Nursing Acuity Based Billing System Procedures: Implications For Revenue

by

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CHAPTER I

INTRODUCTION

In January 1989, the Oregon Health Sciences University (OHSU) Hospital implemented a new billing system based on acuity in eighteen in-patient departments. A fiscal analysis, comparing the new system to the old billing system, showed that the overall effect of the change on nursing revenue was neutral. However, there were differential effects at the department level: Seven of the departments (39%) lost and eleven (61%) gained money as a result of the change in billing.

The hospital administrators and the department directors wanted to know why some departments lost money and how to bring their revenue up to the neutral level or above. The intent of this research was to answer their questions. The first step was to identify factors that influence the accuracy of an acuity-based billing system for predicting departmental revenue. This was accomplished through an analysis of the billing system used at OHSU and a literature review focused on the following two topics: history and methods of charging for nursing service, case-mix and measures of acuity. The literature is summarized below. The conceptual framework

derived from these sources is presented after the review.

History and Methods of Charging for Nursing Service

In reviewing the literature, many articles but very few studies were reported on acuity based billing systems for nursing. In order to better understand the history and methods of charging for nursing service, types of billing identified in the literature were grouped into four categories depending on whether nursing was a cost or a revenue center and whether billing was variable or not (Table 1).

Table 1

A Typology of Billing for Nursing Service

Billing Method	Cost center	VS. Revenue center
Non-variable	Per diem rate include nursing (Patient day)	Separate Per diem rate for nursing (Nursing hours per patient day
Variable	Rates for DRG, RIMs, include nursing	Acuity-based rates for nursing

Cost centers "provide a service or function for which a charge is not generated; thus, revenue is not gained" (Higgerson & Van Slyck, 1982). Revenue centers are services for which a charge is generated and revenue is gained. Variable billing means "billing for specific aspects or levels of nursing care, which vary from patient to patient" (Higgerson & Van Slyck, 1982, p 20). Non-variable billing means charging flat rate which does not vary from patient to patient.

Variable cost and variable billing are two different concepts. Variable cost refers to calculation of the cost per unit of nursing resources consumed for the purpose of internal control only, not for setting rates and billing for nursing services. Variable billing involves rate setting and actually billing of patients both to enhance internal managerial control and to make nursing a revenue center.

Typically, nursing care charges are part of a room rate that includes "routine" nursing services, room and food. This billing method is named cost per diem. Nursing costs are usually defined as salary and fringe benefit expenses for clinical and administrative nursing personnel. "The allocation statistic involves average nursing care costs per patient day by the number of patient days for a selected time period" (Edwardson &

Giovannetti, 1987, p108). Per diem methods are based on the assumption that all patients on similar units are equal in terms of nursing care requirements. This is the oldest cost allocation method for nursing service and has been used in most hospitals in this country and other countries. This method is widely criticized for two reasons: (1)nursing service is not identified as a separate professional billing; (2) it inadequately represents the variablilty in nursing care requirements for different types of patients (Edwardson & Giovannetti, 1987; Ruchlin & Levenson, 1974; Sovie & Smith, 1986 Huckabay, 1988).

Separating charges for nursing service from room charges has been discussed in the literature since the early 1970s. The move toward increased control over the nursing budget has followed two paths: (1) from non-variable billing and nursing as a cost center to variable billing and nursing as a revenue center; and (2) from non-variable to variable billing with nursing remaining a cost center.

<u>From non-variable billing-cost center to variable billing-revenue center</u>

Since 1971, charging patients for the nursing care they require based on acuity has been advocated for the purpose of both internal control and actually generating

revenue. Variable billing is based on the following three assumptions: (1) nursing care is an identifiable entity that can be defined, measured, and assigned a cost; (2) nursing care varies with the patient's diagnosis, level of illness, age, and so forth; and (3) a direction relationship exists between nursing care provided and costs (Higgerson & Van Slycky, 1982, p 20).

Holbrook's study (1972) is the earliest report of separating nursing service billing from hospital room and board charges. Montana Deaconess Medical Center, a 370-bed hospital in Great Falls, implemented a patient classification billing procedure in 1971 with hourly charges specified for each classification (routine nursing care and intensive care). At this first attempt at variable billing, individual patient needs were not addressed. However, nursing service become a revenue center under this billing system.

In the 1980s, more articles appeared describing acuity based billing for nursing (Budd & Propotnik, 1989; Ethridge, 1985; Higgerson & Van Slyck, 1982; Mason & Daugherty, 1984; Sovie & Smith, 1986; Stepura & Miller, 1989). The two classical acuity billing systems are those instituted at St. Luke's Medical Hospital Center (Higgerson & Van Slyck, 1982) and St. Mary's Hospital and Health Center (Ethridge, 1985). The similarity of these

billing system are: (1) using patient classification systems (acuity-staffing) to bill patients for the actual nursing service they receive; and (2) assigning relative-value units (RVUs) to different acuity levels. RVUs were established by studying the composition of the procedure or acuity level (time, supplies, and personnel) and weighing the various factors according to a preestablished criterion (Higgerson & Van Slyck, 1982). The differences between these billing systems are that the hospitals use different patient classification systems and the assign different RVUs for different acuity levels, because they differ in case-mix, nursing personnel, equipment and physical environments.

The disadvantages of this kind of billing system are: (1) "charges at one hospital are not easily compared with those at another; (2) the mix of patients at varying classification levels has a significant effect on revenue, thus increasing the possibility of lower revenue; and (3) more accountability and in some case more work is required of nursing administrators" (Higgerson & Van Styck, 1982). However, the advantages of an acuity billing system are strong and obvious: (1) it is more equitable than past billing practices for patients, third-payers and hospitals; (2) it identifies revenue nursing cost centers; (3) it facilitates

systematic control of revenue and expenses, improving budget planning and management.

From non-variable to variable billing with a remaining nursing cost center

Since 1982, calculating nursing costs based on an acuity system within the prospective payment system based on Diagnosis Related Groups (DRGs) has been started for the purpose of better internal control of hospital nursing costs and to test the adequacy of the DRG classification for allocating nursing cost within the institution. Methods used for allocating hospital service costs involved two major approaches: costs per diagnosis (nursing and medical-DRG diagnosis) (Halloran, 1983; McKibben, Brimmer, Clinton, Galliher, & Hartley, 1985; McCloskey, 1989; Porter-O'Grady, 1985; Rosenbaum, Willert, Kelly, Gray, McDonald, 1988; Wood, 1982); and costs per relative intensity measures (RIMs) (Curtin, 1983; Caterinicchio, 1983; Caternicchio & Davies, 1983). The results of all studies indicate a wide range of nursing hours and nursing costs in each of the DRGs and conclude that DRGs are not homogenous for nursing resource utilization.

Relative Intensity Measures (RIMs) provide a method for determining the costs of nursing service per DRG. RIMs were developed and tested by the New Jersey State

Department of Health in collaboration with the New Jersey Hospital Association during 1977-1979. A total of 3,335 patients from eight hospitals were selected as a sample survey which permitted the collection of reported nursing personnel during the conduct of nursing and non-nursing activities on each shift for each client during the entire length of stay (Caterinicchio, 1983). However, "RIMs cost allocation model is not ready for use in a rate-setting model" (Caterinicchio, 1983) because the RIMs are DRG-specific and different equations are applied to different DRGs.

A study (Wood, 1982) used the concept of variable billing. The Massachusetts Eye and Ear Infirmary, a 174-bed specialty Hospital, began using a productivity-based accounting system in 1976. The hospital developed units of service called clinical care norms (CCNs), which represent the amount of nursing care delivered to patients based on medical diagnosis and day of stay. The system is used for rate setting and productivity evaluation.

No studies specifically identify the factors that influence accuracy of acuity based billing systems. Only one article (Higgerson & Van Slyck, 1982) identified a potential problem associated with such a system: "the mix of patients at varying classification levels has a

significant effect on revenue, thus increasing the possibility of lower revenue" (P 27). Therefore, case-mix should be considered in any study of factors influencing revenue from acuity based billing systems.

Case-Mix and Measures of Acuity

The concept of case-mix is defined as "the proportion of cases of each disease and health problem treated in the hospital" (Hornbrook, 1985). A case-mix method defines groups of cases that are similar in their efficient use of hospital resources (Hornbrook, 1985). Six case-mix methods are currently used in hospitals for measuring in-patient case-mix: DRG, disease staging, patient management categories, APACHE, patient severity index and acuity.

Patient acuity defines groups of patients that are similar in their requirement of nursing resources over a specified period of time (Giovannetti, 1979). The concept of acuity is a variable, shift-by-shift measure based on intensity of care needed by patient, which includes nursing activities relating to assessment, intervention, and evaluation of nursing care. According to Nepple's (1985) model, acuity can be determined by the following four factors: (1) the need for interventions to accomplish activities of daily living (ADLs); (2) the need for spiritual psycho-social

interventions; (3) the need for preventive care and health maintenance, patient education and treatment interventions; and (4) the need for restorative and rehabilitative interventions (p 14).

The primary purpose of acuity is to adjust nursing staffing according to the patient's individual care needs. Patient are typically classified on various dependency needs. Each nursing acuity class is assigned as intensity weight equivalent to hours of nursing care. The range of weights is subdivided into four or five ordinal classes. The sum (or average) of these ordinal scores, together with the number of patients, determines the unit staffing level required, based on a predetermined set of coefficients for the unit.

Connor (1961) and his group developed the first patient classification system to determine the direct care workload for nursing staff. After 29 years, patient acuity classification systems are still in the developing stage. "A majority of hospitals still have not captured or retained patient-specific nursing patient classification data permanently" (Sovie, 1988, p 133).

Two important issues need to be noted. First, "standardization of acuity system has not been pursued because nursing staffs have felt the need to account for regional, institutional, and clinical specialty

differences in patterns of practice" (Hornbook, 1985). Second, "acuity is not a measurement of actual services provided to patients, as it is a prospective index. However, it can be assumed that over large numbers of patients, the nursing care plans imbedded in acuity judgement are actually implemented, so that acuity is likely to be a good proxy measure of nursing intensity" (Hornbook, 1985).

Conceptual Framework

From the literature review and interviews with clinical experts, a conceptual framework depicting the factors that influence accuracy of billing for nursing service was developed (Figure 1). The accuracy of an acuity based billing system depends on the following two inputs: accuracy of daily acuity measures and adequacy of an rate set for each acuity level in relation to the cost of care. In order to obtain the accuracy of daily acuity, the following two conditions must be met: (1) The acuity tool used for determining nursing charges must be reliable and valid (Sovie & Smith, 1986). That is, the patient classification instrument must be based on patient needs and the care deliveries to meet those needs. (2) Implementation of acuity assessment has to be consistent and appropriate. Implementation includes who

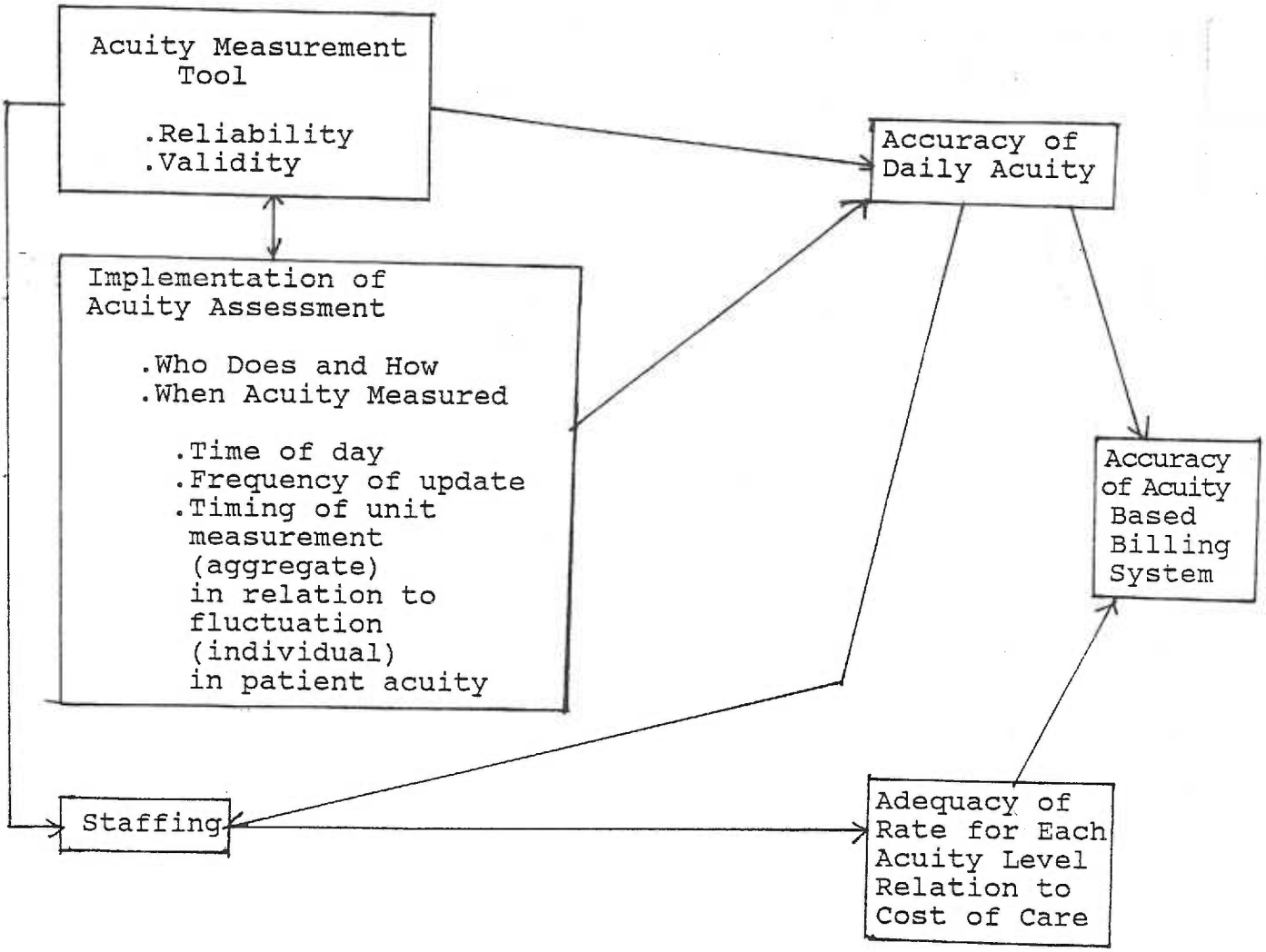

Figure 1. Factors Influencing Accuracy of Acuity Based Billing System for Nursing

does the assessment and how and when acuity is measured.

Appropriate timing for acuity assessment includes consideration of (1) time of day; (2) frequency of update; and (3) timing of unit measurement (aggregate) in relation to fluctuation of (individual) patient acuity. In nursing practice, patient acuity should be measured, ideally, on an individual basis during a 24-hour inpatient day. That is, to accurately reflect patient use of resources, the time of assessing acuity for each patient during a 24-hour day should vary based on the patient's condition and needs for nursing care. But, practically, it is impossible to have nurses assessing acuity on each patient at a different time during the day, because nurses do not have time to do so and it is not realistic for a hospital billing system to operate in this way. Therefore, for efficiency, all patients need to be assessed at the same time for a given unit, if not the hospital as a whole. The best time to measure acuity on a unit will be the time when the aggregate (unit average) acuity is at its highest level for a 24-hour period, which is the predictor of individual acuity that maximizes revenue for the unit. The highest point need not be chosen: the average acuity case-mix for a 24-hour period could be used to identify other appropriate timing for daily acuity assessment,

depending on whether the intent is to maximize or optimize revenue. The daily acuity for billing also influencing the adequency of staffing, because the staffing is based on the daily acuity level and updates for the following two shifts.

The effective management of nursing resources requires a linkage between the costs of service and the patients who receive them. "A nursing patient classification system that is valid and reliable and based on patient needs and the care delivered to meet those needs provides a sound basis for variable billing for nursing care" (Sovie & Smith, 1986). The initial purpose of using an acuity system is for staffing, and then for billing. When a valid and reliable acuity system has been used in a hospital and the hospital is ready to shift from acuity based staffing to acuity based billing, nursing administrators have to make two important decisions: (1) to design a system (including time) of assessing daily patient acuity for the purpose of billing and (2) set the appropriate rate for each level of acuity. Rate setting for acuity levels must reflect the resources used (Higgerson & Van Slyck, 1982) which link the staffing and billing.

A study (Grant, Bellinger & Sweda, 1982) of classifying patients on the day and evening shift for a

2-month period reported that no significant changes in acuity categories were found. However, "each institution must make its own decision on when and how frequently each patient will be classified" (Sovie & Smith, 1986), and this decision must be based on clinical knowledge of the patients' conditions.

Purpose of This Study

The purpose of this study is to determine the appropriate time for assessing acuity to increase the probability that billing will accurately reflect the appropriate acuity level for that group of patients. Specifically, the purpose is to find out if one entry of acuity assessment for billing is appropriate for the whole hospital. If the answer is positive, what is the appropriate time for assessing acuity during a 24-hour period to capture the acuity that best reflects the resources used by patients? If the answer is negative, what are the appropriate time for assessing acuity for different types of units? This study was designed to focus only on appropriate timing for acuity assessment during a 24-hour period because timing is easy to modify if it is a problem. If it is not a problem, the study will provide clues to other sources of inaccuracy for further study.

CHAPTER II

METHODS

Design Overview

This study is designed to be a non-experimental quantitative study. Research questions to be addressed are the following: (1) What is the pattern of acuity case-mix fluctuation over 24 hours for each type of department? (2) How does the timing used now correspond to the fluctuation in acuity over the 24 hour period? (3) Does the correspondence between the set time of acuity assessment and the pattern of fluctuation in acuity differ in the departments which lost money as compared to those which gained money after the shift to acuity based billing?

Data were collected on two samples: All units which have implemented the new billing system and a five units subsample of the 18 units. From 18 units, the following data were collected: (1) Each charge nurse was surveyed to obtain data on background factors influencing acuity case-mix on her unit, and (2) Hospital Analytic Services supplied data on length of stay. In addition on five units, data were collected on all patients for three days to obtain mean acuity measures at five points during a 24-hour period.

Setting and Sample

Setting

The study was done in Oregon Health Sciences University Hospital (OHSUH), a 333-bed, not-for-profit teaching hospital. OHSUH serves as a community hospital for patients from adjacent areas and as a regional medical center for patient with advanced and difficult medical problems. The hospital is organized in a traditional structure with hospital director, associate hospital directors and assistant hospital directors for each important area (Appendix A). The nursing service is a department under an associate hospital director of nursing service, who provides overall direction for the department. In addition, there is an assistant director of nursing for administrative services and education service. These administrative services provide support to the clinical regions. The nursing service department is composed of seven major clinical areas, each headed by an assistant director of nursing. The seven areas are divided into 21 productive units (Appendix B). Each nursing unit is structured as a separate cost center, and each clinical nursing unit director prepares the unit's nursing budget. The budgets are based on the projected acuity of the patients to be serviced during the fiscal year. At present, the department employs 700 registered

nurses. The modality of nursing practice is primary nursing.

The nursing patient classification system (NPCS) of OHSU hospital was developed in 1980 and has been used since then for the purpose of staffing. The acuity tool for routine care units is a factor evaluation model in which 8 factors (hygiene/activity, nourishment, vital signs, elimination, medicines, IVs, intervention and teaching/emotional support) and 32 indicators are used to classify each patient into 4 levels based on patient needs (Appendix C). The acuity tool for critical care units (Appendix D) includes 7 factors: hygiene/activity, diet, elimination, medication/IVs, VS/monitoring, treatments and teaching/emotional support. Compare to routine care tool, the critical care tool covering the same area of care as the routine care tool but only 20 indicators are used under the reduced number of factors and patients are grouped into 3 rather than 4 levels.

The NPCS measures the relative amount of nursing care required by a patient by assigning the patient, through the sum of selected indicator weights, to one of 3 (critical units) or 4 (routine units) categories of nursing acuity--1 representing the lowest need category, and 3 or 4, respectively, representing the highest. The NPCS was tested at the OHSU hospital and found to be

reliable and valid for the purpose of staffing.

On January 16, 1989, a computerized acuity based billing system was implemented for nursing in all units with the exception of the operation room, postanesthesia care unit, outpatient surgery, labor and delivery, and nursery. Prior to 11AM, charge nurses assess the acuity of patient, entry the data into the computer and document the data on patient charts. At 11PM, evening charge nurses need to update patient acuity for admissions and discharges and revises other patients' acuity as necessary on both computer and documents. Admissions or transfers can be entered up to 12:00 midnight.

Billing rates were set by abstracting, from the previous year's actual financial reports, all salary expenses for direct care providers, ward clerks, the float pools, internship programs and orientations, minor equipment and supplies, as well as nursing administration and nursing education. The expenses were distributed by different percentage among three areas, routine units, psychiatric units and intensive care units. Three different base rates (for room/bed) were set for the three areas and four variable charges were set, for nursing care, based on acuity level in each area. Thus, the patient is billed for two charges. The first charge, or basic room charge, is one of three room rates--for

either routine care, critical care or psychiatric care. The second charge, or nursing charge, includes the cost of nursing labor, supplies, and labor-related overhead derived from one of four patient acuity levels. An acuity level 1 patient requires a minimal amount of care in the 24-hour period, whereas an acuity level 3 (for critical units) and level 4 (for routine units) patient require maximum nursing care. As patient needs increase, patient charges increase accordingly. Therefore nursing care is a separate and identifiable charge on the hospital bill. The charge for nursing service corespondent to the patient's designated type. The nursing care charges are added to the basic room charges and summarized on the patient's bill. For example, a bill for a five day stay on a routine unit might appear as follows: 2 days @ ($130 + $ 235-level 2) and plus 3 days @ ($130 + $ 325-level 3)= $ 2,095.

Sample

The 18 units were grouped into two categories that reflected different types of nursing care requirements, critical care and routine care. The latter was further divided into surgical and non-surgical (medical) units. Two units were selected from each of the three groups: cardiovascular care unit (CCU) and critical recovery care unit (CRC) are selected from the group of critical care

units; 10A was selected from surgical units; and 12A & 8C were selected from medical units. The original intent was to select two units from each of the group, the unit that lost the most money and the one that gained the most. However, three exceptions were made in selecting the final sample. First, CCU was selected from the group of critical care units even though the NICU lost more money than CCU, because fiscal service had already found that the rate set for NICU was not appropriate. Second, 12A and 8C were selected from the group of general medical units because the other units in the group are specialty units: 1NW and 2NW are psychiatric units and 13A & 14A are pediatric units. Also, 5C was excluded from the sample because it is being closed. Finally, 10A was the only unit selected from general surgical units because there was no loser in this group. The grouping of all units and the location of the five sample units are shown in Table 2.

Variables and Measurement

The variable of main concern of this study is the pattern of acuity case-mix fluctuation in 24 hours for each selected unit. The pattern was determined by assessing average patient acuity in the selected units five times in a 24-hour period (8AM, 11AM, 2PM, 8PM and 11PM) for three selected days, two weekdays and one day

Table 2

Distribution of All Nursing Units and Sample Units by Revenue Status Under New Billing System

Revenue Status	Critical	Non-critical	
		Surgical	Medical
Gained	CRR**	9C	2NW
	4NE	10A**	12A**
		7A	13A
		8A	14A
			3NW
Lost	NICU	5C***	1NW
	CCU**		8C**
	PICU		
	SICU		

* Units classified by majority of patient type on unit

** Included in study sample

*** 5C was closed for remodeling

on the weekend. For each day, a unit acuity mean was computed for each time period. Then the means for three days were averaged to obtain a set of means for one 24-hour period on each of the units.

These data were collected by the researcher to provide better control over the time of measurement than have been possible if charge nurses were to collect the data. The five observation times for this study were selected for the following reasons: (1) time intervals are distributed throughout day and evening; (2) night hours (from 11PM to 7AM) are omitted because patient care is less likely to be changed than day hours; (3) time of nursing shift exchange is avoided, such as 7AM, 3PM, & 11:30PM); (4) current acuity assessment time (11AM & 11PM) is included to make comparisons possible; (5) time used by other hospitals for acuity assessment (2PM) is included (Higgerson & Van Slyck, 1982; Grant, Bellinger & Sweda, 1982).

Factors related to 24-hour patterns of acuity are the following: (1) disease type; (2) kind of treatment; (3) what time and who does acuity assessment; (4) time of the day patient being admitted, transferred and discharged; (5) origin of patients and their acuity level upon admission; (6) length of stay; and (7) acuity fluctuation patterns for patients during the

hospitalization. These data were collected by conducting a survey (Appendix E) of charge nurses on the 18 units. Length of stay data for each unit were obtained from available records kept by Hospital Analytic Services.

Data Collection Procedures

Three methods of collecting data were used in this study: observation of acuity, survey of charge nurses and abstraction of records.

Observation of acuity

The data on pattern of acuity fluctuation in a 24-hour period were collected by the researcher between April 14 and April 22. Data were collected five times a day on three days for each of the five selected units. The study consisted 60, 1-1.5 hour observations over 12 days on a total of 232 patients. The observation record is designed (Appendix F).

Prior to data collection April 9 to 12, 1990, the investigator learned how to assess patient acuity with two charge nurses (10A and CRR day charge nurses). Evidence of mastering this assessment skill was the percentage of agreement with the 10A and CRR charge nurses. After a satisfactory level of reliability (90-100%) was reached, a pilot study was done on 12A unit as a trial of the data collection procedure for a 24-hour period. The acuity tool was used to classify patient

acuity for five times during the 24-hour period, and data were recorded on the designed for that purpose (Appendix G).

Survey

A survey of all charge nurses for the day shift was conducted during the week preceding the acuity observations. The questionnaire was distributed to each of the 18 units' day charge nurses at a department directors' meeting and returned (100%) by mail within a week.

Records

The average length of stay per unit was collected for 6 months (July of 1989 to December of 1989) from records kept by Hospital Analytic Service. The reported patient acuity level at 11AM and 11PM for each patient on each unit over a period of 8 days was obtained from the Patient Admission Office.

CHAPTER III

RESULTS AND DISCUSSION

The presentation and discussion of results are organized to answer the four research questions.

What Is the Pattern of Fluctuation in a 24-hour Period For Each of the Selected Units?

The acuity case-mix data obtained from patients of each selected unit were weighted to calculate a daily average acuity for each specific unit. Then the values for the three days were averaged to obtain the mean acuity for each of the sampled times during a 24-hour period. The mean weighted acuity was computed in two ways for each sampled unit: (1) based on all patients at the specified time; and (2) based on only patients present for the entire 24-hour period, that is, with partial stay patients omitted.

Table 3 shows the average weighted unit acuity includes all the new admissions, transfers and patients discharged taken in the day. In the routine care group (surgical and medical units), the acuity levels for 10A and 12A fluctuate within a range (2.34-2.49) that is higher than the acuity level for 8C (1.50-1.52) on a scale of 1 to 4. The range of the surgical unit (.13) is wider than that of the either medical unit (.04). In the critical care group, CRR unit's acuity level fluctuates

Table 3

Average Weighted Unit Acuity

By Observation Time and Type of Unit

Type of Unit	Time					Range
	8AM	11AM	2PM	8PM	11PM	
Surg.(10A)	2.41	2.36	2.34	2.49	2.43	0.13
Med. (12A)	2.40	2.42	2.42	2.44	2.40	0.04
Med. (8C)	1.54	1.54	1.50	1.53	1.52	0.04
Cri. (CRR)	2.48	2.38	2.26	2.40	2.37	0.22
Cri (CCU)	1.69	1.73	1.96	1.86	1.93	0.27

* N for each time varies as patients were transferred to and from during the day.

within a higher range (2.26-2.48) than CCU's (1.69-1.96) on a scale of 1 to 3. The values range of CCU (1.69-1.96=.27) is wider than CRR's (2.48-2.26=.22). The two critical units have the largest variation in average weighted acuity per 24-hour period (.22-.27), and medical units have the most stable values (.04). The range for the surgical unit is midway between the range for critical and medical units.

The acuity case-mix values, excluding admissions, transfers and discharges, are listed in Table 4. In the routine care group (surgical and medical units), the acuity patterns with partial stay patients omitted are similar to those with all patients included (Table 3).

The two sets of the acuity values were graphed for each type of unit (routine and critical care units) to compare patterns based on alternative methods of computation. The graph of fluctuation in acuity case-mix pattern during a 24-hour period for critical care units (Figure 2) is separated from the graph for routine care units (Figure 3) because they are using different acuity tools in clinical settings.

Figure 2 shows that the two critical care units differ when all patients are included and when patial stay patients are omitted. The daily fluctuation of CCU's unit acuity is slightly greater than CRR's. The highest

Table 4

Average Weighted Unit Acuity

(Partial Stay Patients Omitted)

By Observation Time and Type of Unit

Type of Unit	Time					Range
	8AM	11AM	2PM	8PM	11PM	
Surg.(10A) N=16.3	2.56	2.44	2.38	2.38	2.38	0.18
Med. (12A) N=19.0	2.44	2.39	2.43	2.44	2.43	0.05
Med. (8C) N=17.3	1.52	1.52	1.50	1.50	1.50	0.02
Cri. (CRR) N=4.7	2.64	2.70	2.53	2.53	2.53	0.17
Cri. (CCU) N=5.7	1.83	1.89	1.95	2.05	2.00	0.22

* N is mean census for 3 days

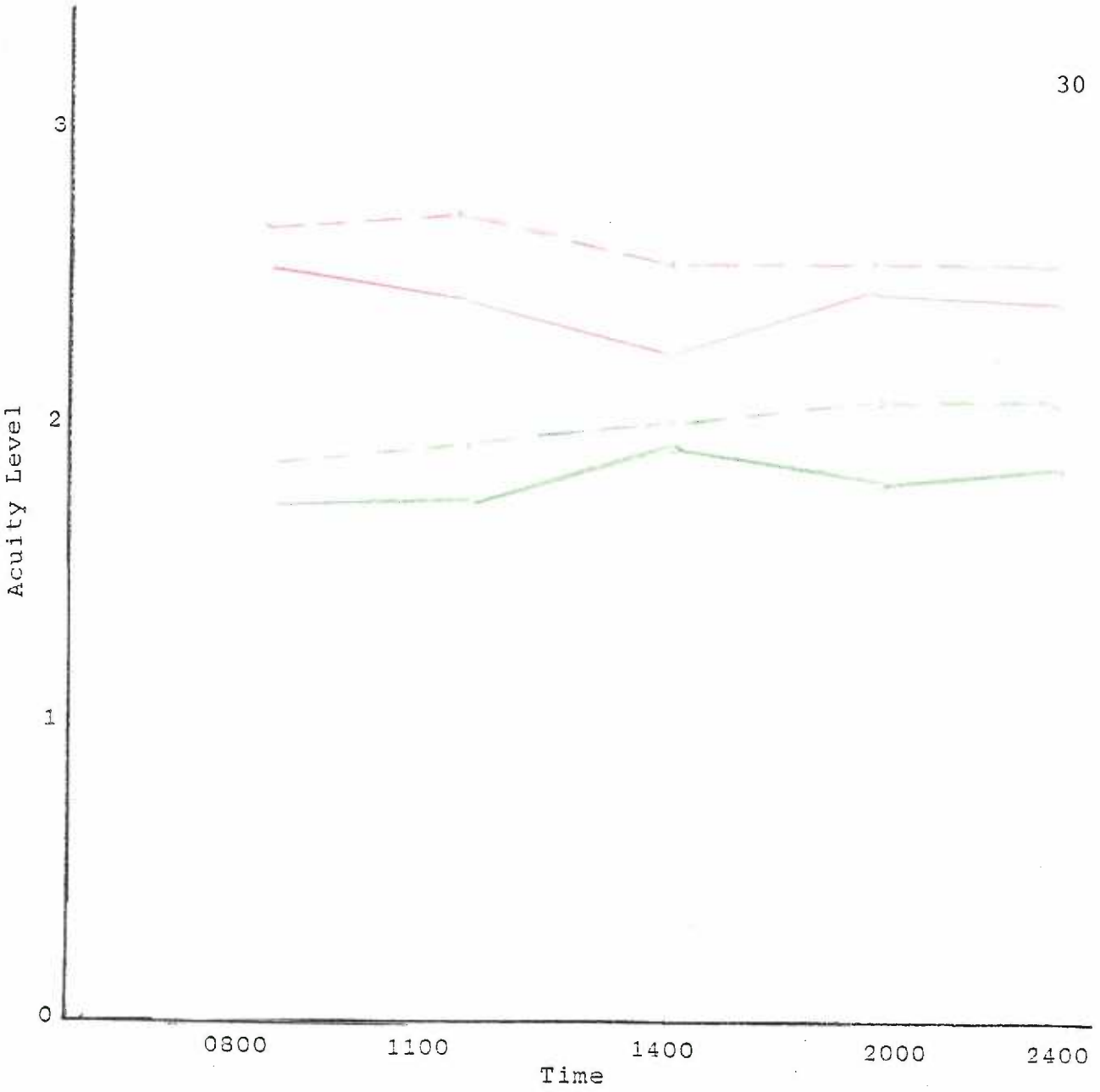

Figure 2. Acuity Case-Mix Flucturation Pattern during 24-hour Period for Critical Care Units.

CRR
CCU

——Acuity case-mix/all patients
----Acuity case-mix/partial stay patients omitted

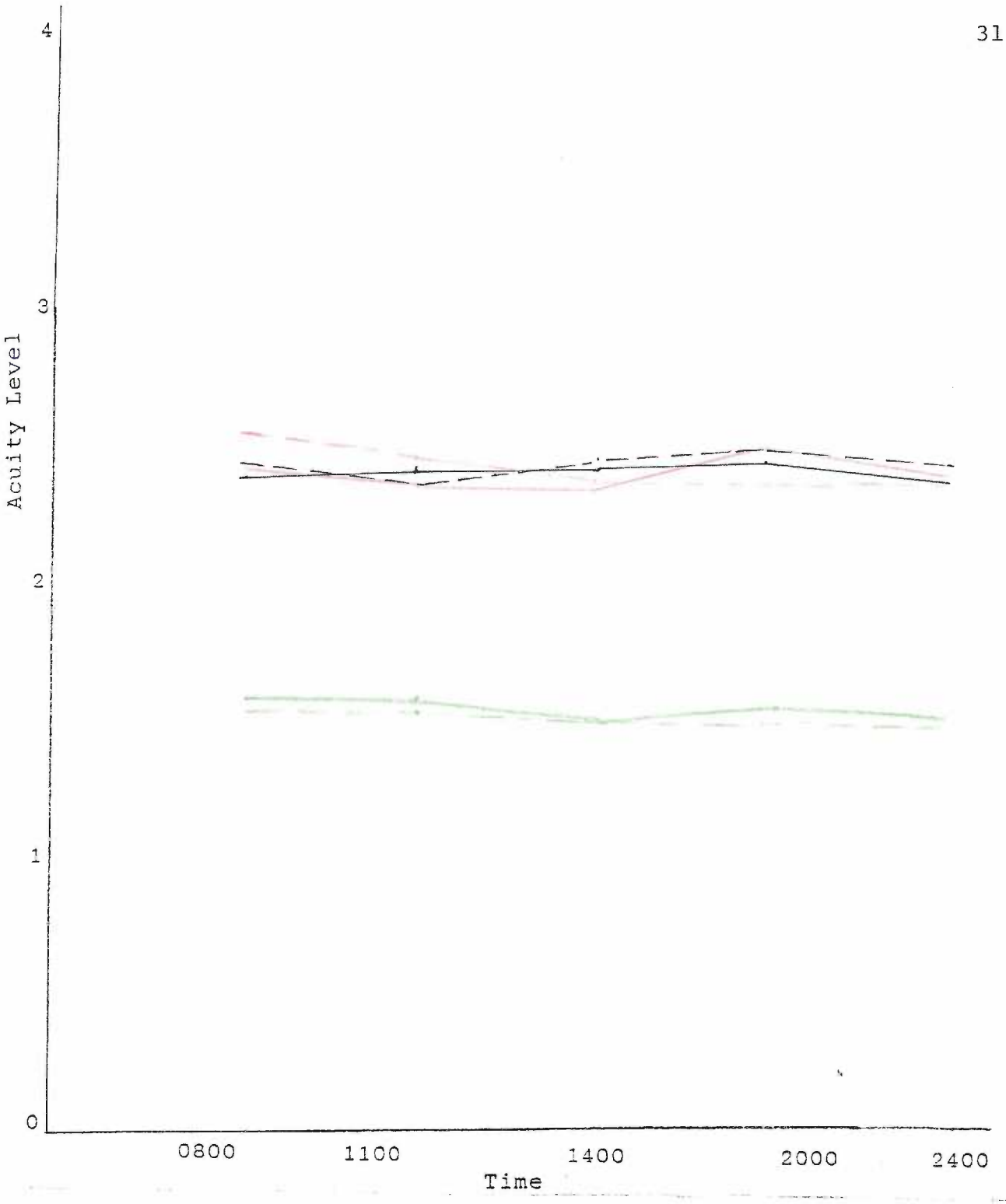

Figure 3. Acuity Case-Mix Flucturation Pattern during 24-hour Period for Surgical and Medical Units.

12A ——Acuity case-mix/all patients
10A ----Acuity case-mix/partial stay
8C patients omitted

point for CCU's acuity pattern with all patients included is at 2PM, which is the lowest point for CRR's. The highest point for CCU's acuity pattern with partial stay patients omitted is at 8PM, but CRR's lowest acuity is at 11AM. All routine units have less fluctuation in acuity over a 24-hour period than do the critical units.

Figure 3 shows that daily fluctuation of both unit acuity case-mix patterns with all patients and without partial stay patients for the surgical unit (10A) are somewhat greater than for the medical units (12A & 8C).

On both critical and routine units (Figure 2 and Figure 3) the unit acuity case-mix during a 24-hour period differ among specialties: The routine medical units (12A & 8C) fluctuate less than the surgical unit (10A), and all fluctuate less than the critical care units (CRR & CCU). Furthermore, the medical units' (8C and CCU) overall mean acuity is lower (between level 1 and 2) than the mean acuity of surgical units, which fluctuates between level 2 and 3.

In addition, the unit acuity patterns for 8C and 12A are similar in that both of the patterns are flat (both ranges are equal to .04) because both units belong to the medical group. The 8C pattern is also similar to both 10A (Surgical unit) and CRR (critical unit) in the way that the three patterns fluctuate throughout the 24-

hour period (higher-low-lower-high-low). The two critical units (CCU & CRR) both have a greater fluctuation range (.22 to .27) than do the routine units (.04 -.13).

Does the Timing Used Now Capture the Highest Acuity For the 24-hour Period?

The mean acuity obtained at currently designated times for assessing acuity (11AM & 11PM) was compared with the highest mean acuity for the 24-hour observation period. The result is displayed in Table 5.

Table 5 shows that critical care units have a larger range of difference (-.03 to -.23) than the surgical unit, and the surgical unit has a larger range (-.06 to -.13) than medical units (0.00 to -.02). This means the critical care units currently are less likely to capture the highest acuity for the 24-hour period than the surgical unit and medical units. In other words, the medical units should capture the highest acuity under current acuity billing system. The most important time is 11PM because billing is based on acuity reported at that time. The peak mean acuity for 8C and 12A (routine medical units) and CCU (critical medical unit) are closer to the acuity values reported at 11PM (.02 to .04) than either surgical unit (.06 to .11). Only one unit (CRR) is far off (.11) its peak acuity values.

The time which reflects the highest acuity during

Table 5

Comparison of Mean Acuity at Current Time of Assessment with Peak with Peak Mean Acuity in 24-Hour Period by Type of Unit

Type of unit	Peak (1)	11AM (2)	11PM (3)	Differences (1-2)	(1-3)
Routine S.	8PM				
(10A)	2.49	2.36	2.43	.13	.06
Routine M.	8PM				
(12A)	2.44	2.42	2.40	.02	.04
Routine M.	11AM				
(8C)	1.54	1.54	1.52	.00	.02
Critical S.	8AM				
(CRR)	2.48	2.38	2.37	.10	.11
Critical M.	2PM				
(CCU)	1.96	1.73	1.93	.23	.03

a 24-hour period for each unit is shown in Table 6. No units had their peak acuity at 11PM, and only one, 8C, had its highest at 11AM. This means that for the majority of units, the current acuity assessment time for the purpose of billing does not capture the highest acuity during a 24-hour period of time.

Does the Correspondence Between the Current Set of Acuity Assessment and the Pattern of Fluctuation in Acuity Differ in the Units That Lost Money as Compared to Those That Gained Money After the Shift to Acuity-Based Billing?

The fiscal analysis which was done in January of 1990 compared the new acuity based billing system and the old traditional billing system for the hospital. The analysis unit was "revenue per patient day" for each unit. The result of the fiscal analysis showed that the overall effect of the change to billing for nursing service was neutral. However, there were differential effects at the departmental level, i.e, seven of the units (39%) lost and eleven (61%) gained money as a result of the change in billing.

The five units selected for this study were divided into two groups: the group that lost money (8C & CCU) and the group that gained money (10A, 12A & CRR). These two groups were compared to determine if they differed in (1)

Table 6

Time of Highest Mean Acuity

In 24-Hour Period By Type of Unit

Type of Unit	Time				
	0800	1100	1400	2000	2300
Routine-S.(10A)				X	
Routine-M.(12A)				X	
Routine-M.(8C)	X	X			
Critical-S.(CRR)	X				
Critical-M.(CCU)			X		
TOTAL	2	1	1	2	0

the ranges of difference between the highest acuity and 11PM acuity; and (2) the unit's pattern of fluctuation in acuity over 24-hour period.

As shown in Table 5, the difference from the highest acuity and the 11pm acuity was negligible for the two units that lost money (.02 and .03), whereas the group that made money included the unit with the largest difference (-.11) under current acuity billing system. In other words, although timing for acuity assessment acuity is appropriate for 8C and CCU, they lost money, and though timing is not appropriate for CRR, it gained money. Therefore, time of assessing acuity does not explain the difference in gaining or losing money for these units.

When the winners and losers are compared on daily patterns of fluctuation in acuity, it is clear that fluctuation per se does not explain the difference for the majority of the units. The two losers (CCU and 8C) have different patterns for the 24-hour period. Although CCU's pattern is unique, 8C's pattern is similar to that of the units which gained money. However, both losers have lower mean acuity levels (between level 1 to 2) than the units that gained revenue (between level 2 to 3). It is more likely that the lower mean acuity for 8C and CCU is a contributing factor to their loss under the new

system.

What Is the Appropriate Time and Methods to Assess Acuity For Different Types of Units During a 24-hour Period?

This study provides information to help nursing administrators to help decide whether the time for acuity measurement is appropriate. Actually, the results of this study support the current acuity assessment time (11AM & 11PM) for all sampled units except CCU.

To determine how the sampled units compared to other units on factors that are believed to affect acuity case-mix, day charge nurses on all 18 units were surveyed. The 18 units were divided into three groups according to the type of service: surgical, medical and critical units. For mixed units, if more than 50% of patients belong to surgical service, then the unit was put in the surgical category; otherwise, the mixed units were put in the medical category. The charge nurses on the 18 units were surveyed to obtain data on several factors which might influence the pattern of daily acuity fluctuation. The factors include (1) who assesses patient acuity, and what time during the day is it measured; (2) general timing of new admissions, transfers and discharges; (3) the source of admissions; (4) average acuity level of patients upon arrivel and departure from the unit; (4)

patients' patterns of acuity during their hospitalization on the unit; and (5) patients' length of stay.

Method of Assessing Patient Acuity During the Day

The result shows that patient acuity assessment was done during 10AM to 11AM for all the three groups except one unit from surgical group sometimes assess patient acuity during 9AM to 10AM. "Who assesses patient acuity" is reported differently among the three groups and the result is summarized as Table 7.

Table 7 shows that in the majority of surgical and medical units (52-60%), staff nurses assessed their assigned patients. Charge nurses assessed acuity for agency nurses who did not know the acuity system. Critical care units either had charge nurses rate all patients or used a combination of staff nurse input and charge nurse assessment.

It make sense for critical care units to use either the charge nurse or a combination of staff nurse input and charge nurse assessment because the patient capacity of critical units (8-22 beds)is smaller than that of routine units (20-32), and therefore, it is possible for the charge nurses to do patient acuity for all the patients. However, in routine care units (surgical and medical), staff nurse input is more important because their size makes it difficult for charge nurse to assess

Table 7

Methods of Assessing Patient Acuity

By Type of Unit: (18 Units Reporting)

Who Assesses Acuity	Type of Unit		
	Critical	Surgical	Medical
	N= 6	N= 5	N= 7
a. Charge nurse only	3	1	2
b. Staff nurse only	0	3	3
c. Combination (both)	3	1	2

all patients or to be familiar with all of them. Staff nurses have the most accurate information about the patient condition and care needs. To evaluate the effects of different methods, the twelve routine units were divided into two groups based on revenue loss. The six critical care units were excluded because the on no unit did only staff nurses assess patient acuity.

The relationship between methods of assessing acuity in routine units and revenue status is shown in Table 8. As shown, 100% of units that use staff nurses to assess patient acuity, and 67% of units which use both charge and staff nurses to assess acuity gained revenue, yet 67% of units which use only charges nurse to assess acuity lost revenue. Thess findings suggest that the best use of staff nurses to assess acuity for billing in routine units is important to the accuracy of the billing. To be successful, of course, requires that staff nurses know how to use the acuity tool before they are made responsible for assessing.

Timing of New Admissions, Transfers and Discharges

The findings of the survey on 24 hour changes in patient mix through admission, transfers and discharge are summarized in Table 9. In the critical care group, the majority (66-83%) of the units' new admissions, transfers and discharges occur throughout the day with

Table 8

Methods for Assessing Acuity on

Routine Units By Revenue Status

Methods of Acuity Assessment	Routine Units			
	Revenue Gained N=9		Revenue Lost N=3	
	#	%	#	%
Staff nurses	6	100	0	0
Charge nurse	1	33	2	67
Both above	2	67	1	33

Table 9

Numbers of Units Reporting Admissions, Transfers and Discharges By Time of Occurrence and Type of Unit

Timing	Types of Units		
	Critical N=6	Surgical N=5	Medical N=7
Admissions			
AM	0	1	0
PM	2	0	0
Throughout day	4	4	7
Transfer In			
AM	0	1	0
PM	1	2	0
Throughout day	5	2	7
Transfer Out			
AM	0	1	0
PM	3	0	2
Throughout day	3	4	5

Table 9 (Continue)

Discharges			
AM	0*	1	0
PM	0*	0	5
Throughout Day	4	4	2

* Discharges on two of the critical units are rare.

the exception of units that hardly have any discharge. Patients from these units are transferred to routine units during either afternoon and evening (50%) or throughout the day. In the surgical group, the majority (80%) of the units' new admissions, transfers out and discharges occur throughout the day. Yet 3 of the 5 surgical units receive transfers either in the afternoon and evening or in the morning. In the medical group, the majority of the units' (71-100%) new admissions, and transfers in and out occur throughout the day, and 5 of the 7 (71%) of units' patients are discharged in the early afternoon and evening.

Timing of new admissions, transfers and discharges is an important factor which directly affects fluctuation in the unit acuity case-mix pattern of the unit. This is illustrated by the differences on the five selected units in acuity case-mix pattern that include only the patients who stayed in a 24-hour period as compared to those including all patients. The timing of new admissions, transfers and discharges affects only the former but not the latter. The timing of new admissions, transfers and discharges usually determine the peak or lowest point of the unit acuity case-mix pattern for all patients. For example, CCU reported that patients to the unit usually are admitted or transferred into CCU between 11AM and

5PM, and transferred to routine units between 2PM and 7PM in the afternoon. This explains the peak at 2PM and drop at 8PM.

Origin of Patients and Average Acuity

The origin of patients coming to the units, and the average acuity for 18 units are summarized in Table 10. The majority of Critical units' patients are transferred and admitted from ER, OR and other hospitals, and their acuity levels at admission are higher than those of patients admitted to routine units. When patients are transferred to the routine units, their acuity levels are lower than when they come in. The majority of surgical units' patients are admitted or transferred from home or ER, and the acuity levels of patients who are admitted directly from their homes prior to surgery are usually low. When the patients are discharged, their acuity levels are also low because they are recovering from surgery. The majority of patients on medical units are admitted or transferred from ER, home and clinics, and their acuity levels are relatively high because they have either acute or chronic diseases that need medical treatment. When they are discharged, their acuity levels are usually lower than when they come in.

The average acuity level of patients upon admission and discharge from units influences the fluctuation in

Table 10

Origin of Patients and Average Acuity

Upon Admission and Discharge by Type of Unit

Critical Group (6 Units)			X Acuity Level(1-3)	
Origin	X %	Range	In	Out
ER	23	.5-60	2.90	1.80
OR	29	0- 97	2.25	1.70
Home	3	0- 10	3.00	1.00
Nursing Home	0	0	0	0
ICU	.03	0- 1	3.00	2.50
CCU	.02	0- 1	3.00	2.00
Others	45	40- 98	2.30	1.40
Total	100	Weighted X:	2.46	1.58

Difference: 2.46-1.58=.88

Table 10 (Continued)

Surgical Group (5 Units)			X Acuity Level(1-4)	
Origin	X %	Range	In	Out
ER	19	5-50	2.80	1.80
OR	5	0-10	3.00	1.75
Home	58	30-80	1.63	1.50
Nursing Home	1	1-3	2.50	2.00
ICU	8	1-15	3.10	1.75
CCU	3	0-10	3.00	2.00
Others	7	0-36	3.00	2.00
Total	100	Weighted X:	2.20	1.66
		Difference:	2.20-1.66=.54	

Table 10 (Continued)

Medical Group (7 units)			X Acuity Level (1-4)	
Origine	X %	Range	In	Out
ER	25	1-95	2.20	1.70
OR	1	0- 3	2.00	1.75
Home	23	0-57	2.00	1.67
Nursing Home	4	0-12	3.00	2.67
ICU	9	0-25	2.83	2.25
CCU	7	0-30	2.50	2.25
Others	31	4-43	2.08	1.64
Total	100	Weighted X:	2.22	1.81
		Difference:	2.22-1.81=.41	

acuity case-mix. The surgical units' acuity patterns are less varied than critical units', and more varied than medical units' pattern. One explanation for this phenomenon might be that the three groups differ in the charge between usual acuity levels on admission and discharge: The difference is largest for the critical care group (.88); smaller for the surgical group (.54); and smallest for the medical units (.41). Therefore, the origin of patients admitted to units and the change in their acuity level from admission to discharge influence the pattern of unit acuity case-mix over a 24-hour period.

Fluctuation of Patient Acuity Over Hospitalization And Length of Stay

Two factors, length of stay and fluctuation of patient acuity over the course of hospitalization, influence the daily acuity pattern on the units. The data of these two factors are listed in Table 11. The reported pattern of acuity fluctuation for patients on critical and medical units is high on admission, low on discharge, and for the surgical units is low on admission, high, then low on discharge. The mean length of stay for the surgical group is shorter than for the medical group but longer than the mean for the critical group.

These two factors are helpful when predicting the

Table 11

Number of Units Reporting Various Patterns of Fluctuation in Patient Acuity Over Length of Stay By Type of Unit

Patient Acuity Patterns During Length of Stay	Critical N = 6	Surgical N = 5	Medical N = 7
a. High-Low	4	-	5
b. High-Low-High-Low	1	-	1
c. Low-High-Low	-	5	-
d. Mixed*	1	-	1
Mean Length of Stay (days)	3.14	5.04	5.70

* Patients had different patterns: No single pattern predominated.

unit acuity case-mix pattern, especially the acuity pattern of patients who stay in the unit for a given 24-hour period. For example, in the surgical group, the acuity fluctuation pattern is low on admission, high after surgery and low on discharge, and the average weighted patient acuity on admission from home is 2.20, somewhat higher after surgery and down to an even lower level (1.66) upon discharge. Also, the mean length of stay is about 5.4 days. if either the length of stay or patient acuity pattern are different, the unit acuity pattern may be different. For example, the acuity fluctuation pattern on one medical unit (8C) is mixed,--that is some patients follow a high-low-high-low pattern, others have different patterns. The length of stay is 5.70 days. By knowing the number of patients in the unit and day of their hospitalization, the unit acuity pattern can be predicted. The pattern is different for critical units. One factor that accounts for medical units' having less daily fluctuation than that either critical units or surgical units is that patients stay longer in a low acuity level.

In summary, the six factors, (1) when acuity is assesses; (2) who assess patient acuity; (3) timing of new admissions, transfers and discharges; (4) origin of patients and average acuity; (5) fluctuation of patient

acuity over hospitalization; and (6) length of stay, can influence the pattern of acuity case-mix fluctuation on hospital units. The following discussion will focus on the appropriate time for the three types of units to assess patient acuity.

Discussion

Medical Group

Two sample units were selected from this group (8C & 12A). Both have unit acuity patterns that show little fluctuation over a 24-hour period (range =.04). They differ in that the 8C unit acuity case-mix pattern fluctuates within a lower acuity level (1.50 to 1.54) than 12A's pattern (2.40 to 2.44). The first and second highest mean acuity during a 24-hour period is at 11AM for both medical units; and the 11PM mean acuity is only slightly lower for both units. Therefore, the current timing for acuity assessment (at 11AM & 11PM) is appropriate for these two units. However, at 8PM, the acuity levels are somewhat higher than the levels at 11PM. Therefore, updating evening acuity might be done at 8P, though the differences are so minimal, that time is not likely to matter. Timing is probably not the reason that the two medical units lost money in the fiscal analysis, because they had very little fluctuation in acuity case-mix during a 24-hour period.

Two reasons that might explain the loss for 8C are: (1) the mean acuity level is low; and (2) the acuity tool may not accurately reflect the nursing care that patients on this unit need. Two types of units in the medical group include medical and mixed surgical and medical units. 8C has predominantly medical patients and 12A has a mix. 8C is a Cardiovascular unit and 90% of their patients come from CCU, ER, home and clinic with an average weighted acuity level on admission of 1.75 (1-4 scale) and an exit level of 1.50. These are lower than the acuity levels of the other units in the medical group (enter, 2.22 and exit, 1.81). The 8C mean daily unit acuity level (1.50 to 1.54) is lower than the daily level on 12A (2.40 to 2.44), because 12A is a mixed medical and surgical unit and 60% of their patient come from ER, OR and ICU with mean admission acuity of 2.50 and mean discharge acuity of 1.83. It is likely that 8C's low acuity level itself may contribute to the loss of revenue. On the other hand, the acuity tool may not accurately reflect the nursing care needs of 8C patients. For example, during this study, a phenomenon observed by the researcher and also reported by the staff nurses was that some patients with heart problems are not stable during a 24-hour period: They may have a heart attack or diagnostic procedure that requires closer observation.

The patient acuity at this moment may be very high but remains so for only 1-2 hours. Thus the patient acuity recorded for the 24 hour may not capture the level of care required by this instability. Nevertheless, staffing must allow for such contingencies. One suggestion may be to modify the acuity tool to give credit for these changes or potential changes in 8C and similar units.

The two psychiatric crisis units are grouped with the medical units in this study because the patients in these units do not require surgical service. However, they do differ in many respects. The psychiatric crisis unit (1NW) had 95% of its patients admitted through the ER with the mean entrance acuity of 2-3 and exit acuity of 3. The patients' acuity patterns are more like these of patients in critical units rather than medical units. The explanation for 8C's losing money does not explain the loss on 1NW. It is interesting to find that the other another psychiatric unit (2NW) gained money in the fiscal analysis. Further, comparison of the two psychiatry units is needed to explain why one lost money and one gained revenue.

Surgical Group

One sample unit (10A) was selected from this group because there were no losers among surgical units. The unit acuity case-mix pattern fluctuates between 2.34 to

2.49 with a range of 0.13. The highest mean acuity occurred at 8PM and the second highest level was at 11PM because more transfers and admissions occur in the afternoon. The unit acuity pattern when partial stay patients are omitted (highest-high-low-low-low) is different from the unit acuity pattern when all patients included (high-low-lower-highest-higher). The current timing for acuity assessment 11AM captures the second highest point of the unit acuity pattern for all patients and the acuity pattern of patients-partial stay patients omitted. Therefore, it is believed that the current timing is appropriate for 10A and surgical units, it is especially important to update the acuity data in the evening at 8PM.

Critical Group

Two sample units (CRR & CCU) were selected from the critical care group, CRR because it gained revenue CCU because it lost money under the new billing system. CRR is a Cardiac Surgery Recovery Room with a bed capacity of eight. The majority of the patients (97%) are transferred from the OR with acuity levels of 3.00 on the average, and transferred to routine units with acuity levels between 1 and 2. The average length of stay is 0.20 days. The peak mean unit acuity is at 8AM and the lowest point is at 2PM with a range for the 24-hour

period of 0.22. The current timing for acuity assessment, 11AM and 11PM, misses the highest points. However, the unit acuity pattern of patients when partial stay patients are omitted is different from the unit acuity pattern when all patients are present. The 24-hour patients have the highest mean acuity at 11AM (high-highest-low-low-low from 8AM to 11PM. In other words, although at 11AM the current assessment time does not capture the highest point for the unit acuity pattern, it captures the highest point of acuity level of patients who stay in the unit for that 24-hour. If the unit nurses carefully update the acuity of new admissions, transfers and discharges, as is expected under current procedure the unit should continue to generate sufficient revenue under the new billing system. Therefore, the current timing for acuity assessment is appropriate for CRR.

CCU is a Coronary Care Unit with a bed capacity of ten. CCU differs from CRR in that CCU does not have any surgery patients. The majority (90%) of the patients are admitted and transferred from either ER (50%) or Clinic (40%) with average acuity levels between 2 and 3, and transferred to 8C or home with acuity levels of 1 to 2. The average length of stay is 0.48 days. The unit acuity case-mix pattern fluctuation is just opposite to the pattern of CRR. The peak mean acuity is at 2PM (1.96) and

the lowest is at 8AM (1.69) with a range of 0.27. The current timing of acuity assessment captures the 4th highest acuity level at 11AM and the second highest at 11PM. The unit acuity pattern when partial stay patients are omitted is different from the unit acuity pattern when all patient included. The patient acuity pattern shows lower-low-high-highest-higher from 8AM to 11PM during a day. It is likely to under assess the patient acuity level because the acuity assessment at 11AM only captures the 4th highest point in both unit acuity patterns of all patient and partial stay patients omitted. In other words, the peak of the acuity pattern of patients who stay in the unit for a given 24-hour period is in the evening, if the charge nurse does not carefully to update the current patients' acuity changes at 11PM or the acuity tool does not accurately reflect the patients' care need for CCU, the patient will be billed at a lower level and the unit is likely to loss money.

In the CCU, patients have temporary unpredictable changes that are not covered by the acuity reported at 11AM or 11PM, because they only lasts 1-2 hours and usually can not be captured by acuity assessment time. Such situations happen throughout the day frequently around 8PM. The researcher encountered this situation

twice at 8PM during the three days of observation in CCU, which resulted in higher acuity level at that time. However, the higher acuity level was not recorded at 11PM, the reading that is used for billing.

Most units (67%) in critical group lost money according to the fiscal analysis. The timing of acuity assessment may or may not be a contributing factor to the loss. It is hard to generalize from the two units (CRR and CCU). Further study is needed to explore additional factors, such as the rate set per acuity level, the validity of the tool, the implementation of acuity procedures, and of which may contribute to the lost of revenue in critical units.

CHAPTER IV

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

Charging for nursing service is a trend for this decade in the U.S. hospitals. Many factors influencing the accuracy of acuity based billing systems. This non-experimental quantitative study was designed to identify the appropriate time for assessing acuity during a 24-hour period to accurately reflect the nursing resources used by patients as a basis for billing.

The conceptual framework for the study was formulated from interviews with clinical experts. The accuracy of a acuity based billing system is influenced by the following three factors: the reliability and validity of the patient classification (acuity) tool, the formula for rate setting and the design and implementation of procedures for monitoring acuity. When and how frequently to assess patient acuity for the purpose of billing is considered to be an important issue in the procedure implementation component. The average weighted acuity case-mix pattern during a 24-hour period at the unit level can used to identify the best time to measure individual acuity to maximize or optimize revenue for the unit.

The research setting was OHSU University Hospital.

Three data collection methods were used in this study. Day charge nurses on all 18 units were surveyed to obtain data on type of patients, time of patient admission, transfer and discharge, origin of incoming patients and acuity level at time of admission, and usual or expected of pattern over the course of hospitalization. Data were collected from hospital records on average length of stay and individual and mean patient acuity at 11AM and 11PM for each of the 18 units. In addition, on five selected units (CCU, CRR, 12A, 10A & 8C), patient acuity data were collected by the researcher five times per day for three days.

A pilot study was done to familiarize the rater with the instrument and to establish interrater reliability with charge nurses. The study consisted of 60, 1 to 1.5 hour observations over 12 days. The 18 units were divided into three groups: critical, surgical routine and medical routine units. Five sample units were purposely selected from the three groups.

The patterns of average acuity in a 24-hour period were diagrammed for each of the five selected units. First with all patients included and then with partial stay patients omitted. Levels of acuity at check-points throughout the day were compared with the 11AM and 11PM readings to determine if the time currently used for

determining the appropriate billing rate reflects daily case-mix. The results indicate that the current timing for acuity assessment is appropriate for medical and surgical routine care units and some critical care units (CRR & 4NE). However, it may or may not be appropriate for the other critical care units (SICU, PICU, NICU) because although the daily fluctuation in unit acuity was not studied for these units, reasons other than timing, such as rate setting, probably account for the loss of revenue. The current timing for acuity assessment is not appropriate for CCU, and the patient acuity tool is suspected to be unsuitable for cardiovascular units (8C & CCU). In addition, data suggest that the use of staff nurses to assess patient acuity improves the accuracy of the information and optimize nursing revenue.

Strengths and limitations

The major strength of this study was to analyze unit patterns of daily acuity case-mix fluctuation to determine the best time to assess acuity for billing purposes. The results of this study indicate that this method is appropriate to study timing for acuity based billing.

Use of multiple methods of data collection was another strength. Three data collection methods were used to enture accuracy. Sample selection took advantage of

the researcher's knowledge: the five units were selected purposly rather than randomly since the researcher knew which comperisons would be most relevant. In addition, the acuity data were collected by the researcher, which allowed better control over the time of measurement than if charge nurses were to collect the data. An added benefit was the opportunity to make other observations about the acuity assessment, use in tool and its practice, such as nurses' attitude toward the acuity assessment, the actual method each unit used to assess acuity, and the validity of the tool for certain types of patients.

Three limitations should be noted. First, generalization is limited because findings are based on five units in one hospital. Other units with different mixes of patients may have different acuity case-mix patterns. Therefore, the findings of the five units can only be generalized to the units which have the same type of patients, but not to psychiatric and pediatric units. Second, observation time was short for each selected unit and the three sampled days may not have been typical. Different workload and treatment schedules may have not been picked up by the selected three days. Third, lack of current, accurate case-mix data for each unit made it difficult to group units by patient case-mix for sampling

purposes and also limits the generalizability of the results from sample units to the groups from which the sample was drawn.

Conclusions

Three conclusions can be drawn from this research. First, timing of acuity assessment is a factor which influences the accuracy of acuity based billing system. Second, the appropriate timing of patient acuity assessment for billing purposes should meet the following three criteria: a) it should capture the highest or second highest mean acuity level during a 24-hour period; b) should be convenient and possible for both staff and charge nurses to complete acuity assessment; and c) should be updated at a time which will pick up the new admissions and transfers for the 24-hour period. Third, the current time for assessing acuity for billing purpose--once daily at 11AM with an update for new admissions, transfers, discharges and major acuity charges at 11PM--is appropriate for both medical and surgical routine units. However, for some critical units, the current timing may not be appropriate because it can not accurately reflect the nursing needs of patients. These results are difficult to generalize to the rest of the units that lost money in critical group because the patients on these units (SICU, PICU & NICU) have

different types of illness with different patterns of acuity over the course of their hospital stay than patients on either CRR or CCU. However, no data are available on how these patterns translate into case-mix variations by unit. Therefore, the current timing for acuity assessment system may or may not be appropriate for these units. Further study is needed to determine the daily patterns of fluctuation in case-mix acuity.

Recommendations

Recommendations for practice

In OHSU hospital, the following are suggested to modify the current acuity billing system for nursing based on the findings of this study.

1. Encourage the use of staff nurses to assess patient acuity to improve the accuracy of the information.
2. Continue to use the current timing for acuity assessment in all routine units and CRR & 4NE, and update the major changes on patient acuity at 11PM, especially the increases in patient acuity.
3. A method, adapted from St. Luke's Hospital, is suggested for use in critical units (except CRR & 4NE) in order to accurately reflect the nursing care required by patient. During each shift the nurse caring for the patient circles the numbers in each category of care (diet, ADL, treatment and so forth) to describe the

patient care needs and nursing activity they have done. At the end of each shift, the RN responsible for the patient adds up the circled points. Although more than one term may be circled in each category of care, only the one with the highest point value is added into the total. At the end of the 24-hour period, the patient acuity level is determined by referral to the total range of the three shift and entering the patient acuity level into the computer for billing. In this way, the highest or second highest acuity level can be captured for billing. Although this way may cost more nurses' time than using the current timing system, it is possible for nurses in critical unit to do it because of the 1:1 or 1:2 nurse/patient ratio. The method could be used temporarily with the existing tool until further study of alternatives is completed.

Recommendations for further study

Studies of unit acuity case-mix patterns in other hospitals are needed. The future studies should be designed to include a larger sample or all the units in the hospital and a longer period of acuity observation time (a week) for each unit. In addition, the patient case-mix data for each unit should be obtained. Furthermore, a study of rate setting should be conducted.

Additional studies conducted at the OHSU Hospital

would be useful: a) A study designed to assess the unit acuity case-mix pattern fluctuation during a 24-hour period for SICU, PICU, NICU & 1NW in the OHSU University Hospital and take a week for acuity observation in each unit; b) A study designed to explore some other reasons, i.e, rate setting and validity of acuity tool for the decreased revenue for CCU, PICU, NICU & SICU; c)An ongoing study of the reliability of the acuity tool; and d) study of the validity of the acuity tool for medical units, since the tool seems to be more appropriate for surgical interventions than medical treatment.

Further research should focus on identifying case-mix of acuity patterns for types of patients rather than per DRG diagnosis group. In current literature, the movement from per diem billing to separate billing for nursing has taken two paths: (1) from non-variable billing and cost center (per diem patient day) to variable billing and revenue center (acuity); (2) from non-variable billing (per diem patient day) to variable billing (DRG, RIMs, and nursing diagnosis) within the cost center. Either have limitations: (1) Acuity billing does not include the reimbursement patients; (2) Nursing cost under each DRG group based on patient acuity only coverers reimbursement patients and nursing service does not become a revenue center. These the two driven forces

on nursing billing does not combine into one direction. A specific method is to study acuity case-mix on types of daily patterns and over length of stay in order to establish a perspective nursing billing system.

Recommendations for theory

A beginning conceptual framework for studying the accuracy of acuity based billing system was formulated for this study. This conceptual framework can serve as a guide for nursing administrators to use in identifying and modifying sources of error in their hospital acuity based billing system.

This study makes the following contributions a conception of billing for nursing service: (1) it identifies the implications of the acuity assessment (who , how and when) for the accuracy of the acuity based billing system; (2) identifies concept of daily acuity which is one of the inputs to accuracy of acuity based billing system and is influenced by the two factors: a) reliability and validity of acuity tool, and b) implementation of acuity assessment. (3) clarifies the relationship between acuity billing and acuity staffing by indicating staffing is influenced by daily acuity and affects the adequacy of rate for each acuity level in relation to cost of care.

Patient acuity classification was initially

developed for the purpose of nursing staffing, and was later used for the purpose of billing. When a hospital is shifting to acuity based billing system, three sets of criteria should be met: (1) the acuity tool has to be reliable and valid for determing the patient's nursing requires and the appropriateness of staffing; (2) implementation of acuity assessment (who, how and when) and timing of daily acuity assessment is very important and various times during a 24-hour period can be used for different types of units based on the units' pattern of daily acuity case-mix fluctuation; and (3) rate setting for each acuity level has to be appropriate for staffing.

The conceptual framework may need to be modified by identifying other factors which influence the accuracy of daily acuity and adequacy of rate setting. This conceptual framework allows nursing administrators to adjust staffing and billing. Little literature is available that deals with staffing-mix and its relation to nursing billing. The relationship of staffing-mix of billing needs to be studied and added into this model. The conceptual framework also would need modification if nursing were to move to a prospective payment system rather than a billing system based on daily acuity or care received. It is only a beginning model and needs to be tested and developed through further studies at OHSU

hospital and elsewhere.

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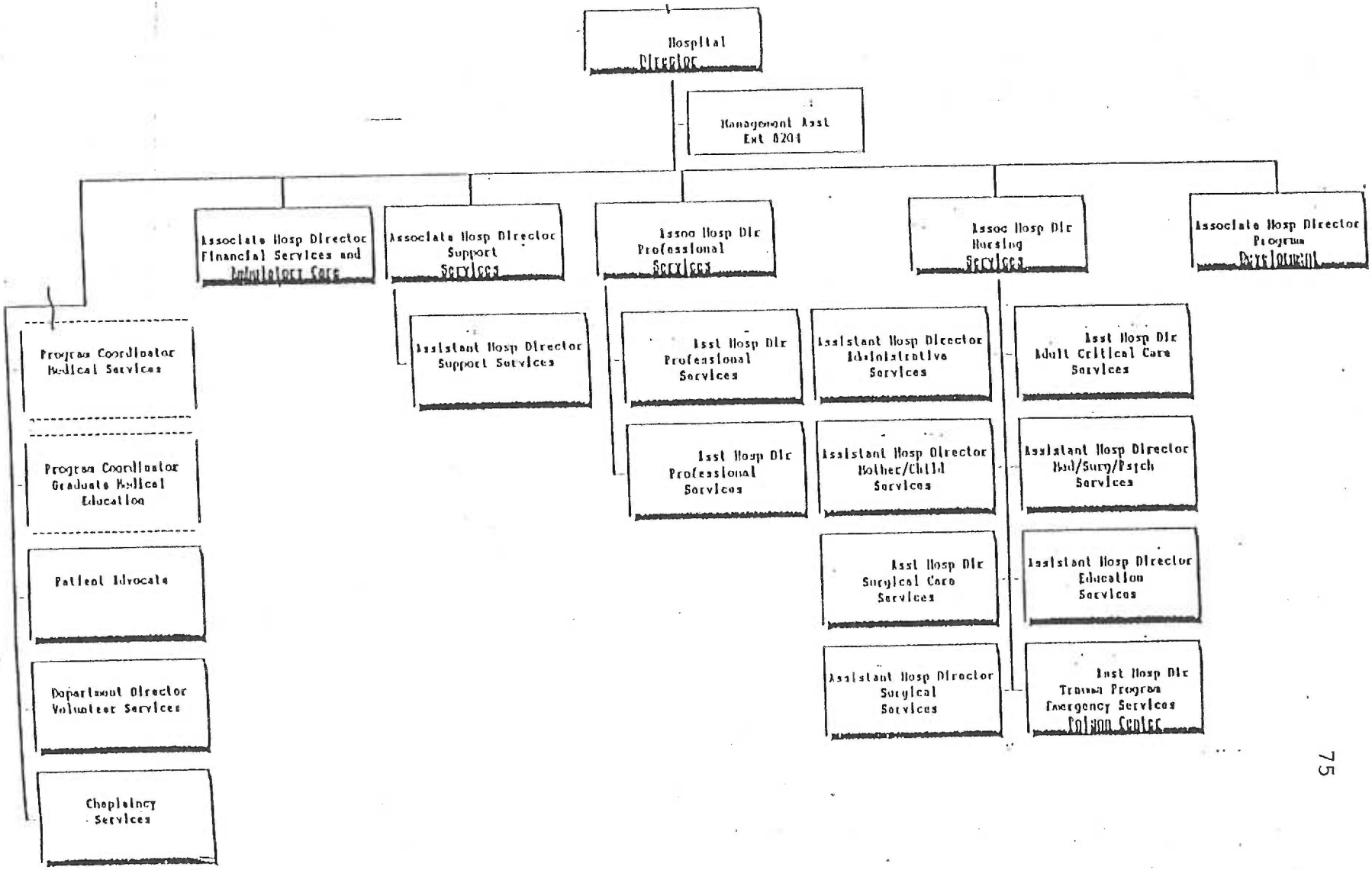
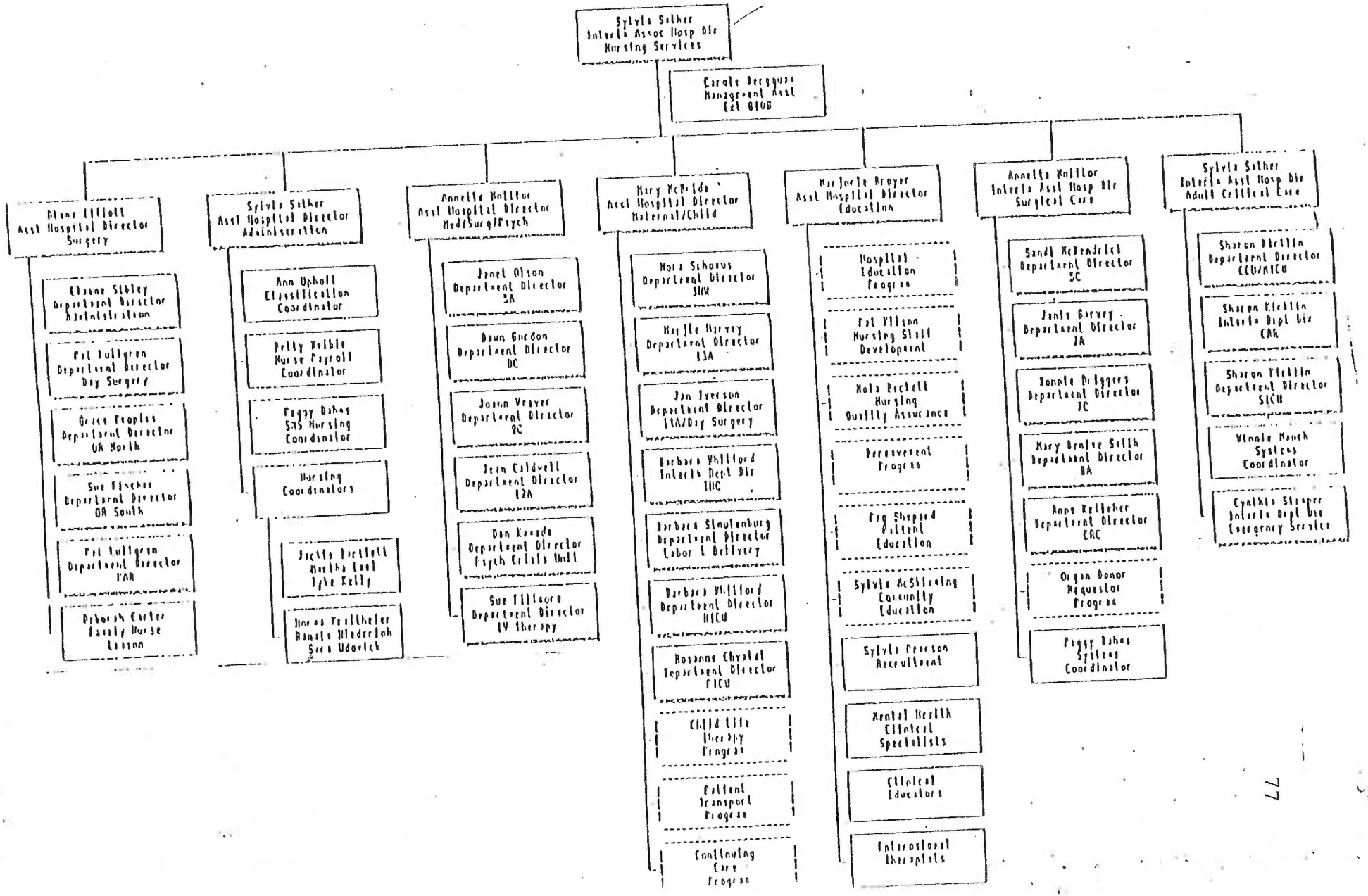
APPENDIX A
OHSU HOSPITAL ORGANIZATIONAL CHART

OREGON HEALTH SCIENCES UNIVERSITY
UNIVERSITY HOSPITAL
Organization Chart



APPENDIX B
OHSU HOSPITAL NURSING ORGANIZATIONAL CHART

OREGON HEALTH SCIENCES UNIVERSITY
UNIVERSITY HOSPITAL
Interim Organization Chart



APPENDIX C
OHSU ACUITY INSTRUMENT FOR ROUTINE SURGICAL AND MEDICAL UNITS

If patient has an IV, mark Requires Partial Assist.

MEDICAL/SURGICAL UNIT: _____

HYGIENE / ACTIVITY	0	Set Up For Activities	2	Requires Partial Assistance	4	Total Assistance (1 person)	6	>1 Person to Position/Transfer
NOURISHMENT	0	Feeds Self NPO	1	Cut and Assist	3	Tube Feeding/Force/ Restrict Fluids	4	Total Feed
VITAL SIGNS	0	Q 8h	1	Q 4h	3	Q 2h VS	4	VS Q 1 hour ≥ 6/24h
ELIMINATION	0	BRP by Self	1	Assist to BR Enema	2	Bedpan/Urinal/Bedside Commode I & O/Incontinence Multiple Enemas	3	Ostomy Care Frequent Assists With Excretion/ Incontinence q 1-2h
MEDS	0	PO or IM Total of 6 or < /8h	2	PO or IM Total of 7-10/8h IV Meds - 1 or 2/8h	4	PO or IM Total of 11-13/8h IV Meds 3/8h	6	PO or IM 14 or > /8h IV Meds 4 > /8h
IVs	0	—	1	Heparin Lock	3	Infusing IV	5	HA/Lipids Blood Products 2 or more IVs
TEACHING / EMOTIONAL SUPPORT	1	Routine Teaching and Emotional Support With Normal Care Activities	2	Special Teaching/ Emotional Support for Patient and/or Family	3	Extraordinary Factors: Major Lifestyle Change Teaching Language Barrier Sensory Deficit Terminal This Shift Confusion/Cognitive Impairment Isolation Moderate Suicide Precautions	6	Extra Factors: Disruptive Behavior Respirator Dependent (x 1 month) Major Suicide Precautions
INTERVENTIONS	1	Q 8h	2	Q 4h	3	Q 2h or more often	5	Q 1h

NAME: DATE: CATEGORY: INITIAL:

Cat.	
I	0 - 7
II	8 - 17
III	18 - 24
IV	25 - 39
V	CCC

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APPENDIX D
OHSU ACUITY INSTRUMENT FOR CRITICAL UNITS

For patients under 12 y.o., do not use hygiene/activity indicators. Critical: CCU & CRR

CRITICAL CARE

DIET	0	Needs Little Assistance With Feeding/NPO	3	Feed, Tube Feed Force or Restrict Fluids		
HYGIENE / ACTIVITY	0	Assistance With Hygiene and Ambulation	4	Complete Bath, Pt. Can Assist With Turn, Amb.	6	Completely Dependent/ Total Care
ELIMINATION	0	Commode/Urinal	1	Bedpan/Foley	3	Incontinent/Diaphoretic
MEDICATIONS/IVs	0	Oral or NG Meds 1 Infusing IVs-Heparin Lock	4	2-4 IV Pushes/Shift 2 Infusing IVs/2 or more Blood Prod./Shift Fluid Challenge	8	5 IV Pushes/Shift 3 Infusing IVs
VS/MONITORING	0	BP q 2-4°	6	BP Q 1-2° plus 1-2 Major and/or 3 Minor Monitoring Modalities	10	BP Q 15-30 min. 2 or Major Plus 4 or Minor Monitoring Modalities
TREATMENTS	0	2 Minor	2	1 Major plus 2 Minor	3	2 or Major and/or 4 or Minor
TEACHING / EMOTIONAL SUPPORT	0	Routine Explanations With Normal Care Activities	2	Routine Teaching With Emotional Support For Patient With New Diagnoses Teaching for Identified Needs of Patient/ Family	4	Extraordinary Factors: Unprepared Family Life-Threatening Complications Language Barrier (ET & Trach) Patient Restrained Isolation

Name: _____ 7-3: ____ 3-11: ____ 11-7: ____

Cat. I 0 - 9
II 10 - 23
III 24 - 37

TREATMENTS

Major: Cardioversion
Suction
Weaning procedure
Ventilator
Kenetic Rx
Auto Transfusion
Major Dressing Change

Minor: Chest PT by Nursing at least once/shift
Pacemaker Checks
Inspirometer by Nursing
ROM
Chest Tube Strip
Air Flow & Other Spec Beds
Gastric Lavage

MONITORING MODALITIES

Major: 12 Lead EKG
Swan Ganz
Cardiac Output
Arterial Line
IABP
ICP
Ultra Filtration
PD
LA Line

Minor: Orthostatic BP q 1 hour in/out
Neuro Checks
Pedal Pulses
Specimen Analysis:
SA
Guaic
Gastric
Lab Draws 1x/shift
Abd Girth
CVP
O_2 Saturation

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APPENDIX E
SURVEY OF DEPARTMENT CASE-MIX

DEPARTMENT # _____ TYPE _____

PATIENT CAMPACITY _____ (Beds)

Please cycle appropriate answer (s) for following questions:

1. What acutal time do you assess acuity for your department?
   a. 7-8am b. 8-9am c. 9-10am d. 10-11am

2. Who acutally assess patient acuity?
   a. Charge nurse b. staff nurses c. both

3. What time during the day are patients being admitted in your department?
   a. Most common time (___am or ___pm) b. Throughout day

4. What time during the day are patients being transferred into your department?
   a. Most common time (___am or ___pm) b. Throughout day

5. What time during the day are patients being discharged from your department?
   a. Most common time (___am or ___pm) b. Throughout day

6. What time during the day are patients being transferred out of your department?
   a. Most common time (___am or ___pm) b. Thoughout day

7. What percentage of your department patient come from in the following four groups and what is the average acuity level for each group?

a. Patient admitted from

-ER	_____	%
-OR	_____	%
-Home	_____	%
-Nursing home	_____	%
-ICU	_____	%
-CCU	_____	%
-Others (be specified)	_____	%

TOTAL: 100%

b. Average acuity level (1-4)

	In	Out
-ER	_____	_____
-OR	_____	_____
-Home	_____	_____
-Nursing home	_____	_____
-ICU	_____	_____
-CCU	_____	_____
-Other	_____	_____
	_____	_____

8. What is (are) the acuity fluctuation pattern(s) for your department patients during the hospitalization?
   a. High-low b. High-low-high-low
   c. Low-high-low d. same admit till discharge
   e. Other (be specified)

Thank you very much!

APPENDIX F
QUANTITATIVE MEASURE
ACUITY ASSESSMENT SCHEDULE SHEET

QUANTITATION MEASURE
ACUITY ASSESSMENT SCHEDULE SHEET

DATA		UNIT #	TIME
Sunday	(4/8/90)	10A	0800 1100 1400 2000 2300
Monday	(4/9/90)	10A	0800 1100 1400 2000 2300
Wedesday	(4/11/90)	10A	0800 1100 1400 2000 2300
Thursday	(4/12/90)	12A	0800 1100 1400 2000 2300
Friday	(4/13/90)	12A	0800 1100 1400 2000 2300
Saturday	(4/14/90)	12A	0800 1100 1400 2000 2300
Sunday	(4/15/90)	CCU & CRR	0800 1100 1400 2000 2300
Monday	(4/16/90)	CCU & CRR	0800 1100 1400 2000 2300
Wedesday	(4/18/90)	CCU & CRR	0800 1100 1400 2000 2300
Thursday	(4/19/90)	8C	0800 1100 1400 2000 2300
Friday	(4/20/90)	8C	0800 1100 1400 2000 2300
Saturday	(4/21/90)	8C	0800 1100 1400 2000 2300

APPENDIX G
ACUITY ASSESSMENT DAILY DATA SHEET

ACUITY ASSESSMENT DATA SHEET

UNIT#___
DAY #____
DATE

PATIENT NAME	ACUITY/TIME 0800	1100	1400	2000	2300
WT. X	A * N = 1 2 3 4	A * N = 1 2 3 4	A * N = 1 2 3 4	A * N = 1 2 3 4	A * N = 1 2 3 4
TOTLE					
X					

AN ABSTRACT OF THE THESIS OF

HONG LI

For the MASTER OF SCIENCE

Data of Receiving this Degree: June 8, 1990

Title: NURSING ACUITY BASED BILLING SYSTEM PROCEDURES: IMPLICATION FOR REVENUE

APPROVED: [redacted]

Joyce Semradek, R.N., M.S.N., Professor
Master Research Project Advisor

The primary aim of this non-experimental quantitative study was to identify the appropriate time for assessing acuity during a 24-hour period to accurately reflect the nursing resources used by patients as a basis for billing. Very little research has been done in this area. An original conceptual framework was formulated based on interviewing clinical experts. The accuracy of an acuity based billing system is influenced by the following three factors: the reliability and validity of the patient classification (acuity) tool, the formula for rate setting and the design and implementation of procedures for monitoring acuity. When and how frequently to assess patient acuity for the purpose of billing is considered to be an important issue in the procedure design component.

The research setting was Oregon Health Sciences University Hospital. Three data collection methods were used in this study. Day charge nurses on all 18 units were surveyed to obtain data on

type of patients, time of patient admission, transfer and discharge, origin of incoming patients and acuity level at time of admission, and usual or expected of pattern over the course of hospitalization. Data were collected from hospital records on average length of stay, individual and mean patient acuity at 11AM and 11PM for each of the 18 units. In addition, on five selected units (CCU, CRR, 12A, 10A & 8C), patient acuity data were collected by the researcher five times per day for three days.

The average weighted acuity case-mix pattern fluctuation during 24-hour period at unit level is used to identify the best time to meaqsure individual acuity to maximize or optimize revenue for the unit. The patterns of average acuity in a 24-hour period were diagrammed for each of the five selected units with all patients included and with partial stay patients omitted. Levels of acuity at check-points throughout the day were compared with the 11AM and 11PM readings to determine if the time currently used for determining the appro[riate billing rate reflects daily case-mix.

The results indicate that the current timing for acuity assessment is appropriate for medical and surgical routine care units and some critical care units (CRR & 4NE). However, it may or may not be appropriate for the other critical care units (SICU, PICU, NICU) because although the daily fluctuation in unit acuity was not studied for these units, reasons other than

timing, such as rate setting, probably account for the loss of revenue. The current timing for acuity assessment is not for CCU, and the patient acuity tool is suspected to be unsuitable for cardiovascular units (8C & CCU). In addition, data suggest that the use of staff nurses to assess patient acuity improves the accuracy of the information and optimize nursing revenue. This study provided information for hospital nursing administrators to use in making decisions regarding modification of the current acuity based billing system.