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DEVELOPMENT OF AN ACUITY-BASED NURSE STAFFING SYSTEM FOR THE POST ANESTHESIA CARE UNIT

HR 95-001
November 1994

UNITED STATES ARMY
ARMY MEDICAL DEPARTMENT CENTER AND SCHOOL
FORT SAM HOUSTON, TEXAS 78234-6000

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REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION: Unclassified	1b. RESTRICTIVE MARKINGS: None
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT: Distribution Unlimited; Approved for Public Release
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S): HR95-001	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION: Center for Healthcare Education & Studies, AMEDDC&S; 6b. OFFICE SYMBOL (If applicable): MCCS-HRC	7a. NAME OF MONITORING ORGANIZATION: U.S. Army Health Professional Support Agency Nursing Consultant (SGPS-CP-N)
6c. ADDRESS (City, State, and ZIP Code): Clinical Administration Branch, CHES 1608 Stanley Road, Bldg 2268 Fort Sam Houston, TX 78234-6125	7b. ADDRESS (City, State, and ZIP Code): Room 603, Skyline Five 5111 Leesburg Pike Falls Church, VA 22041-3258
8a. NAME OF FUNDING/SPONSORING ORGANIZATION; 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS: PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)
"Development of an Acuity-Based Nurse Staffing System for the Post Anesthesia Care Unit" (Unclassified)

12. PERSONAL AUTHOR(S)
Zadinsky, Julie K. LTC, AN

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Final Report	FROM 1992 TO 1993	1994 November	142

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Acuity-Based Staffing; Nurse Staffing System; Nursing Research; Post Anesthesia Care Unit (PACU); Statistical Process Control

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

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Data were collected using (a) the PACU acuity worksheet (Carty, Rea, & Jennings, 1991) at six study sites for a 16-week period, (b) records of nursing hours worked when the acuity information was being collected, and (c) a survey of PACU characteristics sent to 39 Army PACUs in the U.S. Army Health Services Command (HSC, now the U.S. Army Medical Command or MEDCOM). The strong positive correlation ($r > .90$) between daily direct nursing care hours and patient volume supported the development of a general regression

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
☒ UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☐ DTIC USERS	Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL: JULIE K. ZADINSKY, LTC, AN	22b. TELEPHONE (Include Area Code): (210) 221-9333 / 22c. OFFICE SYMBOL: MCCS-HRC

DD Form 1473, JUN 86 *Previous editions are obsolete.*

19. ABSTRACT (Cont.)

model that was used to estimate daily direct nursing care hours from patient volume information. A method of calculating daily nursing care hours (NCHs) was developed based on the combination of direct nursing care hours as calculated with the regression model and the PACU indirect care multiplier (Rea, Jennings, Carty, & Seipp, 1991).

Data collected regarding daily NCHs at the six study sites were analyzed. A method was developed to describe the typical workload of a PACU, to analyze the workload variation, and to determine the appropriate number of nursing personnel to schedule on a daily basis. An expert panel of PACU head nurses recommended the distribution of skill mix for the number of nursing personnel providing patient care. Following analysis of the distribution of daily workload at the study sites, shift distribution guidelines for nursing personnel were developed. An adjustment method was developed to adjust staff in response to workload variation throughout the day, and an audit method was developed to check the accuracy of information collected for the staffing system.

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SUMMARY

The purposes of the study were (a) to provide an acuity-based method of determining nurse staffing needs for post anesthesia care units (PACUs) in the Army Medical Department (AMEDD) and (b) to provide a method of analyzing PACU workload variation. This method of determining staffing needs and analyzing workload variation is known as the Post Anesthesia Care Staffing System (PACS).

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ACKNOWLEDGEMENTS

Numerous individuals made significant contributions to the successful completion of the study. A special acknowledgement goes to COL Bonnie Jennings, who served as the study director and also provided the researchers with numerous invaluable consultations and reviews throughout the research process. Also of importance are COL Jayne O'Donnell and COL Karen Seipp, who developed the research design used for both the Labor and Delivery and PACU nurse staffing studies. They both provided numerous hours of consultation regarding the use of this design in the PACU staffing study.

COL Jane Hudak attended to innumerable administrative details throughout the course of the study. Additionally, she participated as a researcher on the study in such areas as selecting the study sites, training the data collectors, designing the PACU survey, and conducting the meeting of the expert panel for the skill mix recommendation. Other major contributors included the study coordinators at the six study sites, who were responsible for overseeing data collection in their PACUs. The five PACU head nurses on the skill mix panel contributed their time to make a skill mix recommendation, and the head nurses at all PACUs in HSC (now the MEDCOM) contributed to the study by taking the time to complete the lengthy PACU survey. Nursing personnel at all study sites made the study possible by collecting data with the PACU acuity worksheet.

An acknowledgement goes to COL Bonnie Jennings; LTC John Carty, retired; Dr. Martha Bramlett; and Dr. Barbara Wojcik for helping to ensure a scholarly technical report by providing thoughtful reviews of drafts of the report. Additionally, Dr. Barbara Wojcik provided statistical consultation when she was available throughout the course of the

study. Finally, numerous individuals at the U.S. Army Health Care Studies and Clinical Investigation Activity (HCSCIA; now the Center for Healthcare Education and Studies, U.S. Army Medical Department Center & School)--most notably Ms. Patricia Twist and Ms. Janice Ware--contributed their time and talents to the preparation of the technical report.

INTRODUCTION

Background

The Army Medical Department (AMEDD) Study Board tasked the U.S. Army Health Care Studies and Clinical Investigation Activity (HCSCIA) at Fort Sam Houston, Texas, to extend the Workload Management System for Nursing (WMSN) into the post anesthesia care unit (PACU). (HCSCIA is now reorganized under the Center for Healthcare Education and Studies, AMEDD Center & School.) WMSN is an acuity-based staffing system that was developed by Army and Navy researchers in 1985 (Department of the Army, 1990; Misener, Frelin, & Twist, 1983, 1987; Sherrod, 1984; Vail, Morton, & Rieder, 1987). WMSN consists of both a patient classification system, which quantifies nursing workload based on patient acuity, and guidelines for allocation of nursing personnel. WMSN originally was developed for seven inpatient nursing areas: critical care, medical-surgical, obstetrics and gynecology, psychiatry, newborn nursery, pediatrics, and the neonatal intensive care unit.

Nursing workload, commonly measured as nursing care hours (NCHs), includes both direct and indirect care time. Direct care, which provides the basis for classifying patients into acuity categories, is defined as nursing activities that take place in the presence of the patient (Kay, Alcock, Lawrence, & Goodman, 1990; Rea, Jennings, Carty, & Seipp, 1991). Indirect care is defined as nursing activities that are performed away from the patient in support of patient care or unit management (Kay et al., 1990; Rea et al., 1991). As defined in this manner, indirect care includes patient care activities such as preparing equipment for use, conducting patient care conferences, and transporting patients to their receiving units.

Indirect care also includes other activities such as documenting patient care, preparing time schedules, and cleaning the unit.

Extending WMSN into the PACU necessitated the development of a method to quantify PACU direct and indirect care time. Carty, Rea, and Jennings (1991) developed a patient classification system (PCS) that quantifies the time nursing personnel spend providing direct patient care to PACU patients. This PCS is based on 25 critical indicators, which were shown by the research to best account for a patient's direct care time. These critical indicators are specific nursing tasks. Nursing personnel mark the frequency with which the tasks are performed as care is provided. This is a significant difference from WMSN, which requires that critical indicators be marked based on nursing activities that are expected to be completed over the next 24-hour period. Rea et al. (1991) used a stratified work sampling design to determine PACU indirect care time, which was expressed as a percentage of the total amount of time nursing personnel are available to provide patient care.

Purpose

The main purpose of the study was to provide an acuity-based method of determining nurse staffing needs for PACUs in the AMEDD. This method is based on the previous investigations of Army PACU direct care (Carty et al., 1991) and indirect care (Rea et al., 1991) nursing time components. A second purpose of the study was to provide a method of analyzing the variation in PACU workload.

The method of determining staffing needs and analyzing the workload variation that was developed in this study is known as the Post Anesthesia Care Staffing System (PACS).

PACS provides a method of using workload patterns to develop a profile specifying the number of nursing personnel typically needed for patient care. Head nurses can use PACS to determine the number and type of nursing personnel to schedule on a daily basis and to analyze the variation in their workload.

Research Objectives

The following are the research objectives, which represent the development of the main components of PACS:

1. Develop a method by which the typical workload of a PACU can be described and the variation in the workload can be analyzed.

2. Develop a method of determining the number of nursing personnel to schedule on a daily basis.

3. Develop guidelines for the skill mix and shift distribution of nursing personnel.

4. Develop guidelines for adjusting the number of staff during periods of the day when there are changes in the typical daily workload pattern.

5. Develop a method of checking the accuracy of information collected for the staffing system.

Assumptions

Nursing workload in this study was conceptualized as an ongoing process that varies over time. However, nursing workload was measured at specific and limited periods of time at the six data collection sites in this study. It was assumed that the measured nursing

workload accurately reflects the ongoing workload at the data collection sites. Additionally, it was assumed that clinical responsibilities of nursing personnel serving as data collectors did not prohibit them from accurately completing the PACU acuity worksheets.

Definitions

The following definitions were used for terms describing nursing personnel, nursing workload measurements, the staffing system, and patient categorizations:

Nursing Personnel Categories

Fixed Staff. Nursing personnel who have an administrative role in addition to a clinical role on a nursing unit. The need for fixed staff does not fluctuate with patient acuity (Rea et al., 1991). The head nurse, wardmaster, and ward clerk are defined as fixed staff positions in the Post Anesthesia Care Staffing System (PACS).

Variable Staff. Nursing personnel who have a primary responsibility of providing nursing care to patients. The number of variable staff needed per day is directly driven by the number and acuity of patients on the unit (Rea et al., 1991).

Nursing Workload Measurements

Nursing Care Hours. A measure of nursing workload obtained by combining direct care time with an indirect care component, which is made up of indirect care time and nonproductive time. As explained by Rea et al. (1991), this conceptualization of the indirect care component is consistent with accepted Department of Defense (DoD) nursing guidelines (USAMARDA, 1986).

Available Time. Time associated with both productive time (direct and indirect care time) and nonproductive time. Following are the definitions of the components of available time (Rea et al., 1991, pp. 47):

Direct Care Time. Time spent in "nursing activities done in the presence of the patient on the unit."

Indirect Care Time. Time spent in "nursing activities done away from the patient in support of either patient care or unit management."

Nonproductive Time. Time spent in activities that do not contribute to workload productivity, such as "activities of a personal nature (breaks, telephone calls), fatigue, unavoidable delay, wait/stand-by, and meals."

Components of the Post Anesthesia Care Staffing System

Workload Profile. A description of the typical daily workload of personnel in a specific nursing unit over a 3-month period of time. Workload is measured in nursing care hours (NCHs) per day.

Staffing Profile. A description of the number, skill mix, and shift distribution of nursing personnel to schedule on a daily basis. Thus, the staffing profile consists of a staffing range, skill mix, and shift distribution.

Staffing Range. The range of nursing personnel to schedule on a daily basis to accomplish a unit's workload.

Skill Mix. The recommended proportion of different types of nursing personnel to provide patient care on a nursing unit. Skill mix addresses the ratio of professional to paraprofessional staff and also the ratio of licensed practical nurses to nurse assistants.

Shift Distribution. The allocation of nursing personnel to work in turn with each other during different periods of time throughout the hours of operation of a unit (Bell, Warner, & Cameron, 1985; Luczun, 1984). A shift refers to a group of nursing personnel who are assigned to work during a particular period of time, such as 0730 to 1600 or 0900 to 1730.

Adjustment Method. A procedure used to increase or decrease the number of staff during periods of the day when there are changes in the typical daily workload pattern.

Audit Method. A procedure that checks the accuracy of information collected for the Post Anesthesia Care Staffing System (PACS).

Patient Categorizations

Remain Overnight (RON) Patients. Patients who remain in the PACU for postoperative care from the day of their surgery until the following morning.

American Society of Anesthesiologists (ASA) Classification System. A physical status classification system based on the physical condition of a patient independent of the surgery that is to be performed (Stoelting & Miller, 1989). Following are the definitions of the classes (Stoelting & Miller, 1989, p. 114):

ASA Class 1. "No organic, physiologic, biochemical, or psychiatric disturbance."

ASA Class 2. "Mild to moderate systemic disturbance that may or may not be related to the reason for surgery."

ASA Class 3. "Severe systemic disturbance that may or may not be related to the reason for surgery."

ASA Class 4. "Severe systemic disturbance that is life-threatening with or without surgery."

ASA Class 5. "Moribund patient who has little chance of survival but is submitted to surgery as a last resort (resuscitative effort)."

Emergency Operation (E). "Any patient in whom an emergency operation is required."

Patient Categorization by Anesthesia Type

Local Anesthesia Patients. Patients who received only local anesthesia and/or sedation.

Regional Anesthesia Patients. Patients who received regional and/or spinal anesthesia with or without local anesthesia or sedation.

General Anesthesia Patients. Patients who received general anesthesia with or without another type of anesthesia or sedation.

Framework

Direct and Indirect Care Time

The organizing framework of the study was based on the premise that direct care time and the indirect care time component are directly related to and can be combined to represent PACU nursing workload. Direct care time was defined as "nursing activities done in the presence of the patient on the unit" (Rea et al., 1991, p. 47). Direct care was measured by the PACU patient classification system (Carty et al., 1991).

The indirect care time component of nursing workload included both indirect care time and nonproductive time. As explained by Rea et al. (1991), this conceptualization of the indirect care component is consistent with accepted Department of Defense (DoD) nursing guidelines (USAMARDA, 1986). Indirect care time was defined as "nursing activities done away from the patient in support of either patient care or unit management" (Rea et al.,

1991, p. 47). As defined in this manner, indirect care included eight categories of nursing activities: (a) patient care activities done away from the patient--such as preparing equipment for use or ordering medications; (b) patient care conferences--such as change of shift report; (c) activities related to transportation on and off the unit--such as transporting patients to nursing units and transporting patient specimens to the laboratory; (d) communication related to patient care or unit management--such as discussion of a patient's condition with a physician; (e) documentation of patient care and clerical support--such as reading patient records and transcribing orders; (f) activities done in support of unit management--such as preparing the time schedule and counselling staff; (g) cleaning on the unit--such as cleaning equipment; and (h) inventorying, ordering, and restocking supplies and linen (Rea et al., 1991). Nonproductive time was defined as activities that do not contribute to workload productivity such as "activities of a personal nature (breaks, telephone calls), fatigue, unavoidable delay, wait/stand-by, and meals" (Rea et al., 1991, p. 47). The indirect care time component was measured by an indirect care multiplier that was based on both indirect care time and nonproductive time (Rea et al., 1991).

PACU nursing workload referred to all activities involved in providing nursing care to PACU patients. Nursing workload was measured by NCHs per day as plotted over a 3-month period of time in a workload profile. NCHs per day were calculated by mathematically combining direct care time with the indirect care time component.

Nursing Workload

Because one of the purposes of the study was to provide PACU nurses with a method of analyzing workload variation, it is especially important to recognize factors that affect direct

and indirect care time and thus nursing workload in the PACU. These factors and the ways in which they interact with each other affect the variability of nursing workload. O'Donnell and Seipp (1992) developed a nursing workload model that identifies patients, health care delivered, and the nursing care delivery process as major factors that influence nursing workload (see Appendix A). The application of these factors to PACU workload will be discussed.

Patients

The volume of PACU patients and the needs of these patients vary throughout the day and from day to day. This variation has a major impact on nursing workload (Drain & Christoph, 1987). The number and needs of patients who arrive in the PACU throughout the day is determined by the operating room (OR) caseload, which varies due to emergency cases and cancellations. Moreover, patient needs in the PACU vary in unpredictable ways because of postoperative complications (Luczun, 1984). Additionally, the number and needs of patients arriving in the PACU may vary throughout the year for reasons such as the timing of surgical residencies or school vacation.

Health Care Delivered

Health care delivered by nursing and medical personnel as well as health-related disciplines at an MTF affect the type of patients being seen at a facility and thus their nursing care requirements. For example, the health care delivered and thus the patient complexity at a regional multi-trauma center is very different from the patient complexity at a small community hospital.

Nursing Care Delivery Process

The staff delivering care, philosophy of care, facility capacity, equipment, and non-nursing support are factors related to the nursing care delivery process that have been identified as affecting nursing workload (O'Donnell & Seipp, 1992). The number, skill mix, and experience of PACU nursing staff as well as the number, specialty areas, and practice patterns of the surgical staff impact on the care delivery process. For instance, the immediate availability of an experienced anesthesiologist or nurse anesthetist in the PACU to work with nursing personnel affects how nursing care is delivered. Differences in philosophy of care are reflected in unit policies as well as in the range of nursing care provided by PACU nursing staff (Andrews, 1987). For example, the workload varies according to the extent to which nursing personnel are involved in tasks such as providing preoperative teaching and preparing the patient for surgery (Fraulini, 1987).

Additionally, facility capacity factors affecting workload include the number of operating rooms and PACU beds, the hours of operation of the PACU and OR, and the existence of a call system designed for nursing personnel to care for PACU patients after normal duty hours (Luczun, 1984; Spadaccia, 1990). The accessibility of equipment frequently used in patient care as well as the availability of the latest physiological monitoring systems and automated information systems at the patient's bedside influence the care process (Andrews, 1987; Luczun, 1984). Also, non-nursing services that nursing personnel must perform greatly impact on how nursing care is delivered (Andrews, 1987). This includes services that could be provided by respiratory therapists, laboratory technicians, pharmacists, EKG technicians, supply technicians, and housekeeping personnel.

Finally, two factors affecting PACU workload that were not specifically addressed in the workload model (O'Donnell & Seipp, 1992) are the physical design of the unit and the unit's location in relation to other patient care areas (Andrews, 1987). For example, the visibility of patients from a centralized location in the PACU and the amount of time it takes to transport a patient to the surgical wards affect how care is delivered.

Review of Literature

There are very few PACU staffing systems reported in the literature. Unpredictable patient flow and great fluctuations in a patient's acuity during a short length of stay in the PACU were cited as major obstacles to developing a staffing system for this area of practice (Drain & Christoph, 1987). The review of literature includes a brief examination of PACU staffing systems that are being used in non-military institutions and a discussion of their limitations.

PACU Staffing Systems

Most staffing systems are based on a patient classification system (PCS), which refers to "the identification and classification of patients into care groups or categories, and to the quantification of these categories as a measure of the nursing effort required" (Giovannetti, 1979, p. 4). Two common types of PCSs are prototype and factor evaluation systems. Giovannetti (1979) explained that a prototype system "describes the characteristics of patients typical to each category" (p. 5); and in a factor evaluation system, "a number of critical indicators or descriptors of direct care requirements are separately rated and then combined

to designate a patient's category" (p. 5). Prototype PCSs generally are considered more subjective than factor evaluation systems.

At the time of this literature review, most PACU nurses did not use a refined staffing system on a routine basis to assess their staffing needs. However, several researchers reported on the development of prototype PCSs that were used to classify patients into four or six categories based on their need for minimal to intensive nursing care (Allen, 1990; Beach, 1985; Bodenstein & DeLozier, 1983; Shirk & Marion, 1986). These PCSs had guidelines for the nurse-to-patient ratio that should be used to estimate nursing care requirements for patients in each category. Each PCS organized and described its patient categories differently and was designed for use in a specific PACU.

Other nurses reported on more extensive staffing systems that were being developed. For example, Strack and Jones (1983) reported on the development of a staffing system based on a prototype PCS that used three levels of care to classify patients and had recommended nurse-to-patient ratios that were based on these levels of care. Management engineers calculated the required number of NCHs for the unit by combining information obtained from the PCS with a fixed quantity of hours representing indirect care time. They compared the required NCHs per month with the number of hours worked to obtain a productivity rating percentage. Nurses used the productivity rating to monitor changes made in the unit, such as changes in the times when staff were scheduled to arrive for work throughout the day.

Smith, Mackey, and Markham (1985) developed a productivity monitoring system that identified staffing requirements from historical case load data. PACU staff and management

engineers developed a prototype PCS by dividing patients into 2 categories based on their required nursing care. Data obtained from interviews and from 2 weeks of observing PACU work were used to compute patient care hours for each patient category. One use of this system was that historical patient data regarding the number of patients in the PACU throughout the day was combined with patient care hour information to construct case load profile charts. The PACU head nurse used the case load profile charts to match staffing with case load trends.

Two staffing systems were developed for pediatric PACU patients (Kay et al., 1990; Miller, 1986). The system developed by Kay et al. (1990) is an adaptation of Miller's (1986) system. Both of these staffing systems were based on a factor evaluation PCS that had 6 classification categories. Each of the 42 critical indicators was assigned a weighted numerical value according to the complexity of the task, and patients were categorized according to the number of points they received for the indicators. Each classification category was assigned a fixed number of NCHs. Staffing requirements were calculated monthly using the number of patients in each category multiplied by the assigned number of NCHs for the category. Nurses used these systems to compare the total hours needed for patient care with the total number of available nursing hours. They based their requests for more staff and their staffing budget on this information.

Limitations of Existing Staffing Systems

Two major limitations of existing PACU staffing systems were identified. First, the manner in which indirect care time is accounted for in staffing systems needs to be refined. Although nursing workload is comprised of both direct and indirect care time, not all

researchers fully described the indirect care time component of their staffing systems. For example, Shirk and Marion (1986) allowed a fixed amount of indirect care time for their patient categories, and Strack and Jones (1983) provided fixed monthly credits for indirect care. However, these researchers did not define indirect care time or describe how it was derived. Kay et al. (1990) mentioned their self-report method of deriving indirect care time, but they noted that this method provided inaccurate information.

Second, many of the PCSs suffered from a lack of rigorous development. Nurses who reported on the development of a PCS generally did not address the reliability or validity of the instrument, and most did not report a method of determining whether staff members consistently classified patients in the same way when using the PCS. Furthermore, Kay et al. (1990) reported that, in their PCS, some patients were classified into a higher category than warranted due to the length of stay indicator. Other nurses used patient length of stay in various ways in their PCS, but its use deserves further investigation because a patient's length of stay is often determined by such factors as the availability of a staff member to transport a patient to a unit or the availability of a bed on the receiving unit.

In summary, the literature review demonstrated a lack of well-developed PACU staffing systems. Furthermore, no staffing system was found that could be more fully developed for use in PACUs within HSC. Therefore, work proceeded to merge the prior studies of direct and indirect nursing care for PACU patients (Carty et al., 1991; Rea et al., 1991) into a PACU staffing system.

METHODOLOGY

In the methodology section, selection of the data collection sites and the study sample are discussed. Additionally, the measurement instruments and formula used in the study are described. The study procedures--including subject acquisition, protection of human rights, and data collection--are explained. Finally, methods used to manage the data and analyze the research objectives are briefly reviewed.

Study Sites and Sample

Selection of Study Sites

PACUs were considered for selection as study sites if they met five inclusion criteria. First, a PACU had to be a stand-alone unit. That is, a PACU could not coexist in the same location with another unit, such as Same Day Surgery (SDS). Second, a PACU had to have its own separate staffing. For example, the PACU nursing staff could not be responsible for providing patient care in both the PACU and the Surgical Intensive Care Unit (SICU). Third, a PACU could not be undergoing any changes in its physical environment that would influence its workload during the planned period of data collection. Therefore, one PACU in a medical treatment facility (MTF) that was being moved to a new physical location and another PACU in an MTF that was undergoing renovation in the peri-operative area were not considered for selection as study sites. Fourth, a PACU could not be located in an MTF that was in the process of being closed.

Finally, a PACU had to be located within the U.S. Army Health Services Command (HSC) in order to be considered for selection as a data collection site. (HSC was

reorganized as the U.S. Army Medical Command or MEDCOM in 1994.) The workload at several MTFs outside of HSC was atypical at the time of the study because of the rapid reduction in military forces that was occurring overseas. Moreover, there was no reason to believe that a difference existed between nursing care provided to patients in Army PACUs within and outside of HSC.

Data collection sites were selected from PACUs meeting the initial inclusion criteria based on two measures of workload--patient volume and patient complexity (see Table 1). Patient volume was measured by average quarterly minutes of service data available for FY92. Minutes of service refers to the period of time a patient remains in the PACU. Time is counted from admission to discharge, plus 10 minutes for personnel to transport a patient to a receiving unit and return to the PACU. Average quarterly minutes of service reflects more than the average quarterly number of PACU patients. However, workload data were kept by minutes of service rather than by patient volume at the time of the study. Therefore, minutes of service was the only indicator of patient volume readily available for all PACUs within HSC. The tri-service PACU workload strata cutpoints at quarterly averages of 65,000 and 125,000 minutes of service were used to categorize PACUs into low, medium, and high workload strata (Rea et al., 1991).

Patient complexity was measured by the surgical relative case mix index (RCMI) data that were available for FY92 from the Patient Administration Systems and Biostatistics Activity (PASBA). The surgical RCMI refers to an MTF's standardized workload credit for surgical procedures based on diagnosis related groups (DRGs), given that the workload credit

Table 1

Characteristics of Study Sites

Study Site	Workload Strata	Average Quarterly Minutes of Service[a]	Surgical Relative Case Mix Index (RCMI)[a]
1[b]	Low	62,323	1.72
2[b]	Low	62,323	1.72
3	Medium	104,130	.83
4	High	177,322	1.35
5	Low	51,333	.82
6	High	267,051	1.67

Notes. [a] Average Quarterly Minutes of Service and Surgical RCMI are based on data from the first 6 months of FY92. [b] Sites 1 and 2 were separate PACUs at the same MTF. Because their monthly patient volume was almost identical, half of the MTF's Average Quarterly Minutes of Service was reported for both PACUs. Also, no data were available that could be used to calculate a Surgical RCMI separately for both PACUs in this MTF. Therefore, the MTF's Surgical RCMI was reported for both PACUs.

for an average disposition across all Department of Defense facilities is 1.00 (Lichtig, 1986; Moon & Jensen, 1990). An MTF's surgical RCMI reflects more than the complexity of PACU patients. However, it was the best indicator of patient complexity available for all PACUs within HSC, and it was an appropriate indicator to use for comparing PACUs with each other. The variation in surgical RCMI among the study sites is shown in Table 1.

Six data collection sites that were representative of all three workload strata and that varied according to patient complexity were selected. Study site 5 was clearly in the low workload stratum, site 3 was in the high end of the medium stratum, and sites 4 and 6 represented the low and high ends of the high stratum. Study sites 1 and 2 were separate PACUs at the same MTF, and both were at the high extreme of the low workload stratum. Because there was very little difference between the average quarterly minutes of service at study sites 1 and 2 and at PACUs categorized in the low extreme of the medium stratum, sites 1 and 2 were considered representative of PACUs in the high extreme of the low workload stratum as well as PACUs in the low extreme of the medium workload stratum. As would be expected, the two study sites with a surgical RCMI less than one were located in medical department activities (MEDDACs) and were categorized in the low and medium workload strata. The four sites with a surgical RCMI greater than one were located in U.S. Army Medical Centers (MEDCENs) and were categorized in the high extreme of the low workload stratum and in the high workload stratum.

Selection of Subjects

The PACU patient classification system used in this study was designed for use during post anesthesia Phase I, when nursing care focuses on "providing a transition from a totally

anesthetized state to one requiring less acute interventions" (American Society of Post Anesthesia Nurses, 1992, p. 4). Therefore, all patients who received Phase I post-anesthesia care from PACU nursing staff during the data collection period at the study sites were eligible for inclusion in the sample. These patients were admitted to the PACU from the operating room, a clinic, or the same day surgery (SDS) unit, and they were discharged from the PACU to another unit. It was planned that acuity data would be obtained on a daily basis for a 16-week period so that workload and staffing profiles could be developed for each site based on 3-4 months of accurate acuity data. The number of patients who could be included in the sample from the selected data collection sites during this period of time was judged to be adequate for data analysis.

Instrumentation

The PACU patient classification system (Carty et al., 1991) and the PACU indirect care formula (Rea et al., 1991) served as the basis for the measurement of NCHs. Data from a PACU survey also were used in the study. A brief explanation will be given for these instruments and formula.

PACU Patient Classification System

The PACU patient classification system (PCS) is a factor evaluative PCS that accounts for direct care time (Carty et al., 1991). Direct care time was defined as nursing activities that take place in the presence of the patient. To develop the PCS, a panel of clinical nursing experts identified 62 direct care nursing tasks that reflected the full range of PACU nursing. The average time that it took to complete each of the 62 direct care tasks was established by

actual stopwatch timed measurements. A pilot test of the data collection instrument containing these 62 tasks demonstrated a strong reliability (r = .93) and validity (r = .82).

After determination of the instrument's reliability and validity, a study of the 62-item instrument was conducted at a sample of six U.S. Army medical treatment facilities (MTFs), and regression analysis identified 25 indicators that made up the best parsimonious set of direct care predictor tasks. In its final form, the PACU PCS consists of an acuity worksheet containing these 25 critical indicators or nursing tasks (see Appendix B). Pilot testing of the final instrument demonstrated a strong reliability (r = .98) as measured by comparing the direct care time obtained for a patient using the final 25-task instrument with the direct care time obtained using the original 62-task instrument. Pilot testing also demonstrated concurrent validity (r = .90) as measured by comparing the time obtained from the 25-task instrument with the original 62-task instrument stopwatch time.

Extensive written guidelines are available to ensure proper use of the acuity worksheet (see Appendix C). A separate acuity worksheet is used for each patient to document the frequency with which the 25 nursing tasks are performed. The worksheet is designed to be completed by nursing personnel while patient care is being provided. After the patient is discharged from the PACU, the frequency that each nursing task was performed is totalled. The frequencies are used in the PCS regression equation to estimate the total direct care time for each patient.

Indirect Care Multiplier Formula

Rea et al. (1991) conducted a study to determine the PACU indirect care time component (which includes indirect care time and nonproductive time) expressed as a

percentage of the total amount of available time. As previously explained, available time includes time associated with productive time (direct and indirect care time) and nonproductive time. Rea et al. (1991) used a stratified work sampling design for their study of indirect care and collected data at a sample of PACUs in HSC. Their research determined that when using available time and eliminating three fixed positions (head nurse, wardmaster, and ward clerk), the combined indirect care and nonproductive proportion of 76.8% should be used to develop the PACU staffing standard.

Perdue (1990) provided the following indirect care multiplier formula that should be used together with the findings of Rea et al. (1991): 1 + (% indirect / 1 - % indirect). This formula has been shown to accurately demonstrate the relationship between the direct and indirect components of available staff time (see Appendix D). When this formula was applied to the findings of Rea et al. (1991), an indirect care multiplier (ICM) of 4.31 was obtained. This was the ICM that was used in the study and therefore should be used with all applications of the staffing system being developed.

PACU Survey

The PACU survey is a 63-item questionnaire developed by the researchers for the portion of the study concerned with evaluating factors that impact on PACU workload. The questions were developed in accordance with the conceptualization of nursing workload used in the study. A copy of the survey, which was designed to be completed by the head nurse of each PACU in HSC, can be found in Appendix E. Originally it was planned that workload information from the survey would be used to group or cluster PACUs according to their workload. However, because of the results of the regression analysis, it was decided that

further study with PACU clusters would not be conducted. Workload information from the survey was used for other parts of the study, such as the development of shift distribution and staffing adjustment guidelines.

Procedures

Subject Acquisition

Permission to collect data at the six study sites was obtained in coordination with the Chief, Nursing Division, HSC. The chief nurse at each of the data collection sites then appointed a study coordinator for the site. At all sites, the study coordinator was the PACU head nurse. The researchers worked closely with the study coordinators throughout the data collection process to ensure the accurate and reliable collection of data.

Protection of Human Rights

The staff of the Clinical Investigation Division, U.S. Army Health Care Studies and Clinical Investigation Activity, Fort Sam Houston, Texas, reviewed the study proposal. They concluded that the study was exempt from Army Regulation 40-38, the Clinical Investigation Program. Furthermore, it was noted that patient identifiers were preserved on data collection forms only as long as needed for data analysis and that access to these forms was strictly limited to the researchers.

Data Collection

Data were collected using (a) the PACU acuity worksheet at six Army PACUs, (b) the records of nursing hours worked when the acuity information was being collected, and (c) a survey of PACU characteristics sent to all 39 PACUs in HSC. The acuity worksheet

and time schedule data were collected for a 16-week period from June 8 through October 23, 1992. Surveys were mailed to PACU head nurses in July 1992.

Direct Care Time Data

Just prior to the initiation of data collection at a site, training was provided for nursing personnel who would serve as data collectors. To allow for individualized and intensive instruction, personnel were divided into groups of 3 to 4 individuals for a 2-hour training session. The training sessions at the study sites were identical in structure and content. They were based on the written guidelines for use of the acuity worksheet, a copy of which was given to each data collector (see Appendix C). Trainees practiced using the acuity worksheet with three written case studies containing examples of the nursing tasks to be rated. The case studies were corrected and discussed during the training session.

To assess the extent to which trainees could apply the written guidelines to use of the acuity worksheet, criterion-related agreement between the trainee's score and the "correct" score was assessed with a second set of three written case studies (Castorr et al., 1990). Trainees who did not achieve at least 95% agreement with the correct rating of each acuity worksheet were evaluated with a different set of case studies after receiving individualized instruction in their problem areas. The passing percentage of agreement was set at a high level (95%) to maximize the opportunity to discover and clarify all portions of the rating guidelines that were not clear to the trainees. Only 9 (15%) of the 62 trainees required a second evaluation. These 9 personnel, all of whom were paraprofessionals, achieved at least 95% agreement on subsequent testings.

Nursing personnel who started working at the study sites after data collection had begun were trained in the data collection procedure by the study coordinator. Also, at approximately monthly intervals, the study coordinators independently rated a patient on an acuity worksheet with each one of the data collectors. When the data collector did not reach 95% agreement with the study coordinator, the areas of disagreement were discussed, and they independently rated another patient until this level of percentage agreement was attained.

The study coordinator at each site supervised the collection of data from the acuity worksheets on all patients meeting the sample inclusion criteria for the 16-week period of data collection. They mailed their worksheets to the researchers every 1 to 2 weeks throughout the data collection period. The researchers phoned the study coordinators with any questions they had regarding the acuity worksheet data.

Time Schedule and Survey Data

Study coordinators mailed their corrected time schedules to the researchers every 1 to 2 weeks throughout the 16-week data collection period. Information on the time schedules included the total number of hours worked each day for the head nurse, wardmaster, ward clerk, professional nursing staff, paraprofessional nursing staff, professional nursing students, and paraprofessional nursing students.

The PACU survey was mailed to head nurses of the 39 PACUs in HSC during July 1992. Questions from head nurses regarding the completion of the survey were answered by phone. There was a 100% response rate.

Data Analysis

Management of Data

When the acuity worksheet and time schedule data were received at HCSCIA, they were screened for completeness and accuracy of patient information. Study coordinators were consulted regarding missing, illegible, or illogical information. In most cases, the coordinators were able to retrieve the missing or illegible information from patient records. Also, they often were able to explain or correct seemingly illogical information. When a patient's acuity worksheet remained illogical from a clinical perspective after consulting with the study coordinator, that patient was excluded from the study.

As an additional assurance of the accuracy of the acuity worksheet data, acuity data were entered into a data set by trained data entry personnel using a double key entry process. According to this process, each data point was verified by two data entry personnel before being entered in the data set. After data had been entered, the entire data set was subjected to computer programs that used logical expressions making various assertions about the data. These assertions were tested against each record, and a report of the violations of these expressions was generated. Once again, any patient whose acuity worksheet was illogical from a clinical perspective was excluded from the study.

Analysis of Objectives

As previously stated, five research objectives guided the development of the staffing system. Preliminary analyses demonstrated a strong positive correlation ($r > .90$) between daily patient volume and direct care time. Thus, regression analysis was performed to select a model that would predict daily direct care hours from patient volume information. The

development of the workload and staffing profiles was based on the Shewhart method of variance analysis. The shift distribution and staffing adjustment guidelines were developed based on an analysis of workload variation throughout the day. A panel of PACU head nurses was convened to make skill mix recommendations. Finally, the researchers developed an audit method that could be used on a continuing basis by PACU nursing personnel.

FINDINGS

Presentation of the findings consists of a description of sample characteristics, preliminary analyses, analyses conducted for each research objective, and additional analyses. Statistical process control software (Shewhart, 1992) was used for development of the workload profiles, and SAS version 6.07 was used for all other data analyses.

Sample Characteristics

The study sample consisted of 7,034 PACU patients at six study sites. Twenty percent of the entire sample received only local anesthesia and/or sedation, 20% received regional and/or spinal anesthesia with or without local anesthesia or sedation, and 60% received general anesthesia with or without another type of anesthesia or sedation. The distribution of anesthesia type for each study site is shown in Table 2. The sample represents patients who were cared for by physicians from a wide range of clinical services as shown in Table 3. Other demographic characteristics of the sample--including age, duty status, gender, and American Society of Anesthesiologists (ASA) class--are presented in Table 4. The majority of patients in the sample were 18 to 59 years of age and were active duty soldiers or family members. There were almost an equal number of male and female patients in the sample. Also, most patients were categorized in ASA Class 1 or 2, indicating that they had no organic, physiologic, biochemical, or psychiatric disturbance or had only a mild or moderate systemic disturbance (Stoelting & Miller, 1989).

Table 2

Number and Percent of Patients in Each Anesthesia Category by Study Site

Site[b]	Anesthesia Categories[a]						Total
	Local		Regional		General		
1	145	(17%)	240	(27%)	487	(56%)	872
2	71	(8%)	168	(19%)	631	(73%)	870
3	180	(14%)	257	(20%)	859	(66%)	1296
4	292	(24%)	242	(19%)	698	(57%)	1232
5	98	(13%)	190	(26%)	454	(61%)	742
6	655	(32%)	283	(14%)	1084	(54%)	2022
Total	1441	(20%)	1380	(20%)	4213	(60%)	7034

Notes. [a] Local Anesthesia refers to patients who received only local anesthesia and/or sedation. Regional Anesthesia refers to patients who received regional and/or spinal anesthesia with or without local anesthesia or sedation. General Anesthesia refers to patients who received general anesthesia with or without another type of anesthesia or sedation. [b] Sites 1, 2, 4, and 6 are U.S. Army Medical Centers (MEDCENs), while sites 3 and 5 are U.S. Army medical department activities (MEDDACs).

Table 3

Number of Patients Admitted By Clinical Service at Each Study Site During the Data Collection Period

	Study Site						
Clinical Service	1	2	3	4	5	6	Total
Cardiology	4	0	0	15	0	72	91
Cardiovascular/Thoracic Surgery	3	12	0	17	0	35	67
General Surgery	370	13	331	290	185	323	1512
Gynecology	220	0	269	90	129	162	870
Nephrology	1	2	0	3	0	4	10
Neurosurgery	0	57	0	53	0	93	203
Obstetrics	47	0	50	31	40	68	236
Oncology	8	0	0	5	0	4	17
Ophthalmology	0	50	28	36	18	102	234
Oral Surgery	0	102	38	67	53	13	273
Organ Transplant	0	0	0	0	0	46	46
Orthopedics	5	323	251	331	220	305	1435
Otorhinolaryngology	0	183	222	98	58	188	749
Pediatrics	40	52	5	1	2	92	192
Peripheral Vascular Surgery	8	0	0	46	0	59	113
Plastic Surgery	1	75	0	58	0	102	236
Urology	162	1	102	90	37	347	739
Other	3	0	0	1	0	7	11
Total	872	870	1296	1232	742	2022	7034

Table 4

Sample Characteristics for Each Study Site

Characteristics	Study Site 1	2	3	4	5	6	Total
Age							
< 2	24	34	56	15	9	65	203
2-11	48	117	174	53	68	140	600
12-17	24	72	39	29	34	49	247
18-39	327	340	750	519	429	682	3047
40-59	201	167	202	366	144	538	1618
60-79	227	128	73	245	55	512	1240
80-95	21	12	2	5	3	36	79
ASA Class[a]							
1	278	412	675	419	309	617	2710
2	370	328	577	548	403	962	3188
3	207	118	41	198	27	304	895
4	13	12	2	26	1	15	69
Duty Status[b]							
Active Duty	174	268	423	447	281	556	2149
Retired	176	119	74	271	64	498	1202
Family Member	506	469	781	508	396	936	3596
Civilian Emergency	8	11	0	0	1	2	22
Gender							
Female	538	404	697	548	388	917	3492
Male	334	466	599	684	354	1105	3542

Note. [a] 172 records did not indicate an American Society of Anesthesiologists (ASA) Class. [b] 65 records did not indicate Duty Status.

Preliminary Analyses

Preliminary analyses include a description of outliers for the variable, direct care time per patient, and an examination of the stability of the measurement of this variable throughout the data collection period at each study site. Also, the relationship of the variable, direct care time per patient, to the type of anesthesia and to patient volume per day are described. Finally, the development of a regression model to predict daily direct care hours from patient volume is explained.

Direct Care Time

Outliers

An outlier was defined as "an observation (or subset of observations) which appears to be inconsistent with the remainder of that set of data" (Barnett & Lewis, 1978, p. 4). Observations 3 standard deviations (SDs) from the mean of the variable, direct care time per patient, were considered outliers. These observations were inconsistent with the rest of the data set in that, for the same procedure, acuity worksheets in the outlier group either had more indicators marked or had the same indicators marked more frequently.

Outliers were calculated separately for the subsample of patients who had general or regional anesthesia and the subsample who had local anesthesia because in the final analysis, each subsample was used in a separate regression model to predict direct care time from patient volume. All outliers for both subsamples represented patient observations 3 SDs above the mean of direct care time per patient. That is, there were no data points below 3 SDs from the mean of this variable.

The entire sample had a total of 104 outliers, which represented 1.5% of the data set. Outlier observations were found at all six study sites (see Table 5). Of the outliers, 83 were patients who had general or regional anesthesia, and 21 were patients who had local anesthesia or sedation. Outliers were excluded from the preliminary analyses related to development of the regression model.

Direct Care Time Stability

Preliminary analyses were conducted to determine if direct care time per patient, as measured by the acuity worksheet, varied systematically with the time during the 16-week data collection period when the acuity worksheet was completed. A series of scatterplots as well as simple regression models were used for these analyses. The scatterplots and regression models for each study site with time (measured by the day of data collection) as the independent variable and direct care time (measured by the acuity worksheet) as the dependent variable showed no significant relationships. That is, there were no detectable linear trends in the measurement of direct care time per patient throughout the data collection period for the study sites.

Relationship to Anesthesia Type

Analyses demonstrated a significant difference in direct care time per patient based on anesthesia type. As would be expected, the difference in direct care time based on anesthesia type was especially marked between (a) general and regional anesthesia patients and (b) local anesthesia and sedation patients (see Figure 1). This finding was consistent among all study sites.

Table 5

Number and Percent of Patients Who Were Defined as Outliers in Each Anesthesia Category at Study Sites

Site	Anesthesia Categories			
	Local	Regional	General	Total
1	1 (0.7%)	3 (1.3%)	7 (1.4%)	11 (1.3%)
2	0 (0%)	3 (1.8%)	8 (1.3%)	11 (1.3%)
3	1 (0.6%)	3 (1.2%)	35 (4.1%)	39 (3.0%)
4	5 (1.7%)	0 (0%)	4 (0.6%)	9 (0.7%)
5	3 (3.1%)	2 (1.1%)	4 (0.9%)	9 (1.2%)
6	11 (1.7%)	4 (1.4%)	10 (0.9%)	25 (1.2%)
Total	21 (1.5%)	15 (1.1%)	68 (1.6%)	104 (1.5%)

Note. Outliers were defined as patient observations 3 standard deviations from the mean of the variable, direct care time per patient. The percentage in parentheses represents the ratio of the number of patient outliers to the total number of patients in each anesthesia category by study site. For example, (a) 1 outlier to 145 patients with local anesthesia at site 1 means that 0.7% of the patients in this category were outliers and (b) 104 outliers to 7034 patients in the entire sample means that 1.5% of the patients in the sample were defined as outliers.

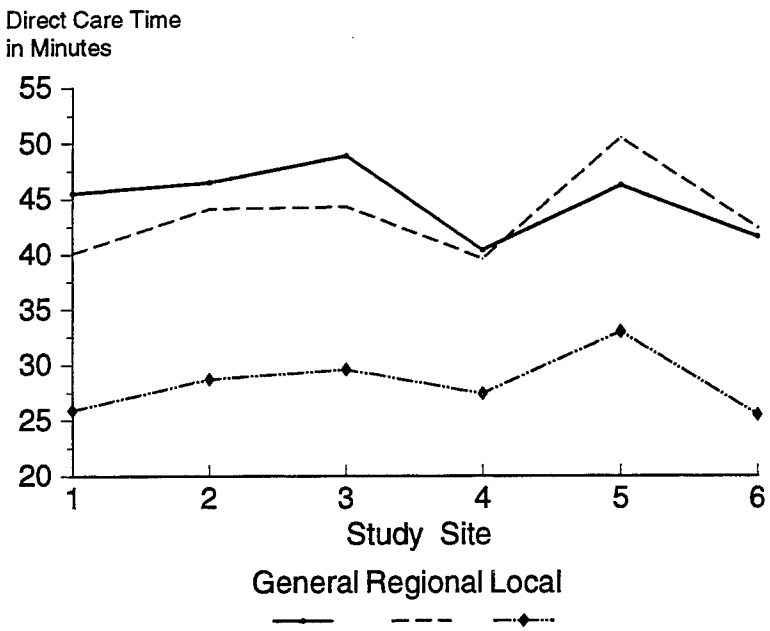

Figure 1. Average direct care time per patient by anesthesia type for each study site.

Relationship to Patient Volume

Preliminary analyses demonstrated a strong positive correlation between daily patient volume and direct care hours per day ($r > .90$). This strong positive correlation was consistent among all study sites for all patients together and for patients by anesthesia type (see Table 6). The correlation between patient volume and direct care time per day at study site 3 is illustrated in Figure 2.

Development of a Regression Model

The strong correlation between daily direct care time and patient volume at each study site supported the development of a regression model to predict direct care time from patient volume. It was decided to explore the development of one regression model based on data from all study sites. The names and definitions of variables used in the regression models are listed in Table 7. These abbreviations are used in text and tables to describe the models.

Criteria for Model Selection

Several linear regression models were evaluated to identify the model with the best possible predictor variables for direct care time. The first criterion for model selection was that the predictor variables should consist of data that can be collected in a reliable and valid manner and are readily available to personnel in all PACUs in the AMEDD. That is, the model should make the staffing system reasonably easy and inexpensive to use.

Second, the final model should accurately describe and predict the dependent variable, daily direct care hours. Regression models that met the first criterion were compared on the basis of their coefficient of determination (R^2), standard error (SE), F value, mean squared error (S^2), sum of squares of prediction errors (PRESS statistic), and sum of absolute

Table 6

Direct Care Hours and Patients Per Day With Their Correlations for Each Site

Site	Anesthesia type	Direct care hours per day (DCH) M	Range	SD	Patients per day (PPD) M	Range	SD	Correlation (DCH:PPD) r[a]	n[b]
1	Local	1.1	0.3 - 3.3	0.7	2.6	1 - 7	1.6	.96	55
	Regional	2.2	0.4 - 5.6	1.3	3.3	1 - 8	1.8	.95	72
	General (Gen)	4.4	0.5 - 9.1	2.0	5.9	1 - 11	2.5	.96	82
	Gen & regional	6.4	0.5 - 13.0	2.6	8.7	1 - 16	3.3	.95	82
	All types	7.1	0.5 - 13.7	2.5	10.5	1 - 17	3.3	.91	82
2	Local	0.8	0.3 - 2.2	0.5	1.7	1 - 5	1.0	.95	43
	Regional	1.9	0.5 - 4.5	0.9	2.5	1 - 6	1.2	.92	65
	General (Gen)	6.2	1.6 - 13.1	2.5	8.0	2 - 17	3.4	.97	78
	Gen & regional	7.8	2.3 - 14.6	2.5	10.1	3 - 20	3.4	.97	78
	All types	8.2	2.8 - 15.1	2.5	11.0	4 - 21	3.5	.96	78
3	Local	1.3	0.4 - 3.3	0.7	2.6	1 - 6	1.3	.97	68
	Regional	2.5	0.5 - 6.5	1.3	3.4	1 - 8	1.9	.95	75
	General (Gen)	8.5	0.8 - 17.8	3.6	10.4	1 - 24	4.6	.97	79
	Gen & regional	10.9	1.6 - 22.2	3.7	13.7	2 - 29	4.7	.97	79
	All types	12.0	1.6 - 23.6	3.8	16.0	2 - 32	5.0	.97	79
4	Local	1.8	0.3 - 4.6	1.1	3.9	1 - 10	2.4	.97	74
	Regional	2.1	0.5 - 5.2	1.1	3.1	1 - 7	1.6	.93	77
	General (Gen)	5.9	0.6 - 10.7	1.9	8.8	1 - 17	2.9	.94	79
	Gen & regional	7.7	0.6 - 15.4	2.5	11.6	1 - 22	3.8	.94	81
	All types	9.4	0.7 - 15.7	2.7	15.1	1 - 23	4.4	.94	81
5	Local	1.0	0.4 - 2.7	0.5	1.9	1 - 5	1.0	.96	50
	Regional	2.6	0.7 - 5.6	1.1	3.0	1 - 6	1.4	.95	62
	General (Gen)	4.6	0.8 - 12.4	2.2	6.0	1 - 17	3.0	.98	75
	Gen & regional	6.7	1.8 - 13.1	2.4	8.5	2 - 17	3.2	.96	75
	All types	7.3	1.1 - 14.2	2.7	10.0	2 - 18	3.6	.97	76
6	Local	3.5	0.4 - 7.9	1.5	8.3	1 - 18	3.5	.98	78
	Regional	2.7	0.5 - 7.3	1.6	3.8	1 - 11	2.3	.96	74
	General (Gen)	9.0	0.5 - 14.7	3.3	12.9	1 - 22	4.7	.96	83
	Gen & regional	11.2	0.5 - 19.7	4.4	16.1	1 - 28	6.2	.97	84
	All types	14.5	0.5 - 23.4	4.8	24.0	1 - 37	7.8	.95	84
All Sites	Local	1.7	0.3 - 7.9	1.4	3.9	1 - 18	3.2	.98	368
	Regional	2.3	0.4 - 7.3	1.3	3.2	1 - 11	1.8	.94	425
	General (Gen)	6.5	0.5 - 17.8	3.2	8.7	1 - 24	4.4	.96	476
	Gen & regional	8.5	0.5 - 22.2	3.6	11.5	1 - 29	5.0	.96	479
	All types	9.8	0.5 - 23.6	4.3	14.4	1 - 37	6.9	.95	480

Note. Outliers 3 SDs from the mean of direct care time per patient are not included in calculations. [a] Pearson correlation of DCH with PPD. [b] Number of days in each sample.

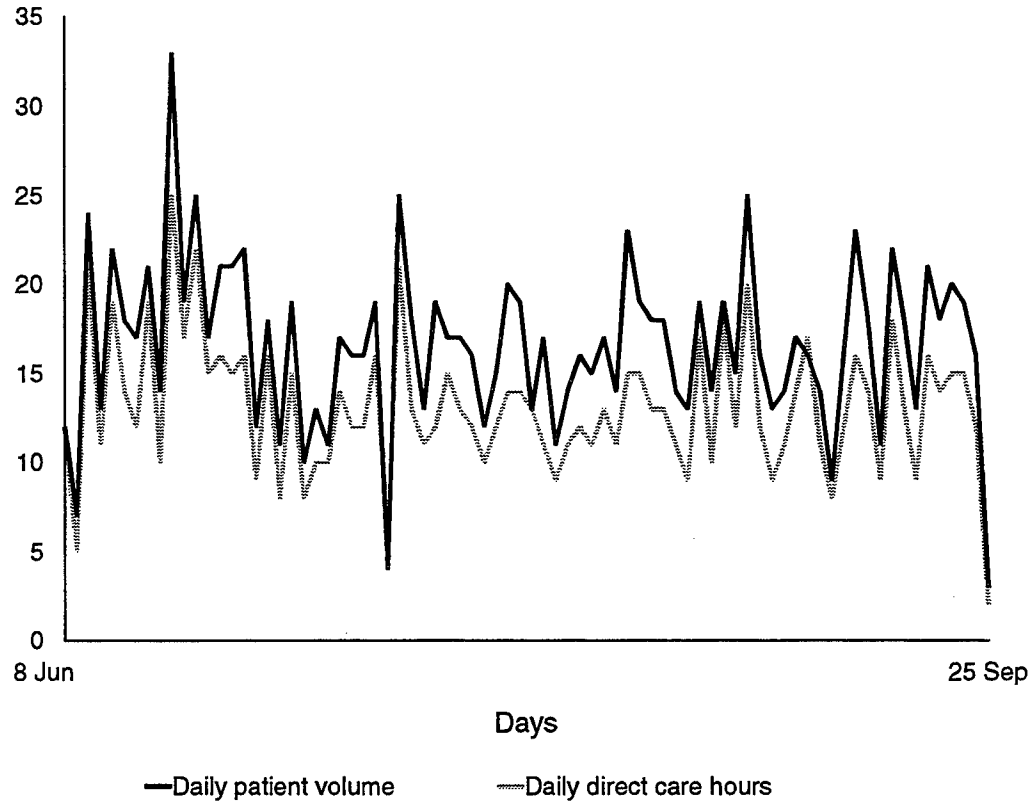

Figure 2. Correlation between daily patient volume and daily direct care hours for study site 3.

Table 7

Name and Definition of Variables Used in Regression Models[a]

Variable	Definition
	Dependent Variables Computed for Each Study Site
DCHDAYLO	Daily direct care hours for local anesthesia patients
DCHDAYGR	Daily direct care hours for general and regional anesthesia patients
DCHDAYSM	Daily direct care hours for patients with all types of anesthesia
	Independent Variables Computed for Each Study Site
LOCDAYSM	Daily number of local anesthesia patients
REGDAYSM	Daily number of regional anesthesia patients
GENDAYSM	Daily number of general anesthesia patients
COMDAYSM	Daily number of general and regional anesthesia patients
PTSDAYSM	Daily number of patients

Notes. [a]Model I DCHDAYSM = PTSDAYSM
Model II DCHDAYSM = GENDAYSM REGDAYSM LOCDAYSM
Model III DCHDAYSM = COMDAYSM LOCDAYSM
Model IVa DCHDAYGR = COMDAYSM
Model IVb DCHDAYLO = LOCDAYSM

prediction errors. Finally, the prediction reliability of the selected models was assessed with a split-sample analysis.

Evaluation of Regression Models

Model I (DCHDAYSM = PTSDAYSM) included the total number of patients per day as the single predictor of daily direct care hours. Although $\underline{R}^2$ was 0.90, the PRESS statistic and $\underline{S}^2$ were larger for Model I than for any other models under consideration (see Table 8). The large PRESS statistic and $\underline{S}^2$ indicated that this model would not give an accurate prediction of direct care hours (Bowerman & O'Connell, 1990). More specifically, the large $\underline{S}^2$ indicated that there would be wide prediction intervals for direct care hours.

Model II included the number of general, regional, and local anesthesia patients per day as separate predictors of daily direct care hours (DCHDAYSM = GENDAYSM + REGDAYSM + LOCDAYSM). It was reasonable to use the number of patients by anesthesia type as predictor variables. Carty et al. (1991) found that direct care time was related to type of anesthesia, and they varied the amount of time given in the PCS for the PACU initial assessment according to the type of anesthesia used. Also, direct care time was related to type of anesthesia in the present study (see Figure 1).

For Model II, the correlation of DCHDAYSM with REGDAYSM ($\underline{r}$ = .44) was lower than the correlation of DCHDAYSM with GENDAYSM ($\underline{r}$ = .87) or LOCDAYSM ($\underline{r}$ = .56). Also, this model had slightly higher values for the PRESS statistic and $\underline{S}^2$ than did some of the other models being considered (see Table 8). At the same time, there was little difference in this model between the regression coefficients for GENDAYSM (.71) and REGDAYSM (.69). That is, the amount of direct care time given to general anesthesia patients (42.6 minutes)

Table 8

Regression of Daily Direct Care Hours on Patient Volume for 5 Regression Models[a]

Explanatory Variable	Regression Coefficients[b] with (SE)				
Model:	I	II	III	IVa	IVb
INTERCEPT	1.33 (0.14)	0.64 (0.12)	0.63 (0.12)	0.49 (0.12)	0.12 (0.02)
PTSDAYSM	0.59 (0.01)				
GENDAYSM		0.71 (0.01)			
REGDAYSM		0.69 (0.03)			
LOCDAYSM		0.35 (0.02)	0.35 (0.02)		0.42 (0.004)
COMDAYSM			0.71 (0.01)	0.69 (0.01)	
R^2	0.90	0.94	0.94	0.92	0.97
F[c]	4,414	2,381	3,575	5,663	10,836
S^2	1.77	1.14	1.14	1.04	0.06
PRESS[d]	856 (495)	552 (404)	550 (402)	498 (384)	23 (71)

Notes. [a]Model I DCHDAYSM = PTSDAYSM
Model II DCHDAYSM = GENDAYSM REGDAYSM LOCDAYSM
Model III DCHDAYSM = COMDAYSM LOCDAYSM
Model IVa DCHDAYGR = COMDAYSM
Model IVb DCHDAYLO = LOCDAYSM

[b] $p < 0.0001$
[c] $p < 0.0001$
[d] PRESS, which is the sum of squares of prediction errors, is reported together with the sum of absolute prediction errors in parentheses.

would not vary greatly with the direct care time given to regional anesthesia patients (41.4 minutes) when using this regression model as part of a staffing system. This indicated that the number of general and regional anesthesia patients could be combined into one variable with no negative practical impact on the staffing system.

Model III included the number of general and regional anesthesia patients combined together as one predictor variable and the number of local anesthesia patients as the second predictor variable (DCHDAYSM = COMDAYSM + LOCDAYSM). However, the scatterplot of DCHDAYSM and LOCDAYSM produced an accordion-like picture, demonstrating a poor fit of this predictor variable in the model ($\underline{r}$ = .56). This model also had slightly higher values for the PRESS statistic and $\underline{S}^2$ than did some of the other models being considered (see Table 8).

Model IV was expressed as dual regression equations IVa and IVb, which were designed to be used together as one model for the staffing system. The part of model IV that included the number of general and regional anesthesia patients combined together as a predictor of their direct care hours (DCHDAYGR = COMDAYSM) is referred to as model IVa. The part of model IV that included the number of local anesthesia patients as a predictor of their direct care hours (DCHDAYLO = LOCDAYSM) is referred to as model IVb. Model IVa had a slightly lower $\underline{R}^2$ (.92) than some of the other models examined, but the PRESS statistic and $\underline{S}^2$ also were smaller--indicating that this model would be a better predictor of daily direct care hours (see Table 8). Model IVb had the largest $\underline{R}^2$ and smallest PRESS statistic and $\underline{S}^2$ of all the models (see Table 8). Also, models IVa and IVb showed fewer outlying influential observations than did other models as noted by the smaller difference between the PRESS statistic and the sum of absolute prediction errors (Myers, 1990). Thus, it was determined

that the dual regression equations IVa and IVb used together as one model allowed for the best prediction of daily direct care hours from daily patient volume by anesthesia type.

Split-Sample Analysis

To assess the reliability of regression equations IVa and IVb, a split-sample (cross validation) analysis was conducted. Data collected for all 6 sites (N = 7,034 patients) were randomly split into two subsets: a "fitting" or "training" sample and a validation sample (Huck, Cormier, & Bounds, 1974; Kleinbaum, Kupper, & Muller, 1988). The process of random division was performed for each site separately. One subsample from each site was combined into a fitting sample (n = 3,546), and the other subsample from each site was combined into a validation sample (n = 3,488). With this method of data splitting, the fitting and validation samples had approximately equal representation from each site (see Table 9).

According to the split-sample analysis technique, data from the fitting subset of patients were used to build regression equations IVa and IVb. The coefficient of determination [$R^2(1)$] from each of these models was used in further calculations. Next, the sample regression equations IVa and IVb were applied to patient volume data from the validation subset of patients. In this step, predicted direct care time values were computed. Finally, the validation sample was used to perform a simple linear regression analysis independently for equations IVa and IVb with predicted values of direct care time as a predictor variable and observed values of direct care time as an outcome variable. The coefficient of determination for each of these regression analyses, referred to as the "cross-validation correlation" [$R^2(2)$], was used to calculate the shrinkage on cross validation. For regression

Table 9

Number of Patients in the Fitting and Validation Samples by Anesthesia Type for Each Study Site

Sample Type by Site		Anesthesia Type			Total
		Local	Regional	General	
Site 1	Fitting	90	122	253	465
	Validation	55	118	234	407
Site 2	Fitting	36	80	311	427
	Validation	35	88	320	443
Site 3	Fitting	90	138	423	651
	Validation	90	119	436	645
Site 4	Fitting	150	113	325	588
	Validation	142	129	373	644
Site 5	Fitting	43	96	243	382
	Validation	55	94	211	360
Site 6	Fitting	320	140	573	1033
	Validation	335	143	511	989
Total	Fitting	729	689	2128	3546
	Validation	712	691	2085	3488

equation IVa, the coefficient of determination [$\underline{R}^2(1)$] was 0.9172. The cross-validation correlation [$\underline{R}^2(2)$] was 0.9046. The shrinkage on cross-validation [defined as $\underline{R}^2(1) - \underline{R}^2(2)$] was 0.9172 - 0.9046 = 0.0126. For regression equation IVb, the shrinkage was the difference between $\underline{R}^2(1) = 0.9425$ and $\underline{R}^2(2) = 0.9313$ or 0.9425 - 0.9313 = 0.0112. Both equations were determined to be reliable based on the fact that shrinkage values less than 0.10 indicate a high reliability of estimation (Kleinbaum et al., 1988). Furthermore, the small shrinkage values supported the decision to use pooled data from all study sites to estimate the regression coefficients in the dual regression equations.

Analyses of Research Objectives

Objective One

The first research objective was to develop a method by which the typical workload of a PACU could be described and the variation in the workload could be analyzed. The calculation of nursing care hours (NCHs) as well as the development of the workload profile and the analysis of workload variation will be explained.

Calculation of Nursing Care Hours

NCHs per day were calculated for each study site by combining the daily direct nursing care hours obtained from the regression model with the PACU indirect care multiplier (ICM). As previously discussed, direct care time was measured using the PACU PCS (Carty et al., 1991), and the ICM was derived from a study of the indirect care time component (Rea et al., 1991). The calculations for using the regression model and the indirect care multiplier to obtain NCHs per day from patient volume information are included in Appendix

F. To evaluate the accuracy of this method of calculating daily NCHs, these "actual" NCHs per day for each study site were plotted over time to provide a graphical display of each site's workload over the entire period of data collection.

Additionally, NCHs per day that nursing personnel were "available" for patient care for each day of data collection were calculated using the time schedule information. Professional and paraprofessional nursing personnel who were assigned to the unit in patient care positions were included in these calculations. Their available time was considered to be the number of hours they spent in direct and indirect care activities as well as time spent in personal activities, unavoidable delay, wait/stand-by, and meals (Rea et al., 1991). The number of hours per day that these personnel were available for care on the unit was totalled to equal the "available" NCHs.

Actual and available NCHs were plotted separately over the entire period of data collection and were compared by visual inspection of the graphs. When the two graphs were viewed with a consideration of the practice patterns and skill mix of nursing personnel at each site, it could be seen that there generally were an adequate number of available NCHs to cover the workload as measured by the actual NCHs. Assuming that PACU head nurses would schedule enough staff to provide adequate nursing care, it was determined that this method of calculating NCHs provided a reasonable estimation of nursing workload.

Development of the Workload Profile

The Shewhart method of variance analysis as outlined in statistical process control (SPC) methodology was used to develop a control chart that could be adapted for use as a workload profile (Shewhart, 1931). A typical control chart displays a process characteristic of interest,

such as nursing workload, that has been measured or computed from a sample over time. For example, PACU nursing workload was measured in this study by NCHs per day over a period of several weeks. As previously discussed, NCHs per day were calculated for each study site by combining the daily direct nursing care hours obtained from the regression model with the PACU indirect care multiplier (ICM).

The control chart is characterized by several statistical properties (McNeese & Klein, 1991; Wadsworth, Stephens, & Godfrey, 1986). The chart contains a center line that represents the mean of the process characteristic. The researcher draws two horizontal lines, referred to as the upper control limit (UCL) and the lower control limit (LCL), so that most of the sample points fall between them when the process is stable or in control. If the process is in control, the plotted points have an essentially random pattern reflecting the natural variability due to common causes of variation within the process itself. Sample points that plot outside the control limits are interpreted as being due to assignable or special causes of variation that are unusual. Eliminating the underlying cause of sample points being outside the control limits makes the process more stable.

To develop the workload profile, the type of control chart and unit of measurement that were to be used had to be determined. Because each subgroup should be as homogeneous as possible with respect to the variability of the process under consideration, NCHs per day was selected as the rational subgroup or unit of measurement (Wadsworth et al., 1986). Several days of the week could not be combined into one subgroup because of variability in the workload between days of the week. Also, there was no subgroup smaller than the day that would be logical to use for monitoring PACU workload.

Because the day was selected as the unit of measurement, the control chart for individual measurements--referred to as the individuals or X chart--was used for the development of the workload profile (Pyzdek, 1990; Wadsworth et al., 1986). Individuals control charts are designed for the normally distributed population (Pyzdek, 1990; Wadsworth et al., 1986). If the process shows evidence of a serious departure from normality, the control limits may not be meaningful. Therefore, the distribution of NCHs per day within the entire 16-week period of data collection was examined for each study site. No marked departure from normality was observed.

Another consideration in developing the control chart was the frequency of data collection. For the workload profile, the data needed were the number of patients recovered in the PACU per day in two categories of anesthesia. PACU head nurses at the six study sites concurred that collecting patient volume information every day they were open to recover patients would be a minimal amount of work and would be much simpler and easier to remember than recording the information less frequently, such as every other week. Furthermore, head nurses of all PACUs in HSC reported on the PACU survey that they had a routine operating schedule of Monday through Friday, except for being closed on holidays. Thus, it was decided that data would be collected for the workload profile on each day the PACU was open to recover patients from a routine operating schedule (usually Monday through Friday). It was noted that, at the time of the study, there were two PACUs in HSC that had a practice of staying open Monday through Friday on a 24-hour basis to provide care for a limited number of remain overnight patients (RONs). As will become evident in

the section on additional analyses, the presence of RONs in a unit would not influence the frequency of data collection for the staffing system.

Additionally, it was decided to develop a workload profile with 3 months of NCH data. When reporting workload data 5 days a week, a quarterly workload profile would have 50-60 data points plotted over time. This is a sufficient number of data points on which to base a control chart (Grant & Leavenworth, 1988; Pyzdek, 1990). Moreover, 3 months is a reasonable period of time on which to base a workload profile, given that no data are available regarding the variability of workload patterns over time. Also, a quarterly workload profile could be generated along with other administrative reports that commonly are generated on a quarterly basis.

Thus, the original data collected for the study were decreased to a 12-week data set to develop a workload profile for each study site. The first and last 2 weeks of data were removed to obtain 12 consecutive weeks of workload data. After developing the workload and staffing profiles with this 12-week data set, the results were compared with workload and staffing profiles developed with the entire 16-week period of data. There were no differences in the decisions that would have been made regarding the development of workload or staffing profiles using the 12-week or 16-week data set. This was further evidence that led to the decision to develop the workload profile with 3 months of NCH data.

Before establishing control limits for the individuals control chart, the variability of the workload process had to be examined (Pyzdek, 1990). First, the moving range control chart with 3 SD control limits was used to estimate the process dispersion or variability of two successive observations of NCHs per day for each study site (McNeese & Klein, 1991;

Pyzdek, 1990). The moving range refers to the absolute values of differences between successive observations on the individuals chart, and these values are plotted as data points on a moving range chart. A moving range chart was made for each site with the center line equal to the mean of the moving range ($\overline{MR}$), the lower control limit equal to 0, and the 3 $\underline{SD}$ upper control limit equal to 3.267 $\overline{MR}$ (where 3.267 is a constant used for the 3 $\underline{SD}$ upper control limit when a moving range of 2 observations is used) (Pyzdek, 1990; Wadsworth et al., 1986). Initial calculations for the center line and 3 $\underline{SD}$ control limits revealed that study sites 3 and 4 each had one data point outside the upper control limit on their moving range charts, and the other four study sites had no data points outside the control limits. According to the procedure for constructing a moving range control chart, the data points outside the control limits for study sites 3 and 4 were removed from their respective data sets, and the standard deviations and means were calculated again. The new moving range charts showed that study site 3 had 1 data point outside the 3 $\underline{SD}$ control limits and study site 4 had no data points outside the 3 $\underline{SD}$ control limits.

Because the moving range charts were in statistical control, an individuals control chart could be constructed for each study site using an estimate of the process standard deviation computed from the moving range chart (where $\underline{SD} = \overline{MR}/d2$, with d2 = a constant of 1.128 when a moving range of 2 observations is used) (Pyzdek, 1990). Four study sites had no data points outside the 3 $\underline{SD}$ control limits, while study sites 3 and 4 each had 1 data point outside the control limits. When data points outside the 3 $\underline{SD}$ control limits were removed from the data sets of study sites 3 and 4 and the standard deviations and means were calculated again, the new individuals charts had no data points outside the 3 $\underline{SD}$ control

limits. It was concluded that most of the variability of NCHs per day for each study site was due to natural or common causes, and therefore the process was in statistical control as evaluated by the 3 SD control limits. That is, the process of providing nursing care to patients as measured by nursing workload at the study sites was interpreted as a stable process.

When a process is in statistical control, the two estimates of process standard deviation--one computed using the moving range chart (where SD = $\overline{MR}$/d2, with d2 = a constant of 1.128 when a moving range of 2 observations is used) and the other using the "standard" method of calculating a standard deviation--are very close (Pyzdek, 1990; Wadsworth et al., 1986). Because the moving range and individuals charts demonstrated statistical control and because the standard method of calculating a standard deviation would be easier for nursing personnel to use when constructing workload profiles, the standard method was adopted for use in setting the control limits for the workload profile.

Moreover, after further analysis of the data, it was decided that 2 SD control limits for the individuals charts would be used for the workload profiles (instead of the 3 SD control limits more commonly used in manufacturing industries). Setting the control limits based on an analysis of the data is entirely appropriate in that Shewhart conceived of the control chart as an empirical tool that should be relevant to the data being analyzed (Mandel, 1991). It was decided to use the 2 SD control limits for two reasons. First, most of the variability of NCHs per day for the study sites fell within 2 SDs from the mean of NCHs per day as demonstrated by the individuals control charts that were developed using the standard method of calculating the standard deviation. Four of the study sites each had only 2 data points

greater or less than 2 SDs from the mean of NCHs per day for the 3-month period of time used to create the individuals charts, while study site 1 had 3 data points and study site 3 had 4 data points greater or less than 2 SDs from the mean of NCHs per day for this 3-month period of time. When data points outside the 2 SD control limits were removed from their respective data sets and the standard deviations and means were calculated again, study sites 2, 5, and 6 each had 1 data point outside the 2 SD control limits, while study sites 1 and 3 each had 2 data points and study site 4 had 4 data points outside the 2 SD control limits. The total number of data points outside the final 2 SD control limits of the 3-month workload profiles ranged from 3 data points for study sites 2, 5, and 6 (which represented 5% of the data points for each of these sites) to 6 data points for study sites 3 and 4 (which represented 10% of the data points for each of these sites).

The second reason for selecting 2 SD control limits was that individuals control charts are not as sensitive to change as are some other types of control charts, but using 2 SD instead of 3 SD control limits would give the charts a higher sensitivity to an out-of-control process (Shainin & Shainin, 1988; Wadsworth et al., 1986). It was noted that setting the control limits at 2 SDs instead of 3 SDs from the mean increases the likelihood of a Type I error, or the error involved in calling a data point out-of-control when it is not (Shainin & Shainin, 1988; Wadsworth et al., 1986). However, the cost of a Type I error, or searching for reasons why a data point is out-of-control when it is not, is low. Nursing personnel can quickly and inexpensively search for possible reasons why there are an increased or decreased number of patients on days representing data points outside the control limits.

The method of developing a quarterly workload profile described in the preceding paragraphs was used to construct a separate profile for each study site. First, the arithmetic mean and standard deviation of NCHs per day were computed for Mondays through Fridays (excluding holidays) for the entire 3-month period of time. The mean served as the center line for the chart, and the upper and lower control limits were placed at 2 SDs above and below the mean (as computed by the standard method of calculating the standard deviation). NCHs per day for the 3-month period of time were plotted on the chart, and data points outside the control limits were removed. The mean and standard deviation were computed on the new data set without the outlying data points, and a chart representing the workload profile with its mean and 2 SD control limits was made for each study site.

The workload profile that has been developed based on the individuals control chart is a pattern of a unit's nursing workload over a specified period of time as expressed in NCHs per day. A workload profile developed in this manner for study site 6 can be found in Figure 3. The profile demonstrates that nurses in this PACU together typically worked a total of 52 to 95 NCHs per day and that one data point fell outside the 2 SD control limits on the workload profile during this 3-month period of time.

Analysis of Variation in Workload

The workload profile is designed to be used for analyzing variation in workload. As has been discussed, there are many factors that affect PACU workload. These factors should be kept in mind when searching for the cause of workload variation. However, it should be remembered that NCHs per day are calculated using a regression model that assigns a fixed amount of direct care time to patients based on the type of anesthesia they received.

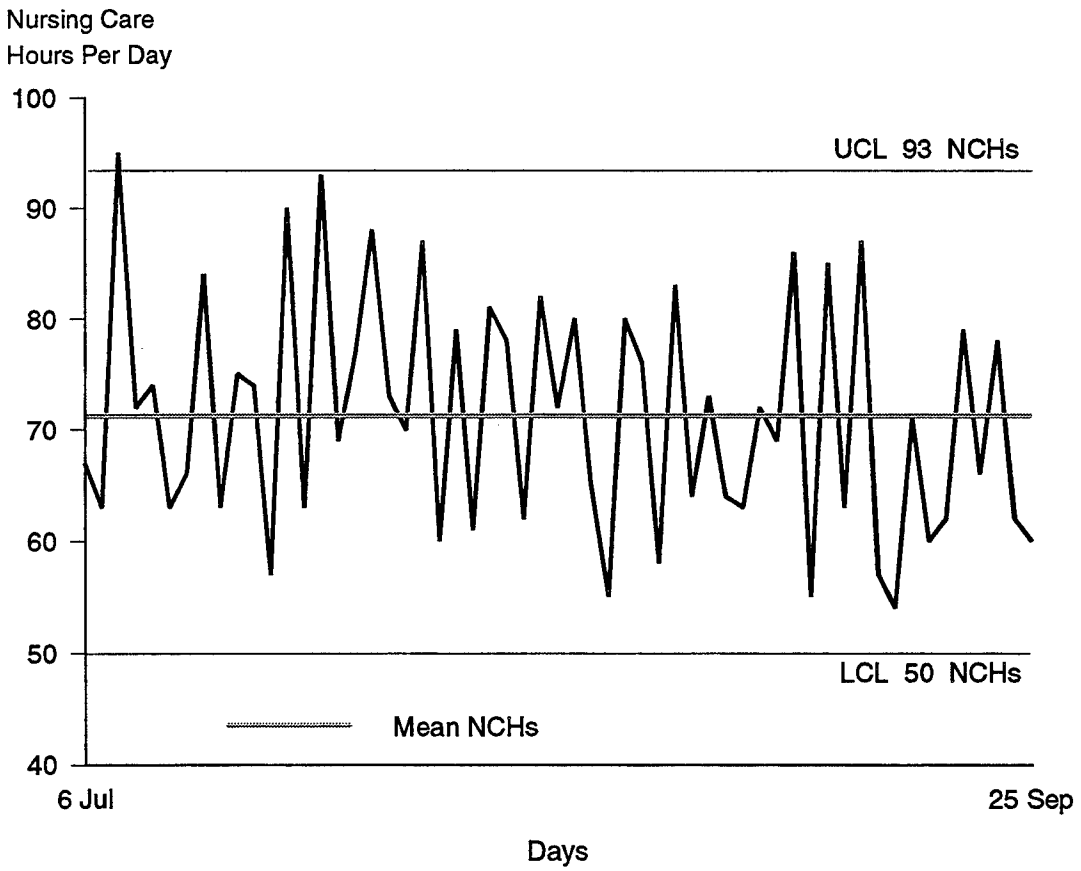

Figure 3. Workload profile for study site 6 with only 1 data point outside the 2 SD upper and lower control limits (UCL & LCL).

Therefore, variation in NCHs per day on the workload profile largely will be due to differences in the number of patients seen per day in each of the two anesthesia groups.

Given this understanding of the NCH data, there are two ways in which head nurses can use their workload profile to analyze variation in workload. The variation in workload profiles for the six study sites was analyzed in these ways. First, the profiles were examined for data points that fell outside the control limits. Even after talking with the study coordinators, no consistent underlying cause was found for the change in patient volume that led to the high and low workload days outside the control limits.

Second, the profiles were analyzed for patterns in the distribution of the data points. For all study sites, a pattern of differences in workload by day of the week was evident. In fact, much of the workload variation could be explained by day of the week differences in workload. Furthermore, these workload differences seemed to be explained by the practices of the clinical services that were allocated operating room (OR) time by day of the week. For example, a busy orthopedic service that always maximized its OR time on Wednesdays with a heavy case load would be a factor that contributes to Wednesdays being a high workload day.

Figure 4 shows that for study site 6, for instance, Wednesday generally was a high workload day and Tuesday was a low workload day. There was some variation within Tuesdays and Wednesdays. However, generally speaking, the workload at study site 6 required more staff on Wednesdays than on Tuesdays during the period of data collection because of the consistent variation in workload between these two days of the week.

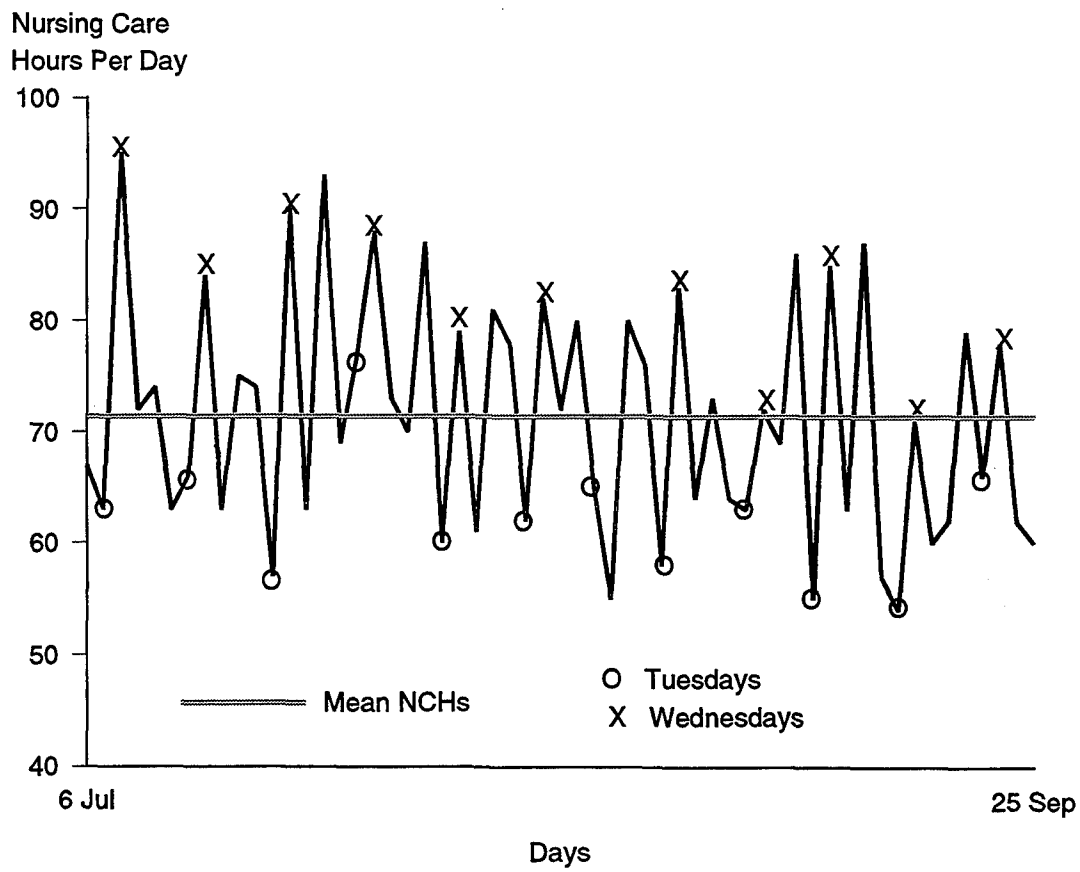

Figure 4. Workload profile for study site 6 with workload differences between Tuesdays and Wednesdays indicated.

Workload profiles were not created for each day of the week with data from the study sites because there were not enough available data points. Only up to 16 data points from the entire period of data collection were available for each day of the week at a study site, but at least 25 to 30 data points are needed to create a control chart (Grant & Leavenworth, 1988; Pyzdek, 1990). However, the quarterly workload profile that is developed with 3 months of consecutive workdays can be used to look for patterns due to variation in workload by day of the week. As demonstrated in Figure 4, a pattern of variation in workload by day of the week is evident when the day of week for each data point is marked on the quarterly workload profile.

Objective Two

The second research objective was to develop a method of determining the number of nursing personnel to schedule on a daily basis to accomplish a unit's workload. This number of nursing personnel, which is reported as a staffing range, refers to variable staff. Variable staff are those whose primary role is to provide nursing care to patients (Rea et al., 1991). Fixed staff have an administrative role in addition to their clinical responsibilities (Rea et al., 1991). Recommendations regarding the number of fixed staff that a PACU needs will be discussed after development of the staffing range is explained. Finally, recommendations for managing days at the extremes of workload will be discussed.

Staffing Range

The staffing needs of a unit are best described as a range of personnel, not an absolute value. The upper end of the staffing range indicates the number of nursing personnel to schedule for patient care on higher workload days and the lower end indicates the number to

schedule on lower workload days. The number of nursing personnel reported in the staffing range is expressed as full time equivalents (FTEs) rounded to the nearest tenth of an FTE. Reporting fractions of an FTE gives head nurses the justification to hire part-time staff to work a specified number of hours per pay period. For instance, a staffing range upper limit of 7.5 FTEs indicates the need on high workload days for 7 variable staff to work full-time (8 hours per day) and 1 variable staff member to work on a part-time basis for 50% of the work day (4 hours per day).

The criterion used to develop the staffing range was that it should represent the number of FTEs needed to accommodate most expected variation in workload. As has been discussed, much of the variation in the workload profiles occurred due to workload differences by day of the week. To determine the staffing range that accommodated most expected variation in workload, the number of NCHs at the mean and at ½, 1, and 2 SDs above and below the mean of each site's workload profile was computed. The NCHs for each of these workload levels was converted to FTEs by dividing the NCHs by 8 and rounding to the nearest whole number. Also, the mean NCHs for each weekday (Monday through Friday) were calculated and converted to FTEs for each study site. The mean FTEs for each weekday in the majority of cases fell within a range of ± 0.5 SD from the mean of each site's workload profile. Furthermore, there was no case in which the mean weekday FTEs exceeded the ± 0.5 SD range of the workload profile by 1.0 or more FTEs.

Additionally, it was noted that in most cases setting the staffing range at ± 1.0 SD instead of ± 0.5 SD from the mean of the workload profile would result in a difference of requiring ½ more FTE at the upper end of the staffing range. A staffing range this wide

would not be justified, especially when the staffing system allows for two fixed staff positions in addition to the number of variable staff recommended by the staffing range. As will be explained, fixed staff can help provide direct patient care on high workload days. Therefore, it was recommended that the staffing range be set at 0.5 SD above and below the mean NCHs in a 3-month workload profile.

The staffing profile for study site 2 can be found in Figure 5. The staffing range of 3.9-5.1 FTEs per day is set at $\pm$0.5 SD from the mean value of NCHs per day for the workload profile. The workload for Wednesdays and Thursdays is indicated on the chart to demonstrate that much of the variability in the workload profile was due to differences in workload between these 2 days of the week. Based on the workload during the data collection period, study site 2 would schedule 4 variable staff for low workload days such as Wednesdays and 5 variable staff for high workload days such as Thursdays.

Allocation of Fixed Staff

The need for fixed nursing staff is recognized regardless of variation in workload. In the PACU staffing system, the head nurse, wardmaster, and ward clerk are recognized as fixed staff positions (see Appendix G). It is important to emphasize that the staffing range indicates the number of variable staff who are needed on the unit in addition to the fixed staff. It was stated that the primary role of the variable staff is to provide nursing care to patients. Therefore, the number of variable staff needed depends on the workload, and the staffing range has been developed so that it varies according to workload.

The general guideline for the allocation of fixed staff is that a PACU should have a baseline of one head nurse and one wardmaster as fixed staff positions. There is an

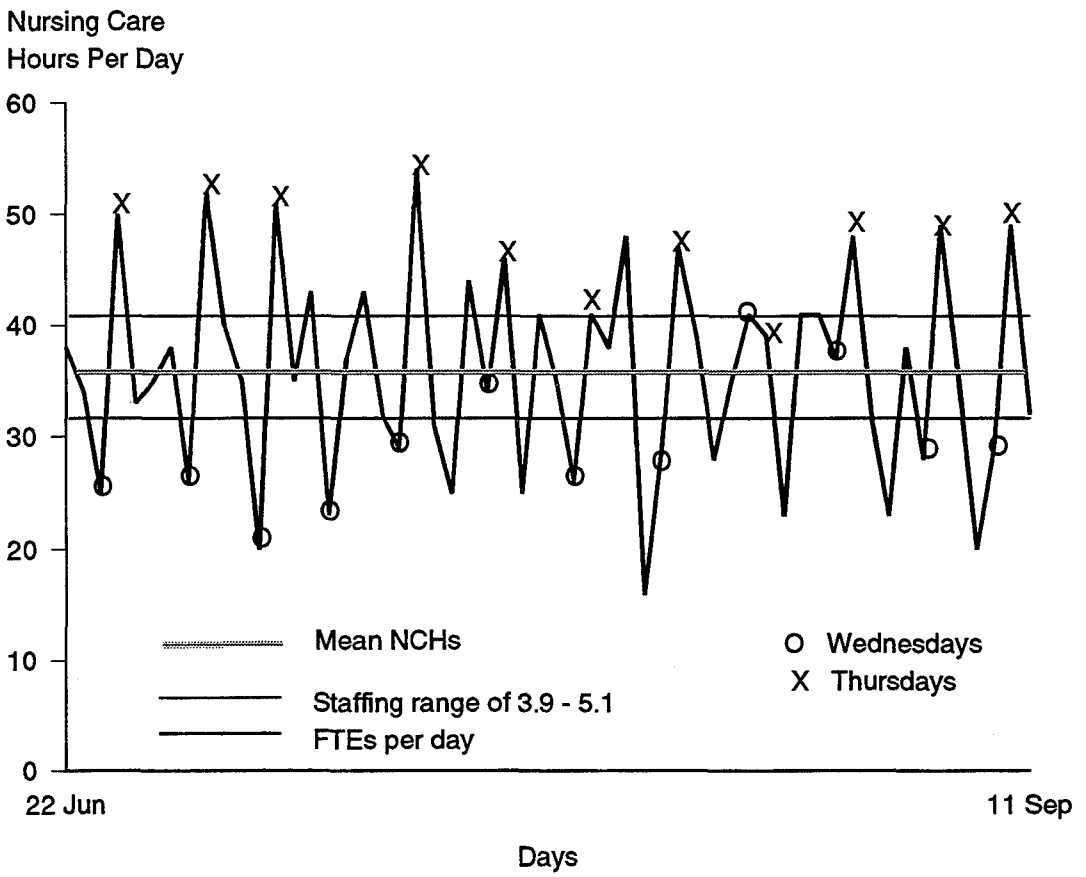

Figure 5. Staffing profile for study site 2 with workload differences between Wednesdays and Thursdays indicated.

exception to this general guideline that applies to PACUs with low workload. When the staffing range indicates that there is sufficient workload to justify no more than the two nursing personnel necessary for minimum staffing, these personnel must serve as both the fixed staff (i.e., head nurse and wardmaster) and variable staff for the unit. The workload in these PACUs does not justify the addition of fixed staff positions to the staffing range. The addition of one paraprofessional fixed staff position is justified when the staffing range indicates a need for approximately three variable staff, and the addition of both one paraprofessional and one professional fixed staff positions are justified when the staffing range indicates a need for approximately four or more variable staff.

Specific guidelines were developed to use for allocation of fixed staff to the PACU (see Table 10). These guidelines follow the principle of having enough workload to justify separate fixed staff positions as outlined above, but they use the average of the staffing range as specific cut-off points for the allocation of fixed staff. Also, a ward clerk was recommended when the workload is sufficient to generate a need for approximately seven or more variable nursing staff per day. This is in accordance with the PACU Joint Healthcare Manpower Standards (Joint Healthcare Management Engineering Team, 1991, 1992).

For example, the staffing range calculated for study site 2 was 3.9 to 5.1 FTEs (see Figure 5). The average of the staffing range for this PACU was 4.5 FTEs [(3.9 + 5.1)/2]. According to the fixed staff recommendations outlined in Table 10, the workload during the data collection period justified staffing this unit with one professional and one paraprofessional staff member to serve as a head nurse and wardmaster in addition to the 3.9

Table 10

Recommendations for Professional and Paraprofessional Fixed Staff Positions Based on the Average of the Staffing Range

	Average of Staffing Range			
Additional Staff Positions	≤2.4	2.5 - 3.4	3.5 - 6.4	≥6.5
Paraprofessional staff position	0	1	1	1
Professional staff position	0	0	1	1
Clerk	0	0	0	1

to 5.1 FTEs to serve as the variable staff. However, the workload did not justify staffing this unit with a ward clerk.

Managing Days at the Extremes of Workload

As has been explained, the staffing range was designed to accommodate most expected variation in workload. However, there will be some days at the high and low extremes of workload when the number of personnel recommended by the staffing range will not be the ideal number for accomplishing the workload as calculated by NCHs per day. There are two ways by which the number of personnel recommended in the staffing range can accomplish the required nursing care more efficiently on very high and very low workload days. First, it should be emphasized that workload is measured as NCHs, which are comprised of direct care and indirect care time. Part of the workload that is generated by indirect care activities, such as restocking supplies, can be shifted from high to low workload days. Expert PACU

head nurses who participated in the study reported this was a common way they managed their days at both extremes of workload.

Second, the fixed staff (i.e., the head nurse and/or wardmaster) can help accomplish the workload on high workload days by working as one of the variable staff members in providing direct patient care. PACU nurses who participated in the study noted that PACU head nurses and wardmasters in the AMEDD commonly provide patient care as part of their duties. According to the PACU survey, the average percentage of time that head nurses of PACUs in each of the 3 workload strata provided patient care was as follows: (a) 86% of the time for head nurses of PACUs categorized in the low workload stratum, (b) 80% of the time for head nurses of medium workload PACUs, and (c) 63% of the time for head nurses of high workload PACUs. All except 4 head nurses provided patient care at least 50% of the time, and a few head nurses noted that they provided patient care at the expense of completing their administrative duties on their off-duty time.

It was noted that in very small PACUs, the variable staff also serve as the head nurse and wardmaster, so there are no separate fixed staff to provide additional direct patient care when needed. However, small PACUs with very low workload are less likely than larger PACUs to have days with high workload that cannot be managed by the number of personnel recommended in the staffing range. The variability in the number of patients seen per day at small PACUs generally is limited by the small number of operating rooms at the MTF.

Objective Three

The third research objective was to develop guidelines for the skill mix and shift distribution of nursing personnel. Together with the staffing range, the skill mix and shift distribution make up the staffing profile.

Skill Mix

Skill mix refers to the recommended proportion of different types of nursing personnel to provide patient care on a nursing unit. The professional:paraprofessional skill mix refers to the proportion of professional to paraprofessional nursing personnel scheduled to work in the unit for the day. Professional nurses include civilian and military registered nurses. Paraprofessional nursing personnel include civilian licensed practical nurses (LPNs), military practical nurses (91Cs), civilian nurse assistants (NAs), and military medical specialists (91Bs). The LPN:NA skill mix refers to the proportion of military and/or civilian practical nurses to nurse assistants and/or medical specialists.

Because there were no empirically based skill mix standards in existence, five PACU head nurses were selected to serve on a panel to make skill mix recommendations for the staffing system. Criteria for selection of the panel members were that each individual had to be a registered nurse with a minimum of one year's experience as a head nurse in a PACU in the AMEDD. From among those personnel who met the selection criteria for the panel, two individuals were head nurses at U.S. Army Medical Centers (MEDCENs) and three were head nurses at medical department activities (MEDDACs). Four panel members were Army Nurse Corps officers, and one was a civilian nurse. The panel members had 1 to 11

years experience in the PACU and 1 to 3 years experience as a PACU head nurse. Two panel members were already involved in the study as study coordinators at data collection sites.

A packet of information was mailed to each panel member. The packet consisted of (a) the American Society of Post Anesthesia Nurses (ASPAN) staffing standards, (b) current skill mix recommendations for the seven inpatient clinical areas using WMSN, and (c) the skill mix that head nurses in the PACUs in HSC reported in the PACU survey as using and as recommending for use in their unit. After studying the packet of information, panel members mailed their skill mix recommendations with their rationale for their recommendations to the researchers. The researchers met with panel members by way of a 2-hour conference call to reach group consensus on the skill mix recommendation.

Panelists reached a group consensus that the ideal professional:paraprofessional skill mix should be 60:40, although some panelists initially recommended a skill mix of 50:50. Panelists commented that the PACU is a critical care unit, and a 60:40 skill mix is consistent with the WMSN skill mix for intensive care areas. Also, all panelists agreed that the potential for complications related to anesthesia or the surgical procedure during the immediate post-operative period necessitates having at least as many professional as paraprofessional nursing staff to provide patient care.

The panel recommended a LPN:NA skill mix of 60:40. This differs from the WMSN intensive care skill mix because nursing assistants can do more tasks--such as patient transport--in the PACU than in the ICU. The larger proportion of LPNs to NAs is

appropriate for the immediate postoperative period because of requirements for continuous patient assessment and monitoring.

The expert panel's recommendations were considered by the researchers together with data on current authorizations of nursing personnel in PACUs within HSC. It was noted that current authorizations for PACUs did not support the panel's ideal professional: paraprofessional skill mix. The average authorization professional:paraprofessional skill mix was 45:55, and the average authorization LPN:NA skill mix was 73:27 at the time of the study.

Therefore, the final recommendation for the staffing system was that a minimum of 50% of the variable staff scheduled daily should be registered nurses. That is, the recommended professional:paraprofessional skill mix was 50:50. The recommended LPN:NA skill mix was 60:40. Given the LPN:NA skill mix of 60:40, the researchers judged a professional: paraprofessional skill mix of 50:50 to be a practical and sound recommendation.

Shift Distribution

Shift distribution refers to the allocation of nursing personnel to work in turn with each other during different periods of time throughout the hours of operation of a unit (Bell et al., 1985; Luczun, 1984). A shift refers to a group of nursing personnel who are assigned to work during a particular period of time, such as 0730 to 1600 or 0900 to 1730. The traditional system of 3 shifts per day with a short period of overlap at the time of change of shifts is not appropriate for a PACU. Instead, PACU nursing staff are best allocated to different shifts according to the typical variation in workload throughout the day, with the greatest number of nursing personnel scheduled to work during times of greatest workload

(Bell et al., 1985; Luczun, 1984). Therefore, shift distribution guidelines were developed based on an indicator of workload variation for the six study sites.

Because PACU workload--as measured by NCHs per day--has been shown to be related to patient volume per day, the hourly patient load in the PACU was used as an indicator of workload. That is, the average number of patients in the PACU for each hour of the day was used to represent the typical daily workload pattern. For each study site, a histogram was used to display the average number of patients for each hour the PACU was open during the period of data collection.

The pattern of workload throughout the day for all study sites was determined by a visual interpretation of the data displayed in Figure 6. For all study sites, the number of patients (and therefore the workload) in the PACU gradually increased over a period of 2 to 4 hours, stayed at a relatively high level for 4 to 5 hours, and then gradually decreased over a period of 6 to 7 hours. Data obtained from the PACU survey verified that this pattern of workload distribution shown throughout the day at the study sites was typical for all PACUs in HSC. This pattern of workload distribution reflected that (a) routine operating room schedules started in the early morning and finished by late afternoon or early evening in all MTFs within HSC at the time of the study and (b) the average workload extended later in the day for PACUs that had a policy of opening to recover emergency cases after the PACU's normal hours of operation and/or a policy of providing care for remain overnight patients (RONs). As demonstrated in Figure 6, the average workload remained higher in the evening for study site 6, which was the only study site that had a policy of providing care for emergency cases throughout the night and also a policy of providing care for RONs.

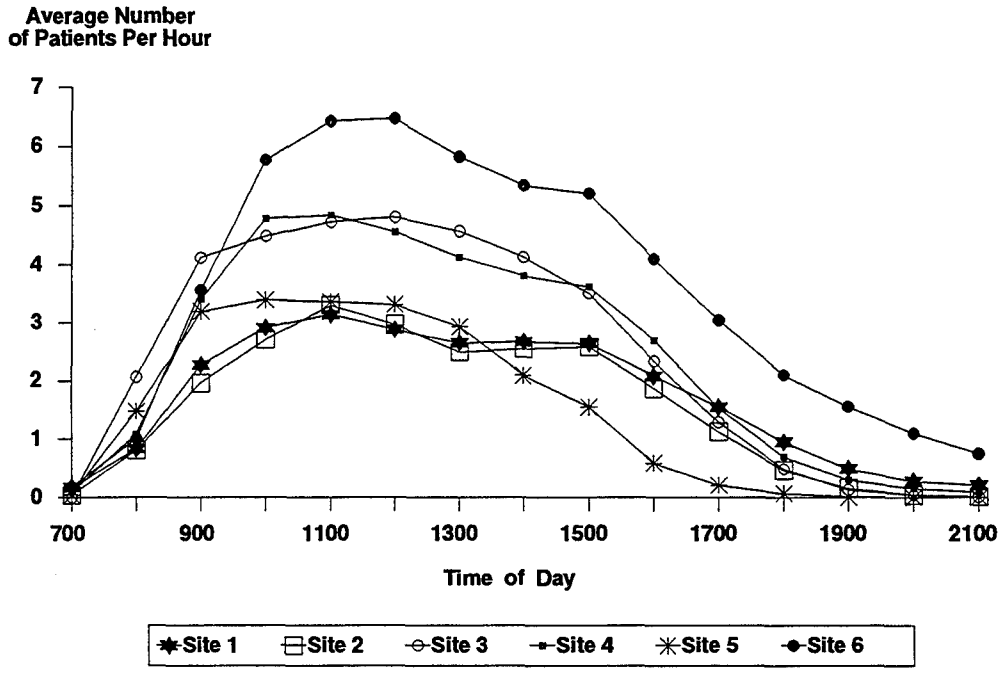

Figure 6. Average number of patients per hour for each study site.

The pattern of gradually increasing and then decreasing workload in the PACU throughout the day supports the use of staggered shifts that enable nursing personnel to be distributed according to each PACU's typical variation in workload throughout the day. This allows for most nursing personnel to be scheduled when the workload is expected to be greatest. It also allows for minimal coverage with at least one professional and one paraprofessional staff member on duty during periods of the day with the lowest expected workload. For example, the average shift distribution reported on the survey for study site 4 was as follows: (a) 1 RN or 1 91C/LPN on the 0730-1600 shift, (b) 1-2 RNs and 2-3 91Cs/LPNs on the 0800-1630 shift, (c) 1 RN and 1-2 91Cs/LPNs on the 0930-1800 shift, and (d) 1 RN and 1 91C/LPN on the 1100-1930 shift. At the time of the survey, this PACU did not have any nurse assistants (NAs) assigned to the unit.

Objective Four

The fourth research objective was to develop guidelines for adjusting the number of staff during periods of the day when there are changes in the typical daily workload pattern. The staffing adjustment method should not be confused with the method of shift distribution. As previously stated, shift distribution refers to the allocation of nursing personnel to work in turn with each other during different periods of time throughout the hours of operation of a unit (Bell et al., 1985; Luczun, 1984). The staffing adjustment method refers to a procedure used to increase or decrease the number of staff during periods of the day when there are changes in the typical daily workload pattern. Conditions that occur throughout the day resulting in changes in the typical daily workload pattern demand a temporary reallocation of staff.

The adjustment method is based on the fact that the distribution of workload throughout the day varies according to the number of patients to be taken care of at a time. Therefore, PACU nurses need to look for possible changes in their usual number of patients to recover at the same time in the PACU when they update their operating room schedule throughout the day. For example, if several operating rooms have more than the usual number of short cases scheduled first on their list, there will be an increased number of patients to recover in the PACU during a short period of time in the morning. Also, there may be several emergency cases added at midday to an already full operating room schedule resulting in more than the usual number of patients to recover at the same time in the afternoon. Furthermore, PACU nurses need to use their clinical judgment to determine the point at which the number and type of increased or decreased patients expected in the unit represents a significant change in the typical daily workload pattern such that a temporary adjustment of the number of staff to provide patient care is needed.

The staffing adjustment method refers to two simple procedures that head nurses can use to increase or decrease the number of staff during periods of the day when there are changes in the typical daily workload pattern. First, a shift may be changed to start earlier or later so that more staff are present during the time of increased workload and/or fewer staff are present during the time of decreased workload. When shifts are adjusted, the desired skill mix needs to be maintained. Also, a minimum of one professional and one paraprofessional staff member should be on duty whenever patients are in the unit.

Second, the head nurse and wardmaster can help with patient care during periods of increased workload and perform their administrative duties during periods of decreased

workload. This is a reasonable procedure to suggest for the staffing adjustment method. As previously discussed, the PACU survey revealed that head nurses of PACUs in HSC commonly provided patient care during times of increased workload. Also, PACU nurses who participated in the study indicated that it was common practice for wardmasters of PACUs in HSC to provide patient care during times of increased workload.

Objective Five

The fifth research objective was to develop a method of checking the accuracy of information collected for the staffing system. The procedure that was developed to check the accuracy of information collected for the staffing system is referred to as the audit method. The reported information consists of the number of PACU patients recovered per day by type of anesthesia received.

First, the information to be audited needs to be collected. All nursing personnel should be instructed in the procedure for recording the number of PACU patients seen per day by type of anesthesia received. Written instructions for recording this information and a sample patient volume worksheet can be found in Appendix H. Personnel need to record the number of PACU patients seen per day by anesthesia type. All nursing personnel can identify patients on the operating room schedule who are admitted to the PACU and record the type of anesthesia they had. Because patients who actually arrive in the PACU and the type of anesthesia they had often differ from what is written on the operating room schedule, nursing staff need to be careful to make the necessary corrections on the schedule so that accurate patient volume by anesthesia type can be recorded.

To provide consistency in the data collection procedure, it is recommended that one person in each PACU be designated as the unit recorder. The recorder should be able to interpret the type of anesthesia written on the corrected operating room schedule and accurately record numerical information. The recorder is responsible for recording patient volume by anesthesia type on a patient volume worksheet and for entering this information into an automated system that will be used to compute daily nursing care hours (NCHs). As explained in greater detail in Appendix H, the patient volume worksheet should provide space for recording the number of patients recovered by PACU nursing staff for each day by the type of anesthesia received.

The patient information that has been collected should be audited at least once each 3 months. Thus, there would be at least one audit on data submitted for each quarterly workload profile. Additionally, an audit should be performed whenever there seems to be a discrepancy between the number and type of patients who are being cared for in the PACU and who are being reported in the patient volume information.

According to the audit method, the head nurse--or another registered nurse who the head nurse designates as an auditor--should check one day's records of patients recovered in the PACU. The auditor identifies the accuracy of the patient volume and type of anesthesia for each patient by comparing for that day (a) the operating room schedule that has been corrected by the nursing staff to reflect the patients who were admitted to the PACU and the type of anesthesia they received, (b) the PACU's patient volume worksheet, and (c) the standard operating room form (DA Form 4107) that identifies the patient and the type of anesthesia received.

Because of the relative simplicity of obtaining the patient volume information, 100% agreement between the operating room schedule, the patient volume worksheet, and DA Form 4107 for one day's records of patients is expected. If 100% agreement is not attained, the reason for the inconsistent information should be identified, and nursing staff should be given instructions regarding any problems that have been identified in collecting the patient volume information. Inconsistent information may be caused by inaccurate recording of the number and/or type of anesthesia on the operating room schedule or patient volume worksheet or by inaccurate completion and/or interpretation of DA Form 4107. It may be the PACU or operating room staff or the auditor who did not record or interpret the information correctly. After the PACU head nurse or another designated person has provided the staff with the necessary training, the audit should be repeated until 100% agreement between the corrected operating room schedule, the patient volume worksheet, and DA Form 4107 is attained for one day's records of patients recovered in the PACU.

Additional Analyses

Acuity data also were collected for 153 remain overnight patients (RONs), who were not part of the study sample that has been described in this report. RONs were patients who remain for postoperative care in the PACU from the day of their surgery until the following morning. All RONs were at study site 6, which was the only study site that had a policy of staying open 24 hours to provide care for up to 3 RONs in addition to patients having emergency surgery during the night. RONs at this site were described as patients who did not require an intensive care unit, but needed closer monitoring than patients on a surgical

ward. There were 128 RONs who had general anesthesia, 22 RONs who had regional anesthesia, and 3 RONs who had local anesthesia over the 16-week data collection period.

The development of a regression model to predict direct care time from patient volume for RONs was not pursued for several reasons. First, a moderate correlation was found between daily patient volume and direct care hours per day for RONs ($\underline{r} = .77$) as opposed to the high correlation ($\underline{r} > .90$) for all other patients in the study. Also, there were only a small number of RONs in the study ($\underline{n} = 153$), and all RONs were from one study site.

It should be noted that the workload and staffing profiles were not designed to account for nursing staff needed to care for RONs throughout the duration of their stay in PACU. At the time of the study, there were two PACUs in HSC that had a policy of staying open 24 hours to provide care for up to 3 RONs at a time. In these cases, minimum staffing of one professional and one paraprofessional nursing personnel would be needed to provide care for RONs during the hours when the PACU was not receiving routine post-anesthesia patients. For example, for study site 6, it was estimated that additional minimal staff would be needed from 2000 in the evening until 0700 the next morning to provide nursing care for RONs throughout the night. The high cost of staffing a PACU throughout the evening and night hours highlights the need to examine the policy of keeping the PACU open on a 24-hour basis to provide care for a few RONs throughout the night.

DISCUSSION

The purposes of this study were to provide an acuity-based method of determining nurse staffing needs for PACUs in the AMEDD and to provide a method of analyzing PACU workload variation. In this section, findings related to the research objectives are discussed.

Objective One

The first research objective was to develop a method by which the typical workload of a PACU could be described and the variation in workload could be analyzed. Because of the strong positive relationship between patient volume and direct care time at all study sites, a regression model was developed to predict direct care time from patient volume. Predictor variables were selected that yielded the simplest adequate model to predict daily direct care hours from patient volume information. Using patient volume to account for acuity eliminated use of the acuity worksheet for the staffing system. PACU nurses will spend much less time collecting daily patient volume information for their staffing system than they would have spent completing acuity worksheets. Yet the staffing system is still based on a sound method of capturing acuity-based workload information because of the high correlation between daily direct care time and patient volume.

The workload profile was developed to be used with NCH data over a 3-month period of time using 2 SD control limits. These decisions were based on workload data collected from six study sites for a 16-week period of time. Once the staffing system is implemented and patient volume data are collected over a one-year period of time, the variability of the PACU

workload should be examined again to determine whether there are any indications for changing the 3-month reporting period or the 2 SD control limits.

Head nurses can use the workload profile to help them monitor, evaluate, and improve the workload process on an ongoing basis. When the evaluation of the workload process identifies opportunities for improvement, head nurses can make recommendations for change based on their workload data. Evaluation of the effectiveness of any changes can be done by continuously monitoring the workload process. Use of the workload profile in this manner will enhance the head nurse's overall program to continuously assess and improve the quality of care in the PACU (Flarey, 1993; Levin, 1993).

Head nurses should not view the workload in the PACU in isolation from the workload in other units in the MTF. For example, the OR's workload directly influences the PACU's workload, and the PACU's workload directly influences the workload of the surgical wards. If a PACU's workload varies by the day of the week and the high workload day is Thursday or Friday, this pattern of workload affects the surgical wards in that the wards may have to increase their staffing on the weekends to meet the patient care needs of the increased number of postoperative patients on the weekends.

Objectives Two and Three

The second and third research objectives were to develop methods for determining the number of nursing personnel to schedule on a daily basis and to develop guidelines for the skill mix and shift distribution of nursing personnel. The staffing range that is provided for the PACU head nurse on a quarterly basis together with the skill mix and shift distribution

guidelines are referred to as the staffing profile, which represents a pattern of the unit's typical staffing needs.

The staffing range refers to the range of nursing personnel to schedule on a daily basis to accomplish a unit's workload. This number of nursing personnel is reported as a range so that head nurses can schedule their staff according to expected differences in workload. Moreover, head nurses should use the workload profile to analyze variation in their workload patterns so they can staff their units more efficiently. For example, nurses can examine why certain days of the week have a much heavier workload and require more nursing personnel. This is an important consideration in that head nurses could more easily staff all days with their staffing range if they had a more consistent workload of regularly scheduled surgeries throughout the week.

Skill mix refers to the recommended proportion of different types of nursing personnel to provide patient care on a nursing unit. A 50:50 professional:paraprofessional skill mix and a 60:40 LPN:NA skill mix were recommended for the staffing system after consideration of the expert panel's recommendation and the current authorization skill mix. Head nurses using the staffing system should note the skill mix that they are able to use in the PACU and the influence that this skill mix seems to have on nursing care that is provided. This information could be used to re-evaluate the recommended skill mix after the staffing system has been used for one year.

Shift distribution refers to the allocation of nursing personnel to work in turn with each other during different periods of time throughout the hours of operation of a unit (Bell et al., 1985; Luczun, 1984). Although the analysis of workload data collected in this study

supported the use of staggered shifts in the PACU, a system of staggered shifts is not a new concept. Most head nurses reported in the PACU survey that they were using a system of staggered shifts for their unit. Moreover, experienced head nurses who participated in the study reported that they were monitoring their typical daily workload pattern and staggering their shifts accordingly.

Head nurses can determine how best to stagger their shifts by determining the typical distribution of their workload throughout the day. The average number of patients in the unit for each hour of the day can be estimated by using an hourly count of the number of patients in the PACU for each hour the PACU is open. The number of patients in the unit is counted once each hour (e.g., at 0730, 0830, 0930, 1030, etc.) for 3 to 4 weeks. At the end of this period of time, the average of each hourly count is calculated. The average number of patients for each hour of the day can be graphed to obtain the unit's typical distribution of workload throughout the day.

Objective Four

The fourth research objective was to develop guidelines for adjusting the number of staff during periods of the day when there are changes in the typical daily workload pattern. These guidelines are referred to as the adjustment method. Again, the adjustment method is not a new concept for the PACU. Experienced head nurses reported that they had used this method to provide adequate patient care during times of increased workload. However, the findings in this study regarding the relationship of direct care time to patient volume support the use of a staffing adjustment method that is based on the number of patients needing

nursing care at any given time. Moreover, a formalized method of staff adjustment becomes another tool that nurses can use to manage their unit. This is especially important during the present time of cost constraints when there is no pool of personnel available to work in the PACU during short periods of increased workload.

Objective Five

The fifth research objective was concerned with developing an audit method, which consists of a simple procedure for checking the accuracy of information collected for the staffing system. The information needed for the staffing system consists of the number of PACU patients recovered per day by type of anesthesia received. All staff members should be educated in the procedure used for collecting the necessary patient information for the staffing system so they can plan and conduct their own audits. Providing nurses with a simple method of conducting their own audit at least once each quarter and more frequently at their own discretion helps them manage their staffing system at the unit level.

CONCLUSIONS

A scientifically sound but clinically practical approach was used in this study to develop a Post Anesthesia Care Staffing System (PACS) for PACUs in the AMEDD. PACU head nurses in the AMEDD can use the staffing profile together with the skill mix and shift distribution guidelines to determine the number and type of nursing personnel needed to meet their unit's patient care needs on a day-to-day and shift-by-shift basis. Also, the staffing adjustment guidelines can be used as a practical measure to maximize existing nursing resources during times of unexpected variation in workload throughout the day. Because nursing services are the largest consumer of personnel in medical treatment facilities (MTFs), section supervisors and chief nurses of MTFs must be able to justify nursing staff expenses and maximize existing nursing resources with a staffing system such as PACS. Additionally, head nurses can use the workload profile to continually monitor and improve their workload process. Nursing personnel at the unit level are most familiar with the intricacies of the workload process in their PACU. Thus, they are in the best position to interpret the workload profile and search for ways to improve the workload process.

RECOMMENDATIONS

First, it is recommended that the nurse staffing system outlined in this study be accepted as the Post Anesthesia Care Staffing System (PACS) and be implemented in all PACUs in the AMEDD. PACU personnel can record the number of patients recovered in their unit per day by anesthesia type and enter this information into an automated system, which can be used to calculate NCHs per day. An individual at HSC (now reorganized as the U.S. Army Medical Command or MEDCOM) who is designated to manage the staffing system can use statistical process control software to create the workload and staffing profiles. This system manager can use the workload profiles to compare the workload of different groups of PACUs, such as all low workload sites. However, it is important that the workload and staffing profiles be sent back to the head nurses in a timely fashion so they can evaluate their staffing needs. Additionally, head nurses can use the workload and staffing profiles to monitor and evaluate their workload process on an ongoing basis.

Second, it is recommended that a follow-up study be conducted after nursing workload data have been collected with the PACS for one year. The system manager at HSC could be the person to conduct the study. One purpose of the study would be to determine whether workload data obtained over a one-year period of time would indicate a need to adjust the method used to develop the workload and staffing profiles. Another purpose would be to determine if there are trends in the workload data based on events such as the timing of surgical residencies. Results of the study would be used to adjust the staffing system methodology as needed and to estimate future PACU workload for purposes of planning long-term staffing and budget needs.

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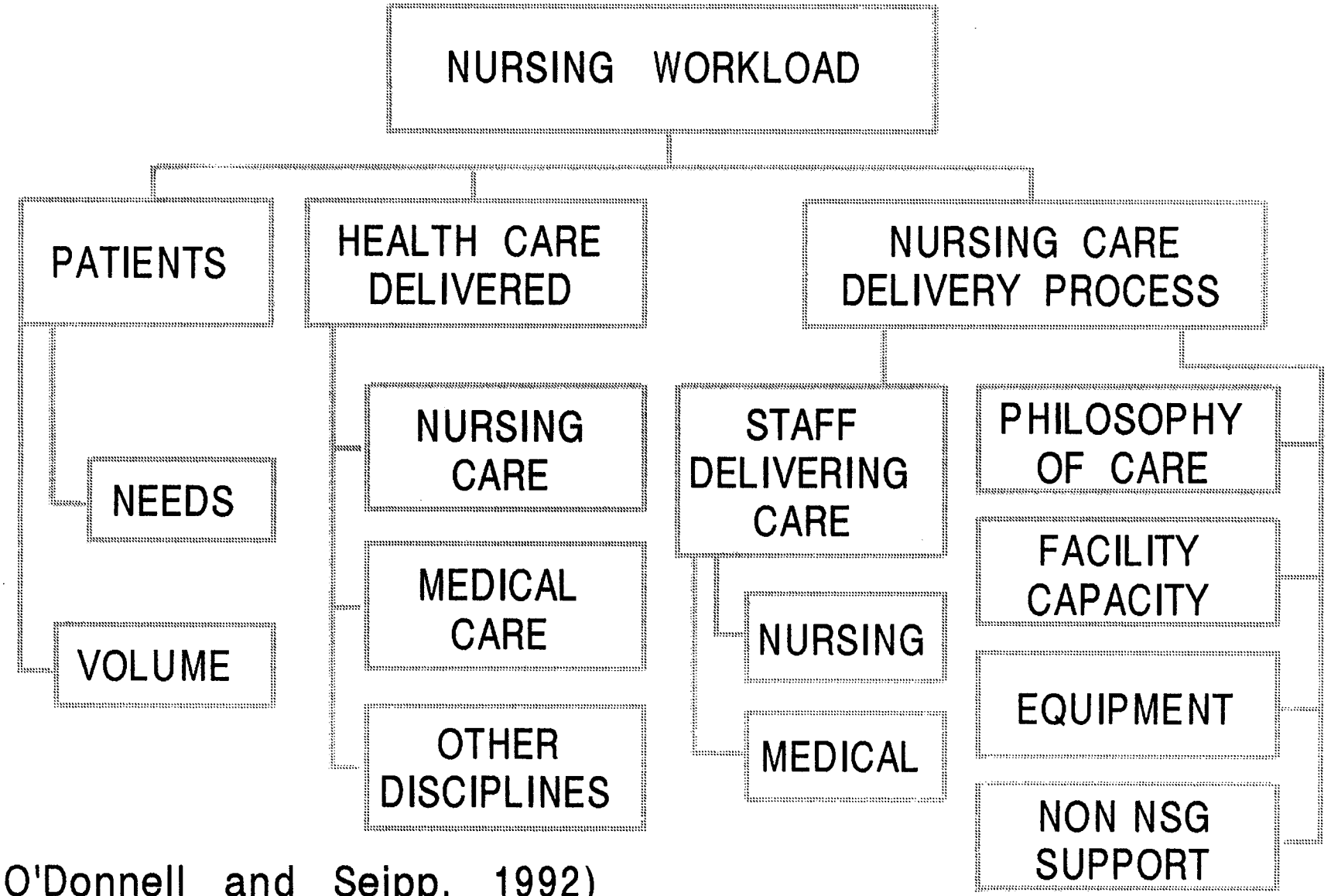
APPENDIX A

O'Donnell and Seipp's Nursing Workload Model

A MODEL OF NURSING WORKLOAD



(O'Donnell and Seipp, 1992)

APPENDIX B

PACU Acuity Worksheet*

*Typographical errors were found in three critical indicators on the PACU acuity worksheet as it was published in the original PACU technical report (Carty et al., 1991). The following corrections were made before the acuity worksheet was used in this study: (a) "Suctioning--all types" was corrected to "Suctioning--oral"; (b) "Dressing change, small (≤4" by 8")" was corrected to "Dressing change, small (<4" by 8")"; and (c) "Dressing change, large (>4" by 8")" was corrected to "Dressing change, large (≥4" by 8")."

WORKLOAD MANAGEMENT SYSTEM FOR NURSING - POST ANESTHESIA CARE UNIT ACUITY WORKSHEET

SECTION I: General Information

Date _____
Day Month Year

Time Admitted _____

Time Discharged/Transferred _____

Continuation Sheet ☐ Yes

SECTION II: Initial Assessment

(Select only one)

☐ General anesthesia

☐ Spinal or regional anesthesia

☐ Local anesthesia and/or sedation

SECTION III: Multiple Occurring Activities

(Place "tick" mark each time done)

PACU PARAMETERS	Counting Area N	D	E	Total No.
Stir-up routine				
Vital signs				
Motor/sensory testing				
Neuro assessment				
Circulation/pulse checks				
Monitor adjustments				
Measure output				
Nausea/emesis care				

IV THERAPY	Counting Area N	D	E	Total No.
IV bottle change with flow rate adjustment				
IV medication				
IV insertion				
IV/arterial line blood sample				
PROCEDURES				
Oxygen administration				
Suctioning - oral				
Urinary catheterization				
Venipuncture - blood sample				
Dressing change, small (<4" by 8")				
Dressing change, large(≥ 4" by 8")				
EKG - rhythm strip or 12-lead				
SUPPORT ACTIVITIES				
Patient position change				
Incontinent care				
Occupied bed change				

VERIFICATION

N _____
D _____
E _____
(R.N.Initials)

Stamp Plate

HSC Form 565-R (TEST) (HCSCIA) 1 Jun 92

SECTION II: INITIAL ASSESSMENT

Initial assessment refers to a series of continuous nursing activities that are done for patients as soon as they enter the PACU. The assessment begins when a nursing staff member starts any one of the nursing care activities listed below and ends when the continuous nursing activities stop. Some patients will require all of the following nursing activities when they enter the PACU; other patients will require only a few of them:

- Insure airway patency, assess respiratory status, initiate oxygen therapy and stir-up routine as needed, and orient to unit;
- Check and record B/P, pulse, respirations, temperature, and neurological and/or motor-sensory responses;
- Connect the patient to the pulse oximeter and cardiac monitor and record observations;
- Assess integrity of IV/central/arterial lines, place IV fluids/blood products on IV pole, check amount of fluids in bag(s), and check flow rate;
- Assess patient's total condition, inspect dressings and drains, assess patient's body position, and reposition if necessary;
- Receive report from anesthesia personnel, report baseline measurements (PARS) to anesthesia personnel, and record initial assessments on flow sheet or appropriate form.

ANESTHESIA TYPE: ***(Select only one)***

- **General anesthesia**: Mark if above nursing activities are performed for patient who received only general anesthesia **OR** general plus spinal/regional **OR** general plus local anesthesia and/or sedation.
- **Spinal or regional anesthesia:** Mark if above nursing activities are performed for patient who received only spinal or regional anesthesia **OR** spinal/regional plus local anesthesia and/or sedation.
- **Local anesthesia and/or sedation:** Mark if above nursing activities are performed for patient who received **ONLY** local anesthesia and/or sedation.

APPENDIX C

Guidelines for Using the PACU Acuity Worksheet

WORKLOAD MANAGEMENT SYSTEM FOR NURSING-POST ANESTHESIA CARE UNIT ACUITY WORKSHEET: GUIDELINES FOR USE

1. **Introduction**: The WMSN-PACU worksheet is used to document how frequently certain direct nursing care activities occur. The nursing activities listed on the worksheet do not cover all the nursing activities that PACU nurses do for their patients. Rather, the activities listed are those that best account for the total direct nursing time spent caring for PACU patients. This information is used to classify patients according to their acuity. The worksheet has three sections to complete.

a. **Section I** (*General Information*) contains general information such as the date and time of admission and discharge/transfer.

b. **Section II** (*Initial Assessment*) refers to a series of nursing care activities that are done for patients as soon as they enter the PACU. Some patients will require all of the following nursing activities when they enter the PACU, whereas other patients will require only a few of them:

★ Insure airway patency, assess respiratory status, initiate oxygen therapy and stir-up routine as needed, and orient to unit;

★ Check and record blood pressure, pulse, respirations, temperature, and neurological and/or motor-sensory responses;

★ Connect the patient to the pulse oximeter and cardiac monitor and record observations;

★ Assess integrity of IV/central/arterial lines, place IV fluids/blood products on IV pole, check amount of fluids in bag(s), and check flow rate;

★ Assess patient's total condition, inspect dressings and drains, assess patient's body position, and reposition if necessary;

★ Receive report from anesthesia personnel, report baseline measurements (PARS) to anesthesia personnel, and record initial assessments on flow sheet or appropriate form.

The amount of nursing time for the initial assessment has been found to vary according to the type of anesthesia used (e.g., it takes longer to do the initial assessment of a patient receiving a general anesthesia than a patient receiving local anesthesia). Therefore, check the type of anesthesia used (general, spinal/regional, or local) to account for the appropriate amount of nursing time for the initial assessment.

c. **Section III** (*Multiple Occurring Activities*) lists nursing care activities that you do for your PACU patients throughout their stay in PACU. Each time you complete one of these activities, place a tick mark in the appropriate space. The tick marks will be added up when a patient is discharged or transferred.

2. **Starting the Worksheet**: Start a separate worksheet for each patient admitted to PACU. It is important to keep the worksheet near the patient while in the PACU so all nursing personnel can use it to mark completed nursing activities.

a. Stamp the worksheet with the patient's identification plate in the bottom left hand corner. Make sure all information on the stamp plate is legible.

b. Write the date and time of admission in **Section I.** Use military time.

c. Mark only ONE block in **Section II.**

1) Mark **General anesthesia** for the patient who received general anesthesia OR general anesthesia plus spinal/regional anesthesia OR general anesthesia plus local anesthesia and/or sedation.

2) Mark **Spinal or regional anesthesia** for the patient who received spinal or regional anesthesia OR spinal/regional anesthesia plus local anesthesia and/or sedation.

3) Mark **Local anesthesia and/or sedation** for the patient who received local anesthesia and/or sedation.

3. **Using the Worksheet**: In **Section III**, mark all nursing care activities completed during the patient's stay in PACU. Place one tick mark in the area labeled "Counting Area" each time you complete one of the identified nursing activities.

a. Keep the worksheet near the patient so you can mark activities as they occur. All nursing staff providing care for the patient are responsible for marking completed activities.

b. Record the mark in the block labeled for the appropriate shift. Use the night shift block for all activities completed from 2300 until 0700 hours, the day shift block for all activities completed from 0700 until 1500 hours, and the evening shift block for all activities completed from 1500 until 2300 hours. For example, if you admit a patient to PACU at 1400

hours, mark activities completed before 1500 hours in the day shift block, and mark activities completed at or after 1500 hours in the evening shift block.

c. It will be easier to total the marks if you avoid stray marks and record the tick marks in groups of five. Review the worksheet at the end of your shift or when the patient has been discharged/transferred to assure that all completed nursing activities have been marked.

4. **Continuing the Worksheet**: Start a new worksheet for patients who remain in the PACU after 2400 hours.

a. Stamp a new worksheet using the patient's identification plate.

b. Write the new date in **Section I.**

c. Leave the time of admission blank. (The patient has already been admitted).

d. Check the "yes" box for "Continuation Sheet" located in **Section I.**

e. Do not complete **Section II** on the new worksheet. (The initial assessment was already done on admission to PACU).

5. **Finishing the Worksheet**:

a. When a patient is discharged or transferred:

1) Write the time of discharge/transfer from the PACU in **Section I.**

2) Total the tick marks for each nursing care activity in the counting area in **Section III** and write the total in the "Total No." column for each nursing activity.

3) Remove the worksheet from the patient's record before transferring or discharging the patient.

4) Give the worksheet to the charge nurse to review for legibility and completeness.

b. When a patient remains in PACU after 2400 hours:

1) Add the marks in each counting area in **Section III** and write the total in the "Total No." column for each nursing activity.

2) Give the totaled worksheet to the charge nurse to review for legibility and completeness.

3) Start a new worksheet. Refer to the section, "Continuing the Worksheet."

6. **Reviewing Finished Worksheets:** The charge nurse reviews completed worksheets to assure that:

a. each worksheet is stamped with the patient's identification plate and all information is legible;

b. each worksheet has the correct date, time of admission and discharge or transfer, and marking of continuation sheet in **Section I** as appropriate;

c. only one block is marked in **Section II** to indicate type of anesthesia used;

d. tick marks in **Section III** are accurately totaled.

The charge nurse on each shift verifies that the worksheets are legible and complete by initialling the appropriate space in the bottom right hand corner of the sheets. Store completed worksheets in a safe location designated by the PACU Head Nurse.

WORKLOAD MANAGEMENT SYSTEM FOR NURSING-POST ANESTHESIA CARE UNIT ACUITY WORKSHEET: OPERATIONAL DEFINITIONS

Section II: Initial Assessment

Initial assessment refers to a series of continuous nursing activities that are done for patients as soon as they enter the PACU. The assessment begins when a nursing staff member starts any one of the nursing care activities listed below and ends when the continuous nursing activities stop. Some patients will require all of the following nursing activities when they enter the PACU, whereas other patients will require only a few of them:

★ Insure airway patency, assess respiratory status, initiate oxygen therapy and stir-up routine as needed, and orient to unit;

★ Check and record blood pressure, pulse, respirations, temperature, and neurological and/or motor-sensory responses;

★ Connect the patient to the pulse oximeter and cardiac monitor and record observations;

★ Assess integrity of IV/central/arterial lines, place IV fluids/blood products on IV pole, check amount of fluids in bag(s), and check flow rate;

★ Assess patient's total condition, inspect dressings and drains, assess patient's body position, and reposition if necessary;

★ Receive report from anesthesia personnel, report baseline measurements (PARS) to anesthesia personnel, and record initial assessments on flow sheet or appropriate form.

1. **General anesthesia**: Mark if the nursing activities are performed for a patient who received general anesthesia **OR** general anesthesia plus spinal/regional anesthesia **OR** general anesthesia plus local anesthesia and/or sedation.

2. **Spinal or regional anesthesia**: Mark if the nursing activities are performed for a patient who received spinal or regional anesthesia **OR** spinal/regional anesthesia plus local anesthesia and/or sedation.

3. **Local anesthesia and/or sedation**: Mark if the nursing activities are performed for a patient who received local anesthesia and/or sedation.

Section III: Multiple Occurring Activities

A. PACU Parameters

1. **Stir-up routine**: Includes time to instruct patient to cough and deep breathe, answer questions about surgery, re-orient to place and time, assess level of comfort, determine if patient can be medicated for pain, give fluids if permitted, and leave the area.

2. **Vital signs**:

T, P, R, and B/P: Includes time to place equipment at bedside; obtain temperature, pulse rate, respiratory rate, blood pressure, and O_2 saturation; record results of measurements; and remove equipment from area.

OR

P, R, and B/P: Includes time to place equipment at bedside; obtain pulse rate, respiratory rate, blood pressure, and O_2 saturation; record results of measurements; and remove equipment from area.

3. **Motor/sensory testing**: Includes time to assess extremities for sensation awareness and muscle strength, record results, and leave the area.

4. **Neuro assessment**: Includes time to adjust room lights and check pupillary reflexes with flashlight; make inquires within the framework of interviewing that will give information about the patient's orientation, memory, intellectual performance, and judgment; assess extremities for sensation awareness and muscle strength; record results; and leave the area.

5. **Circulation/pulse checks**: Includes time to check extremity for pulse (rate and strength), swelling, numbness, and tingling; evaluate temperature and color of the skin; assess the patient's ability to move the part; record results; and leave the area.

6. **Monitor adjustments**: Includes time to attach monitor (e.g., cardiac monitor or pulse oximeter) to patient and set or change alarm settings; readjust devices attached to patient (not just turning off alarm); and leave the area.

7. **Measure output**: Includes time to place calibrated cylinder or container at bedside; measure and record output of urine, emesis, or any type of drainage; and remove equipment from area.

8. **Nausea/emesis care**: Includes time to position patient to protect airway and/or hold emesis basin for those patients experiencing nausea, retching and/or vomiting; provide oral care when necessary (cleanse mouth with appropriate agent); and remove equipment from area. [Also mark "Measure output" for measuring and recording emesis at bedside.]

B. IV Therapy

1. **IV bottle change with flow rate adjustment**: Includes time to place equipment at bedside, remove used IV container and replace with new container, calculate and adjust flow rate, and remove equipment from area.

2. **IV medication**:

Intravenous-IV push: Includes time to place equipment at bedside, select site for injection of medication utilizing existing system, administer medication, record in chart, and remove equipment from area;

OR

Intravenous piggy-back: Includes time to place equipment at bedside, select site for administration of solution utilizing existing system, hang medication and adjust flow rate, record on Intake and Output Record, and remove equipment from area.

3. **IV insertion**: Includes time to place equipment at bedside; apply tourniquet to extremity; cleanse site; perform venipuncture; connect IV tubing; apply ointment and dressing and tape securely; time, date and initial dressing; calculate and regulate flow rate; record on Intake and Output Record; and remove equipment from area.

4. **IV/arterial line blood sample**: Includes time to place equipment at bedside, clear system, obtain blood sample through stopcock, flush system, label samples, and remove equipment from area.

C. Procedures

1. **Oxygen administration** (Initial and/or adjustment): Includes time to place equipment at bedside, turn on oxygen, fit the mask over the mouth and nose or fit nasal prongs, adjust headband, regulate oxygen flow rate, evaluate fit and patient's response to oxygen and equipment, and leave the area. [Does not include oxygen administration during the initial assessment.]

2. **Suctioning - oral**: Includes time to place or set up equipment at bedside, suction oral cavity with suction catheter/oral suction tip, flush catheter before and after each aspiration, and replace or remove used equipment from area.

3. **Urinary catheterization**:

Indwelling-catheterization: Includes time to place equipment at bedside, prepare patient, insert indwelling catheter, inflate balloon, tape catheter in place, connect to urinary drainage bag, and remove used equipment from area. [Also mark "Measure output" when measuring and recording urinary output at bedside.]

OR

Straight-catheterization: Includes time to place equipment at bedside, prepare patient, insert catheter, empty bladder, remove straight catheter, and remove used equipment from area. [Also mark "Measure output" when measuring and recording urinary output at bedside].

4. **Venipuncture - blood sample**: Includes time to place equipment at bedside, apply tourniquet to extremity, cleanse site, perform venipuncture, withdraw blood sample, apply pressure to puncture site, apply labels on blood tubes, and remove equipment from area.

5. **Dressing change, small (less than 4" by 8")**: Includes time to place equipment at bedside, remove soiled dressing, cleanse skin, apply dressing to site, and remove equipment from area.

6. **Dressing change, large (equal to or larger than 4" by 8")**: Includes time to place equipment at bedside, remove soiled dressing, cleanse skin, apply dressing to site, and remove equipment from area.

7. **EKG - rhythm strip or 12-lead**: Includes time to place equipment at bedside; prepare equipment for use; apply leads; obtain rhythm strip or 12-lead EKG; remove leads; record name, date and time; and remove equipment from area.

D. Support Activities

1. **Patient position change**: Includes time to a) remove support pillows, reposition patient, and apply support pillows for reasons of comfort and/or b) assist with positioning and removal of x-ray film and leave the area.

2. **Incontinent care**: Includes time to place equipment at patient's bedside, bathe buttocks, perineum, and thighs; change bedding; and remove equipment and soiled linen from area.

3. **Occupied bed change**: Includes time to place linen at bedside, turn patient on side, roll linen to one side of bed, replace with clean linen, turn patient to freshly made side of bed, remove soiled linen, complete bed making, and remove soiled linen from area.

APPENDIX D

PACU Indirect Care Multiplier Formula

HSHN-H (5-5c) 4 June 1993

MEMORANDUM FOR HQDA (DASG-CN), 5109 Leesburg Pike, Falls Church, VA 22041-3258

SUBJECT: Indirect Care Multiplier Formula for Post Anesthesia Care Units

1. This is a decision paper.

2. PURPOSE. Provide approval of the method used to calculate the indirect care multiplier (ICM) in the Post Anesthesia Care Unit (PACU) staffing system.

3. DISCUSSION. a. The ICM and direct care time are used to calculate total nursing care hours and staffing levels. The Perdue report (1990) "Evaluation of the Methodological Issues of the Major Studies in the Development of the WMSN Patient Classification System" provided the recommended ICM formula. It is derived correctly and accurately demonstrates the relationship between the direct and indirect components of available staff time. It is the appropriate formula to apply to variable nursing care.

b. This diverges from the formula used in the Workload Management System for Nursing (WMSN). That formula is more appropriately applied to regularly occurring activities, such as time schedule preparation. Use of the current WMSN ICM formula in the PACU staffing system would underrepresent the number of recommended staff (TAB B).

4. RECOMMENDATION. Recommend that Brigadier General Adams sign proposed 1st Endorsement at TAB A.

ORIGINAL SIGNED

2 Encls
1. TAB A (Proposed 1st End)
2. TAB B (ICM Formula)

WILLIAM B. YORK, JR.
Colonel, MC
Director, HCSCI

DASG-CN (HSHN-H/4 Jun 93) (5-5c) 1st End LTC Zadinsky/er/AV 471-0278
SUBJECT: Indirect Care Multiplier Formula for Post Anesthesia Care Units

Office of the Chief, Army Nurse Corps, Room 623, Skyline Five, 5109 Leesburg Pike, Falls Church, VA 22041-3258

FOR Director, Directorate of Health Care Studies and Clinical Investigation, Building 2268, Fort Sam Houston, TX 78234-6100

This action has been Approved/Disapproved_____.

ORIGINAL SIGNED

Encl
nc

NANCY R. ADAMS
Brigadier General, AN
Assistant Surgeon General/
Chief, Army Nurse Corps

PACU Indirect Care Multiplier Formula

1. The WMSN ICM formula is: 1 + % indirect time. The Perdue formula is: 1 + (% indirect / 1 - % indirect).

2. The table demonstrates that for 12 hours of direct care, the WMSN formula produces less than half the number of staff produced by using the Perdue formula.

Formula	ICM	Nursing Care Hours	**Recommended Staff**
Perdue	4.31	51.72	**6.5**
WMSN	1.77	21.24	**2.7**

APPENDIX E

PACU Survey

MTF_____ July 1992

Development of an Acuity-Based Nurse Staffing System for Post Anesthesia Care Unit (PACU)

Instructions: Please answer the following questions by filling in the blank or circling the answer that applies to you and your PACU. Please answer every question. If the question is not applicable to your PACU, please state NA. If you need more room for your responses, use the reverse side of the paper. In addition to returning your survey, please send us copies of your monthly MEPERS reports for the last year (the report that lists the number of patients recovered per month in your PACU for each clinical service).

Medical Treatment Facility

1. How many Operating Rooms does your facility have? _____

2. What are the normal working hours of the Operating Room?

   a. Monday through Friday _____ to _____

   b. Saturday _____ to _____

   c. Sunday _____ to _____

3. How many operational beds does your PACU have? _____

4. What are the normal hours of operation for your PACU?

   a. Monday through Friday _____ to _____

   b. Saturday _____ to _____

   c. Sunday _____ to _____

5. Who recovers your PACU patients after normal duty hours? (Circle all that apply and explain.)

   a. SICU/critical care staff in their unit

   b. On-call PACU staff in the PACU

   c. On-call PACU staff in SICU/critical care unit

   d. Other (please specify)

6. Which best describes the physical lay-out of your PACU?

a. Separate unit; have beds designated solely for PACU patients

b. Combined unit; share beds for PACU patients with another unit (specify type of unit_____)

c. Other (please specify)

7. Is your PACU used as overflow for critical care patients (e.g., patients may be scheduled to be recovered in SICU but are cared for in PACU because there are no available beds in SICU, etc.)? If so, what is your estimate of how many overflow patients you have per month in your PACU? How does this influence your nursing workload?

8. Which clinical areas other than the Operating Room use the PACU for recovery of patients (e.g., special procedures done in a clinic, surgeries done somewhere other than the Operating Room, etc.)?

	Clinical area	Type of procedure	Average # patients/month
a.			
b.			
c.			
d.			
e.			

9. Where is your PACU located in relation to the Operating Room and the SICU? Please explain how this location influences your ability to obtain help from anesthesia and nursing staff in special situations.

10. Does your facility have a Same Day Surgery or Ambulatory Surgery Center? If so, about how many Same Day Surgery patients do you recover in your PACU per month? Do these patients present any special problems that influence your nursing workload (e.g., Do you ever have to discharge Same Day Surgery patients to home)? If you don't have a Same Day Surgery unit now, do you anticipate one in the near future?

Anesthesia Personnel

1. How many anesthesiologists and nurse anesthetists are assigned to your facility (not including those in training)?

2. Does your facility have a training program for anesthesiologists or nurse anesthetists?

3. What Medical Officer is in charge of your PACU? How does he/she influence your PACU and your nursing workload? Please explain.

Nursing Staff

1. Who is your immediate first-line supervisor/rater (e.g., Head Nurse, SICU; Chief, Surgical Nursing Section, etc.)?

2. Within the Department of Nursing's organizational structure, which clinical nursing section does your PACU belong to?

3. How many nursing personnel do you have for your PACU (**including** Head Nurse and NCOIC but **excluding** Agency/Contract nurses)?

	Authorized	Assigned
ANC	_____	_____
Other RNs	_____	_____
91C	_____	_____
LPN	_____	_____
91A	_____	_____
91B	_____	_____
Nursing Assistant	_____	_____

4. Does your unit share staffing with another nursing unit? If so, which unit?

5. List the number of Agency/Contract nurses you routinely use each week and the number of hours each nurse works per week. Do the contract/agency nurses present any special problems for you in regard to your workload and/or staffing (e.g., how much advance notice do you have to give in order to use them)?

6. What is the average percentage of time you, as the Head Nurse, devote to clinical care of PACU patients? Please explain.

7. What is the educational background for all RNs assigned to your unit, including yourself? Fill in the number of RNs for each educational level, and identify your education by placing an asterisk (*) beside your educational level.

Educational Background	Number of RNs
Diploma	_____
Associate degree	_____
BSN	_____
MSN	_____
Doctorate	_____
Other	_____

8. What is the PACU and critical care nursing experience of your assigned PACU nursing staff? Circle the skill level of each staff member (e.g., ANC or RN) and fill in total number of years of PACU and critical care experience.

	Years of PACU Experience	**Years of Critical Care Experience**
a. ANC or RN:		
1. Head Nurse (ANC or RN)	_____	_____
2. ANC or RN #2	_____	_____
3. ANC or RN #3	_____	_____
4. ANC or RN #4	_____	_____
5. ANC or RN #5	_____	_____
6. ANC or RN #6	_____	_____
b. 91C or LPN:		
1. NCOIC (91C or LPN)	_____	_____
2. 91C or LPN #2	_____	_____
3. 91C or LPN #3	_____	_____
4. 91C or LPN #4	_____	_____
5. 91C or LPN #5	_____	_____
c. 91A/91B/Nursing Assistant (NA):		
1. 91A or 91B or NA #1	_____	_____
2. 91A or 91B or NA #2	_____	_____
3. 91A or 91B or NA #3	_____	_____
4. 91A or 91B or NA #4	_____	_____
5. 91A or 91B or NA #5	_____	_____

9. How many of the RNs have certification from professional nursing organizations, including yourself? Fill in the number of RNs who are certified and list the type of certification held. Please place an asterisk (*) beside your certification.

Certification	Number of RNs
_____	_____
_____	_____
_____	_____

10. What types of students do you have assigned to your PACU (e.g., 91C students, 91B Medical Proficiency Training Students, etc.)? How many students do you have, how frequently do they rotate through your unit, and how long does each student stay on your unit? How does having the students impact on your nursing workload? Please explain.

11. Do you have a problem with rapid turnover of nursing personnel assigned to your PACU? Please comment.

12. What shifts do you have for your PACU and what is the average number of nursing personnel assigned to each shift?

Shift Times	ANC/RN	91C/LPN	91A/91B/NA
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

13. Do you think the number of nursing personnel (for each skill level) currently assigned to the PACU is adequate?

	ANC/RN	91C/LPN	91A/91B/NA
a. Less than adequate	_____	_____	_____
b. Adequate	_____	_____	_____
c. More than adequate	_____	_____	_____

Please explain your answer:

14. What type of staffing do you recommend for your PACU? (Please indicate the number of staff for each skill level that you consider ideal for your unit.)

Shift Times	ANC/RN	91C/LPN	91A/91B/NA
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Please explain your answer:

15. Please state any specific staffing assignment policies/guidelines you have in your PACU (e.g., 1 staff member per child under ____ years, 1 staff member per ventilator patient).

16. How do you get more staff when your PACU gets busier than anticipated? (Circle all that apply and indicate how frequently you use each strategy.)

a. Request staff be pulled from another unit

b. Staff from another unit help out informally

c. Request agency or float pool staff

d. Request PACU staff work overtime

e. Call in off-duty PACU staff

f. Other (please specify)

17. If you use an "on call" system, approximately how many times a month are PACU staff members called in to recover patients? What are the days and the hours that are covered "on call"?

18. What would you like to change about the way that you adjust your staffing to accommodate unanticipated fluctuations in nursing workload? Please explain.

19. When do you receive the Operating Room schedule and what information do you use from it to adjust your staffing?

20. What information from the Operating Room schedule would you like to have for adjusting the number of staff you have assigned to your unit for a particular day?

21. Which types of patients on your Operating Room schedule do you know with fair accuracy will <u>not</u> be recovered in your PACU? Where will they go from the OR instead of PACU (e.g., SICU, Same Day Surgery, Ward)?

OR Patients **NOT** Recovered in PACU	Place of Recovery

22. What are the average number of add-ons and cancellations to the daily OR schedule?

PACU Patients

1. What is the average number of patients recovered in your PACU per month?

2. Which **months** do you have the heaviest workload and why?

3. Which **months** do you have the lightest workload and why?

4. Which **days of the week** do you have the heaviest workload and why?

5. Which **days of the week** do you have the lightest workload and why?

6. Which **hours of the day** do you have the heaviest workload and why?

7. Which **hours of the day** do you have the lightest workload and why?

8. What is your best estimate of the percentage of patients recovered in your PACU who have received the following anesthesia?

Type of Anesthesia	Percentage of Patients
a. General anesthesia	_____
b. Spinal or regional anesthesia	_____
c. Local anesthesia and/or sedation	_____

9. What is your best estimate of the percentage of patients recovered in your PACU who have the following ASAs?

ASA Category	Percentage of Patients
a. ASA 1	_____
b. ASA 2	_____
c. ASA 3	_____
d. ASA 4	_____
e. ASA 5	_____

10. What is the usual or typical PARS score of patients on admission to your PACU?

11. List the types of operative or diagnostic procedures you recover that require the most nursing care time at the bedside and why? Approximately how many cases per month of each of these procedures do you recover?

12. Describe the nursing care activities you do for your PACU patients that require the most nursing care time at the bedside. How frequently or routinely do you do these activities?

13. What is the average number of C-section patients you recover per month? Does the Labor & Delivery Unit at your facility also recover C-section patients? If so, please explain (e.g., L&D may only recover C-section patients during certain hours).

14. Describe the nursing workload of the average C-section patient (e.g., does their nursing care require more or less time than your average PACU patient, etc.).

15. Which age categories of your PACU patients require the most nursing care time and why?

16. Describe any new nursing practices you are doing now that you were not doing several years ago.

17. How else would you describe your PACU patients and the nursing care that you provide for them?

a. Are most of your patients active duty or retired?

b. Do you have a large number of pediatric or elderly patients?

c. How often do you have patients who require a ventilator?

d. How often do you use Patient Controlled Analgesia (PCA) pumps?

e. Describe other characteristics of your PACU patients that influence your nursing workload and your staffing.

PACU Policies

1. Do you have a Standard Operating Procedure (SOP) for routine vital signs or for any other nursing practices that influence your nursing workload? If so, please explain and/or send us a copy of the SOPs with your survey.

2. What guidelines do you have for differentiating what nursing care must be given by an RN versus a 91C/LPN versus a 91A, 91B, or Nursing Assistant? Please explain and/or return with your completed survey a copy of your SOPs describing these guidelines.

3. How many and what type of nursing personnel are required to be in your PACU at all times (e.g., at least 1 RN and 1 LPN/91C)?

4. What is the required minimum length of stay in your PACU for the following types of patients:

a. for patients recovering from general anesthesia?

b. for patients recovering from spinal anesthesia?

c. for patients recovering from local anesthesia and/or sedation?

d. for any other categories of patients?

5. Does your PACU have a required minimum number of personnel to transport patients back to their unit and a required skill level?

a. Number of nursing personnel:_____

b. Skill level of nursing personnel: _____

6. What is the average amount of time required for staff to transport patients to their unit and return to the PACU?

7. What is your visitation policy and how does it influence your nursing workload?

a. No visitors allowed

b. 1 parent may visit child
(age of child:_____)
(duration of visit:_____)

c. Spouse/significant other may visit
(duration of visit:_____)

d. Other (please specify)

8. Do you have standing orders for patient care on issues such as medications and discharge criteria?

a. If yes, do you like your standing orders? Why or why not?

b. If no, do you want standing orders? Why?

General Information

1. Describe and discuss any new or anticipated changes in your facility, your PACU, or the patient population served by your facility that may influence the nursing workload in your PACU.

2. Does your PACU have a computer(s)? If yes, how do you use the computer(s)? (Circle all that apply.)

a. Patient monitoring
b. Admission/disposition
c. Lab/x-ray results reporting
d. Order entry
e. Nursing care plans/documentation
f. Other (please describe)

3. Which of the following **non-nursing** support does your PACU receive? (Fill in the blanks as appropriate.)

Type of Support	Hours per Day	Type of Tasks
Ward Clerk		
Housekeeping		
Laboratory		
Supply		
Pharmacy		
Respiratory Therapy		
Transport/Escort		
EKG		
Other (please list)		

Thank you very much for the time and effort you have taken to complete this survey and to send us copies of your MEPERS reports for the last year! Comment on anything about your PACU that we may have overlooked. Your input will help us develop a useful nurse staffing system for your PACU. Also, please feel free to contact us with any comments or suggestions.

COL Jane Hudak or LTC Julie Zadinsky
Nursing Studies Branch (HSHN-H)
U.S. Army Health Care Studies and Clinical Investigation Activity
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We would like to share the results of the survey with you. Due to the demands of the PACU staffing study, we do not expect to have the final survey results in the near future. However, if you would like to receive a summary of the major findings of the survey, please indicate below:

☐ Yes, I would like to receive a summary of the major findings of the survey. Please mail the summary to me at the PACU at this MTF. I will notify you by phone or mail if my duty position and address change.

APPENDIX F

Method of Calculating Nursing Care Hours Per Day

Method of Calculating Nursing Care Hours Per Day

Patient volume information is entered into a data set in such a way that each day has two observations. The first observation is the total number of patients seen by PACU nursing personnel for one day in the General and/or Regional/Spinal anesthesia category. The second observation is the total number of patients seen for one day in the Local anesthesia and/or Sedation category. Calculations are done for each observation in the data set. Note that each observation is by day. Also, the data set should consist of daily observations for a 3-month period of time because this is the amount of data needed to develop one quarterly workload profile.

1. Patient volume will be reported by number of patients per day in 2 different anesthesia categories:

   (a) patients who had General anesthesia and/or Regional/Spinal anesthesia and
   (b) patients who had Local anesthesia and/or Sedation.

2. The number of patients per day who had General anesthesia and/or Regional/Spinal anesthesia is put into the following formula as X1. Y1 is the direct care hours per day for these patients.

   $Y1 = 0.485687 + [0.694732\ (X1)]$

3. The number of patients per day who had Local anesthesia and/or Sedation is put into the following formula as X2. Y2 is the direct care hours per day for these patients.

   $Y2 = 0.124070 + [0.419431\ (X2)]$

4. To obtain the total direct care hours per day for all patients (Y3): Add Y1 and Y2.

   $Y3 = Y1 + Y2$

5. To obtain the total nursing care hours (NCHs) per day for all patients: Multiply total direct care hours per day (Y3) by 4.31 (the Indirect Care Multiplier or ICM).

   $\text{NCHs per day} = Y3 * 4.31$

APPENDIX G

PACU Fixed Staff Definition

HSHN-H (5-5c) 4 June 1993

MEMORANDUM FOR HQDA (DASG-CN), 5109 Leesburg Pike, Falls Church, VA 22041-3258

SUBJECT: Post Anesthesia Care Unit Fixed Staff Definition

1. This is a decision paper.

2. PURPOSE. Provide approval of the definition of fixed staff used by the Post Anesthesia Care Unit (PACU) staffing system to calculate nursing care hours.

3. DISCUSSION. a. Fixed staff positions are recognized regardless of variation in workload and include those that are primarily administrative in nature: (head nurse [HN], wardmaster [WM], and ward clerk [WC]). The PACU staffing system identifies the recommended number of variable nursing staff (registered nurses, licensed practical nurses and nursing assistants) based on variation in patient workload. Medical treatment facilities and other agencies will be required to use the same definition of fixed staff for development of future manpower standards if they utilize PACU acuity data.

b. The PACU indirect care study (Rea, Jennings, Carty, & Seipp, 1991) also recommended the HN, WM, and WC as fixed staff. This diverges from the Workload Management System for Nursing (WMSN) definition of fixed staff as only the HN and WM. Identifying the WC as variable staff limits the flexibility of the large PACUs that may need a WC because their duties include only secretarial functions. Also, identifying the WC as variable staff slightly increases the number of recommended variable staff per day (TAB B).

4. RECOMMENDATION. Recommend that Brigadier General Adams sign the proposed 1st Endorsement at TAB A.

ORIGINAL SIGNED

2 Encls
1. TAB A (proposed 1st End)
2. TAB B (NCH Calculation)

WILLIAM B. YORK, JR.
Colonel, MC
Director, HCSCI

DASG-CN (HSHN-H/4 Jun 93) (5-5c) 1st End LTC Zadinsky/er/AV 471-0278
SUBJECT: Post Anesthesia Care Unit Fixed Staff Definition

Office of the Chief, Army Nurse Corps, Room 623, Skyline Five, 5109 Leesburg Pike, Falls Church, VA 22041-3258

FOR Director, Directorate of Health Care Studies and Clinical Investigation, Building 2268, Fort Sam Houston, TX 78234-6100

This action has been Approved/Disapproved_____.

ORIGINAL SIGNED

Encl
nc

NANCY R. ADAMS
Brigadier General, AN
Assistant Surgeon General/
Chief, Army Nurse Corps

Calculation of Nursing Care Hours

1. Nursing care hours (NCH) and the number of recommended variable nursing staff are calculated from direct care time and the indirect care multiplier (ICM). The higher the ICM, the higher the number of recommended staff.

2. Rea et al. (1991) determined in their study that defining fixed staff as the HN, WM, and WC produced a slightly lower ICM than defining only the HN and WM as fixed staff. The difference in the two ICMs is small because only the high workload PACUs in the study had a WC. The following table demonstrates this point using 20 hours of direct care time. When fixed staff is defined as the HN, WM and WC, the recommended number of staff is 10.8. If fixed staff is only the HN and WM, the recommended number of staff is 11.0.

Fixed Staff	Nursing Care Hours	Recommended Staff
HN, WM, WC	86.20	**10.8**
HN, WM	87.80	**11.0**

APPENDIX H

Method of Recording Patient Volume Information

Method of Recording Patient Volume Information

1. Record the number of patients who receive routine post-anesthesia care from PACU nursing staff. These patients may be recovered (a) during normal hours of operation by PACU nursing staff or (b) after normal hours of operation by on-call PACU nursing staff.

2. Record the number of patients recovered per day in 2 different anesthesia categories.

(a) In the first category, record the number of patients who had general AND/OR regional/spinal anesthesia. Also record here the number of patients who received one of these anesthesias PLUS local anesthesia and/or sedation.

(b) In the second category, record the number of patients who received ONLY local anesthesia and/or sedation.

3. For recording purposes, each day begins at 0001 hours and ends at 2400 hours. Record each patient visit in the PACU only once, even if the visit extends past midnight. A patient visit is defined as an episode of care that includes admission to the PACU, an initial assessment, routine post-anesthesia care, and discharge to another unit.

4. Patients who are in the PACU for other than routine post-anesthesia care generate workload that is not captured by the staffing system. Head nurses who have patients of this type should consider ways to capture the workload generated by these patients so that they can justify the need for extra staff in addition to the number of staff indicated in the staffing profile. Two categories of patients in the PACU for other than routine post-anesthesia care are as follows:

(a) Remain Overnight patients (RONs) are those patients who are identified to remain overnight for postoperative care in the PACU from the day of their surgery until the following morning. These patients may be counted once on the patient volume worksheet to account for the workload involving their phase I post-anesthesia care. However, the workload resulting from their extended post-operative care in the PACU is NOT captured by the staffing system.

(b) Same Day Surgery (SDS) patients are counted once on the patient volume worksheet to account for the workload resulting from their routine post-anesthesia nursing care. However, workload generated by SDS preadmission, preoperative, or extended postoperative care is NOT captured by the staffing system.

Patient Volume Worksheet Example

Record the number of patients recovered by PACU nursing staff for each day by the type of anesthesia the patient received.

Month/Year _____

Date	General & Regional/ Spinal Patients	Local/ Sedation Patients	Date	General & Regional/ Spinal Patients	Local/ Sedation Patients
1			17		
2			18		
3			19		
4			20		
5			21		
6			22		
7			23		
8			24		
9			25		
10			26		
11			27		
12			28		
13			29		
14			30		
15			31		
16					

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