980. However, in high intensity theaters of operations, as in North Africa and Italy (at Cassino and Anzio) during World War II, neuropsychiatric casualty rates of 1200 to 1500 per 1000 strength per year (for short periods) were not uncommon in rifle battalions (Appel and Beebe, 1946).

The wounded-in-action rate and the psychiatric casualty rate are direct functions of several factors. The 1973 war between Israel and the Arab Nations demonstrated that the increasing lethality of the modern integrated battlefield (involving continuous, highly mobile battles) subjected soldiers to greater stresses than found in past conflicts. With the probability of increased stresses (as may be expected from sustained, continuous operations in chemical and/or nuclear environments), planners must anticipate an increase in the risk of psychiatric casualties. The factors most affecting the psychiatric casualty rate include:

a) intensity of the conflict

b) duration of the conflict (as in continuous, sustained operations)

c) whether troops are caught by surprise

d) whether troops are caught in a defensive posture with no opportunity to retaliate

e) the degree of training the troops have had with

(1) a variety of stressful environments (chemical, biological, or nuclear environments in protective clothing).

(2) sophisticated weapons systems and technology.

f) the confidence the leaders and unit members have in their abilities to carry out the missions.

Because of the variability in the above factors, making an accurate prediction of the numbers of psychiatric casualties likely to occur in future conflicts will be difficult. Historical data and current planning factors estimating 2.8/1000/day with a 5% hospitalization rate (current AMEDD Theater Casualty Treatment/Evacuation Model) would seem to be grossly under-estimating the potential psychiatric casualty rate. It seems likely that there will be as many, if not more, psychiatric than wounded-in-action casualties in a high intensity, continuous operations, integrated battlefield during the initial stages of the conflict.

In order to estimate the probable rates, more accurate data need to be collected. Incidence rates from such operations as Reforger, training exercises at Fort Irwin, FTXs in chemical and/or continuous operations, may provide the information needed to assess the future psychiatric casualty workload.

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Appendix C

Dental Conditions

DNBI Rates and Military Medicine

The impact of dental disease on combat non-effectiveness is largely unknown. Quantitative information from historical data has been sufficient only in the area of maxilofacial injury requiring hospitalization. This has permitted a documentation of dental resource requirements for these conditions only within the current AMEDD Theater Casualty Treatment/ Evacuation Model.

Attempts to document the theater of operations nonbattle dental injury and dental disease impacts from civilian sources[15] and from prospective studies of training exercises[1,4,10,23] have resulted in data insufficient to predict personnel and equipment requirements. Unless this requirement can be quantified planning will continue to be subjective and based on the recall of dental personnel who have had experience in a theater of operation. The recall of experience of Vietnam may or may not be typical of future conflict and certainly does not fit the scenarios currently used for training.

At the present time Dental Studies Office, DCDHCS, Academy of Health Sciences, has initiated a study for FY 82/83 titled "Theater of Operations Dental Workload Estimates." This study will quantify dental workload due to disease and nonbattle injury as well as battle related trauma for a theater of operation.

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