NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

THE DETERMINATION OF NURSING MANPOWER REQUIREMENTS IN HUMANITARIAN ASSISTANCE MISSIONS FOR HOSPITAL SHIPS

by

Fritzi McDonald

June 2007

Thesis Co-Advisors:	Anke Richter Paula Konoske

THIS PAGE INTENTIONALLY LEFT BLANK

REPORT DOCUMENTATION PAGE			*Form Approved OMB No. 0704-0188*
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, 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** June 2007	**3. REPORT TYPE AND DATES COVERED** Master's Thesis	
4. TITLE AND SUBTITLE The Determination of Nursing Manpower Requirements in Humanitarian Assistance Missions for Hospital Ships			**5. FUNDING NUMBERS**
6. AUTHOR(S) Fritzi McDonald			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000			**8. PERFORMING ORGANIZATION REPORT NUMBER**
9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A			**10. SPONSORING/MONITORING AGENCY REPORT NUMBER**
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.			
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.			**12b. DISTRIBUTION CODE** A

13. ABSTRACT (maximum 200 words)

The purpose of this thesis is to determine the nursing manpower requirements for humanitarian and civic assistance missions performed by Navy hospital ships. The qualitative analysis component of this thesis includes a comprehensive literature review performed on doctrines, guidances, past humanitarian mission studies, and nurse staffing models. In contrast, the quantitative analysis component includes an Ordinary Least Squares regression analysis to estimate patient length of stay. Various model constructions are reviewed, utilizing different patient controls and indicators in an effort to identify a reasonable estimation approach and to validate the integrity of the available empirical data from the USNS MERCY 2006 deployment. Furthermore, a Chi-square test is conducted to review the statistical significance between the observed patient ICD-9 classification frequencies in an effort to better understand the types of capabilities that a future mission should expect to provide. The results of these analyses are applied in the development of an estimation calculator to define shipboard inpatient nursing manpower requirements. The thesis also provides suggestions for areas of future research that will provide insight regarding additional staffing requirements in other areas such as MEDCAPS, which is necessary for developing a more robust calculator.

14. SUBJECT TERMS **Manpower Requirements, Hospital Ships, Humanitarian Assistance, Nursing**			**15. NUMBER OF PAGES** 105
			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** UL

NSN 7540-01-280-5500 Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

THIS PAGE INTENTIONALLY LEFT BLANK

THE DETERMINATION OF NURSING MANPOWER REQUIREMENTS IN HUMANITARIAN ASSISTANCE MISSIONS FOR HOSPITAL SHIPS

Fritzi McDonald
Commander, United States Navy
M.S., Nursing Informatics, University of Maryland, Baltimore, 2005

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF BUSINESS ADMINISTRATION

from the

NAVAL POSTGRADUATE SCHOOL
June 2007

Author: Fritzi McDonald

Approved by: Anke Richter, PhD
Co-Advisor

Paula Konoske, PhD
Co-Advisor

Robert N. Beck, Dean
Graduate School of Business and Public Policy

THIS PAGE INTENTIONALLY LEFT BLANK

ABSTRACT

The purpose of this thesis is to determine the nursing manpower requirements for humanitarian and civic assistance missions performed by Navy hospital ships. The qualitative analysis component of this thesis includes a comprehensive literature review performed on doctrines, guidances, past humanitarian mission studies, and nurse staffing models. In contrast, the quantitative analysis component includes an Ordinary Least Squares regression analysis to estimate patient length of stay. Various model constructions are reviewed, utilizing different patient controls and indicators in an effort to identify a reasonable estimation approach and to validate the integrity of the available empirical data from the USNS MERCY 2006 deployment. Furthermore, a Chi-square test is conducted to review the statistical significance between the observed patient ICD-9 classification frequencies in an effort to better understand the types of capabilities that a future mission should expect to provide. The results of these analyses are applied in the development of an estimation calculator to define shipboard inpatient nursing manpower requirements. The thesis also provides suggestions for areas of future research that will provide insight regarding additional staffing requirements in other areas such as MEDCAPS, which is necessary for developing a more robust calculator.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

LIST OF FIGURES

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF TABLES

THIS PAGE INTENTIONALLY LEFT BLANK

I. INTRODUCTION

A. BACKGROUND

The *National Security Strategy* (*NSS*) of the United States highlights the President's strategic vision and provides a framework to address national security concerns. Its purpose "is to help make the world not just safer but better" (White House, 2002, p. 1). The United States does this by devoting time and resources to fostering international relationships and establishing institutions that will strengthen other countries to address domestic crises (White House, 2002). The security documents published subsequently by the White House and Department of Defense (DoD) support the President's vision and expound on plans towards reaching the vision. Specifically, the *National Defense Strategy* establishes strategic goals for the armed forces and provides guidance for the *National Military Strategy* (*NMS*). The *NMS* specifies that the US will be involved in defense activities which promote favorable security conditions in its best interest. These activities build alliances and partnerships while developing the capabilities of other nations to defend themselves and while protecting the interests of the US. In promoting global security and stability, the US military establishes itself as a forward presence overseas. As a forward presence, the armed forces are involved in security cooperation activities to strengthen relations between the US and other nations. These activities have proven invaluable at a relatively small cost to the US (Joint Chiefs of Staff, 2004).

In addition, the *Medical Readiness Strategic Plan* supports these strategic documents as well as providing guidance for others (Department of Defense, ASDHA, 1998). In the *Medical Readiness Strategic Plan*, "The military medical departments exist to support their combat forces in war and in peacetime, to maintain and sustain the well being of the fighting forces in preparation for war" (1998, p. 23). Subsequently, the mission of the Military Health System (MHS) is, "to enhance the DOD and our nation's security by providing health support for the full range of military operations and sustaining the health of all those entrusted to our care" (US Fleet Forces Command, 2006,

p. 1). Wartime and peacetime operations range from major regional contingencies to military operations other than war (i.e., MOOTW).

Since the 1990s, the armed forces have been increasingly involved in MOOTW (Department of Defense, ASDHA, 1998). According to the *Naval Warfare Publication 3-07*, MOOTW, "encompasses all military operations short of major theater war." MOOTWs are conducted primarily to prevent war, promote peace, and support other nations during emerging crises (Department of the Navy, 1998). Per DoDD 3000.05 (Department of Defense, 2005), stability operations are central to US military missions in furthering the interests of the US. Of mutual benefit, the host nation receives security, support in rebuilding infrastructure, and humanitarian assistance. Under the different types of MOOTW, foreign humanitarian assistance (FHA) is carried out to alleviate the human suffering and deprivation which result from disasters (Joint Chiefs of Staff, 2001).

The Defense Security Cooperation Agency (DSCA) manages the Department of Defense's security cooperation programs in support of the strategic security objectives (Department of Defense, DSCA, 2006). Within the context of FHA, the Defense Security Cooperation Agency executes various assistance programs. The Humanitarian and Civic Assistance (HCA) program falls under the DSCA's Humanitarian and Mine Action programs (Department of Defense, DSCA, 2003). HCA activities are planned and must be performed in conjunction with military operations which promote the security interests of both the US and the host nation while simultaneously providing a training opportunity for service members to utilize their operational readiness skills. Medical, dental, and veterinary services are provided as part of the HCA. In addition to these primary mission objectives, other activities such as the construction of transportation systems, sanitation facilities, and public facilities are also performed, which provide secondary benefits to the host nation (Department of Defense, 1994).

The HCA program is carried out in the Stability, Security, Transition, and Reconstruction Operations (SSTRO) and is part of a Combatant Commander's (COCOM) theater security cooperation plan (TSCP) (Fleet Operational Health Concept of Operations, 2006). These operations lay the foundation for deterring aggression, strengthening alliances, and facilitating diplomacy (Department of Defense, DSCA, 2006). The SSTRO are given similar priority as combat missions (Department of Defense, 2005). The SSTRO include responding to disaster emergencies to improve health conditions and prevent epidemics as well as conducting planned HCAs. The SSTRO demonstrates the US's willingness to assist other nations. The Health Support Services contribute to the Combatant Commanders' TSCP by conducting medical civic action programs (MEDCAPs) comprising of medical and dental services as part of the HCA as well as employing the hospital ships (US Fleet Forces Command, 2006).

To clarify the definition of humanitarian assistance, humanitarian assistance (HA) operations are conducted in response to disaster emergencies or endemic conditions. In contrast, HCAs are planned events performed in conjunction with military operations (Department of the Navy, 1998). The military, unlike any other association, has the organizational structure, trained personnel, available resources, and capability for rapid deployment to respond with humanitarian assistance or humanitarian and civic assistance programs for short durations. Civilian organizations have long been experts in humanitarian assistance. These organizations serve as excellent sources of information, usually lead humanitarian efforts, have established networks in various geographical locations, and manage long-term rehabilitation once the military presence has left. An interagency approach with host nations, international organizations, and non-governmental organizations (NGOs) is necessary to maximize resources and to continue efforts long after the military has terminated the mission (US Fleet Forces Command, 2006).

B. PROBLEM STATEMENT

Recently, military hospital ships have been tasked with humanitarian assistance and disaster relief missions (HA/DR) comprising of the Tsunami in 2005, Hurricane Katrina in 2005, and the USNS MERCY 2006 deployment. The Tsunami mission and the 2006 deployment have been part of the Theater Security Cooperation Plan for the Commander, US Pacific Command (PACOM). It has been implied that there will be future missions in conjunction with Stability, Security, Transition, and Reconstruction Operations involving the use of hospital ships. Each mission is unique and requires the tailoring of assets. Based on history, hospital ships provide both shipboard medical services and shore-based outreach programs such as MEDCAPs.

Currently, the manpower requirements for hospital ships are based on the wartime mission; the ships' capabilities are configured to provide combat casualty trauma care. Such manpower requirements and capabilities are not necessarily required by nor do they meet the objectives for humanitarian assistance operations. As it stands, manpower requirements have not been established for humanitarian assistance missions. Issues such as the ships' mission and capabilities, patient population, geographical location, and logistics influence the determination of manpower requirements.

C. PURPOSE OF THE THESIS

The main purpose of this thesis is to provide an initial framework for nursing manpower requirements planning for humanitarian assistance missions. To achieve this aim, three analyses are performed. The first provides a general overview of the T-AH platform and its manpower requirements, specifically with regard to the nursing manpower requirements. The second examines the medical mission of the USNS MERCY 2006 deployment to include the services delivered and the process for determining the nursing staffing requirements and the actual staffing used. The final develops a calculator to estimate current nursing manpower requirements which will serve as a template to assist in planning for future humanitarian assistance missions executed by hospital ships.

D. SCOPE OF THE THESIS

This thesis focuses on determining the nursing manpower requirements for humanitarian and civic assistance missions performed by Navy hospital ships. Disaster Relief missions are not included in this examination other than to serve as supporting information. The estimation calculator is based on a data analysis from the USNS MERCY 2006 deployment. The estimation of nursing manpower requirements will be based primarily on the shipboard inpatient requirements; however, additional nurse requirements will be identified for future research and development of the calculator.

E. METHODOLOGY

The research methodology consists of both qualitative and quantitative approaches. A comprehensive literature review is performed which includes doctrines, guidances, past studies on humanitarian missions, and nurse staffing models. The quantitative analysis includes conducting an Ordinary Least Squares regression analysis to estimate the length of stay for patient populations. Various model constructions will be reviewed, utilizing different patient controls and indicators in an effort to identify a reasonable estimation approach and to validate the integrity of the available empirical data. The results of this analysis will in turn be applied in the development of the staffing calculator. Furthermore, a Chi-square test will be applied to review the statistical significance between the observed patient ICD-9 classification frequencies in an effort to better understand the types of capabilities that a future mission should expect to provide. Lastly, a staffing estimation calculator will be developed utilizing Excel software to identify nurse staffing requirements contingent on the underlying assumptions of the calculator and the characteristics of the proposed mission.

THIS PAGE INTENTIONALLY LEFT BLANK

II. T-AH PLATFORM OVERVIEW

A. CHAPTER OVERVIEW

This chapter provides a brief overview of the Navy's hospital ships—including the missions, operational status, and deployment history. The ships' operational profiles and clinical capabilities are discussed. The overall manpower requirements for staffing the hospital ships are presented. The Nurse Corps manpower requirements for the various operational profiles in support of the wartime mission are primarily examined. In conclusion, the critical wartime subspecialties of Nurse Corps officers are summarized in conjunction with the manpower requirements.

B. HOSPITAL SHIPS

The Navy's two hospital ships are the USNS MERCY (T-AH 19) in San Diego, California, and USNS COMFORT (T-AH 20) in Baltimore, Maryland. Commissioned in 1986 and 1987 respectively, these ships were converted San Clemente Class supertankers that now function as afloat medical treatment facilities. The two have similar characteristics and capabilities. Furthermore, the hospital ships are similar to any tertiary care hospital in the US. The ships have the capability of providing intensive combat casualty management through a range of surgical, medical, and support services and are designed for long-term operations of greater than 60 days that minimize the footprint of military forces on land. The Commander, Military Sealift Command, operates and maintains the ships with a civilian mariner crew. The Bureau of Medicine and Surgery (BUMED) is responsible for the operation of the medical treatment facility (MTF) and for staffing the MTF with military medical and non-medical personnel (Department of the Navy, OCNO, 2004). The hospital ships offer flexibility in responding to diverse military operations; their extensive clinical facilities can be tailored to meet different mission requirements.

1. Medical Mission

The Navy's hospital ships have two missions. The primary mission, "is to provide rapid, flexible, and mobile acute medical care to Marine, Army, and Air Force units deployable ashore, and to naval amphibious task forces and battle groups afloat" (Department of the Navy, OCNO, 2004, p. EX-1). In the OPNAVINST 3501.161C (Department of the Navy, OCNO, 1997), the secondary mission states, "the ships (with appropriate tailoring of manning, medical material/equipment and provisions) are capable of providing mobile surgical hospital service for use by US government agencies involved in disaster or humanitarian relief or limited humanitarian care incident to these missions or peacetime military operations." The majority of published doctrines, guidances, and instructions in regard to the T-AH platform pertain to the primary mission.

2. Operational Profiles

The capabilities for the two hospital ships are described by the Required Operational Capabilities (ROC) and the Projected Operational Environment (POE). The ROC, determined under readiness states, drives the manpower requirements for each hospital ship (Department of the Navy, OCNO, 1997). There are four general readiness states identified which specify the operational capabilities expected of the ship. Readiness State I supports the primary mission and constitutes full readiness in preparation for actual or imminent hostilities. In contrast, Readiness State II represents a tailored contingency readiness in preparation for actual or potential limited hostilities, while Readiness State III implies preparation for performing current operations utilizing modified assets (Department of the Navy, OCNO, 2004). Table 1 displays the ROC for Readiness States I-III, which represent the readiness states of greatest interest to this project. The information consists of the number of operating rooms and maximum bed capacity as well as the number of patients flowing through the system. However, additional information, including the type and severity of patients, would be valuable for more precise planning and more appropriate reconfiguration of medical resources. Readiness State IV, on the other hand, requires the capability of getting underway by conducting engineering dock and sea trials for training purposes and the testing of systems to ensure the capabilities of the hospital ship. Interestingly, the POE indicated that Readiness States II and III may be sufficient to support the secondary mission (Department of the Navy, OCNO, 1997). However, even under expeditionary warfare circumstances, only two operating rooms may be sufficient to support the required mission capabilities for military operations based on historical combat data. This argument stems from the nature of Post-Cold War conflicts, which are expected to be smaller in scale, thus leading to a smaller number of casualties (Department of the Navy, OCNO, 2004). The ROC/POE have not been updated since 1997 and require additional review to ensure that capabilities continue to support future military operations. Additionally, the ROC/POE should identify specifically the capability requirements for HA missions as these may result in an operational profile of less than four operating rooms and 250 beds.

Table 1. The Hospital Ship's Required Operational Capability (ROC) for Readiness States I-III

ROC	Readiness State I	Readiness State II	Readiness State III
No. of operating rooms	12	6	4
No. of post-surgical recovery beds	20	15	10
No. of intensive care beds	80	60	40
No. of intermediate beds	400	320	200
No. of minimal care beds	500	105	NA
Total beds	1000	500	250
Maximum patient flow	300 patients in 24 hours	150 patients in 24 hours	75 patients in 24 hours
Average patient flow	200 patients per day for 3 days	100 patients per day for 3 days	50 patients per day for 3 days
Sustained patient flow	100 patients per day	50 patients per day	25 patients per day
Patients assumed to require surgery	60 %	60 %	60 %

3. Echelon of Care

Health Support Services has shifted its focus from traditional combat care emphasizing post-casualty intervention to the prevention of casualties. The traditional echelons of care (Levels of Care) have been transformed to capabilities of care. The capabilities of care increase with sophistication of medical care. First-responder Capability (the former Level of Care I) requires initial stabilization of patients at the point of injury/illness. The next capability (the former Level of Care II) is Forward-resuscitative Care, in which patients are provided life- and limb-saving emergency medical treatment such as resuscitation and surgery close to the point of injury/illness. The Theater Hospitalization Capability (the former Level of Care III) provides a range of in-patient services such as emergency, surgical, primary care, dental, laboratory, and pharmacy within the theater of operations. The hospital ships and fleet hospitals provide this capability. The Definitive Care Capability (the former Levels of Care IV and V) provides acute, convalescent, restorative, and rehabilitative services in a fixed MTF outside of the theater of operations. Meanwhile, the En Route Care Capability provides medical treatment of patients along the continuum of capabilities of care during evacuation (US Fleet Forces Command, 2006).

4. Operational Status

The hospital ships are maintained in Reduced Operational Status (ROS) while in their layberths; a small crew consisting of civilian mariners and Navy MTF personnel support the ships at Readiness State IV. Upon receiving activation orders, the hospital ships transition from ROS to Full Operational Status (FOS) and can deploy within 5 days in support of the primary mission. The joint crew plays a critical role in activating the ship. The ROS Navy crew is responsible for the readiness and maintenance of the equipment, supply inventories, systems, and work areas within the medical treatment facility (Department of the Navy, OCNO, 2004). As for the secondary mission, additional lead time may be required to reconfigure the hospital and establish the staffing to support the military operation (Department of the Navy, OCNO, 1997).

5. Activation of the Hospital Ships to FOS

The Unified Commander typically makes the decision to employ the hospital ship in support of military operations and directs the Naval Component Commander to proceed. The Naval Commander, Fleet Forces Command or Commander, US Pacific Fleet (Commander in Chief of the US Atlantic Fleet or Pacific Fleet) submits a formal activation order to the Chief of Naval of Operations (CNO) and the Commander, Military Sealift Command. The activation order contains the ship's mission and port of departure information to facilitate the transition from ROS to FOS. The CNO then directs multiple commands to include Chief of BUMED to execute the activation plans to ready the hospital ship for deployment. The Fleet Commander directs when to deploy the hospital ship (Department of the Navy, OCNO, 1998a; Department of the Navy, OCNO, 2004).

6. Clinical Capabilities

Clinical capabilities consist of surgical services, medical services, and support services. Surgical services encompass a broad spectrum of specialties—including general surgery, cardiothoracic, plastic, orthopedics, and general dentistry. Medical services also offer multiple specialties such as internal medicine, intensive care, and psychiatry. Clinical support services consist of casualty receiving, in-patient services, radiological services, laboratory, central sterile supply, medical supply, pharmacy, physical therapy, dental services, optometry/lens lab, morgue, laundry, and two oxygen producing plants (Department of the Navy, OCNO, 2004). The hospital ship can be customized with additional or a different mix of resources—such as augmentation with pediatrics, gynecology and family medical services to perform similar functions as a community hospital if required by the mission. In achieving this range of clinical capabilities, a full complement of medical personnel is required.

C. MANPOWER REQUIREMENTS

1. THCSRR Model

During the 1990s, in an effort to reduce the Department of Defense's (DoD) total force structure of the services to an optimal size, two studies (the "733 Study" and "733U") were conducted to determine the total medical personnel requirements to support the wartime and peacetime missions (GAO, 1996). As a result of these studies, the Total Health Care Support Readiness Requirements (THCSRR) model was developed by Navy Medicine to determine and project its medical manpower readiness requirements to support the wartime and day-to-day operational support missions. Additionally, the number of personnel (as determined by these two missions) supports the third mission: peacetime beneficiary care (Weber, 1994). This model has been refined since its development to reflect changes in strategic planning and force structure by the DoD, the Joint Chiefs of Staff, and the services. THCSSR has the capability to generate new estimates of medical personnel readiness requirements as missions and policies change (Weber, 1994).

The Combatant Commanders-in-Chief (CINCs) develop operational plans (OPLAN) for each major theater war (MTW). As part of the operational planning, the CINC's planners determine the medical theater workload requirements. The goal is for the services to provide enough medical resources to support the MTWs. Planners use software tools to calculate the theater workload requirements. Some of the assumptions and planning factors include the population at risk, casualty rates for wounded in action and disease non-battle injuries, lengths of stay, and evacuation policy across the continuum of care. The bed requirements for the different Levels of Care or Capabilities of Care are then determined. Level III care platforms (consisting of hospital ships, fleet hospitals, and overseas MTFs) are responsible for meeting the theater workload requirements for populations of varying size and risk and varying casualty streams. It is difficult to determine the staffing requirements for these platforms mobilizing to uncertain environments. BUMED, N931, using THCSRR, determines the staffing packages down to the subspecialty level based on the ROC/POE for these platforms and opinions of subject-matter experts. These are then incorporated as part of the THCSRR wartime requirements (CNA, 2001). The process consists of the DoD providing an operational scenario. The number of beds are then estimated and allocated by platform, after which the staffing packages are developed. Essentially, the operational requirements drive the operational capabilities. Navy Medicine determines how to fill the requirements (Weber, 2007, February 16).

Each command has an Activity Manpower Document (AMD) which provides its allocation of manpower requirements and authorizations to perform its assigned mission, function, and tasks (MFTs) or the ROC/POE. This document provides detailed information on the USNS MERCY's active duty staffing requirements and billet structure for the medical treatment facility. The AMD is extracted from the Total Force Manpower Management System (TFMMS) database that maintains the total force manpower requirements (Department of the Navy, OCNO, 1998b). The overall manpower requirements for the MTF on the hospital ship are presented in Table 2 from the COMSCINST 5400.8A (Department of the Navy, CMSC, 1998). The manpower requirements are aggregated by line officers, staff corps officers, and enlisted personnel for each capability profile. These are the number and type of personnel required for the USNS MERCY to perform the capabilities under each readiness state. The ROS crew is assigned to the USNS MERCY as their permanent duty station. The critical core represents the essential compliment of personnel required for the activation of the MTF who are required to report within 24 hours of an activation order (Department of the Navy, CMSC, 1998). The number of operating rooms and beds required are dependent on the military operation. BUMED is responsible for augmenting medical and non-medical military personnel to the MTF. The primary sourcing command of these personnel for the USNS MERCY is Naval Medical Center San Diego, and for the USNS COMFORT is the National Naval Medical Center Bethesda. As for the secondary mission, BUMED collaborates with the Commander, Military Sealift Command and the Commander in Chief, US Atlantic Fleet or Pacific Fleet to determine the number and mix of personnel for actual staffing of the hospital ship (Department of the Navy, OCNO, 1998a). Medical and non-medical personnel at sourcing commands are assigned a component unit identification code identifying their operational platforms. This assignment process establishes manning of the platforms (Bureau of Medicine and Surgery, 2000).

Table 2. MTF Activity Manpower Document (AMD) Summary

	ROS-5	Critical Core	Readiness State III: 250 BEDS / 4 Ors	Readiness State II: 500 BEDS / 6 Ors	Readiness State I: 1000 BEDS / 12 ORs
Line Officers	0	6	6	6	6
Medical Corps	0	10	40	54	66
Dental Corps	0	0	2	4	4
Med. Svc. Corps	3	11	17	20	20
JAG Corps	0	0	1	1	1
Nurse Corps	2	21	87	130	168
Supply Corps	1	5	5	5	5
Chaplain Corps	0	0	2	2	2
Non-Med Enlisted	25	131	238	242	244
Medical Enlisted	27	124	339	485	698
Total	58	308	737	949	1214

*table adapted from COMSCINST 5400.8A (Department of the Navy, CMSC, 1998).

2. Nurse Corps Requirements

Nurse Corps (NC) officers are integral members of the Navy Medical team supporting the warfighter. NC requirements for the T-AH platform have been identified through the THCSRR model. The requirements indicate the number and specialty mix of nurses needed to provide in-patient clinical services. As mentioned previously, requirements can be reviewed in the AMD. In the AMD, every officer manpower requirement is first identified by the designator code which denotes the specialty qualification of an officer. For example, all Nurse Corps (NC) officers are identified by the designator code of 2900. The Navy Officer Billet Classification (NOBC) codes distinguish the area of specialization and general duties of the requirement. For instance, the NOBC of 0944 is designated for a staff nurse, and 0904 identifies a critical care nurse. Subspecialty Codes (SSP) are assigned to the requirement to specify additional qualifications beyond those indicated by the designator code and NOBC code (Navy Personnel Command, 2006, October). On the personnel side, the subspecialty code system accounts for each officer's education, training and specialty experiences. The system serves as a tool to identify nursing skills in the personnel inventory and is used for comparing the personnel inventory to the mission requirements. Subspecialty codes are maintained in the Bureau of Medicine and Surgery (BUMED) Manpower Information System (BUMIS), and data feeds update the Bureau of Naval Personnel (BUPERS) Officer Personnel Information System (OPINS). In Table 3 the NC requirements for the T-AH platform are displayed by the NOBC and SSP codes.

Table 3. Active Duty Nurse Corps T-AH Platform Billets by Specialty from the Activity Manpower Document

Subspecialty NOBC/SSP	Critical Core	250 Beds	500 Beds
Clinical Specialist 0925/1910	1	3	3
Critical Care Nursing 0904/1960	4	20	33
Emergency Nursing 0906/1945	3	13	13
Medical-Surgical Nursing 0944/1910	4	29 includes 2 psychiatric nursing billets	48 includes 3 psychiatric nursing billets
Nurse Anesthetist 0952 /1972	2	4	7
Nurse Practitioner 0963/1976 and 1981	0	2	2
Perioperative Nursing 0932/1950	4	13	21
Education and Training Management 3215/3150	1	1	1
Director	2	2	2
Total Nurse Corps billets	21	87	130

A brief description is provided for each NOBC and SSP identified in the nursing requirements for the T-AH platform (Navy Personnel Command, 2006, October; Navy Nurse Corps, 2005). NC officers holding any of these NOBC/SSP codes practice in a variety of settings—including military treatment facilities, clinics, fleet hospitals, and hospital ships. It is important to note that the NOBC 0944 Professional Registered Nurse is designated as a general staff nurse performing direct nursing care. The 0944 code is associated with several subspecialty codes. The following subspecialties are critical wartime requirements to support the primary mission aboard the USNS MERCY and USNS COMFORT.

- NOBC 0904 / 1960 SSP Critical Care Nurse. The nurse provides highly specialized nursing care for life-threatening illnesses in both intensive and post-anesthesia care units.

- NOBC 0906 / 1945 SSP Emergency/Trauma Nurse. The nurse provides emergency/trauma nursing care consisting of triage, emergency, or restorative for acute, life-threatening injuries and illnesses in emergency departments or casualty receiving areas.

- NOBC 0932 / 1950 SSP Perioperative Nurse. The nurse provides nursing care to surgical patients in the preoperative, intraoperative, and postoperative phases.

- NOBC 0952 / 1972 SSP Nurse Anesthetist. The nurse anesthetist administers general and regional anesthesia to patients of all ages and conditions undergoing a variety of surgical and medical procedures, treating patients with acute or chronic pain, and women in childbirth.

- NOBC 0925 Clinical Nurse Specialist. The nurse holds a specialized Master's degree in a specific nursing discipline. The nurse functions in a consultant role to the nursing staff in the area of specialization and is involved in research. Specialization can be in any nursing discipline such as critical care, emergency/trauma, medical-surgical, and pediatrics.

- NOBC 0944 / 1910 SSP Medical-Surgical Nurse. The nurse provides nursing care to patients with acute or chronic disease conditions, surgical interventions, or terminal illnesses.

- NOBC 0944 / 1930 SSP Psychiatric/Mental Health Nursing. The nurse provides nursing care for patients with psychiatric disorders and substance abuse.

- NOBC 3215 / 3150 Education and Training Management. This NC officer holds a Master's degree and is responsible for the management and development of education and training programs for his/her respective command to meet the Navy's education and training requirements.

The nature of wartime vice HA missions are somewhat different and, therefore, should have different manning requirements. Due to the non-intensive combat casualty management nature of HA missions, based on historical data, and as a result of lessons learned from previous missions, the following subspecialties are identified as important manpower requirements for an HA mission (Comlish, 2007; Morrow & McGrady, 2006, November; Nebelkopf, 2006, September). Further analysis will be provided later in this research to provide more thorough recommendations concerning these manpower requirements. At the present time, there are no true wartime requirements for nurse practitioners. The nurse practitioners serve as substitutes for various subspecialties such as critical care, medical-surgical, maternal/infant health, or pediatrics.

- NOBC 0944 / 1920 SSP Maternal/Infant Health Nursing. The nurse provides nursing care to women in the antepartum, intrapartum, and postpartum phases as well as care to their newborns.

- NOBC 0944 / 1922 SSP Pediatric Nursing. The nurse provides nursing care to the pediatric population with acute or chronic disease conditions, surgical interventions, or terminal illnesses.

- NOBC 0944 / 1940 SSP Community Health Nursing. The nurse practices a combination of nursing and public health disciplines to promote and maintain community health through population-based programs.

- The NOBC 0963 Primary Care Nurse Practitioner. This NOBC identifies a general nurse practitioner which provides comprehensive health care and health maintenance to specific patient populations. This NOBC is associated with the subspecialties 1974, 1976, 1980, and 1981. These practices include "independent and interdependent decision-making and direct accountability for clinical judgment" (Navy Nurse Corps, 2005).

- NOBC 0963 / 1974 SSP Pediatric Nurse Practitioner. The pediatric nurse practitioner provides primary care to children.

- NOBC 0963 / 1976 SSP Family Nurse Practitioner. The family nurse practitioner provides primary care to individuals and families throughout their lifetime and across the health spectrum.

- NOBC 0963 / 1980 SSP Women's Health Practitioner. The women's health practitioner provides primary care to healthy women and their babies in the field of obstetrics and gynecology with emphasis in well-woman gynecology.

- NOBC 0963 / 1981 SSP Nurse Midwife. The nurse midwife provides primary care to healthy women and their babies in the field of obstetrics and gynecology with emphasis in prenatal care, labor and delivery management, and postpartum care.

3. Deployment History of the Hospital Ships

Both hospital ships have been deployed in a variety of missions and to a variety of geographical locations. These missions have included supporting international humanitarian assistance and disaster relief operations, domestic relief, wartime operations, and training exercises. As history demonstrates, the hospital ships have been used more for unique missions than to provide surgically intensive trauma support, which is its primary mission. The following section summarizes the deployment history for both ships.

a. USNS MERCY's Deployment History

Since its commission in 1986, the USNS MERCY first deployed in 1987 on a humanitarian mission to the Philippines, where the ship's medical personnel treated 1,000 in-patients and saw 62,000 out-patient visits from February to July. In 1990-1991, the ship deployed to support Operation Desert Shield/Storm and provided medical care to 690 admitted patients and performed 300 surgeries. In 1997, the ship participated in Kernel Blitz amphibious exercises conducted in southern California (GlobalSecurity.org, n.d.). In 2005, the ship deployed to support Operation Unified Assistance I for tsunami relief in Banda Aceh, Indonesia, with a capability of 2 operating rooms, 100 beds and 10 intensive-care beds. The capability for this mission is an example which is not covered in Readiness States I-III. The ship's medical personnel treated 176 patients shipboard with only 7 tsunami-related cases; 135 were regular surgical patients, and 34 were regular medical patients. A total of 295 surgical procedures were performed. In addition, medical personnel saw 1,703 patients on shore in the local hospitals, with the majority being patients seeking prescriptions or eye care (Morrow & McGrady, 2006, November). While MERCY was in the area, Nias, Indonesia, suffered an earthquake; immediately, Operation Unified Assistance II was initiated. Medical personnel treated 95 patients onboard the ship, 47% of which had earthquake-related injuries requiring surgery; 53% had conditions unrelated to the earthquake. Of the 53%, half had surgery primarily for removal of masses and the other half were medical patients (McGrady, 2006, November).

b. USNS COMFORT Deployment History

The USNS COMFORT has been deployed on support missions since 1990. In 1990-1991, the ship supported Operation Desert Shield/Storm. The ship's medical personnel provided medical care to 700 admitted patients, performed 337 surgical procedures, and saw 8,000 outpatient visits from September to March. In 1994, during Operation Sea Signal, the ship deployed with the capability of one operating room and 50 in-patient beds to provide basic medical support and serve as a migrant processing center for the Haitians. Also, in 1994 during Operation Uphold Democracy, the ship deployed with a 250-bed capability to provide medical and surgical support to US and allied forces and emergency care to the Haitians. In 1998, during the Baltic Challenge, the ship participated in a multinational exercise involving 11 countries to, "improve cooperation peace support operations" (USNS COMFORT, n.d.). In 2001, during Operation Noble Eagle, the ship deployed to the New York Harbor with a 250-bed capability. However, the ship's personnel ultimately provided respite services and basic medical care to disaster relief workers after the 9/11 attack. The ship had 561 clinic visits for minor care and conducted 500 mental health consultations during the mission. In 2002, during Medical Central Europe (MEDCEUR 02), the ship conducted training exercises concentrating on, "humanitarian assistance, disaster relief, and joint medical operations" involving Lithuania, Latvia, Estonia, Poland, Germany, Sweden, the United Kingdom, and the United States. In addition, the ship saw 700 patients from the Baltic nations during these exercises. In 2003, during Operation Enduring Freedom/Operation Iraqi Freedom, the ship's medical personnel provided medical care to 700 patients and performed 590 surgical procedures in 56 days (USNS COMFORT, n.d.). In 2005, during Hurricane Katrina Relief Operations, the ship was deployed with a 250-bed capacity to provide medical care in the relief and recovery operations in the affected region. While in Pascagoula, Mississippi, 1,259 patients were treated shipboard with 3.2% being admitted. Additionally, over 8,000 patients were seen in shore-based activities. While in the port of New Orleans, Louisiana, a total of 102 patient encounters were seen onboard with 20.6 % admitted during the 12 days in port (Nebelkopf, 2006).

c. Deployment Obeservations

The review of the deployment history illustrates that the planned staffing requirements for a specific mission varied drastically from what was needed in the actual mission and capacity served. In the wartime mission, Operation Desert Storm/Shield, the low volume of incoming combat casualties resulted in the hospital ships' personnel practicing community medicine for the majority of patients treated onboard (Department of the Navy, OCNO, 2004). In the domestic disaster relief mission, Hurricane Katrina, there was more of a need for pediatricians and family medicine physicians in Pascagoula than a surgically intensive MTF. Of all patients treated there, 30.6 % were for miscellaneous/administrative/follow-up which consisted of medication refills and immunizations, while the next significant categories were respectively medical/surgical, respiratory, and injuries (other). In New Orleans, of the 102 patients treated on the ship, 25% were for routine and emergency dentistry, 20% for injury (other), and 10% for injuries from motor vehicle accidents—indicating a need for more dentists and emergency physicians in this type of mission (Nebelkopf, 2006). However, the number of patient encounters onboard the ships as well as the relatively brief duration of the mission may not justify increasing the numbers of these types of physicians. In international disaster relief, Operation Unified Assistance I and II, once again a surgically intensive MTF was not indicated based on the numbers of patients treated for disaster-related injuries and conditions. Clearly, the overall picture of the health care needs of a population is difficult to determine if such an assumption is just based on the numbers and types of patients treated or the number of surgical operations performed. It is important to consider that many different factors and conditions influence both how the ships are utilized as well as the types and numbers of patients treated shipboard (Seifert, 2006).

THIS PAGE INTENTIONALLY LEFT BLANK

III. MEDICAL MISSION ANALYSIS

A. CHAPTER OVERVIEW

This chapter summarizes the USNS MERCY 2006 deployment. The shore-based and shipboard missions are discussed. In addition, data from patient encounters for the MEDCAPs and shipboard surgical services are examined. The evaluation of staffing is mainly focused on nurse staffing for this humanitarian mission. The composition of nurse staffing for active duty nurses and nurses from NGOs are presented. Finally, the methodology and assumptions in determining in-patient staffing are reviewed.

B. MEDICAL MISSION

In 2006, the Secretary of Defense authorized the deployment of forces to support the Theater Security Cooperation Plan (TSCP) and Humanitarian Assistance Operations (HA) of the Commander, US Pacific Command (PACOM). In conjunction with the TSCP, the USNS MERCY deployed from April to September to provide humanitarian assistance to medically underserved populations in the PACOM area of responsibility (AOR) (Naval Health Research Center, 2006a). The PACOM Commander's purpose was "to send a strong message of U.S. compassion, support and commitment to the Pacific region by leveraging and continuing the goodwill developed during the Unified Assistance" (Bureau of Medicine and Surgery, February 2006). A concept of operations (CONOPS) was established to provide an overall picture of and outline the Commander's intent for this deployment. According to the USNS MERCY's CONOPS, there were three underlying assumptions of the mission, including: supporting the ashore HA activities, providing out-patient and in-patient shipboard health services support, and partnering with NGOs (Bureau of Medicine and Surgery, February 2006). These assumptions are important for a number of reasons. For one, establishing a partnership with NGOs is valuable to the Navy because NGOs have expertise in humanitarian assistance; in addition, the utilization of the professional skill sets of their volunteers augments the skills sets of the medical forces. The CONOPS also delineated the medical capabilities necessary during the deployment, comprised of: general and specialty surgical services, primary care and consultative services for adults and pediatrics, obstetrical/gynecological consultative services, dental care, ophthalmology and optometry services, immunization services, and educational services for the host nation. Furthermore, the crew size and surgical procedures based on minimal staffing requirements are outlined in the CONOPS (Bureau of Medicine and Surgery, February 2006).

The PACOM's AOR consists of the Asian-Pacific region. The 2006 deployment of the USNS MERCY involved visiting the following destinations: Zamboanga, Republic of the Philippines (RP); Jolo Island, RP; Tawi Tawi, RP; Chittagong, Bangladesh; Simeulue Island, Indonesia (ID); Nias Island, ID; Banda Aceh, ID; Tarakan, ID; Kupang, West Timor, Indonesia; and Dili, Timor-Leste, Democratic Republic of East Timor (see Appendix A, Map dated April 3, 2006). This humanitarian deployment also consisted of returning to the area devastated by the 2005 Tsunami. A brief summary is presented highlighting the health status and statistics of each country served during the mission (see Table 4 to follow). Aggregate information of this nature is helpful in identifying major health problems and significant underlying health-service needs of the host nations, both of which are important and valuable perspectives when planning for medical missions in humanitarian assistance operations.

C. BACKGROUND ON COUNTRIES

1. Republic of the Philippines

The Republic of the Philippines has a population of approximately 85 million people, 30.4 % of whom are poor and living in rural areas. At 24.09 births per 1000 population, this country has one of the highest birth rates in Asia while at the same time suffering from one of the highest maternal mortality rates. The population growth rate is 2.36% annually. The population distribution consists of 34.8% of population aged between 0-14 years, 4.2% of the population aged over 65 years, and an approximately equal population proportion of males and females. Interestingly, the literacy rate is over

90%. Health services are decentralized in the country, with a health system consisting of provincial and district hospitals managed by the provincial governments and rural health units, as well as health stations, managed by municipal governments. Consequently, inhabitants living in rural areas have difficulty accessing and paying for health services. When payments for health services are made, approximately 60% of the expense is out-of-pocket. Additionally, the migration of doctors and nurses from rural to urban areas is a major health-system issue that results in even less care availability to the poor in rural regions. The leading causes of death in the country include heart disease, strokes, cancer, accidents, chronic obstructive pulmonary disease, diabetes mellitus, and kidney disease. Many of these diseases are the result of poor lifestyle choices such as tobacco use, unhealthy diets, and physical inactivity. As for communicable diseases, tuberculosis remains prevalent in the Philippines (World Health Organization, 2006).

2. Indonesia

Indonesia has a population of approximately 210 million, 27% living below the national poverty level, with the majority of the population living in rural areas. This country experiences an annual population growth rate of 1.14%. The population distribution consists of 30.77% of the population aged 0-14 years and 4.61% of the population aged over 65. The male and female population proportion is about equal, and the country demonstrates a male literacy rate of 93.4% and a female literacy rate of 85.5%. Both human and nature-inflicted hardships plague the country. Over one million women and children have been displaced due to armed conflicts and violence in a country that is also prone to natural disasters such as earthquakes and floods. The health system in sub-districts for both rural and urban areas consists of at least one health center headed by a physician with an additional two or three sub-centers staffed primarily by nurses. Family health posts are located at the village levels; these offer preventative and health-promotion services. The promulgation of clean water sources is identified as a major health priority while maternal health is a significant concern in rural areas due to lack of skilled birth attendants. Major health problems such as tuberculosis and malaria are endemic to the area. Cardiovascular diseases and tuberculosis are the leading causes of death in the country (WHO, 2004b).

3. Bangladesh

Bangladesh has a population of approximately 129 million people with 50% of the population being poor. The country has a 1.51% population growth rate. The population distribution consists of 40.0% of the population aged 0-14 years and 5.9% of the population aged over 65 years. The male and female population distribution is about equal, with literacy rates of 71.9 and 62.2% respectively for males and females. The health system structure consists of health and family welfare centers, health complexes, and district general hospitals. Maternal mortality is a problem in this country. Endemic diseases such as tuberculosis, malaria, and leprosy are major health problems in Bangladesh, and common diseases such as acute respiratory infection account for 33% of deaths under the age of 5 years. Cancer and cardiovascular diseases are the leading causes of death (WHO, n.d.).

4. Democratic Republic of Timor-Leste

Timor-Leste has a population of 947,000 people with over 40% of the population living in poverty. The population growth rate is 3.93% annually. Interestingly, although the male to female distribution is approximately equal, the population is noticeably young—with 48.1% of the population under 17 years of age. Furthermore, 46% of the population over the age of 11 years is illiterate. The country became an independent nation in 2002 after many years of occupation and armed conflict. However, in 2006 the country was once again plagued with unrest and violence. As a result, the health infrastructure was severely damaged as many health care workers have, consequently, left the region. The health system structure consists of hospitals, community health centers, and health posts. The main health problems consists of high infant and maternal mortality rates, maternal and child malnutrition, common childhood illness such as acute respiratory and diarrheal diseases, endemic diseases such as tuberculosis, malaria, and leprosy, low immunization coverage, and the lack of safe drinking water. Communicable diseases account for 60% of deaths (WHO, 2002).

Table 4 displays the vital statistics for each country for comparison (WHO, 2004a-e). There are a few observations worth mentioning. A healthy life expectancy for an adult in Bangladesh and Timor-Leste is lower than in the two other countries. Additionally, these two countries have higher child mortality for children less than 5 years of age. As for Timor-Leste, the 9.6% total health expenditure of GDP is more than likely based on the need to rebuild the health system infrastructure after the destruction and damage in the recent years. In comparing the number of doctors and midwives (per 1000 population), Indonesia and Timor-Leste have a higher ratio of midwives. Lastly, in Bangladesh, the number of midwives is higher than nurses.

Table 4. Country Statistics

Country Statistics	Philippines	Indonesia	Bangladesh	Timor-Leste
Life expectancy at birth m/f	65.0/72.0	65.0/68.0	62.0/63.0	61.0/66.0
Healthy life expectancy at birth m/f	57.1/61.5 (2002)	57.4/58.9 (2002)	55.3/53.3 (2002)	47.9/51.8 (2002)
Child mortality under 5 m/f (per 1000)	40/28	41/36	81/73	91/69
Adult mortality m/f (per 1000)	260/149	239/200	251/258	267/184
Total health expenditure as % of GDP	3.2 (2003)	3.1 (2003)	3.4 (2003)	9.6 (2003)
Physicians (total)	44,287 (2000)	29,499 (2003)	38,485	79
Physicians (per 1000 population)	0.58 (2000)	0.13 (2003)	0.26	0.10
Nurses (total)	127,595 (2000)	135,705 (2003)	20,334	1,468
Nurses (per 1000 population)	1.69 (2000)	0.62 (2003)	0.14	1.79
Midwives (total)	33,963 (2000)	44,254 (2003)	26,460	327
Midwives (per 1000 population)	0.45 (2000)	0.20 (2003)	0.18	0.40

Note: Estimates are for 2004 unless otherwise indicated. The information is compiled from individual country statistics (WHO, 2004a-e).

D. MEDICAL SERVICES ASHORE

Shore-based primary medical services and surgical services were provided at each host nation. MEDCAPs and outreach programs staffing the host nation's medical facilities with USNS MERCY staff were the two shore-based activities conducted. MEDCAPs were provided by outreach teams, sometimes called expeditionary teams. MEDCAPs were coordinated between the personnel of the USNS MERCY and the host nation. The number of MEDCAPs varied at each host nation and required daily planning as each one had different logistical requirements. The USNS MERCY provided the medical personnel and supplies for these shore activities.

1. Patient Encounters

During the 2006 USNS MERCY deployment, a total of 9,508 patient visits were conducted in MEDCAPs. The majority of these patient visits, 62.3%, occurred in Tawi Tawi, Kupang, and Tarakan. Table 5 displays a summary of the total patient visits aggregated by the International Classification of Diseases, 9th Revision, Clinical Modification codes (ICD-9-CM) (see Appendix B for MEDCAP patient data by location). There were three primary diagnosis categories of patients seen: 19.9% were diagnosed with diseases of the respiratory system, 11.7% with symptoms, signs, and ill-defined conditions, and 10.7% with diseases of the musculoskeletal system and connective tissue. ICD-9 codes were not assigned for 22% of patient visits, which are accounted for by physical exams, immunizations, and unidentifiable diagnoses (NHRC, 2006a). The Naval Health Research Center (NHRC) obtained the data from the daily mission briefs prepared during the deployment, aggregated the data and assigned ICD-9 codes based on the patient diagnoses recorded by physicians. Demographics of patients seen in MEDCAPs were unavailable, and dental and optometry services were not included in the data.

Table 5. Summary of Patients Treated in MEDCAPs by ICD-9 Categories
(adapted from NHRC, 2006a)

ICD-9 Category	No.	%
Congenital anomalies	22	*
Diseases of the blood and blood-forming organs	2	*
Diseases of the circulatory system	334	3.5
Diseases of the digestive system	780	8.2
Diseases of the genitourinary system	477	5.0
Diseases of the musculoskeletal system and connective tissue	1017	10.7
Diseases of the nervous system and sense organs	244	2.6
Diseases of the respiratory system	1894	19.9
Diseases of the skin and subcutaneous tissue	389	4.1
Endocrine, nutritional and metabolic diseases and immunity disorders	292	3.1
Infectious and parasitic diseases	561	5.9
Injury and poisoning	198	2.1
Mental disorders	19	*
Neoplasms	75	*
Signs, symptoms, and ill-defined conditions	1108	11.7
No Code Assigned**	2096	22.0
Total patients seen	9508	

Note: 1. * indicates negligible numbers of patients with recorded diagnoses.

2. ** indicates no ICD-9 code assigned due to lack of standardized terminology for diagnosis or illegible documentation of diagnosis.

2. Staffing Composition of MEDCAP Teams

Due to the operational nature of the MEDCAP, there are a number of staffing elements required to compile a team. The teams were comprised of the following functional areas: command and control, clinical, pharmacy, dental, optometry, immunizations, and force health protection. The command and control functional area consisted of personnel such as the officer-in-charge, assistant officer-in-charge, logistics, communications, public affairs, and patient administration. The clinical functional area was staffed on average with nine personnel consisting of primarily physicians of varying specialties and, occasionally, a family nurse practitioner. Generally, two nurses assisted in the immunization functional area—for an average of seven personnel staffing this area (NHRC, 2006b). Besides working in immunizations, nurses managed the patient flow through the designated out-patient clinics (Comlish, 2007). Force health protection consisted of security personnel. The teams were staffed primarily with military personnel and augmented with personnel from NGOs. The average outreach team consisted of 44 personnel, with team sizes ranging from 24 to 55 personnel on any given expedition (NHRC, 2006b).

3. Outreach Program in the Host Nation's Medical Facility

Medical services were coordinated with the Host Nations to staff local hospitals with USNS MERCY personnel. However, these activities varied at each location, and the physicians were of varying specialties. In general, nurses were not used for these activities except for administering immunizations or performing training. The outreach program recorded about 19,000 patient visits during the 2006 deployment. The majority of patients, 73%, were seen for primary health care needs. The specialties of orthopedics and mental health each saw approximately 2% of the total number of patients (NHRC, 2006a). For the purpose of this thesis, this program and data specifics were not examined closely.

E. MEDICAL SERVICES SHIPBOARD

Surgical services were the primary mission aboard the USNS MERCY at each location. Surgical and medical care was provided to in-patients onboard the hospital ship. Typically, patients requiring internal medicine services such as diabetics are not treated aboard the hospital ship in this type of humanitarian mission because these patients require long-term management, and the ship is only at a location for a short duration. There were also some patients worked up for surgery, although surgery would be performed by the host nation or elsewhere. Additionally, a number of patients were served with diagnostic procedures; in this way, the MERCY crew assisted the host nation physicians in diagnosing and determining treatment. Many surgical cases were at least an overnight stay or two-day stay because the patients required preoperative testing and post-surgical care (Comlish, 2007).

Each host nation's local hospital personnel referred surgical candidates to the USNS MERCY. The USNS MERCY personnel further screened the patients as surgical candidates. The resulting surgical workload was based on patient need, available resources, and the ship's length of stay at each location (NHRC, 2006a). The arrival and exit dates were factored into the case load and discharge planning (Comlish, 2007). A total of 5,327 patients were screened for surgical services, with 1,144 screened for pediatric surgery, 3,806 for general surgery, 286 for plastic surgery, and 91 for oral maxillofacial surgery. The largest number of patients screened for surgery was in Zamboanga, where a total of 1,725 individuals were reviewed for surgical candidacy (NHRC, 2006a).

1. Patient Encounters

The active duty and NGO physicians aboard the USNS MERCY performed 502 surgeries from May through July in the 2006 deployment. The data for actual surgeries performed in Tarakan, Kupang, and Dili were not available. Table 6 summarizes the characteristics of the surgical patients. The distribution of male and female patients was nearly equal. Overall, the pediatric/adolescent populations under the age of 19 years comprised 37.2% of the patient population, with 29.1% of those patients being under the age of 10 years. Patients over 50 years of age represented 23.3% of the surgical cases. Overall, 14.9% of the patients received two surgical procedures, and 5% received three or more procedures. The majority of patients, 80.3%, had general anesthesia administered during the surgeries (NHRC, 2006a).

Table 6. Characteristics of Surgical Patients aboard the USNS MERCY (adapted from NHRC, 2006)

Characteristic	No.	%
Gender		
Female	238	47.4
Male	264	52.6
Age in years		
0-4	86	17.1
5-9	44	8.8
10-19	56	11.2
20-29	55	11.0
30-39	67	13.3
40-49	76	15.1
≥50	117	23.3
Unknown	1	0.2
Location		
Zamboanga	89	17.7
Jolo Island	82	16.3
Tawi Tawi	61	12.2
Bangladesh	56	11.2
Simeulue Island	46	9.2
Nias	84	16.7
Banda Aceh	84	16.7
Total surgeries	502	

Table 7 summarizes the ICD-9 categories of surgical patients treated from May through July 2006 (see Appendix C for surgical patient data by location). Four ICD-9 categories were identified as containing 71% of the surgical patients based on the primary diagnoses. These consist of congenital anomalies, diseases of the digestive system, diseases of the nervous system and sense organs, and endocrine, nutritional and metabolic diseases, and immunity disorders. The category of congenital anomalies involved surgical repairs of cleft lips and palates, while the category for diseases of the digestive system included patients with hernias. In contrast, the category for diseases of the nervous system and sense organs included patients with cataracts, while a goiter was a common patient condition of those identified in the endocrine, nutritional and metabolic disease, and immunity disorders classification. Furthermore, a second diagnosis was recorded for 6.4% of the 502 surgical patients. The second diagnoses primarily involved the diseases of the genitourinary system, diseases of the skin and subcutaneous tissue, and dental examinations (NHRC, 2006a). NHRC obtained the data from the deployment surgical log recorded on an Excel workbook. Additionally, NHRC aggregated the data and assigned ICD-9-CM codes.

Table 7. Primary and Secondary ICD-9 Diagnoses among Surgical Patients Treated aboard the USNS MERCY during a Humanitarian Mission, May-July 2006 (NHRC, 2006a)

ICD-9 Group Description	Primary diagnosis (n = 502)		Secondary diagnosis (n = 32)	
	No.	%	No.	%
Congenital anomalies	105	20.9	1	3.1
Diseases of the blood and blood-forming organs	0	0.0	1	3.1
Diseases of the circulatory system	2	0.4	1	3.1
Diseases of the digestive system	81	16.1	0	0.0
Diseases of the genitourinary system	31	6.2	15	46.9
Diseases of the musculoskeletal system and connective tissue	17	3.4	1	3.1
Diseases of the nervous system and sense organs	80	15.9	1	3.1
Diseases of the respiratory system	3	0.6	0	0.0
Diseases of the skin and subcutaneous tissue	6	1.2	4	12.5
Endocrine, nutritional and metabolic diseases, and immunity disorders	91	18.1	0	0.0
Injury and poisoning	24	4.8	2	6.3
Neoplasms	28	5.6	0	0.0
Signs, symptoms, and ill-defined conditions	33	6.6	0	0.0
V72.2 dental examinations	1	0.2	6	18.8

2. Staffing Composition for Shipboard Services

This section discusses the nursing component of staffing aboard the USNS MERCY. The nurses consisted primarily of active duty Navy and volunteers from NGOs. There were 37 active duty nurses deployed and 44 nurses from participating NGOs. The Navy mainly partnered with the non-governmental organization, Project Hope. However, other NGOs included Aloha Medical Mission, International Relief

Team, and Save the Children. Under the Nursing Directorate, nurses were assigned to the casualty receiving area (CASREC), the intensive care unit (ICU), and the medical-surgical wards based on the individual's professional nursing specialty experience. The ICU, instead of the post anesthesia care unit (PACU), was used for surgical recoveries. Perioperative nurses were assigned to the Surgical Department within the Surgical Services Directorate. Specialty experience included critical care, emergency/trauma, perioperative, medical-surgical, nurse anesthetist, nurse practitioners in family health and midwifery, community health, and education. As for the leadership structure, the director of nursing services (DNS) was the senior nurse assigned to the USNS MERCY as a primary duty station, and military nurses were assigned as division officers for each functional area. Additionally, there were limited instances of nurses from Project Hope who had prior military experience and had deployed for the 2005 Tsunami who were placed in division officer roles.

Although the data do not indicate nurses with maternal/infant specialty experience, the lessons learned for the mission indicated there were nurses with this type of experience for in-patient care and support of education missions ashore (NHRC, September 2006). The participating family nurse practitioners and midwife could have accounted for this experience. The personnel data from the MERCY crew database was aggregated by NHRC (September 2006). However, with regard to departmental assignments, the data do not necessarily specify job assignments clearly; therefore, these details are not discussed.

3. Composition of Nurses from NGOs

Table 8 demonstrates the distribution of nurses from NGOs by location. As shown, the majority of nurses came from Aloha Medical Mission and Project Hope. The TZU CHI organization participated only in Zamboanga, while the Save the Children organization had two community health nurses participating in Jolo and Tawi Tawi. The International Relief Team provided a variety of nurses in Nias and Banda Aceh. More generally, at Banda Aceh, there were nurses from several organizations participating in the mission. Nurses from NGOs supported the humanitarian mission across all locations (NHRC, 2006b).

Table 8. Total Number of Nurses from NGOs Participating Aboard the USNS MERCY at Each Location Visited during Deployment

NGOs	Zamboanga	Jolo	Tawi Tawi	Chitta-gong	Simeulue	Nias	Banda Aceh	Tarakan	Kupang	Dili
Aloha Medical Mission	3	3	3	1	2	3	1		1	2
International Organization for Banda Aceh							1			
International Organization for Migration							2			
International Relief Team						6	5			
Project Hope	9	9	9	10	10	8	15	9	9	9
Save the Children		2	2							
TZU CHI	10									
Total	22	14	14	11	12	17	24	9	10	11

Note: The total numbers of nurses are not summed over the locations per NGO because nurses may have served at multiple locations.

Table 9 provides the nurse subspecialties by location. It is important to note that the nurses from the NGOs embarked and disembarked at different points during the deployment. As shown, a wide range of specialty experience from the associated organizations covered all functional areas of the hospital ship, thus supplementing the active duty staff. The ward nurses are tabulated by their respective professional nursing subspecialty.

Table 9. Total Number of Nurses by Subspecialty from NGOs Participating Aboard the USNS MERCY at Each Location Visited during Deployment

Nursing Subspecialty	Zamboanga	Jolo	Tawi Tawi	Chittagong	Simeulue	Nias	Banda Aceh	Tarakan	Kupang	Dili
Critical Care	1	1	1				1	1	1	1
Community Health		2	2	2	2	3	3			
Emergency	7*	6*	6*	4	4	5*	7*	4	5*	5*
Perioperative	7	2	2	2	2	2	3	1	1	1
Professional Nursing				2	2	3**	2	2	2	3
Nurse Practitioner	1 FNP	1 FNP	1 FNP	1 FNP	1 FNP	2 FNP	4 FNP 1 MW	1 FNP	1 FNP	1 FNP
Specialty unavailable	6	2	2		1	2	3			
Total	22	14	14	11	12	17	24	9	10	11

Note: * 1 individual holds critical care nursing specialty; ** 1 individual with nursing administration specialty; MW is midwife.

4. Composition of Active Duty Nurses

During this humanitarian mission, there were 36 Navy nurses and one Air Force nurse deployed on the hospital ship. The majority of the Navy nurses came from Naval Medical Center San Diego. Others came from Naval Hospitals Camp Pendleton, Twentynine Palms, Pensacola, Guam, and Okinawa. The active duty nurses embarked on the hospital ship in two waves. Ten of these nurses were on the hospital ship for only a portion of the deployment. In addition to the US active duty nurses, there were seven nurses from the Armed Forces of the Philippines and three from the Indonesia Armed Forces (NHRC, 2006b). Table 10 identifies the number of US active duty nurses distributed by specialty. As demonstrated, 70.2% of the subspecialties held as a primary code by nurses are critical care, perioperative, medical-surgical, and professional nursing. The data from the MERCY crew database were reconciled against the data from the

Bureau of Medicine and Surgery (BUMED) Manpower Information System (BUMIS), which maintains current subspecialty codes for the entire Navy Medical Department (Morrison, 2006).

Table 10. Total Number of US Active Duty Nurses by Subspecialties

Subspecialty NOBC/SSP	No.	%
Nurse Anesthesia 0952/1972	2	5.4
Community Health Nursing 0944/1940	1	2.7
Critical Care Nursing 0904/1960	7	18.9
Emergency Nursing 0906/1945	1	2.7
Medical-Surgical Nursing 0944/1910	5	13.5
Pediatric Nursing 0944/1920	3	8.1
Perioperative Nursing 0932/1950	8	21.6
Professional Nursing 0944/1900	6	16.2
Nursing Education 0944/1903	1	2.7
Manpower 3130	1	2.7
Senior Nurse	1	2.7
Subspecialty code unavailable	1	2.7
Total nurses	37	

F. ACTIVE DUTY STAFFING PROCESS

A brief overview of the active duty staffing process for this mission is provided according to the interviews conducted by the researcher (Navarro, 2007; Comlish, 2007). Once the Commander of PACOM has decided to conduct a military operation involving medical personnel, the medical planners at PACOM and US Pacific Fleet (PAC Fleet), utilizing their own planning tools, determine the active duty staffing packages (or the numbers and specialty mix of staff consisting of medical department personnel required for the mission). Higher-level authority initiates a request for medical forces consisting of these active duty staffing packages. Then, the tasking must be validated by BUMED to determine if BUMED is able to support the mission. During the validation process the appropriate number and mix of staff is reviewed according to the staffing packages requested and based on the intended mission. For example, the staffing package may not consider certain types of nurses (such as pediatrics) for the mission when it is evident this will be needed. The coordination and partnership with NGOs would be taken care of at the PACOM level since it is a PACOM mission. (Note: Additional information regarding the NGO partnership was unavailable.) BUMED acts as the consultant during this situation, particularly in the credentialing process of healthcare providers. Once the validation process and negotiation of the staffing packages were completed between PACOM and BUMED, the USNS MERCY leadership then determines its capabilities based on the mission and plans the actual staffing of the ship based on the manpower requirements (Navarro, 2007). In contrast to the already-determined staffing package, the actual staffing may differ due to a variety of reasons—including the availability of personnel requested.

At the senior nurse level for the USNS MERCY, data were reviewed from the Expeditionary Medical Program for Augmentation and Readiness Tracking System (EMPARTS) for T-AH platform personnel to select active duty nurses for augmentation based on previous shipboard experience and subspecialty codes. The deployment readiness status of medical department personnel is monitored within EMPARTS. It should be noted that EMPARTS lacks interoperability with other systems and may not have the most current subspecialties maintained by nurses. The individuals assigned to the T-AH platform may not necessarily be those who deploy for various reasons. The selections of staff with specific skill sets are then negotiated with Naval Medical Center (NMC) San Diego, since this is the primary source of active duty nurses for the USNS MERCY. In this process, NMC San Diego has to consider competing priorities such as operational missions it is supporting, available resources, the need to maintain safe practices within the facility, the availability of staff requested, and any quality-of-life concerns with the staff (Comlish, 2007). Once all is considered and any negotiations are complete, the ideal mix of nurses for the mission may not necessarily be the staff that is ultimately deployed. Until the nurses have embarked on the hospital ship, changes still occur; even then, nurses may change during the course of the mission. However, the number of active duty nurses deployed will generally be fixed.

G. STAFFING IN-PATIENT AREAS

The senior nurse aboard the USNS MERCY managed the manpower projections based on the available information regarding the active duty and NGO nurses to deploy. Project Hope screened, selected, and credentialed their personnel. The senior nurse aboard the ship does not have the ability to influence the numbers and types of nursing staff, since these details are set by higher authority within the chain of command. The resumes of nurses from Project Hope were sent to the senior nurse just prior to the deployment of the hospital ship. This advance notification was beneficial for planning purposes. While the USNS MERCY was in transit, the senior nurse was notified that nurses from Aloha Medical Mission would be participating in the mission as well; however, the types of specialties and arrival dates were unknown (Comlish, 2007). For both military and NGO nurses, currency and competency of skills is critical for staffing purposes. On occasion, nurses arrive onboard the hospital ship with skills other than the required skill sets in the designated subspecialty for which their assignment was intended. The staffing of in-patient areas becomes complex when there is a degree of uncertainty regarding the available nurses and their types of specialties.

Manpower projections for each functional area were based on 4 rotations and were updated as information became available. The numbers of nurses from Project Hope and Aloha Medical Mission fluctuated in rotations 1 through 4 during the mission (see Table 8). The locations for rotation 1 were Zamboanga, Jolo, and Tawi Tawi. For rotation 2, the locations were Bangladesh, Simeulue, and Nias. For rotation 3, the only location was Banda Aceh. The locations for rotation 4 consisted of Tarakan, Kupang, and Dili.

H. FACTORS IMPACTING STAFFING PLANS

A variety of factors were considered when the plans were developed for staffing the functional areas. The key elements included the bed requirements for the functional areas, hours of operation, number of available nurses by specialty, and staffing standards for safe practice. The planned shift structure was 12 hours on and 12 hours off, while nurse-to-patient ratios from the California Nurses Association were used to support staffing decisions. One other important factor to consider when planning is anticipated staffing arrival and departure dates. Such attentiveness would provide continuity of patient care and ensure that there is minimal impact to patient care services as a result of shifting staffing availability. Issues can arise if a majority of staff are disembarking while replacement nurses are embarking at the same time. New personnel require orientation and training upon boarding the hospital ship. Furthermore, cultural sensitivity was an additional concern during this mission, which influenced the decision to permit patients to each have an escort. This policy decision resulted in further staffing strains by requiring the operation of more wards for sleeping accommodations for the escorts (top bunks were not used for patients or escorts due to safety concerns) (Comlish, 2007).

The discharge of patients requires a brief mention because it also impacted staffing. The optimal discharge disposition for in-patients is ambulatory. However, there were cases such as orthopedics, more complicated than expected operations, or post - surgical complications that required the USNS MERCY to transport patients back to the host nation on a litter. It was critical to have discharge planners consisting of a dedicated nurse or a team with a nurse at all sites because nurses were responsible for coordinating the myriad details required for such patient transfers. These nurses were drawn from in-patient care areas to coordinate the transfer of care with the host nation. Generally, the USNS MERCY had a host nation doctor or a Ministry of Health Official as a point of contact to assist in coordinating the continuity of care for patients requiring continued hospitalization. Furthermore, ambulatory patients required notifying a point of contact to coordinate follow-up care in the host nation (Comlish, 2007).

I. ASSUMPTIONS FOR PROJECTING NURSE STAFF REQUIREMENTS

Assumptions were based on bed requirements and nursing staff requirements for each area. These were used in projecting nurse staffing requirements. The number of nurses available was compared to the staffing requirements to determine any shortfalls (Comlish, 2007). Because the military nurses represented a fixed resource pool, any shortfalls were addressed by NGO nurses, who augmented the in-patient staffing. Staffing for onboard medical services was not based on the acuity level of patients or the number of patients. It is also important to realize that the ship was forced to make do with the number and skill-mix of nurses that arrived; the nursing care to patients was determined via the ad hoc capabilities with which the ship was provided during the mission.

Table 11 displays an example of the assumptions used to project nurse staffing for CASREC, ICU, and the medical-surgical wards during the deployment. These were general assumptions developed—staffing guidelines do not necessarily add up to an accurate total. Additionally, these assumptions were subject to change as the mission or capabilities changed. As noted in the table, the bed requirements increased during the mission; however, the overall number of active duty nurses and NGO nurses remained relatively the same. The CASREC was the point of entry for all patients and escorts and where all escorts were screened for tuberculosis. In addition, one of the wards was designated for pediatric patients during the deployment. The ICU began with four beds and then expanded to eight beds during the mission. Generally, ICU patients are not recommended due to the ship's short duration at a location; however, staffing must be ready for these types of admissions. Additionally in the ICU, there was an isolation unit consisting of 11 beds and maintaining an average census of 6-8 patients. This required staffing with the medical-surgical nurse-to-patient ratio of 1:5 instead of the ICU nurse-to-patient ratio of 1:2. In the medical-surgical wards, the number of beds expanded from 23 beds to 84 beds during the mission. The maximum capacity for three wards was 84 beds, in which only the lower bunks could be utilized due to safety precautions. This dramatic expansion resulted from allowing the patient escorts to sleep near the patients on the ward (Comlish, 2007).

Table 11. Assumptions for Projecting Nurse Staffing

Assumptions	CASREC	ICU	Medical-Surgical Ward (included pediatrics)	Three Medical Surgical Wards (included pediatrics)
Bed Requirements:	13 beds	8 beds	23 beds	84 beds
Hours of operation:	12-hour day shift	If open only during day, 12-hour shift for surgical recoveries. Must plan for 24 hours in case of overnight patients.	24/7	24/7
Additional staff requirements:	2 nurses for transport and discharge	4 additional nurses if open for 24 hours		2 nurses for isolation ward
Standard of care: Registered nurse to patient ratio	1:4	1:2	1:5 for adults 1:4 for pediatrics	1:5 for adults 1:4 for pediatrics
Nursing staff requirements:	4 nurses plus division officer	4 nurses plus division officer	12 nurses plus division officer	18 nurses plus division officer
Total	7	7 or 9	13	21

Note: Information compiled from various example staffing projection worksheets (Comlish, 2007)

In summary, the majority of nursing manpower requirements consisted primarily of in-patient shipboard nursing for the critical care unit and medical-surgical wards. There were additional nurses required for discharge planning, transportation of patients within the MTF and the isolation ward, which were pulled from the available staff. Certain functions do not require a fulltime nurse; therefore, these functions can be filled by multitasking nurses from different areas. In any event, this is important to consider for staffing purposes. The following functional areas required nurses for this mission.

1. In-patient nursing care:
    a. Medical-surgical wards—this included setting up a temporary pediatric ward
    b. Critical care unit
    c. Isolation ward
2. Surgical nursing care:
    a. Operating rooms
3. Out-patient shipboard nursing care:
    a. Casualty Receiving
4. Outreach programs in the Host Nation:
    a. MEDCAPS

THIS PAGE INTENTIONALLY LEFT BLANK

IV. NURSING MANPOWER ESTIMATES

A. CHAPTER OVERVIEW

The purpose of this chapter is to develop an estimate for nursing manpower requirements for hospital ships performing humanitarian assistance missions. Patient length of stay (LOS) estimates are required in order to establish baselines for the nursing manpower calculator. The first step in this chapter is to develop an Ordinary Least Squares regression model to estimate the patient LOS, regressing the dependent variable on a series of independent controls. Conclusions regarding the most appropriate model to apply in the calculator and the integrity of the empirical data will be drawn at the end of the regression analysis. In addition, a Chi-square test is applied to the cross-border ICD-9 patient classification distributions to provide further insight regarding underlying assumptions applied in the staffing calculator. Lastly, the assumptions, underlying calculations and fundamental methodology of the nurse staffing calculator are discussed.

B. NURSING MANPOWER REQUIREMENTS VERSUS ACTUAL STAFFING

A standardized staffing package for humanitarian missions would be optimal however as will be discussed in this chapter there are a number of factors to be considered. This section offers a reference point for when the estimation calculator is discussed at the end of the chapter. Table 12 provides a comparison of the active duty nursing requirements based on the AMD, the DEPORD, BUMED validation process, and the actual staffing on the USNS MERCY. The DEPORD for the USNS MERCY 2006 Deployment modeled the staffing package from the staffing for the 2005 Tsunami mission. The DEPORD requested a core package, a medical-surgical and inpatient staff package, and a humanitarian assistance expeditionary medical team package. The core staff package billets are determined in the AMD. The medical-surgical and inpatient staff package consisted of an additional two critical care nurses, three emergency nurses, and one nurse anesthetist. The humanitarian assistance expeditionary medical team package consisted of an additional perioperative nurse and four education and training nurses (NHRC, February 2006). The BUMED validation process reduced this number to 27 (Navarro, 2007). The actual staffing of the USNS MERCY was different from both of these recommendations. There are 28 nurses noted in the table by specialty however, nine additional nurses with other specialties were accounted for which consisted of one community health nurse, six professional nurses, one manpower nurse, and one nurse without a subspecialty code. Therefore, the total number of active duty nurses is 37. Additionally, the total number of nurses for the humanitarian mission by site is presented in Table 13. These numbers may vary because nurses (both those from NGOs and the Navy Nurse Corps) are embarking and disembarking at different sites. The total number of active duty nurses and NGOs are based on the data files provided by NHRC (2006b and September 2006).

Table 12. Comparison of AMD Requirements, DEPORD Requirements, BUMED Validation Process, and USNS MERCY Actual Staffing (BUMED, November 2006; NHRC, 2006b, February 2006, and September 2006; & Navarro, 2007)

Subspecialty NOBC/SSP	Critical core requirements	250 beds requirements	DEPORD requirements	BUMED requirements validation process	USNS MERCY Actual active duty nurse staffing
Clinical Specialist 0925/1910	1	3	1	0	0
Critical Care Nursing 0904/1960	4	20	6	5 to include 3 with pediatric intensive care experience	7
Emergency Nursing 0906/1945	3	13	6	3	1
Medical-Surgical Nursing 0944/1910	4	29 includes 2 psychiatric nursing	4	7 includes 2 pediatric and 1 maternal infant health	8 includes 3 pediatric nurses
Nurse Anesthetist 0952 /1972	2	4	3	3	2
Nurse Practitioner 0963/	0	2 includes 1976 and 1981	0	2 includes 1974 and 1976	0
Perioperative Nursing 0932/1950	4	13	4	4	8
Education and Training Management 3215/3150	1	1	5	2 nursing education (1903)	1 nursing education (1903)
Director	2	2	1	1	1
Other nurse specialties	0	0	0	0	9
Total Nurse Corps billets	21	87	30	27	37

Table 13. Total Number of Active Duty Nurses and NGO Nurses for the 2006 USNS MERCY Deployment (NHRC, 2006b and September 2006)

Site	No. of active duty nurses	No. of nurses from NGOs	Total no. of nurses
Zamboanga	37 (7 foreign)	22	59
Jolo Island	37 (7 foreign)	14	51
Tawi-Tawi	37 (7 foreign)	14	51
Bangladesh	32	11	43
Simeulue Island	35 (3 foreign)	12	47
Nias	35 (3 foreign)	17	52
Banda Aceh	35 (3 foreign)	24	59
Tarakan	34 (1foreign)	9	43
Kupang	34 (2foreign)	10	44
Dili	33 (1 foreign)	11	44

C. NURSE STAFFING MODELS

A staffing model is a tool to estimate the number and mix of personnel required to perform work on a specific unit (Coleman, 1995). Initially, a staffing model for humanitarian missions was to be developed by linking the higher level ICD-9 categories based on the patient encounters from the 2006 deployment with the number of nursing requirements and specialty mix. However, ICD-9 codes do not directly translate to nursing care. Seago (2006) indicates "the work of registered nurses (RNs) in hospitals is rarely organized around disease-specific populations. Rather, patients are grouped by age and/or intensity of nursing care…" (p. 423). Additional data would be required such as the Current Procedural Terminology (CPT) codes based on the ICD-9 categories or a record of nursing interventions for each patient. The CPT codes document medical procedures and interventions provided to patients (AMA, 2007). These data were unavailable in the data sets and would require a laborious review of individual patient treatment records. Next, standardized manpower methods for calculating staffing requirements were reviewed and found outdated. However, these mostly apply to fixed

MTFs and the new standards are pending dissemination. Neither of these approaches was feasible to develop an estimation calculator.

A review of the nursing literature was conducted to look at the available staffing models in the civilian sector and factors influencing staffing models. A staffing standard for humanitarian missions was not found in the literature or on websites of organizations involved in humanitarian assistance operations. Subsequently, reviewing hospital organizations, it was found that a standardized staffing model does not exist because organizations differ from each other as well as departments within the organizations differ from each other. Therefore, factors influencing staffing were reviewed. The challenge is to calculate the appropriate number of nurses to meet patient care needs.

A universal staffing model does not exist to serve all inpatient hospital settings (Seago, 2002). Variables such as patient population, patient needs, and level of care are different in patient care units and should be considered when developing staffing models. Another indicator, nursing hours per patient day, has been used in staffing models as well. However, this should be used cautiously because it is based on averages and sees patients as equally in need of care (ANA, 1999). Seago (2002) indicates other factors to consider when developing staffing models include nurse expertise, the number of physicians, work intensity, ancillary support, and nursing support staff.

Patient classification systems are used in hospital environments to determine the acuity levels of patients. These systems are measurement tools that utilize a standardized set of criteria to forecast the number of nurses required based on categorizing patients' severity of illness/condition and intensity need for nursing care (Maine Nurse, 2004). The level of patient acuity determines the number of nurses required to provide nursing care to patients (DeGroot, 1994). There are a number of issues with patient classification systems such as over inflation of patient needs, accuracy and reliability of the systems, and motivation of nurses to input the data. However, the acuity level of patients as an indicator should be factored in when calculating nursing requirements.

Nurse staffing ratios are guidelines for developing hospital staffing models and are used to establish minimum staffing levels of nurses in hospitals. The nurse-to-patient ratios relate to the average number of hours of nursing care provided in patient care units. Some states, such as California, have legislatively mandated minimum staffing ratios. However, this has not been universally mandated. Additionally, in the instances where nurse-to-patient ratios have been legislatively mandated the enforced staffing ratios are not consistent. There is a lack of evidence to determine the required number of nurses for different inpatient populations (Seago, 2002). The nurse-to-patient ratios do not consider the differences in patients, nurses' experience and skills, and the hospital environment (Welton, Unruh, & Halloran, 2006). These ratios do not account for variability in the clinical environment within a hospital or across organizations (Lake & Friese, 2006). Patient needs vary according to the individual and nursing care must be tailored to the patient. There is evidence to indicate that lower nurse-to-patient ratios are associated with improved patient outcomes (Seago, 2002). Furthermore, studies have found that higher nurse-to-patient ratios have been related to increased patient lengths of stay (Seago, 2006). Despite the potential concerns and given the available data, these ratios serve as an adequate minimum standard to utilize in this study.

1. Estimating Patient Length of Stay (LOS)—Regression Analysis

One critical element in determining inpatient nurse staffing requirements for a humanitarian mission is calculating the patient length of stay. This is an important element because surgical services aboard the ship result in the majority of inpatient admissions and require nursing care during the preoperative and post-operative period. Multiple Ordinary Least Squares (OLS) regression models are constructed to examine the relationships between patient services (i.e., surgery type vs. no surgery) and patient characteristics (i.e., factors including age, gender, treatment site etc.) and their resulting impacts on estimated patient LOS. Of these regressions, results from the two primary models are presented in this text.

Data from the patient admission/discharge log and the surgery log were utilized in these analyses. Because the surgical data are unavailable for Tarakan, Kupang, and Dili, the admission/discharge data for these locations were also excluded for consistency. The data from the two aforementioned logs were merged in an attempt to generate a more robust analysis. This approach was necessary as there are a number of standing concerns regarding the integrity of the data. For example, the admission/discharge log recorded some surgical patients which were not in the surgical logs and vice versa. In the logs, each patient entry has a pseudo unique patient identifier. These were utilized to match the surgical logs which capture surgery type, surgery duration, the number of procedures, gender, and age; these data were then merged with the patient care location and recorded patient admission and discharge dates from the admission/discharge log. Once merged, further binary variables were coded to indicate the surgery type, gender, ward in which the patient recovered (ICU vs. medical-surgical ward) post-operatively as well as binary variables to indicate the country of treatment and the specific location of treatment. Country of treatment consists of a group of locations by country such as Zamboanga, Jolo, and Tawi Tawi for the Philippines. It should be noted that due to the low instances of patient encounters, less than 1% of the time individually, the surgical specialties of dental, ear, nose and throat (ENT), and oral maxillary facial surgery (OMFS) were grouped together in the binary OTHER_SURG. Additionally, continuous variables were generated to indicate the patient age in years, patient LOS in days, and the total time spent in the operating room (OR) measured in minutes.

2. Regression Results when Estimating LOS by Surgical Services

a. Model I

The first approach explored in the patient LOS analysis grouped the patient data by surgical service. The surgical classification base-case in the following models was general surgery, which is then modeled against the other surgical types as well as patients who received no surgical services. The general linear model structure is as follows:

$$\text{LOS} = \beta_0 + \beta_1\text{GYN} + \beta_2\text{OPTHAMOLOGY} + \beta_3\text{ORTHO} + \beta_4\text{PEDS} + \beta_5\text{PLASTIC} + \beta_6\text{UROLOGY} + \beta_7\text{OTHER\_SURG} + \beta_8\text{NO\_SURG} + U$$

Table 14 indicates the sample parameter estimates for the above-proposed population model. A review of the associated p-values indicates that the patient surgery types are generally statistically significant in estimating patient LOS. The explanatory variables such as NO_SURG, GYN, and OPTHAMOLOGY are statistically significant at the 1% level for both one-tailed and two-tailed tests. Furthermore, ORTHO and UROLOGY are both significant at the 5% level suggesting the null hypothesis states that the parameter estimate is equal to zero can be confidently rejected in favor of the alternative two-tailed hypothesis that the parameter estimate is not equal to zero. The negative parameter estimate signs for NO_SURG, OPTHAMOLOGY, UROLOGY, and PEDS indicate that the estimated patient LOS is shorter in duration than patients treated by the base case, general surgery. This is the simplest possible model that provides an interesting baseline for estimating patient LOS. The goal of the additional regression analyses is to determine if controlling for other patient characteristics will improve the model's predictive power and to better understand how these characteristics may impact patient LOS.

Table 14. Model I: Parameter Estimates utilizing Surgical Services and all Admission/Discharge Records and Surgical Log

Variable	Parameter Estimate	Significance
Intercept	3.85064	***
Surgical Specialty		
NO_SURG	-1.30413	***
GYN	0.74026	***
OPTHAMOLOGY	-0.46603	***
ORTHO	0.67567	**
PEDS	-0.31940	
PLASTIC	0.11674	
UROLOGY	-0.56494	**
OTHER_SURG	1.14935	***
Corrected Total	631	
R-square (Adjusted)	0.2666 (0.2572)	
Global F-test	<0.0001	

Note: * indicates 10% significance level, ** indicates 5% significance level, *** indicates 1% significance level

b. Model II

The linear regression that included all possible patient characteristics is Model II whose results are shown in Table 15. These patient characteristics include indicators for the recovery ward, age, gender, number of procedures, procedure duration, and country of service. Additionally, the male and female average life expectancies as presented in the country overviews were included in this model to serve as a proxy for local population health and presumably local health-care quality and availability. More specifically, an average life expectancy is expected to reduce the patient LOS because it is expected that such individual would be, on average, healthier with better local availability to health-care and would then experience a shorter post-operative recovery time.

$$LOS = \beta_0 + \beta_1 RECOVER\_WARD + \beta_2 FEMALE + \beta_3 AGE + \beta_4 NUM\_PROCEDURES + \beta_5 PROCEDURE\_TIME + \beta_6 GYN + \beta_7 OPTHAMOLOGY + \beta_8 ORTHO + \beta_9 PEDS + \beta_{10} PLASTIC + \beta_{11} UROLOGY + \beta_{12} OTHER\_SURG + \beta_{13} NO\_SURG + \beta_{14} IND + \beta_{15} BANG + \beta_{16} LIFE\_EXP + U$$

When contrasting the resulting parameter estimates from Model I with the results of Model II, all the variables from Model I that were at least significant at the 10% level are still statistically significant. Of the eight explanatory variables added to this model, only two (PROCEDURE_TIME and BANG) were identified as being statistically significant. Additionally, it should be noted that the sign for PLASTIC changed from negative to positive in the second model. Although this change is of concern, it should be noted that the parameter estimate was not statistically significant in Model I. Lastly, although Model II provides considerable more detail with regard to patient characteristics, when controlled for, these characteristics only provide a slightly better explanation of the variability across the dependent variable. Specifically, when comparing the adjusted R-square values of the two models, Model I yields an adjusted R-square of 0.2572, while Model II yields an R-square only 1.07% higher at 0.2679. Since Model II does not provide any significant improvement in predictability in exchange for the increase complexity, it is not deemed prudent to continue using the model in further analysis. The results from Model I will be applied in the development of a staffing-requirement calculator.

Table 15. Model II: Parameter Estimates utilizing Patient Controls, Country Controls, all Admissions/Discharge Records, and Surgical Logs

Variable	Parameter Estimate	Significance
Intercept	1.36437	
RECOVER_WARD	-0.24411	
FEMALE	0.10466	
AGE	0.00429	
NUM_PROCEDURES	0.01880	
PROCEDURE_TIME	0.00305	***
Surgical Specialty		
NO_SURG	-0.71242	***
GYN	0.41430	
OPTHAMOLOGY	-0.41849	***
ORTHO	0.56517	**
PEDS	-0.35202	
PLASTIC	-0.37689	*
UROLOGY	-0.61455	**
OTHER_SURG	0.52014	
Region		
IND	-0.07925	
BANG	1.20026	***
LIFE_EXP	0.03228	
Corrected Total	542	
R-Square (Adjusted)	0.2895 (0.2679)	
Global F Test	<0.0001	

Note: * indicates 10% significance level, ** indicates 5% significance level, *** indicates 1% significance level

A number of additional regression analyses were run to determine if some combination of these patient characteristics could better explain the model variance and/or whether the significance of the explanatory variables changed. Examining these models (results not shown), the parameter estimates, especially those which are significant, were very robust across all of the models. Additionally, the R-squared (adjusted) of the regression did not improve by more than 0.01 regardless of the applied variable combination. This result is reassuring and reinforces the decision to use Model I in the nurse manpower calculator.

c. Model III

Model II was analyzed for one additional perspective in an effort to examine if the significance levels of the model are robust. As mentioned before, there were a number of concerns regarding the integrity of the data and the consistency between the patient admission/discharge log and the patient surgery log. The patient admission/discharge log contains 1,106 patient entries, 543 of which were utilized in the above parameter estimates as indicated by the corrected total figures of the regression results due to incomplete or missing values. However, the patient surgery log only contains entries for 502 patients. It was not possible to verify if the additional 604 patients identified in the admission/discharge log were originally thought to require surgical attention but were subsequently treated and released without surgery; if the patients not accounted for in the surgery log had received surgery; or there was an inconsistency in the record maintenance of the surgery log. Although a majority of patients were admitted for surgeries, other patients were admitted for other conditions and diagnostic testing (Comlish, 2007).

Model III-A and Model III-B presented below are included to demonstrate the unrestricted parameter estimates of the population model estimated in Model II. A Chow test was applied to test the results of the model with the restricted model being Model II (n= 543) and the two unrestricted models being the sample of patients with surgical log records, Model III-A (n= 502, of which only n=387 had complete data to run in the regression) and the sample of patients from the admission/discharge log who did not have entries in the surgical log, Model III-B (n=604 of which only n= 155 had complete data to run the regression). With a resulting p-value of 0.81640 for the Chow Test, evidence suggests that the two sub-samples yield statistically similar results. More specifically, the p-value is not significant at any of the usual levels, thus leading to the conclusion that the null hypothesis that the parameter estimates between the two un-restricted samples are the same may not be rejected in favor of the alternative hypothesis that the parameter estimates are different. This result indicates that the two un-restricted samples are yielding consistent estimates. Therefore, the larger dataset will continue to be used.

Table 16. Model III-A: Unrestricted Model using Patients with Surgical Records

Variable	Parameter Estimate	Significance
Intercept	2.26458	
RECOVER_WARD	-0.25393	
FEMALE	0.23221	
AGE	0.00626	*
NUM_PROCEDURES	0.00965	
PROCEDURE_TIME	0.00311	***
Surgical Specialty		
NO_SURG	0	
GYN	0.37570	
OPTHAMOLOGY	-0.50561	***
ORTHO	0.59673	**
PEDS	-0.25468	
PLASTIC	-0.27564	
UROLOGY	-0.57562	**
OTHER_SURG	0.53183	
Region		
IND	0.11110	
BANG	1.14454	***
LIFE_EXP	0.01597	
Corrected Total	386	
R-Square (Adjusted)	0.2165 (0.1849)	
Global F Test	<0.0001	
Sum of Squared Errors	387.09422	

Note: * indicates 10% significance level, ** indicates 5% significance level, *** indicates 1% significance level

Table 17. Model III-B: Unrestricted Model using Patients with no Surgical Records

Variable	Parameter Estimate	Significance
Intercept	-6.61948	
RECOVER_WARD	-0.18377	
FEMALE	-0.59325	
AGE	0.00141	
NUM_PROCEDURES	0	
PROCEDURE_TIME	0	
Surgical Specialty		
NO_SURG	0	
GYN	0	
OPTHAMOLOGY	0	
ORTHO	0	
PEDS	0	
PLASTIC	0	
UROLOGY	0	
OTHER_SURG	0	
Region		
IND	-0.37567	
BANG	1.89242	**
LIFE_EXP	0.14830	
Corrected Total	155	
R-Square (Adjusted)	0.1147 (0.0790)	
Global F Test	<0.0053	
Sum of Squared Errors	172.49332	

Note: * indicates 10% significance level, ** indicates 5% significance level, *** indicates 1% significance level

d. Chi-square Testing for Cross-border ICD-9 Patient Classifications

In the literature concerning humanitarian type missions, variability in mission requirements, patient populations, and patient care needs across geographical locations have been documented which makes it challenging to develop staffing packages. In chapter II, the history of deployments identifies that each mission and patient population is unique and requires a specialty mix of providers and nurses to support the services and capabilities of the hospital ship. Nebelkopf (2006) states:

> Different missions (or even different phases of the same mission, as in this case) require different rosters to meet patients' needs. Given different geographic locations, different levels of care, and different demographics, the medical personnel that are needed to support disaster relief missions might vary widely. (p. 29)

Even with this said, there are also similarities such as types of services and diagnoses across the different missions. For example, it has been cited that humanitarian missions provide primary care (Sharp, Yip, & Malone, 1994). Additionally, the hospital ships can serve as a community hospital depending on the mission but must be augmented with additional assets and a tailored staff (NTTP 4-02.6, 2004). It is important to emphasize and plan for a flexible staffing mix that is able to accommodate a myriad of patient care requirements.

The data from the HA missions in the Philippines and Indonesia are evaluated for variability and similarities in patient populations. By utilizing a chi-square test for consistency to evaluate the statistical significance of the differences between the country sample of the HA mission, it is possible to draw conclusions regarding the expected patient conditions and therefore the type of care that will be required. The chi-square test is designed such that the samples are identified as the aggregate data from Indonesia and the Philippines, while the classes are the observed ICD-9 patient classifications. In generic form the Chi-square test is generalized in the following manner. Table 18 provides the resulting calculations of the Chi-square test as identified in Figure 1.

Figure 1. Generalized Calculation of the Chi-square Statistic

	Class 1	2	…	j	…	K	Total
Sample 1	n_{11}	n_{12}	…	n_{1j}	…	n_{1K}	N_1
Sample 2	n_{21}	n_{22}	…	n_{1j}	…	n_{2K}	N_2
Total	n_{1}	n_{2}	…	n_{j}	…	n_{K}	$N_1 + N_2$

Where; n_{ij} represents the frequency of individuals in the *i*th sample in the *j*th class. Another second table of expected frequencies is calculated with the expected value calculated as the product of the total of the *i*th row and the *n*th class divided by the sum of the observed frequencies (adapted: Kanji, 1993, p. 75-76).

Table 18. Chi Square Test of Statistical Consistency across ICD-9 Codes in Surgical Cases

	Congenital Anomalies	Diseases of the circulatory system	Diseases of the digestive system	Diseases of the genitourinary system	Diseases of the musculoskeletal system and connective tissue	Diseases of the nervous system and sense organs	Diseases of the respiratory system	Diseases of the skin and subcutaneous tissue	Endocrine, nutritional and metabolic diseases and immunity disorders	Injury and Poisoning	Neoplasm	Signs, symptoms, and ill-defined conditions	V72.2 Dental Examination
Philippines	32.00	1.00	43.00	14.00	8.00	27.00	2.00	1.00	64.00	9.00	14.00	16.00	1.00
Indonesia	19.00	1.00	38.00	17.00	8.00	53.00	1.00	5.00	27.00	15.00	14.00	17.00	0.00
Totals	51.00	2.00	81.00	31.00	16.00	80.00	3.00	6.00	91.00	24.00	28.00	33.00	1.00
Estimates													
Philippines	26.47	1.04	42.04	16.09	8.30	41.52	1.56	3.11	47.23	12.46	14.53	17.13	0.52
Indonesia	24.53	0.96	38.96	14.91	7.70	38.48	1.44	2.89	43.77	11.54	13.47	15.87	0.48
Squared Differences / Estimate													
Philippines	1.16	0.00	0.02	0.27	0.01	5.08	0.13	1.44	5.95	0.96	0.02	0.07	0.45
Indonesia	1.25	0.00	0.02	0.29	0.01	5.48	0.14	1.55	6.42	1.03	0.02	0.08	0.48
x^2 =	32.34												
p-value =	0.0021												

The Chi-square was calculated to be X2(12) = 32.34, p<.01. Because the p-value is statistically significant at the 1% level, the null hypothesis that the patient population distribution of ICD-9 classifications between the Philippines and Indonesia are the same can be rejected in favor of the alternative hypothesis that the patient population distribution is different across the two samples. This result reinforces the finding from Model II that the country was a statistically significant variable. Future work could try to determine whether the ICD-9 variation between countries accounted for the variation in length of stay observed between countries (as seen in Model II). In the manpower calculator, we assume that patient mix is the driving factor behind the country variances and focus on Model I. This result is important to consider when developing a nurse staffing calculator because it underscores the importance of utilizing a flexible staff that will be able to adjust to the specific patient population requirements and needs. Therefore, the manpower calculator should be rerun for each aspect of the mission that changes the expected patient composition that will be seen by the hospital ship.

D. ESTIMATING NURSING MANPOWER REQUIREMENTS

1. Assumptions for Estimating Nurse Staffing Requirements

The assumptions are determined from previously referenced humanitarian type missions and lessons learned from these missions.

- The hospital ship will provide the same standard of care as Naval Medical Centers.
- Medical care will be provided at the same level that can be sustained by the host nation’s infrastructure upon the ship’s departure.
- The mission will be of short duration. For example, the average time at a site was 5.3 days for the 2006 USNS MERCY Deployment.
- The ship’s arrival and exit day must be accounted for when planning surgical services and discharging patients.
- Surgical services will be provided to the host nation.
- Intensive care capability is required for complex medical or post-surgical patients or recovering of surgical patients.

- Inpatient nursing care is required.

- The casualty receiving area functions as an emergency department and outpatient treatment area. Nurses are required to triage and process all patients and personnel. This area is the point of entry for boarding the hospital ship.

- The population for HA missions will include women, pediatrics, and elderly patients.

- Patient acuity level varies significantly by location and type of providers onboard. It is influenced by the duration of the mission and the host nation's heath care infrastructure where performing simple or complex cases are dependent on these factors. For example, an ophthalmologist performing cataract surgeries results in higher volume of cases and lower acuity therefore requiring less nursing care. In Bangladesh, Operation Smile repaired cleft lips and cleft palates which resulted in lower volume and slightly higher acuity. Other cases such as orthopedics and gynecology are performed at a lower volume and result in a higher acuity (Comlish, 2007).

- Augmentation of the ROS and critical core crew should be based first on active duty nurses since this is a fixed source and not be driven by NGO availability because of the uncertainty involved.

2. Nursing Manpower Requirements Calculator

An estimation calculator in Excel was developed to determine the inpatient nursing manpower requirements for humanitarian missions based on the data from the USNS MERCY 2006 humanitarian assistance mission. The calculator consists of four components including operating room capacity, surgical patient requirements, non-surgical patient requirements, and nursing staffing requirements. The assumptions are generated from the data obtained from the surgical log, the patient LOS as estimated by the regression analysis, and the previously mentioned assumptions. This calculator serves as a model to begin calculating nursing requirements however; additional information would need to be collected to provide more realistic estimations. Furthermore, due to the lack of supporting empirical data or standardized service practices, the calculator will not attempt to estimate explicit MEDCAPS staffing standards. The subsequent section will discuss the calculator.

In determining the operating capacity of the mission, multiple steps are performed to compute the total number of surgical patients per mission (Figure 2). For the daily operating time in minutes, assume the operating room is open 12 hours per day and specify the number of ORs utilized during the mission. During the humanitarian mission deployment two to three operating rooms were used. The total daily operating time is calculated by multiplying the daily operating time by the number of ORs. The number of days of a mission's duration is entered. For the average OR utilization, a percentage of usage is determined which accounts for slack time in operations and the arrival to a location and exit from the location by the hospital ship. A 90% baseline is applied in the calculator however, further research may provide more detailed information regarding the OR flow rates which may reveal that this baseline should be adjusted. The total mission OR availability is calculated in minutes by multiplying the total daily OR time, mission duration, and average OR utilization. Next the average OR time by surgical type are estimated as per the OLS estimates presented above. From the surgical logs the proportion of patients and average OR time by surgical specialties across all locations (except for the excluded locations) are computed. A weighted average OR time is figured in minutes by the sum product of patient proportion and average OR time. A weighted average is used for each surgical specialty otherwise the OR time would have been higher because the specialties are not serving an equal number of patients. Finally, the total surgical patient capacity/mission is estimated by dividing the total mission OR availability by the weighted average OR time. As presented, the spreadsheet is an example of a one-day mission at one location with two ORs. The assumptions can be changed based on the variables such as the mission character, number of days, or proportion of patients across surgical specialties.

Figure 2. Using the Calculator to Identify Total Surgical Patient Capacity per HA Mission

OR Capacity			
Mission Characteristics			
Daily Operating Time/OR (min)	720		
Number of ORs	2		
Total Daily Operating Time (min)	1440		
Mission Duration (days)	1		
Average OR Utilization (% days)	0.9		
Total Mission OR Availability (min)	**1296**		
Median OR Time by Surg Type (min)	**Patient Proportion**	**Average OR Time (min)**	
OTHER_SURG	0.03	213	
GENERAL	0.39	117	
GYN	0.07	161	
OPTHAMOLOGY	0.18	93	
ORTHO	0.06	154	
PEDS	0.08	139	
PLASTIC	0.22	149	
UROLOGY	0.06	111	
		Weighted Average OR Time (min)	139.72
		Total Surgical Patient Capacity/Mission	**9.28**

The next component is to establish the surgical patient care requirements (Figure 3). The patient population consists of those having surgeries as established above. The patient proportion by surgical specialties is based on the data from the deployment. The proportions are calculated by grouping and counting the number of cases by specialty. Then the standard deviation of the proportion is multiplied by 1.28, the z score representing an 80% service level. The product is then added to the patient proportion in order to ensure the staffing would be sufficient to support the patient population 80% of the time on average. Therefore, it should be noted that in totality the sum of the proportions in the calculator is greater than one. The patient volume by surgical specialties is then calculated by multiplying the patient population by the patient proportion for each surgical type. The LOS is taken from the regression analysis (Model I) and involves computing the partial effects by adding the parameter estimate for each surgical type to the estimated intercept. This attempts to control for surgical groups. The care days is computed by multiplying patient volume and the estimated LOS per surgical specialty. There is an additional component, the acuity quotient, included in this calculation. The purpose of the acuity quotient is to identify differences in care requirements across patient surgeries. However, the empirical data did not provide any detail regarding patient acuity, thus it was not possible to derive appropriate generalizations with regard to this calculation. This is reflected in the fact that the acuity quotient is currently set to 1, indicating the patient care needs are the same for all surgical and non-surgical patients. Future research may be able to reveal more accurate conclusions regarding the patient acuity characteristics. The care days calculation implies the time required to cover patients while in the inpatient setting.

Figure 3. Using the Calculator to Identify Total Surgical Patient Care Days

Surgical Patient Care Requirements

Surgical Patient Population 9.275516757

Surgical Type	Patient Proportion	Patient Volume	LOS	Acuity Quotient	Care Days
OTHER_SURG	0.03	0.30	5.00	1	1.48
GENERAL	0.39	3.59	3.85	1	13.81
GYN	0.07	0.62	4.59	1	2.83
OPTHAMOLOGY	0.18	1.70	3.38	1	5.76
ORTHO	0.06	0.58	4.53	1	2.61
PEDS	0.08	0.72	3.53	1	2.53
PLASTIC	0.22	2.08	3.97	1	8.26
UROLOGY	0.06	0.52	3.29	1	1.70
		Total Surgical Patient Care Days			**38.97**

Patients other than surgical patients are admitted to the hospital ship. The non-surgical patient care requirements need to be considered (Figure 4). The data from the deployment lacks reliability and therefore this component is not evaluated in the model. The admission/discharge log does not contain specialty information. It is assumed that 60% of the patients have surgery during the mission and consequently that 40% of the patients would be non-surgical. These percentages are used in estimating patients for the combat mission and may need adjusting. This means that the number of non-surgical patients is two-thirds of the number of surgical patients. In the calculator, all patients are grouped under not having surgery and the estimated LOS for NO_SURG from the regression Model I is applied. The same steps are performed as in estimating the surgical patient care requirements.

Figure 4. Using the Calculator to Identify Total Non-Surgical Patient Care Days

Non-Surgical Patient Care Requirements					
Ratio of non-surg patients to surg patients	0.67				
Patient Population	6.21				
Patient Type	**Patient Proportion**	**Patient Volume**	**LOS**	**Acuity Quotient**	**Care Days**
NO_SURG	1.00	6.21	2.55	1.00	15.83
		Total Non-surgical Patient Care Days:			**15.83**

Next, a weighted average LOS is calculated (Figure 5). This is the sum product of patient proportions and estimated LOSs. This incorporates the 60% surgical and 40% non-surgical composition of patients. This is performed because the LOS differs for each specialty type.

Figure 5. Utilizing a Weighted Average LOS for Surgical and Non-Surgical Patients

Weighted Average LOS	
Weighted Average LOS (for Surg and Non-Surg Patients):	3.54

The nurse staffing requirements are derived once the preceding components have been estimated (Figure 6). First, the total care days equals the sum of both the surgical and non-surgical patient care requirements. The average daily patient population is the total care days divided by the weighted average LOS. The daily nurse workload is based on 12 hours shifts onboard the ship. The specialty ratios of the number of nurses to patients are based on the general guidelines for the specialties (CNA, 2004). The patient care area weight consists of the inpatient specialties of critical care, medical-surgical, and pediatric, which have been calculated similar to the patient proportions in the previous sections. It should be noted that these proportions do not sum to one because the standard deviations of the proportions are considered in an effort to estimate staffing levels sufficient to serve the patient population 80% of the time (thus the proportions sum to more than 1). The specialty proportion was estimated from the average daily census of patients in these areas from the overall mission. The daily bed requirement is the average daily patient proportion multiplied by the patient care area weight. The personnel requirements equal the specialty ratio multiplied by the daily bed requirement divided by the daily nurse workload. The sum of the personnel requirements for each nursing specialty equals the total nursing manpower requirement.

Figure 6. Using the Calculator to Estimate Nurse Staffing Requirements

Nurse Staffing Requirements

Daily ICU Patient Proportion at 80% Confidence: 0.20
Daily Ward Patient Proportion at 80% Confidence: 0.96

Total Patient Care Days	54.80
Average Daily Patient Population	15.48
Daily Nurse Workload (days)	0.50
Specialty Ratio	
Critial Care	0.50
Medical Surgical	0.20
Pediatric	0.35

Inpatient Nurses

Nursing Specialties	Patient Care Area Weight	Daily Bed Requirements	Personnel Requirements
Critical Care Nursing	0.20	3	3
Medical Surgical Nursing	0.96	15	6
Pediatric Nursing	0.35	5	4
		Total Manpower Requirement:	**13**

Additional Nurse Requirements

Nursing Specialties

OR Nurses
Casualty Receiving Nurses
Discharge Nurses
Transport Nurses
MEDCAP Nurses

An additional note regarding calculations concerns the use of averages in the calculator. The law of averages indicates that 50% of the time the hospital ship would be understaffed if only using averages. Based on a normal distribution, if a mission wants to serve the patient population 80% of the time in the system then 20% of the time would be understaffed. To correct this, the lengths of stay would need to be overstated. For the proportion of population for each surgery specialty and proportion of patients admitted to wards and ICU, the average surgery time and LOS would have to account for the standard deviations and add them to the averages.

E. ADDITIONAL STAFFING CONSIDERATIONS

The operating room functional area is considered separate from the inpatient setting. Nursing manpower requirements in the OR are dependent on the number of operating rooms used. Although, nurse-to-patient ratios indicate one perioperative nurse to one patient, additional information including details of the OR processing of patients is required. Specific information was unavailable to evaluate the actual staffing of nurses used during the mission.

The Casualty Receiving area differs from inpatient areas. CAS REC has several different functions such as providing emergency services, outpatient treatment, and processing of all patients. This area was usually open only for 12 hours per day during the HA mission (Comlish, 2007 and NHRC, 2006). In determining the nursing manpower requirements for this area, the proportion of functions performed would need to be validated and estimates of patient treatment times generated for each function. The data from the admission/discharge log does not provide details about the services in CAS REC.

Other additional nurse requirements are needed for discharging and transporting patients. However, it is unknown if a full time nurse is necessary to perform these functions. Information was unavailable to ascertain the actual number of hours and duties required for discharge planning. As for nurses to transport patients, it seems these were adhoc responsibilities when certain patients required a nurse to monitor them during transportation within the hospital ship. The number of nurses for MEDCAPs was small based on mission data. A more detail account of the nurse's role in this outreach program is needed to establish nursing requirements. These additional requirements have been listed in the calculator without formulas since further research is necessary for estimation (see Appendix D for the example of the estimation calculator).

V. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

A. CHAPTER OVERVIEW

This chapter presents the findings of this thesis with respect to the original goals delineated in Chapter I. Then the conclusions are discussed. Additionally, the limitations of the study are mentioned. Finally, recommendations for further research to establish nursing manpower requirements for humanitarian missions are provided.

B. SUMMARY

The primary question addressed in this study was "What are the nursing manpower requirements for the shipboard and shore based components of humanitarian assistance missions using hospital ships?"

The purpose of this research is to provide an initial framework and tool to use in planning nursing manpower requirements for humanitarian assistance missions executed by the hospital ships. The mix of nursing subspecialties to be utilized in humanitarian missions was explored in the process. The research in this study investigated two areas for developing the framework to determine nursing manpower requirements. First, a mission analysis of the USNS MERCY 2006 deployment examined the types of patients treated and the nurse staffing process that was implemented including the methodology and assumptions. Second, the research analyzed the statistical relationship between surgical services and patient characteristics on the estimated patient length of stay.

The mission analysis demonstrated that patient encounters consisted of shipboard and shore based health care services. The shipboard services encompassed both surgical services and non-surgical services. The main source of patient encounters were admissions as a result of patients having surgeries. This was the primary area investigated in the study. The non-surgical cases could not be examined due to incomplete data. In both cases however, the patient population included adults and pediatrics. Surgical services offered a range of specialty types including pediatrics and gynecology. As for the shore based services, MEDCAPs and the outreach programs in the host nation medical facilities were conducted. These activities varied by location. The data for the MEDCAPs were captured in the ICD-9 categories however, workload cannot be determined based on aggregate numbers by category and location. For the MEDCAPs, a database did not exit of patient encounters consisting of the daily number of patients seen, diagnosis of each encounter, specialties of physicians, or treatments. NHRC pulled the data from daily reports and determined the ICD-9 category based on the patient's diagnoses. In contrast, the surgical log and admission/discharge logs maintained entries for patient encounters. However, even though the surgical log was the most complete database, data were not available for three sites. The data for the outreach programs in the host nation medical facilities only provided the specialty types of patients treated by percentages, therefore this shore based activity could not be evaluated.

In addition to trying to estimate the nurse workloads, the current nurse staffing process was examined for planning guidance. The nurse staffing process, from higher level authority to the shipboard MTF level, is complex. Unlike the already established nursing manpower requirements for the primary mission to provide combat care, requirements have not been determined for humanitarian assistance missions.

During the MERCY 2006 deployment, the inpatient areas demanded the majority of nursing manpower requirements to deliver nursing care to patients. The staffing of nurses consisted of a partnership between the active duty nurses and nurses from non-governmental organizations, predominantly Project Hope. The staffing of active duty nurses was fixed from the onset of the mission with minimal fluctuations during the mission. The staffing of nurses from NGOs did fluctuate during the mission by location. A range of nursing specialties were covered by both active duty and NGOs during the mission including community health, pediatrics, nurse practitioners. The main specialties were perioperative, critical care, emergency nursing, and medical-surgical nursing.

The second component of the mission analysis, the staffing methodology, was based on bed requirements and nurse-to-patient ratios. The nurses from NGOs augmented the active duty staff. Each clinical area had a designated division officer in charge. Additionally, each area required specific nurses to perform functions such as discharge planning and the transporting of patients within the MTF. A pediatric ward was established at one point during the mission for a high volume of pediatric patients. An isolation ward was maintained for patients requiring respiratory isolation. Additional wards were opened to provide hospitality services for escorts of patients. These additional ward requirements further distributed and increased the workload of the nursing staff. Furthermore, only a small number of nurses were used in the MEDCAPs. In summary, nurses were required for the inpatient areas, operating rooms, casualty receiving, and MEDCAPs.

The myriad of factors outlined above highlight the complexity of nursing workload in humanitarian missions. Despite the increased complexity, these elements are important in developing staffing schedules but are not necessarily applicable to the development of manpower requirements. Manpower requirements should be derived from a generalized approach that encompasses a mix of nursing specialties to deliver care in the inpatient and outpatient areas to a diverse patient population that may be encountered in humanitarian assistance missions. The daily nurse staffing needs are managed via staffing schedules dependent on patient census and workloads. The detail captured in these daily schedules does not directly drive the manpower requirements of the mission.

The second area of the study investigated the statistical relationship between surgical types and patient characteristics on the LOS. Two regression models were constructed. Model I examined the relationship of surgical specialties on the patient LOS. This analysis found that patient surgical specialties were statistically significant in estimating the LOS. Model II examined the relationship between surgical specialties and patient characteristics on the patient LOS. Adding the patient characteristics only slightly improved the explanatory power of the model. The only two significant variables were procedure time and the country Bangladesh. A Chow test was conducted on model II to validate the robustness of the model due to data integrity issues. The Chow test concluded that the data from the surgical log and the admission/discharge log were not statistically different and therefore the larger data set, admission/discharge log would be utilized further in the study. Additionally, a Chi-square test looked at the sample populations of surgical patients based on ICD-9 codes between two sample countries, Indonesia and the Philippines. The test found that the patient population distribution across ICD-9 codes is different across the two samples. This result underscores the importance of utilizing a flexible staff that will be able to adjust to the specific patient population.

C. CONCLUSIONS

The estimation calculator was designed to determine the nursing manpower requirements for inpatient nursing aboard the hospital ship. The assumptions for this calculator are based on the estimated LOS for surgical patients from the regression analysis and the mission analysis. The total surgical patient capacity drives the estimation of the inpatient nursing requirements. Typically, bed requirements drive the nursing requirements in hospitals. However, in the calculator the daily bed requirement is only one factor used in estimating the number of nurses. The nurse-to-patient ratios serve as an underlying assumption deriving the requirements in conjunction with the estimated patient LOS. The manpower requirements for the nursing specialties, critical care, medical-surgical, and pediatrics, can be estimated. Estimation for nursing specialties in the functional areas such as the operating room, casualty receiving, and MEDCAPs could not be formulated into the calculator. Further research in these areas is necessary to incorporate the nursing specialties for emergency and perioperative nursing. The estimation calculator provides a framework for calculating nursing manpower requirements and identifies other areas for continued development.

While conducting this study, the literature and the mission analysis discussed the uniqueness of humanitarian missions, patient populations, and patient care needs across geographical locations. Based on the variability of these components, it was mentioned that staffing requires tailoring a specialty mix of health care providers to care for patients. The difference in population samples for surgical cases was confirmed in the Chi-square test of this study. Despite this variability, emphasis should be placed on establishing the minimum nursing manpower requirements that are flexible in providing care to a diverse patient population.

D. LIMITATIONS

The limitations of this study are important to consider when applying the framework for determining nursing manpower requirements for humanitarian missions. There a number of issues with the data. The surgical data from the surgical logs were inconsistent with the admission/discharge logs. The data were incomplete for the non-surgical inpatient admissions from the admission/discharge logs. The data collection for MEDCAPs and the outreach programs in the host nation medical facilities were collected from mission briefs and level of effort spreadsheets which lack the level of detail required for rigorous analysis. Additionally, nursing data were not available for casualty receiving and the inpatient areas. A more complete analysis would require nursing care/interventions associated with patient diagnoses.

Although this study provides a starting point for establishing nursing manpower requirements, when generalizing the results of this thesis it is important to realize that the data are only based on the 2006 USNS MERCY deployment. Furthermore, this thesis is focused on planned humanitarian missions and does not consider other mission types such as disaster relief missions which would involve emergency type care and predictable patient populations. Additionally, if there were more complete documentation regarding the underlying assumptions that established the nursing manpower requirements for the primary mission these assumptions could provide further guidance in developing accurate humanitarian missions requirements. When considering the uniqueness of each humanitarian mission there is still an underlying commonality of providing surgical services when utilizing the hospital ships. Although it is a generalization, it is this surgical capacity that drives the total patient population in the estimation calculator. The estimation calculator is designed for inpatient clinical areas comprising three nursing specialties: critical care, medical-surgical, and pediatrics. The calculator does not calculate the nursing manpower needs for outpatient areas such as the operating room and casualty receiving as well as competing missions such as MEDCAPs because additional data are required for analysis.

E. RECOMMENDATIONS FOR FUTURE STUDIES

The research presented in this study provides opportunities for future work in establishing standardized nursing manpower requirements for humanitarian missions. There is additional opportunity to develop nursing requirements for the outpatient areas. This would include primary data collection and functional area examination. Furthermore, defining the role of nurses in MEDCAPs and outreach programs is an additional area to study. Another prospect for research is linking nursing interventions to patient diagnoses and thereby determining the nursing specialties required and the substitutability of those specialties. This research also, lends itself to future studies in the area of defining the appropriate skill mix (nurses and unlicensed staff) for the various inpatient and outpatient units on the hospital ships. Moreover, determining the mix of military nurses and nurses from NGOs to staff hospital ships is another area to examine. Since hospital ships are likely to continue to execute more humanitarian missions in the future, the need for a more accurate tool in planning nursing manpower requirements continues.

LIST OF REFERENCES

American Medical Association (AMA) (2007). *CPT process: How a code becomes a code*. Retrieved online March 20, 2007, http://www.ama-assn.org/ama/pub/category/3882.html

American Nurses Association (ANA) (1999). Principles for nurse staffing with annotated bibliography. Washington, D.C.: American Nurses Association.

Bureau of Medicine and Surgery, M-1 Manpower (2006, November 11). *USNS MERCY Activity Manpower Document* (*AMD*). Retrieved via e-mail January 16, 2007, from LCDR T. Maeder, tkmaeder@us.med.navy.mil

Bureau of Medicine and Surgery, M-3 Current Operations (2006, February 16). *USNS MERCY Deployment CONOPS Brief*. Retrieved via e-mail January 18, 2007, from LCDR C. Navarro, canavarro@us.med.navy.mil

Bureau of Medicine and Surgery. (2000). *BUMEDINST 6440.5B. Medical augmentation program (MAP)*. Retrieved January 17, 2007, from http://navymedicine.med.navy.mil/default.cfm?selmod=706435D4-8C78-A781-8663C37197B239CD&seltab=directives&type=ALLBMDDIR

California Nurses Association (2004). Ratio Basics. Retrieved online January 21, 2007, http://www.calnurse.org

Coleman, R. (1995). The 24-hour business: Maximizing productivity through round-the-clock operations. AmacomBks.

Comlish, J. (2007). [Personal communication with author via phone and e-mail correspondence.] CDR J. Comlish, senior nurse executive aboard the USNS MERCY during the 2006 deployment and 2005 Tsunami deployment (January 16, 2007, January 18, 2007, and February 12, 2007), jean.comlish@nmcsd.med.navy.mil

DeGroot, H. (1994). Patient classification systems and staffing. *Journal of Nursing Administration, 24*(9), 43-51.

Department of Defense, Assistant Secretary of Defense for Health Affairs. (1998). *Medical readiness strategic plan (MRSP) 1998-2004*. DoD 5136.1-P. Retrieved December 19, 2006, from http://stinet.dtic.mil/oai/oai?&verb=getRecord&metadataPrefix=html&identifier=ADA357865

Department of Defense, Defense Security Cooperation Agency. (2003). *Humanitarian assistance and mine action programs.* Retrieved January 10, 2007, from http://www.dsca.mil/samm/Chapter%2012%20-%20HA%20and%20MA%20Programs.pdf

Department of Defense, Defense Security Cooperation Agency. (2006). *DSCA overview* (ppt). Retrieved January 10, 2007, from http://www.dsca.osd.mil/about_us.htm

Department of Defense. (1994). *DoDD 2205.2. Humanitarian and civic assistance (HCA) provided in conjunction with military operations.* Retrieved November 17, 2006, from http://www.dtic.mil/whs/directives/

Department of Defense. (2005). *DoDD 3000.05. Military support for stability, transition, and reconstruction (SSTR) operations.* Retrieved November 17, 2006, from http://www.dtic.mil/whs/directives/

Department of the Navy, Commander Military Sealift Command. (1998). COMSCINST 5400.8A. *Consolidated plan for the activation and deactivation of T-AH 19 MERCY class hospital ships.* Retrieved December 19, 2006, from http://www.msc.navy.mil/instructions/doc/54008a.doc

Department of the Navy, Office of the Chief of Naval Operations (1997). OPNAV Instruction 3501.161C. *Required operational capabilities and projected environment (ROC/POE) for T-AH 19 (MERCY) class hospital ships*. Retrieved via fax February 21, 2007. Point of contact: LT. M. Pugh, Operations Officer, USNS MERCY, mapugh@mercy.navy.mil

Department of the Navy, Office of the Chief of Naval Operations. (1998a). OPNAV Instruction 5440.75A. *Administration, operation, and logistic support of T-AH 19 MERCY class hospital ships.* Retrieved January 17, 2007, from http://www.npc.navy.mil/ReferenceLibrary/Instructions/

Department of the Navy, Office of the Chief of Naval Operations. (1998b). OPNAVINST 1000.16J. *Manual of Navy total force manpower policies and procedures.* Retrieved July 12, 2006, from http://www.npc.navy.mil/ReferenceLibrary/Instructions/

Department of the Navy, Office of the Chief of Naval Operations. (2004). *Navy tactics, techniques, and procedures, NTTP 4-02.6 hospital ships.* Retrieved December 19, 2006, from https://wwwa.nko.navy.mil/portal/page?paf_pageId=page117

Department of the Navy. (1998). *Naval warfare publication (NWP 3-07). Naval doctrine for military operations other-than-war.* Retrieved December 19, 2006, from https://wwwa.nko.navy.mil/portal/page?paf_pageId=page117

General Accounting Office (GAO) (1996). *Wartime medical care: Personnel requirements still not resolved.* GAO/NSIAD-96-173. Washington, DC. Retrieved December 19, 2006, from http://www.gao.gov/archive/1996/ns96173.pdf

GlobalSecurity.org (n.d.). T-AH MERCY. Retrieved January 17, 2007, from http://www.globalsecurity.org/military/agency/navy/tah-19.htm

Joint Chiefs of Staff (2001). Joint Publication 3-07.6. Joint tactics, techniques, and procedures for foreign humanitarian assistance. Retrieved January 10, 2007, from Dudley Knox Library Digital Archives Collection. http://205.155.65.56/uhtbin/cgisirsi.exe/9NWeaqYq6d/SIRSI/68270006/503/287

Joint Chiefs of Staff. (2004). *National military strategy of the United States of America 2004. A strategy for today; A vision for tomorrow*. Retrieved December 19, 2006, from http://www.defenselink.mil/news/Mar2005/d20050318nms.pdf

Kanji, Gopal K. (1993). *100 statistical tests*. Stage Publications. London, UK, 75-76.

Lake, E. & Friese, C. (2006). Variations in nursing practice environment: Relation to staffing and hospital characteristics. *Nursing Research, 55*(1), 1-9. Retrieved online February 12, 2007, http://gateway.ut.ovid.com/gw1/ovidweb.cgi

Maine Nurse (2004). *Text of LD 616*. Retrieved online January 21, 2007, http://www.findarticles.com/p/articles/mi_qa4110/is_200402/ai_n9398457/print

McGrady, E. D. (2006, November). *USNS MERCY deployment for Operation Unified Assistance: Implications for afloat disaster response.* CRM D0012636.A2/Final. Center for Naval Analyses (CNA). Retrieved via e-mail January 17, 2007, from CDR D. Farr, BUMED Liaison at CNA, farrd@cna.org

Morrison, V. (2006). *SSC update for Nurse Corps homepage on NKO.* Navy Medicine, Manpower, Personnel, Training & Education Command, Directorate for Workforce Management. Retrieved February 10, 2007, from https://wwwa.nko.navy.mil/portal/splash/index.jsp

Morrow, R., & McGrady, E. D. (2006, November). *The medical and health care mission of USNS MERCY to Banda Aceh, Indonesia.* CRM D0012639.A1/Final. Center for Naval Analyses (CNA). Retrieved via e-mail January 17, 2007, from CDR D. Farr, BUMED Liaison at CNA, farrd@cna.org

Naval Health Research Center (NHRC), Medical Modeling and Simulation Department (2006a). *USNS MERCY 2006 deployment data slides for MEDCAPs, host nation local MTF, and shipboard surgical services*. Retrieved via e-mail January 9, 2007, from T. Negus, negus@nhrc.navy.mil

Naval Health Research Center (NHRC), Medical Modeling and Simulation Department (2006b). *Nurse staffing data slides from USNS MERCY 2006 deployment*. Retrieved via e-mail December 11, 2006, from T. Negus, negus@nhrc.navy.mil

Naval Health Research Center (NHRC), Medical Modeling and Simulation Department (2006, February). *USNS MERCY DEPORD* (DTG: 081740Z). Retrieved via e-mail January 17, 2007, from T. Negus, negus@nhrc.navy.mil

Naval Health Research Center (NHRC), Medical Modeling and Simulation Department (2006, September 25). *USNS MERCY 2006 deployment data files consisting of mercy crew, surgical logs, and admission/discharge logs. Also, lessons learned from 2006 deployment.* ID # LLWE0-13904. Point of contact: T. Negus, negus@nhrc.navy.mil

Navarro, C. (2007). [Personal communication via phone and e-mail with author.] LCDR C. Navarro, canavarro@us.med.navy.mil, Bureau of Medicine and Surgery, M-3 Current Operations (January 18, 2007 and January 19, 2007).

Navy Nurse Corps (2005). *Nurse Corps subspecialty code management.* Retrieved February 2, 2007, from https://wwwa.nko.navy.mil/portal/page?paf_pageId=page11924

Navy Personnel Command (2006, October). *Manual of Navy officer manpower and personnel classifications.* (Vol. I, major code structures)—NAVPERS 15839I. Subspecialty (SSP) codes, Part B and Navy Officer Billet Classification (NOBC) codes, Part C. Retrieved December 19, 2006, from http://buperscd.technology.navy.mil/bup_updt/upd_CD/BUPERS/OFFCLASS/OfficerManMenu.htm

Nebelkopf, D. (2006, September). *USNS Comfort deployment in support of Hurricane Katrina relief operations: Medical mission and data analysis.* CRM D0014803.A2/Final. Center for Naval Analyses (CNA). Retrieved via e-mail January 17, 2007, from CDR D. Farr, BUMED Liaison at CNA, farrd@cna.org

Seago, J. A. (2006). Chapter 39. Nurse staffing, models of care delivery, and interventions. Retrieved online February 12, 2007, http://www.ahrq.gov/clinic/ptsafety/chap39.htm

Seago, J.A. (2002). The California experiment: Alternatives for minimum nurse-to-patient ratios. *Journal of Nursing Administration, 32*(1), Retrieved online February 12, 2007, http://gateway.ut.ovid.com/gw1/ovidweb.cgi

Seifert, J. L. (2006, September). *USNS Comfort deployment in support of Hurricane Katrina relief operations.* CRM D0014911.A1/Final.Center for Naval Analyses (CNA). Retrieved via e-mail January 17, 2007, from CDR D. Farr, BUMED Liaison at CNA, farrd@cna.org

Sharp, T., Yip, R., & Malone, J. (1994). US military forces and emergency international humanitarian assistance: Observations and recommendations from three recent missions. *Journal of American Medical Association, 272* (5), 386-390. Retrieved online February 4, 2007, http://gateway.ut.ovid.com/gw1/ovidweb.cgi

US Fleet Forces Command. (2006). *Fleet operational health: Concept of operations.* Retrieved via e-mail January 9, 2007, from T. Negus, negus@nhrc.navy.mil. (Note: Commander, US Fleet Forces Command, 1562 Mitscher Ave, Suite 250, Norfolk, VA 23551-2487).

USNS COMFORT (n.d.). *USNS COMFORT deployment History*. Retrieved January 17, 2007, from http://www.comfort.navy.mil/deployments.html

Weber, T. H. (1994). The THCSRR model: Determining navy medicine's readiness manpower requirements. *Navy Medicine*, September-October, 19-22.

Weber, T. H. (2007, February 16). [Personal communication via phone with author.] CDR T. Weber, timothy.h.weber@navy.mil, OPNAV 931C2, Manpower Resources, Bureau of Medicine and Surgery.

Welton, J., Unruh, L., & Halloran, E. (2006). Nurse staffing, nursing intensity, staff mix, and direct nursing care costs across Massachusetts hospitals. *Journal of Nursing Administration, 36*(9), 416-425. Retrieved online February 12, 2007, http://gateway.ut.ovid.com/gw1/ovidweb.cgi

White House. (2002). *The national security strategy of the United States of America*. Retrieved December 19, 2006, from http://www.whitehouse.gov/nsc/nss.html

World Health Organization (WHO), Regional Office for the Western Pacific. (2006). *Philippines, country health information profiles*. Retrieved February 23, 2007, from http://www.wpro.who.int/countries/phl/

World Health Organization (WHO), Regional Office of South-East Asia. (2002). *Country health profile—Timor-Leste*. Retrieved February 23, 2007, from http://www.searo.who.int/EN/Section313/Section1526.htm

World Health Organization (WHO), Regional Office of South-East Asia. (n.d.). *Country health profile—Bangladesh*. Retrieved February 23, 2007, from http://www.searo.who.int/EN/Section313/Section1515_6038.htm

World Health Organization (WHO). (2004a). *Country statistics—Bangladesh*. Retrieved February 23, 2007, from http://www.who.int/countrie/bgd/en/

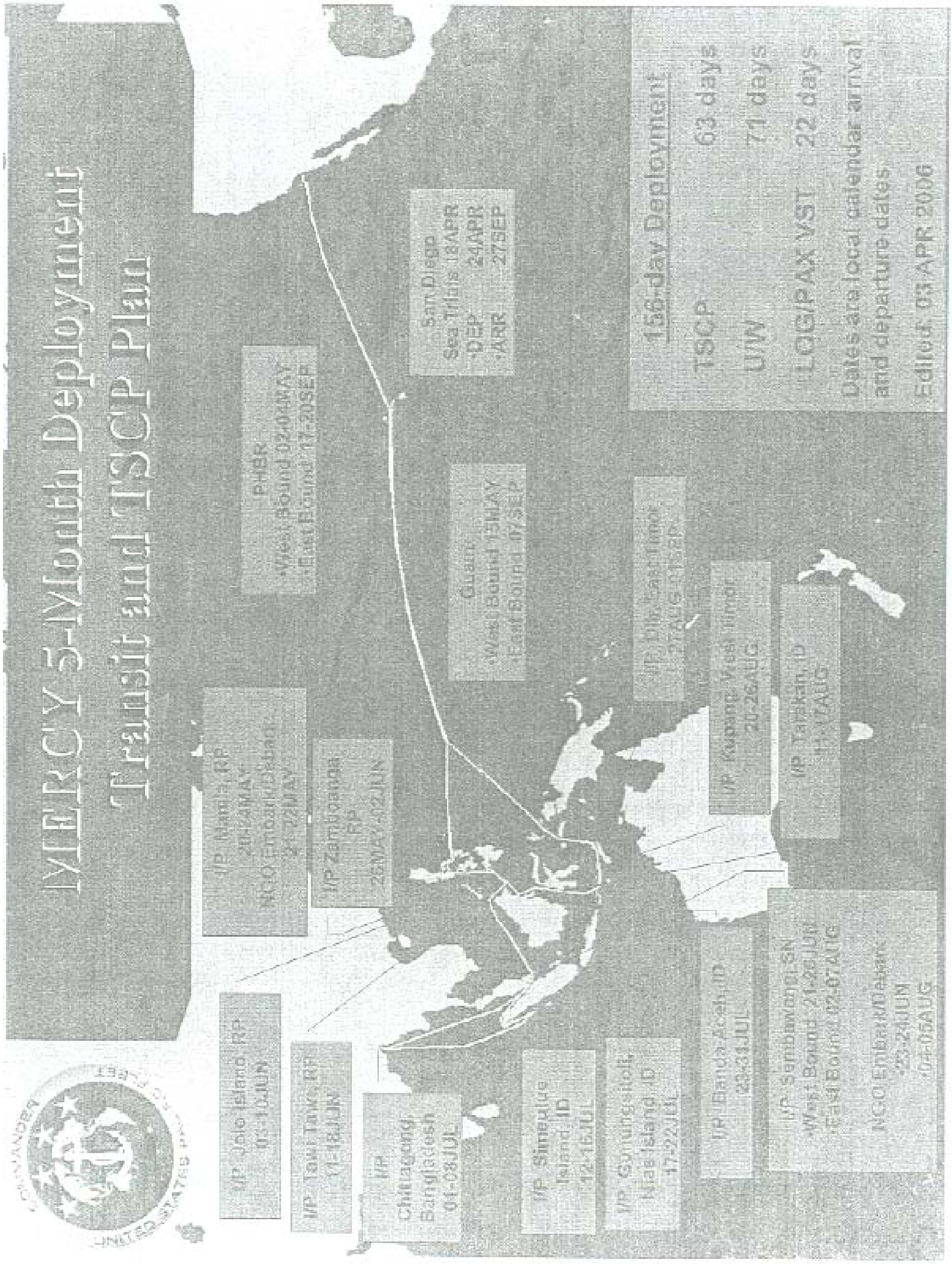
World Health Organization (WHO). (2004b). *Country statistics—Indonesia*. Retrieved February 23, 2007, from http://www.who.int/countries/idn/en/

World Health Organization (WHO). (2004c). *Country statistics—Philippines*. Retrieved February 23, 2007, from http://www.who.int/countries/phl/en/

World Health Organization (WHO). (2004d). *Country statistics—Timor-Leste*. Retrieved February 23, 2007, from http://www.who.int/countrie/tls/en/

World Health Organization (WHO). (2004e). *Health action in crises—Indonesia*. Retrieved February 23, 2007, from http://www.who.int/hac/crises/idn/en/

APPENDIX A. MERCY 5-MONTH DEPLOYMENT PLAN



THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX B. MEDCAP PATIENT DATA

MEDCAP Patient data

ICD9 Category	Zamboanga	Tawi Tawi	Jolo	Simeulue	Nias	Banda Aceh	Kupang	Tarakan	Dili	Total Count
Infectious and Parasitic Diseases	20	112	43	24	48	34	117	161	2	561
Neoplasms	1	11	4		1	3	28	27		75
Endocrine, Nutritional & Metabolic Diseases and Immunity Disorders	6	44	11	20	17	18	93	79	4	292
Disease of the Blood & Blood-forming Organs			1					1		2
Mental Disorders		2		1	2	2	5	6	1	19
Diseases of the Nervous System & Sense Organs	8	48	26	18	18	25	43	54	4	244
Disease of the Circulatory System	9	24	9	23	26	28	72	138	5	334
Disease of the Respiratory System	58	342	273	84	160	89	349	515	24	1894
Diseases of the Digestive System	8	74	33	51	93	43	235	207	36	780
Diseases of the Genitourinary System	5	65	24	14	16	22	96	226	9	477
Diseases of the Skin & Subcutaneous Tissue	15	54	17	17	35	18	68	159	6	389
Diseases of the Musculoskeletal System & Connective Tissue	6	84	46	92	193	83	232	269	12	1017
Congenital Anomalies			1		2	2	3	9	5	22
Certain Conditions Originating in the Perinatal Period										
Symptoms, Signs, & Ill-defined Conditions	1	219	147	55	147	80	244	206	9	1108
Injury and Poisoning	4	23	18	15	19	14	47	56	2	198
Complications of Pregnancy, Childbirth, & the Puerperium										
No Code Assigned*	415	357	87	80	62	69	329	393	304	2096
Total patients seen at each site	**556**	**1459**	**740**	**494**	**839**	**530**	**1961**	**2506**	**423**	**9508**

Based on recorded data. Does not include dental extractions and optometry visits. No code assigned includes physical exams, immunizations and unidentifiable diagnoses.

Medical Modeling, Simulation, and Mission Support

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX C. PRIMARY ICD-9 DIAGNOSES BY GEOGRAPHICAL SITE AMONG SURGICAL PATIENTS

Primary ICD9 diagnoses by geographical site among surgical patients treated aboard the USNS Mercy during a humanitarian mission, May–July 2006

ICD9 Group Description	No. (%)													
	Zamboanga (n = 89)		Jolo Island (n = 82)		Tawi-Tawi (n = 61)		Bangladesh (n = 56)		Simeulue Island (n = 46)		Nias (n = 84)		Banda Aceh (n = 84)	
Congenital Anomalies	14	(15.7)	9	(11.0)	9	(14.8)	54	(96.4)	1	(2.2)	6	(7.1)	12	(14.3)
Circulatory System Diseases	0	(0)	0	(0)	1	(1.6)	0	(0)	0	(0)	0	(0)	1	(1.2)
Digestive System Diseases	20	(22.5)	12	(14.6)	11	(18.0)	1	(1.8)	11	(23.9)	12	(14.3)	15	(17.9)
Genitourinary System Diseases	2	(2.2)	7	(8.5)	5	(8.2)	0	(0)	2	(4.3)	10	(11.9)	5	(6.0)
Musculoskeletal System and Connective Tissue Diseases	0	(0)	6	(7.3)	2	(3.8)	1	(1.8)	1	(2.2)	2	(2.4)	5	(6.0)
Nervous System and Sense Organs Diseases	17	(19.1)	6	(7.3)	4	(6.6)	0	(0)	15	(32.6)	16	(19.0)	22	(26.2)
Respiratory System Diseases	2	(2.2)	0	(0)	0	(0)	0	(0)	1	(2.2)	0	(0)	0	(0)
Skin and Subcutaneous Tissue Diseases	0	(0)	1	(1.2)	0	(0)	0	(0)	3	(6.5)	1	(1.2)	1	(1.2)
Endocrine, Nutritional and Metabolic Diseases, and Immunity Disorders	24	(27.0)	25	(30.5)	15	(24.6)	0	(0)	2	(4.3)	19	(22.6)	6	(7.1)
Injury and Poisoning	1	(1.1)	5	(6.1)	3	(4.9)	0	(0)	2	(4.3)	5	(6.0)	8	(9.5)
Neoplasms	5	(5.6)	6	(7.3)	3	(4.9)	0	(0)	5	(10.9)	4	(4.8)	5	(6.0)
Symptoms, Signs, and Ill-defined Conditions	4	(4.5)	4	(4.9)	8	(13.1)	0	(0)	4	(8.7)	9	(10.7)	4	(4.8)
V72.2 Dental Examination	0	(0)	1	(1.2)	0	(0)	0	(0)	0	(0)	0	(0)	0	(0)

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX D. NURSING MANPOWER REQUIREMENTS CALCULATOR

OR Capacity

Mission Characteristics	
Daily Operating Time/OR (min)	720
Number of ORs	2
Total Daily Operating Time (min)	1440
Mission Duration (days)	1
Average OR Utilization (% days)	0.9
Total Mission OR availability (min)	**1296**

Median OR Time by Surg Type (min)	Patient Proportion	Average OR Time (min)	
OTHER_SURG	0.03	213	
GENERAL	0.39	117	
GYN	0.07	161	
OPTHAMOLOGY	0.18	93	
ORTHO	0.06	154	
PEDS	0.08	139	
PLASTIC	0.22	149	
UROLOGY	0.06	111	
		Weighted Average OR Time (min)	139.72
		Total Surgical Patient Capacity/Mission	**9.28**

Surgical Patient Care Requirements

Surgical Patient Population 9.275516757

Surgical Type	Patient Proportion	Patient Volume	LOS	Acuity Quotient	Care Days
OTHER_SURG	0.03	0.30	5.00	1	1.48
GENERAL	0.39	3.59	3.85	1	13.81
GYN	0.07	0.62	4.59	1	2.83
OPTHAMOLOGY	0.18	1.70	3.38	1	5.76
ORTHO	0.06	0.58	4.53	1	2.61
PEDS	0.08	0.72	3.53	1	2.53
PLASTIC	0.22	2.08	3.97	1	8.26
UROLOGY	0.06	0.52	3.29	1	1.70
		Total Surgical Patient Care Days			**38.97**

Non-Surgical Patient Care Requirements

Ratio of non-surg patients to surg patients	0.67
Patient Population	6.21

Patient Type	Patient Proportion	Patient Volume	LOS	Acuity Quotient	Care Days
NO_SURG	1.00	6.21	2.55	1.00	15.83
		Total Non-surgical Patient Care Days:			**15.83**

Weighted Average LOS

Weighted Average LOS (for Surg and Non Surg Patients):	3.54

Nurse Staffing Requirements

Total Patient Care Days	54.80	**Daily ICU Patient Proportion at 80% Confidence:**	0.20
Average Daily Patient Population	15.48	**Daily Ward Patient Proportion at 80% Confidence:**	0.96
Daily Nurse Workload (days)	0.50		

Specialty Ratio

Critial Care	0.50
Medical Surgical	0.20
Pediatric	0.35

Inpatient Nurses

Nursing Specialties	**Patient Care Area Weight**	**Daily Bed Requirements**	**Personnel Requirements**
Critical Care Nursing	0.20	3	3
Medical Surgical Nursing	0.96	15	6
Pediatric Nursing	0.35	5	4
		Total Manpower Requirement:	**13**

Additional Nurse Requirements

Nursing Specialties

OR Nurses
Casualty Receiving Nurses
Discharge Nurses
Transport Nurses
MEDCAP Nurses

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center
   Ft. Belvoir, VA

2. Dudley Knox Library
   Naval Postgraduate School
   Monterey, CA

3. Anke Richter, Associate Professor of Operations Research
   Defense Resource Management Institute
   Naval Postgraduate School
   Monterey, CA

4. Paula Konoske, Department Head
   Medical Modeling, Simulation & Mission Support, Department 161
   Naval Health Research Center
   San Diego, CA

5. Fritzi McDonald
   Graduate School of Business and Public Policy
   Naval Postgraduate School
   Monterey, CA