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Analyzing Fluctuating Unit Census for Timely Staffing Intervention

Executive Summary

- While significant improvements have been made in capturing patient acuity, staffing management systems often underestimate workload in terms of patient volume.
- "Total Treated Patients," which includes the sum of admissions, discharges, patients admitted and discharged within the same day, and patients on the unit for 24 hours, was used to more accurately reflect the workload on a given unit.
- This measure helps to capture what many studies have demonstrated: an admission or discharge requires at least 30 minutes of focused work.
- A Unit Activity Index (UAI) was calculated to assess the need for further workload evaluation if the result was greater than 50%: average number of admissions, transfers, and discharges divided by average number of total treated patients times 100.
- More sensitive measures like these support better allocation of staff across the 24-hour clock in shifts that may be different in length and start time than traditional shifts.

IN TODAY'S EVER-CHANGING and demanding health care environment, hospitals are increasingly required to deliver high-quality health care at costs that often do not cover expenditures. Nursing labor costs are and have been the greatest single source of expense in a hospital's budget (Tuttas, 2003), and thus the line item most likely to be reduced by administrators looking for timely savings. Unfortunately, impulsive cutbacks geared toward quick budget improvements can have disastrous effects on patient care (Aiken, Clarke, Sloane, Sochalski, & Silber, 2002; Aiken, Clarke, & Sloane, 2000), as well as adversely affecting nurse satisfaction (Burke, 2003; Havens, 2001). In view of current nursing shortage issues, with predictions of increasing and more problematic shortages looming on the horizon (Buerhaus, 2001; Buerhaus & Staiger, 1999), budgetary innovations that responsibly and reliably utilize nurse labor while augmenting patient care and nurse satisfaction can be a boon to the current hospital environment.

Computer information systems can provide data needed to manage budgetary dilemmas. Technologic advances in the area of staffing and census tracking are becoming commonplace in the current hospital environment. Currently, there is technology available that enables managers to track patient numbers and nursing staff requirements daily, or in increments of 8 hours, 4 hours, and 1 hour (Budreau, Balakrishnan, Titler, & Hafner, 1999). Yet universal application of these innovative capabilities has not been adopted. One novel approach to the application of tracking and predicting nurse staffing needs in several

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units of a large Midwestern academic medical center is described.

Background

Hospitals have steadily evolved over the years and continue to transform daily. No area of the hospital is more reflective of these dynamic changes than the current nursing units, which are often a mecca of activity as patients arrive, are discharged, or have unexpected condition changes requiring increased nurse care hours, all in the same 24-hour period. Historically, nursing units weren't always this busy. During the 1960s and 1970s, patients could expect to be admitted to hospital units for a minimum of 5 to 7 days and often as long as 2 weeks (Barber, 1977; Swain, Kilpatrick, & Marsh, 1977). Patients were not as ill and did not have as many complicating conditions. Many of them were admitted overnight for routine tests, including physical assessments. Patient admissions did not start until after 11:00 am, since discharges did not occur until 11:00 am (Jacobson, Seltzer, & Dam, 1999). Under these conditions, the system of budgeting nursing services by midnight census evolved. Although it was recognized that units had activities requiring increased nurse care hours during the day, these activities were for the most part predictable, and could be captured adequately by regularly scheduling increased staff during the day and evening shifts. Staffing was typically based on midnight census; however, this method was increasingly criticized as nursing unit activities increased in the 1980s and 1990s (Arthur & James, 1994).

These activities came in the form of additional patients coming and going from units on a daily basis, not adequately captured in the midnight census prediction (Vissers, 1995). Nursing staff, finding that patients were often admitted and discharged from the same bed during a single shift, reported that the workload of nursing staff was significantly increased and influenced by the intense and time-consuming admission/discharge patient care requirements occurring at unpredictable times throughout the shift (Jacobson et al., 1999). Walker (1990) reported a busy surgical unit as having overtime which can be directly related to the time of heaviest admissions. For 28 consecutive days, data were gathered from patient records, nursing payroll, and nursing units. The data indicated that during the time of heaviest admissions, a 3-hour period from 3:00 pm until 6:00 pm, 49% of the overtime was used. Walker stated that "because the nursing care requirements of the admitted patients exceeded that of the discharged patients, the workload demand on the nurses progressively increased as these hours passed" potentially increasing by as much as 3 hours (1990, p. 318). This is also substantiated in an early, oft-cited work by Shukla (1985), in which he states "each time a patient is admitted to a unit, the work load index of that unit will be increased by 3.5 nursing hours" (p. 96).

Recently, it has been postulated that the midnight patient census does not adequately reflect the complexity of nursing care required by the patient population ebb and flow throughout a shift (Volpatti, Leathley, Walley, & Dodek, 2000). Additionally, the midnight census does not necessarily correlate well with the actual numbers of nurses required to staff units (Volpatti et al., 2000). Moreover, average daily census (ADC) figures which incorporate a similar snapshot look at a nursing unit activity are also inadequate to predict nursing care needs (Budreau et al., 1999).

As an alternative approach, Jacobson et al. (1999) developed the concept of *total treated patients*, defining it as: "...the total sum each day of the four category types. The four categories include: (a) full-day patients occupying a bed for the full 24-hour period, (b) discharge patients from the unit, (c) admission patients to the unit, and (d) admission/discharge patients to/from the unit on the same day, not present at midnight" (p. 56).

This concept illustrates the difference between midnight or average daily census versus the actual numbers of patients who are cared for on a unit in a day's time.

To demonstrate the importance of this concept and its usefulness in application across nursing units, a field study comparison of staffing needs determined by midnight census, ADC, and total treated patients was generated from computer data supplied by a large Midwestern academic medical center. Units with high and low numbers of total treated patients were examined.

The computer system in the study hospital, which provides timely tracking of nursing care hours and patient census data (Budreau et al., 1999), was used to generate field study data. The automated system, labeled Caregiver Patient Ratio (CGPR), was designed in 1998 as a data repository that nurse managers can query through a series of predesigned reports (Budreau et al., 1999). Data are pulled from the hospital's human resource and patient census databases so that the number of direct caregivers is paired each hour with the number of patients on the unit. Caregiver hours are divided by patient hours to calculate the CGPR, which when multiplied by 24 hours, yields the nursing hours per patient day (NH/PD). The data are refreshed weekly and displayed graphically to demonstrate trends over time, including registered nurse, licensed practical nurse, and nursing assistant hours of care provided. Additional data elements provided in the system include skill mix, admission/dis-

charge/transfer (ADT) activity, and timing of ADT activity throughout a 24-hour period.

Data from the CGPR system were reviewed to identify units with a large amount of ADT activity. Although data were available from a total of 48 units, units having psychiatric, obstetrical, pediatric, or operating room/post-anesthesia patients were excluded from analysis to provide a more manageable sample size. This left a total of 21 units in the intensive care division and two medical/surgical clinical divisions (see Table 1). Units for analysis were then chosen from each of the three divisions by reviewing 12 months of data and selecting two units with high ADT activity and one unit with low ADT activity, for a total of nine units selected overall (see the units with asterisks in Table 1).

From the selected units, data on midnight census, ADC, and total treated patients were examined (see Table 2.) The number of total treated patients was derived from the ADT activity reported in the CPGR system, and compared to midnight census and ADC. It was found that, although units demonstrated numerous admissions, transfers in, transfers out, and discharges, the recorded census varied only by the net change of activity. Therefore, a unit with a midnight census of seven, with two admissions and two discharges throughout the 24-hour period, would continue to show a midnight census of seven, ignoring the census fluctuations created by the ADT patients. If the admissions were four and the discharges were two, the midnight census would reflect this, showing nine patients in the census figures.

Further computations validating the intensive ADT activity were required, which included calculating the unit activity index (UAI). This is the ratio of ADT patients to total treated patients, derived by dividing the average number of admissions, transfers, and discharges by the average number of total treated patients and multiplying by 100. According to Jacobson et al. (1999), a unit with a UAI of 50% or greater is a high activity unit that warrants workload evaluation, as this indicates the unit has greater volume of admission, discharge, and transfer patients than its own full-day patients. This value is calculated and reported in Table 2. Of the nine units examined, only one unit was at or exceeded 50%. This was a head and neck surgical unit.

Even without the UAI calculations, one can see that the total patient care hours required are not fully captured by using midnight census or ADC for staffing needs. The dilemma centers around assigning a valid amount of care hours to the patients who are processed for admission, transfer in or transfer out, and discharge. A review of the literature demonstrates a paucity of definitive information related to this issue. Based upon expert clinical opinion, Budreau et al. (1999) used 30 minutes as the average patient care time required for an admission, and found no appreciable increase in required patient care hours, leading to a conclusion that ADT had little effect on the NH/PD for the three shifts of the unit studied. Upenieks (1998) related that the admission/discharge process as recorded in time-motion studies completed over a 2-year period on a 36-bed surgical unit averaged 34 minutes each, taking 7% of the nurse's time in an 8-hour shift. Duclos-Miller (1996) relates the "reasonable and customary time for each admission has been identified as 30 minutes" (p. 40). In addition, the recent publication of *Nursing Intervention Classifications* (Dochterman & Bulechek, 2004), lists the intervention "admission care" in the table of interventions which require 16 to 30 minutes of RN basic time (p. 960).

While there appears to be some agreement about the extra time required for an admission, there is a lack of definitive research demonstrating a clear conversion figure for hours of nursing care required by ADT patients. The recommended approach for determining conversion measures is time studies with skilled observers, including repetitive studies to ensure validity (Williamson & Johnston, 1988). This is clearly out of the scope of this field study. However, some analyses and conclusions can be generated from the data using the time-motion study information reported by Upenieks (1998), which seems to be the most recent and most applicable in view of the outcome of the initial analysis. Upenieks gathered data from a busy surgical unit, and the unit selected with high UAI is also a busy surgical unit at the study hospital.

Data Analysis

The head and neck surgical unit (see Table 2) had on average 14.462 ADT patients per day. Using the 34 minutes (obtained from Upenieks' time study) divided by 60 minutes (to convert the minutes to parts of an hour) gives a staffing hour factor of 0.567. Multiplying the average number of ADT patients of 14.462 by the staffing hour factor of 0.567 indicates that the amount of additional patient care requirements from ADT activity on the head and neck surgical unit is 8.19 hours.

During the study period, the head and neck surgical unit had an ADC of 11 patients and was staffed each shift by five caregivers yielding a CGPR of 0.45 or 10.9 NH/PD. Assuming that the additional patient activity of 8.19 hours occurred during the day shift from 7:00 am to 3:00 pm so that the equivalent patient census during that 8-hour period would be approximately 12 patients, then an additional 0.4 RN (3.2 hours) would be required to maintain the NH/PD at 10.8 during that 8-hour

Table 1.
ADT Average Monthly Data
March 1, 2002 – February 28, 2003

Division/Unit	Admissions	Transfers In	Transfers Out	Discharges	Total ADT
Intensive Care Division					
MICU	27.1	60.3	70.5	17.1	174.9
CVICU	34.3	69.1	84.8	19.0	207.2
Medical cardiology	89.5	130.3	85.1	133.7	438.5 *
Cardiology/Thoracic	49.1	165.0	89.0	124.9	428.0 *
Neurosurgery	19.3	161.9	65.3	116.4	362.9
Monitored neurosurgery	14.9	109.3	93.8	31.3	249.2
Neurosurgical ICU	13.3	51.6	59.1	5.5	129.4
General Surgical ICU	17.8	71.0	81.8	6.7	177.3
TCV ICU	25.3	51.8	73.3	3.4	153.8
Pulmonary care	4.5	28.0	20.6	12.0	65.1 **
Medical/Surgical Division 1					
Organ transplant	77.9	85.8	63.8	99.5	326.9
Gynecology/Oncology	52.7	116.3	55.2	113.5	337.7
Head and neck surgical	124.0	96.0	48.8	171.2	439.9 *
Hematology/Oncology	56.3	54.3	43.4	67.5	221.6
Medical-Surgical oncology	70.0	84.6	56.2	98.5	309.3
GI surgery	51.3	125.3	72.6	104.9	354.2 *
Adult BMT	15.8	10.3	10.3	15.6	52.0 **
Burn/Trauma	23.6	80.3	65.5	38.4	207.8
Medical/Surgical Division 2					
Orthopedics/Urology	119.8	278.0	120.5	276.8	795.2 *
General medicine	92.9	195.3	122.0	166.6	576.7 *
Medical psychiatry	13.6	58.8	47.9	24.3	144.6 **

* High-activity units chosen for analysis
** Low-activity units chosen for analysis

period. Intuitively, this would not appear sufficient to cover the 14 plus patients that will be arriving daily, in addition to the patients that are there. However, these data do support Budreau et al.'s (1999) earlier findings of no significant impact on NH/PD with ADTs. Nonetheless, recent research has demonstrated that even small increases of nurse staff levels can have a positive impact on patient care outcomes (Wells, 2004) as well as providing a "sense of decreased burden" to existing staff (Blankenship & Winslow, 2003, p. 12). Staff also perceived improvement to patient care with the addition of staff for increments less than an entire shift (Blankenship & Winslow, 2003).

There are several factors to be considered related to this preliminary field study, from a nursing administration perspective and from a nursing informatics perspective. From the nursing administrative perspective, these numbers seem to indicate that better data are needed related to nursing time spent with ADT patients. Anecdotal reports of time-motion studies carried out in institutions not publishing results seem to indicate that 34 minutes undervalues this workload indicator. An independent time-motion study in this particular hospital should be carried out to establish the correct measure for each unit in this institution, as patient workload can vary from unit to unit (Walker, 1990), and validity is increased with the use of studies taken from the actual

Table 2.
Data for Selected Units
March 2002 – February 2003

Nursing Division and Unit	Average Midnight Census	Average Daily Census	Average Daily ADTs	Average Daily Total Treated	Unit Activity Index
Intensive Care Division					
Medical cardiology	21.555	21	14.416	35.971	40.1%
Cardiology/Thoracic	19.339	20	14.071	33.47	42.0%
Pulmonary care	6.966	7	2.140	8.711	24.6%
Medical/Surgical Division 1					
Head and neck surgical	13.78	11	14.462	28.242	51.2%
GI surgery	16.847	19	11.645	28.492	40.9%
Adult BMT	11.729	8	1.710	13.439	12.7%
Medical/Surgical Division 2					
Orthopedics/Urology	34.61	34	26.143	60.753	43.0%
General medicine	36.525	37	18.960	55.485	34.2%
Medical psychiatry	10.559	10	4.754	15.313	31.0%

units evaluated (Williamson & Johnston, 1988). Additionally, time-motion studies would be useful for transfers in, transfers out, and discharges, as there currently are no reported data in the recent literature related to these terms. (The NIC information lists the intervention "transport" [Dochterman & Bulechek, 2004, p. 741] as requiring less than 15 minutes of care time, but does not appear to account for many of the required nurse activities in transferring a patient unit to unit; rather, it appears to focus on the physical time spent with a patient during transport.) There is some evidence that the time spent in the room with the patient during an admission interview does not adequately capture the entire workload burden of that admission (Shukla, 1985), yet Upenieks uses time in the room as the basis for the admission data. Clearly, a documented substantial increase in the minutes spent *on* ADT patients, rather than *with* ADT patients, could affect the NH/PD values significantly.

However, there is more to consider than simply using numerical calculations to derive increases in staff required to meet patient care demands. As noted by Jacobson et al. (1999), tracking the hourly changes in the patient numbers could indicate a need to change traditional shift schedules and assigned staffing ratios. A unit such as the head and neck surgical unit could schedule additional part-time or per diem staff from 9:00 am till 6:00 pm, when most ADT activity occurs. Presenting such innovative but costly changes to a cost-conscious administration is enhanced through the use of the CGPR data indicating timing and magnitude of increased ADT activity. Computer-generated tables and graphs from the system provide compelling yet simple-to-grasp data of the nature that is generally preferred by managers (Choo, 2002).

Additionally, these reports will assist managers in analyzing and explaining budget variances for a particular time period, as data reflecting increased or decreased census associated with increased or decreased staffing are readily available. Again, using data for efficient staffing and presenting administration with detailed, up-to-date reports supporting staffing levels is an important management skill for unit managers to master.

From a nursing informatics standpoint, knowledge management is a key issue in the hospital environment today (Bakken, 2001). Graves and Corcoran (1989) define nursing informatics as a "combination of computer science, information science, and nursing science designed to assist in the management and processing of nursing data, information and knowledge to support the practice of nursing and the delivery of nursing care" (Graves & Corcoran, 1989, p. 227). For nursing administration, the recognition and embracing of nursing informatics as a "...science designed to assist in the management" (Graves & Corcoran, 1989, p. 227) is an appropriate first step, yet a large paradigm shift for many in health care organizations today.

There seems to be a wealth of knowledge at the nurse manager's fingertips, with much of it collect-

ed in a fairly sophisticated system. However, the information needs harvesting and sharing, with adequate interpretation, application, and dispersal of findings. For this to be realized, nursing management must partner with information technology services, along with accounting services, working together to design systems that will facilitate the provision of patient care at an optimal, cost-effective level. As Minsky (1986, quoted in Choo, 2002) states, "very few of our actions and decisions come to depend on any single mechanism. Instead, they emerge from conflicts and negotiations among societies of processes that constantly challenge one another" (p. 2). Nursing leadership must initiate a nursing/informatics/management society that will create and grow in an environment of shared challenges.**$**

REFERENCES

Aiken, L.H., Clarke, S.P., & Sloane, D.M. (2000). Hospital restructuring: Does it adversely affect care and outcomes? *Journal of Nursing Administration, 3*(10), 457-465.

Aiken, L.H., Clarke, S.P., Sloane, D.M., Sochalski, J., & Silber, J.H. (2002). Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction. *Journal of the American Medical Association, 288*(16), 1987-1993.

Arthur, T., & James, N. (1994). Determining staffing levels: A critical review of the literature. *Journal of Advanced Nursing, 19*, 558-565.

Bakken, S. (2001). An informatics infrastructure is essential for evidence-based practice. *Journal of the American Medical Informatics Association, 8*(3), 199-201.

Barber, R.W. (1977). A unified model for scheduling elective admissions. *Health Services Research, 12*, 407-415.

Blankenship, J.S., & Winslow, S.A. (2003). Admission-discharge-teaching nurses: Bridging the gap in today's workforce. *Journal of Nursing Administration, 33*(1), 11-13.

Budreau, G., Balakrishnan, R., Titler, M., & Hafner, M.J. (1999). Caregiver-patient ratio: Capturing census and staffing variability. *Nursing Economic$, 17*(6), 317-324.

Buerhaus, P. (2001). Expected near- and long-term changes in the registered nurse workforce. *Policy, Politics & Nursing Practice, 2*(4), 264-270.

Buerhaus, P.J., & Staiger, D.O. (1999). Trouble in the nurse labor market? Recent trends and future outlook. *Health Affairs, 18*(1), 214-222.

Burke, R.J. (2003). Hospital restructuring, workload and nursing staff satisfaction and work experiences. *The Health Care Manager, 22*(2), 99-107.

Choo, C.W. (2002). *Information management for the intelligent organization* (3rd ed). Medford, NJ: Information Today, Inc.

Dochterman, J.M., & Bulechek, G.M. (2004). *Nursing interventions classifications (NIC)*. St. Louis: C.V. Mosby, Inc.

Duclos-Miller, P.A. (1996). Workload measurement tracking system. *Nursing Management, 27*(9), 39-41.

Graves, J.R., & Corcoran, S. (1989). The study of nursing informatics. *Image: Journal of Nursing Scholarship, 21*(4), 227-231.

Havens, D.S. (2001). Comparing nursing infrastructure and outcomes: ANCC magnet and nonmagnet CNEs report. *Nursing Economic$, 19*(6), *258-266*.

Jacobson, A.K., Seltzer, J.E., & Dam, E.J. (1999). New methodology for analyzing fluctuating unit activity. *Nursing Economic$, 17*(1), 55-59.

Minsky, M. (1986). *The society of mind*. New York: Free Press.

Shukla, R.K. (1985, Spring). Admissions monitoring and scheduling to improve work flow in hospitals. *Inquiry, 22*, 92-101.

Swain, R.W., Kilpatrick, K.E., & Marsh, J.J. (1977). Implementation of a model for census prediction and control. *Health Services Research, 12*, 380-395.

Tuttas, C.A. (2003). Decreasing nurse staffing costs in a hospital setting: Development and support of core staff stability. *Journal of Nursing Care Quality, 18*(3), 226-240.

Upenieks, V.V. (1998). Work sampling: Assessing nursing efficiency. *Nursing Management, 29*(4), 27-29.

Vissers, J.M.H. (1995). Patient flow based allocation of hospital resources. *Journal of Mathematics Applied in Medicine and Biology, 12*, 259-274.

Volpatti, C., Leathley, M., Walley, K.R., & Dodek, P.M. (2000). Time-weighted nursing demand is a better predictor than midnight census of nursing supply in an intensive care unit. *Journal of Critical Care, 15*(4), 147-150.

Walker, E.J. (1990). Staffing accommodations to hospital admissions. *Nursing Economic$, 8*(5), 314-318.

Wells, J.C. (2004). The case for minimum nurse staffing standards in nursing homes: A review of the literature. *Alzheimer's Care Quarterly, 5*(1), 39-51.

Williamson, W.J., & Johnston, J. (1988). Understanding, evaluating and improving nursing productivity. *Nursing Management, 19*(5), 49-54.

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Larson L. (2001). The humanity of palliative care. *Trustee, 54*(5), 14-18.

Levitz, G.S., & Brooke, Jr., P.P., (1985). Independent versus system-affiliated hospitals: A comparative analysis of financial performance, cost, and productivity. *Health Services Research, 20*(3), 315-339.

McCarthy, E.P., Burns, R.B., Ngo-Metzger, Q., Davis, R.B., & Phillips, R.S. (2003). Hospice use among Medicare managed care and fee-for-service patients dying with cancer. *JAMA, 289*(17), 2238-2245.

McCue, M.J., Thompson, J.M., & Dodd-McCue, D. (2000/2001). Association of market, mission, operational, and financial factors with hospital's level of cash and security investments. *Inquiry - Blue Cross and Blue Shield Association, 37*(4), 411-422.

Meraviglia, M.G, McGuire, C., & Chesley, D.A. (2003). Nurses' needs for education on cancer and end-of-life care. *The Journal of Continuing Education in Nursing, 34*(3), 122-127.

Patrick, D.L., Curtis, J.R., Engelberg, R.A., Nielsen, E. & McCown, E. (2003). Measuring and improving the quality of dying and death: Determinants of successful aging. *Annals of Internal Medicine, 139*(5), 410-415.

Teno, J.M., Clarridge, B.R., Casey, V., Welch, L.C., Wetle, T., Shield, R., et al. (2004). Family perspectives on end-of-life care at the last place of care. *Journal of the American Medical Association, 291*(1), 88-93.

Weinick, R., & Cohen, J. (2000). Leveling the playing field: Managed care enrollment. *Health Affairs, 19*(3), 178-184.

Yafchak, R. (2000). A longitudinal study of economies of scale in the hospital industry. *Journal of Health Care Finance, 27*(1), 67-89