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Nurse Labor Data: The Collection and Interpretation of Nurse to Patient Ratios

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Abstract

Nurse labor has been shown to be related to some patient outcomes but varying definitions and measurement approaches have resulted in conflicting findings about the nature of the relationship. Nurse administrators and researchers need to know rates of missing data and error in labor data to better inform decision making. The authors compare the degree of completeness and the agreement between these approaches (nurse survey and nurse to patient ratio staffing plans) to obtain patient-to-nurse ratios at the unit level.

For more than a decade, the impact of nurse staffing on patient outcomes in hospitals has been explored, but with mixed or conflicting results. Researchers (1) noted that nurse labor accounted for significant variation in some patient outcomes but not others. Nevertheless, the National Quality Forum identified nurse labor as a critical nurse sensitive indicator. Nurse administrators also are obligated to monitor and report nurse labor measures to a variety of entities, such as the Magnet Recognition Program and The Joint Commission.

The contradictory nurse labor findings may be related to a variety of methodological issues, such as the composition of existing databases, staffing allocation strategies, and design and analytic techniques.(2) The ability to analyze data reflecting the labor quantity that the patient experienced and the data's accuracy are of particular concern to nurse administrators trying to determine whether and how staffing influences key organizational and patient outcomes. These considerations are in turn, important in determining how best to allocate nursing resources. Hours of care per patient day (HPPD) has been argued to be the most precise measure of the amount of care provided to patients (3) yet this variable does not account for time spent in noncare activities. This is because the basis of calculation is usually paid hours, i.e., time that includes participation in unit activities, continuing education, and other non-patient specific tasks.

How to measure nurse labor is increasingly important as recognition grows that some patient outcomes are sensitive to and vary at the level of the individual unit.(4) Examples include falls, physical restraints, device disruption, and ventilator associated pneumonia. Spetz et al (5) recently compared measurements of nurse staffing using data from the American Hospital Association Annual Survey of Hospitals, The California OSHPD Annual Disclosure Reports, the CalNOC data set, and the California Workforce Initiative. Differences in nurse staffing

levels across data sets were noted, with the greatest difference arising in comparisons of unit level data with that derived from hospital level aggregated payroll. These differences may arise from the inability of the payroll approach to delineate direct and indirect care, floating and classification errors or payroll delays. Researchers examining the role of nurse labor on outcomes have reported the omission of up to 20% of hospitals in data sets provided by accrediting and governmental agencies because the data are incompatible with any known staffing practice.(6) For example, the senior author encountered recent acute care hospital data sets in which institutions with an average 200 or more daily census reported providing more than 20 HPPD at the hospital level. Given that even intensive care units (ICUs) rarely provide 20 HPPD, these reports lack credibility.

These reports may indicate problems beyond entry errors. The extent to which errors in non-outlier data from these sources exists is unknown for hospital and unit level data. In recently concluded studies, 2 of 40 hospitals indicated that data were compiled based on unit costs, not hours.(7) These institutions were unwilling to retrieve the time sheets of individuals and begin calculation anew. At more than 40% of the hospitals, the hours of care per patient day per unit were subject to error because the hours of temporary workers were drawn from different periods (e.g., calendar months) than those of regular staff (e.g., 2 week pay periods) and were not routinely added to a unit's total.

An alternative to the HPPD measure, the patient to nurse (PTN) ratio approach presents advantages but also challenges. Given that measuring the exact number of nursing minutes for an individual patient is not economically feasible, the PTN approach comes closer to reality because it omits activities like unit management and continuing education days from the labor calculation. PTN ratios are used in almost every US institution as a basis for staffing assignments. Although the PTN ratio may be modified because of patient needs, it forms the core from which adjustments are made. One PTN measurement challenge lies in the data source. Aiken and Patrician (8) pioneered a method that involves staff nurse reported PTN ratios through nurse surveys. This staff nurse method for determining PTN relies on an adequate nurse response rate, representation across shifts and nurse respondent adherence to the definition of "assigned patients". Bias in reporting numbers of assigned patients is possible. Further, the approach does not assist in determining the labor input of non-RNs.

To address these concerns, the authors developed a method of data collection that involves determining PTN ratios based on nurse to patient ratio staffing plans. These types of plans specify under what conditions a specific nurse to patient ratio should be applied or changed based on numbers of patients. These matrices include nursing personnel by type, making it theoretically possible to explore the influence of RN and of assistive nursing personnel. A concern is that the real staffing ratio could be higher or lower if the ratios indicated by the staffing plan are not being implemented. A comparison with the results achieved by the staff nurse method within the same work period is thus warranted.

This article's purpose is to compare these 2 sources of PTN ratio statistics in terms of data availability and agreement. The findings will assist nurse administrators who wish to track individual unit level performance and those who seek to compare multiple units in their organization and systems. The data also provide nurse administrators the information needed to judge the credibility of national benchmarks. The findings will assist researchers in working toward a consensus regarding how to collect data that represent, as closely as possible, the patient experience at the unit level.

Methods

Study Design

As part of a larger study of the role of capital, labor, and process variables in explaining variation in patient falls, therapy disruptions, and physical restraint use, 40 acute care non-federal hospitals with an average daily census of greater than 99 patients were selected randomly from 6 metropolitan areas (Chicago, Dallas-Fort Worth, Denver, Houston, New York, and Phoenix) that represent the Western, Southern, Midwestern, and Northeastern regions of the US. The random selection was stratified to include at least one large teaching hospital in each area. Metropolitan areas were chosen because of the US population's concentration in such locations; the hospital volume level was chosen because almost 90% of the care is delivered in hospitals of this size. Details of hospital enlistment and characteristics are available. (blinded for review) The sample generally represented all US hospitals in terms of ownership and location (urban versus suburban). Large hospitals were slightly over represented. As part of the conditions of participation, each hospital designated a nurse as a Site Contact (SC) to assist in making data collection arrangements.

Data Collection Procedure

The project was approved by the investigators' institutions and by each participating institution's institutional review board for conformity with human subjects and privacy standards. Data collection regarding PTN ratio involved (1) structured staffing ratio reviews with unit leadership and (2) nurse surveys on at least one adult medical, one surgical, and one general ICU per hospital. The non-ICUs were chosen based on their status as the highest users of physical restraints in the institution during an earlier study phase. If no general ICU existed, one medical and one surgical ICU were included; in a few cases 3 ICUs or acute units were studied to insure medical and surgical specialization representation.

One of 4 senior project members collected staffing ratio data provided by all unit leader. At 28 of the hospitals, the principal investigator conducted data collection with the designated project team member; the inter-rater reliability checks demonstrated greater than 98% agreement. The PTN ratios, provided by unit leadership, were collected during an overall unit environment assessment. Unit leaders were asked to have the staffing data for a designated month available at the interview.

The second approach, the nurse survey (71 items plus demographic information), included items from the Revised Nursing Work Survey, as well as questions related to environmental practices, supplies, and equipment.(8) The item related to PTN ratio was toward the end of the survey and was based on the ten developed and tested by Aiken and Patrician. The item asked the nurse to indicate the "number of patients you were responsible for the last shift you worked." To ensure comparability with earlier studies, surveys from RNs who worked at least 16 hours per week as staff nurses were used in the analysis.

Approximately 10 days before distributing surveys, the SC posted flyers announcing the survey. The SC discussed the survey at unit meetings or through other unit communication tools (e.g. e-mail). The nurse surveys were distributed through the units' commonly used communication methods. This usually involved placement of the survey with an explanatory cover letter in each RN's mail box. Nurses returned surveys to locked boxes placed at convenient unit locations. Envelopes were provided to raise the sense of confidentiality. An option to return the survey through inter-hospital mail was provided. Only project personnel had keys to the locked boxes. Measures to avoid a sense of coercion (e.g. not condoning survey completion at staff meetings) were taken. A second distribution was conducted approximately 2 weeks later.

Analyses—After cleaning procedures were applied, the data were analyzed using a standard statistical package (SPSS, 2002). The resulting data set represents 55 ICUs and 82 acute care adult units. The 1,824 returned nurse surveys represent an average unit response rate of 46.8% (SD =22.5), a rate that exceeds most other unit level studies. For the comparison of nurse reported and unit leader reported PTN ratios, only units with a nurse survey response rate of at least 20% or more than 3 nurses were included. These limits were selected based on the numerical distribution and an examination of the distribution of possible returns. The latter was an important statistical, as well as clinically credible, consideration given the number distributed per unit ranged from 10 to 120. This wide range was a function of variation in unit size and ICU/non-ICU status.

After examination of distribution statistics, the staff nurse reported PTN ratio was calculated as the mean of the ratio reported by the unit's nurses. The unit leader reported PTN ratio was calculated by weighting the ratio for differences by shift. For example, if a 12 hour shift pattern was used and the ratio was 1 patient to 1 RN on the day shift and 2 patients to 1 RN on the night shift, the ratio was calculated as $(1*0.50) + (2*0.50)$ with the result being 1.5 patients to 1 RN.

Almost all units used a sliding scale approach to account for census changes. For example, a sliding scale staffing ratio system may call for the addition of an extra RN once half the units' RNs carry one patient more than the ratio suggested for the shift. For example, if there are 4 RNs scheduled for the shift and each should normally attend 4 patients the ratio would be 4 patients to 1 RN and the total census 16. A typical sliding scale would indicate if the census rises to 18 patients that 2 of the nurses would be assigned 5 patients resulting in an overall ratio of 4.5 patients to 1 RN. If 19 patients were present, the scale would indicate that an extra RN must be scheduled resulting in a 3.8 to 1 ratio. On units with sliding scale staffing ratios, the highest possible PTN ratio was used.

The ratio of assistive nursing personnel to RN was calculated by dividing the number of these personnel by the number of RNs per shift. Approximately 25% of units reported employment of licensed practical/vocational nurses (LP/VNs) but their roles, and thus place, in the staffing ratio calculation differed. If the staffing plan counted the LP/VNs in the RN staffing ratio (i.e., LP/VN assigned a patient load with an RN "covering" for specific tasks), they were accounted for in the RN portion of the calculation. If they were specified to be assistive personnel assigned to tasks, they were included in that part of the calculation. Seventy-two percent of unit leaders reported employing no LP/VNs or using the LP/VN(s) as a technician (i.e., not given a patient assignment and thus a part of the assistive personnel staffing plan). Only 5% of ICU unit leaders reported employing any LP/VNs; 36.3% of non-ICUs reported measurable systematic use of LP/VNs.

Results

Most units (86.8%) attained sufficient staff nurse survey response rates to warrant inclusion in the analysis. Major causes for survey non-response were investigator verified labor-management issues (e.g. unionization efforts were ongoing) and institutional requests to omit units where other surveys had recently been conducted.

All unit leaders indicated the use of staffing ratios although many were careful to indicate that staffing changes outside of the staffing ratio formula could be made based on patient acuity or heavy transfers, admissions and discharge activities. The Pearson correlation of the unit PTN ratio based on the staff nurse surveys and the unit leader reported ratio was high, $r = 0.96$ ($p < .001$). The mean difference between the 2 variables was 0.23 patients (SD=0.58). On 20 units the unit leader ratio was less than that obtained through the staff nurse survey by greater than

0.5 patients and on 6 units the staff nurse survey ratio was less by this amount. The average PTN ratio in ICUs was 2.1 to 1 (SD=0.31) based on nurse survey data and 2.0 to 1 (SD=0.37) based on unit leader provided data; in non-ICUs the comparable statistics were 5.9 to 1 (SD=1.04) versus 5.6 to 1 (SD=1.1).

Nurse Manager Reported Assistive Nursing Personnel Ratios

Most ICU leaders reported no or very low (e.g., one aide per shift for the entire unit) assistive nursing personnel use. The average number of assistive personnel on non-ICU units was 0.60 (SD = 0.22) per nurse. Comparison with staff nurse provided data was not possible because the number of assistive personnel assigned to a nurse was not a survey item.

Discussion and Conclusion

The ability of all unit leaders to supply ratio based staffing plans speaks to their overwhelming use as a staffing tool. A limitation in applying these findings to new studies is the on-going relationship the investigators had with the hospitals. As part of the larger project, most institutions were in contact with the researchers for approximately one year. The data submission rates from either nurses or unit leaders probably represent the high end of the possibility. Researchers attempting to amass this information by mail may experience lower completion rates and more problems in interpreting the information supplied. Nurse administrators conducting studies in their own systems would not have this problem. The study was limited to non-federal hospitals with an average daily census greater than 100; studies in other types of hospitals may yield different results.

Reliance on the nurse survey approach may limit the ability to capture labor data from only units without major labor conflicts. On 2 units whose response rates were 0, labor-management issues were the acknowledged cause. In one hospital undergoing preparation for a unionization vote, surveys could not be distributed. The administration of competing surveys may also limit the nurse survey approach. At one hospital a nurse survey had been conducted recently and we were asked not to distribute surveys to avoid respondent fatigue. Another challenge is the expense of conducting a nurse survey; unless other data are to be collected from staff nurses, the cost of collecting data for a single labor ratio statistic element needs to be weighed against its benefit. An additional issue with the nurse survey approach lies in the item's query about the last shift worked by the respondent. This specification is critical if there is any reason to believe staffing varies by shift, a common occurrence outside of ICUs. Researchers must examine the survey results for shift representation.

Given little variation in the results of the 2 data collection approaches, the use of the unit leader as the data source has several advantages. These include efficiency, ease in clarifying shift and census staffing adjustments and lack of need to obtain good staff nurse survey response rates. Several unknowns remain to be explored, however, before recommending this as a general strategy for multi-site unit based studies. The first concerns the impact of the researcher's presence. Unit leaders seemed very comfortable explaining their staffing grids and most could do so in a matter of minutes. Some made photocopies of the staffing ratios for our use. A mailed approach or one that relies on collecting individual unit staffing grids from a central nursing administrative center that does not allow for clarification may result in errors. Nurse administrators should at least compare results from their hospital's central data center with the unit leaders' reports if they plan to use centralized sources. A non-confrontational approach to unit leaders should be used. The second unknown is the extent to which the unit leader can report shift and census adjustment rules in a survey format. In this study the researchers made the calculations to account for PTN ratio because the managers provided the ratios per shift in a variety of formats. Until this issue is resolved, the unit leader PTN ratio approach should continue to rely on on-site data collection.

Since the study was designed and executed, there have been many improvements in recognizing of the reasons why admissions, transfers and discharges (ATDs) add to workload and thus might need to be adjustments for overall workload.(5,9) Although ATD is a workload adjustment, not a labor quantity variable, we suggest that researchers routinely collect ATD information when collecting labor data. ATD information could assist nurse administrators to further discern underlying causes of discrepancies in patient outcomes between units with similar patient acuity and PTN ratios. Although ATD is but one part of workload intensity, it is one that can be measured objectively.(10)

Further exploration of how to use the assistive personnel statistic is also required. Since analyzing the results, we have informally queried more than 20 practicing nurses about how well the assistive personnel statistic helps capture the assignment of these personnel. Using examples from this study's obtained staffing ratios, For example, we asked if the nurse staffing for 2 nurses was the same if 1 is assigned 8 patients with 1 helper and the other is assigned 4 patients with a helper who is shared with another nurse. No one answered that the staffing is the same; all said the nurse with 6 patients had a greater workload. This response suggests that combining the assistive personnel statistic with the PTN ratio statistic through some simple additive or multiplicative formula is unwarranted. Until this issue is addressed, we recommend that the assistive personnel statistic be considered as a variable distinct from the PTN ratio.

The collection of robust labor data at the unit level remains a challenge. Use of a unit leader to provide PTN ratios appears to provide the most complete and accurate data. Administrators and researchers employing this approach should plan for some type of secondary confirmation that the PTN ratio is accurate, either through nurse surveys or some other external measure. Determining how variability in workload intensity, especially that resulting from ATD, interacts with nursing staff ratios in explaining variation in patient outcomes is vital for nurse administrators in determining how to provide high quality care. Future research must develop ways to account for assistive personnel time. In the interim, we recommend it continue to be examined separately from the PTN ratio.

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Table 1

A Comparison of patient to nurse (PTN) Ratios Obtained by Staff Nurse and Unit Leader Staffing Plan Data

Unit Type	Mean (Standard Deviation) PTN Ratios	
	Staff Nurse Survey Method	Unit Leader Provided Staffing Plan Ratios
Intensive Care Unit	2.1 to 1 (0.31)	2.0 to 1 (0.37)
Non - Intensive Care Unit	5.9 to 1 (1.04)	5.6 to 1 (0.22)