

Cost Outcomes of Supplemental Nurse Staffing in a Large Medical Center

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Use of agency-employed supplemental nurses on nursing personnel costs was examined in 19 adult patient care units in a large academic medical center. Results indicated that the modest use of supplemental nurses was cost-efficient with regard to overall nursing personnel costs, but heavy reliance on supplemental nurses to meet staffing needs was not cost-efficient. In addition, there was no statistical difference in hourly personnel cost between the use of supplemental nurses and overtime worked by permanent nurses. **Key words:** *costs and cost analysis, hospitals, nurse staffing, nursing personnel costs, supplemental nurses*

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HOSPITALS commonly use agency-employed supplemental nurses (also referred to as contract, agency, or temporary nurses) to meet staffing needs due to staffing shortages or temporary vacancies. A survey of nurse executives in 693 acute care US hospitals indicated that 54% of hospitals used supplemental nurses in 2001.¹ In a recent study of 665 hospitals serving a quarter of all hospital admissions in the United States, the proportion of nurses working a nursing shift who were supplemental nurses ranged from 0% to 56% in 2005-2006, with 60% of hospitals employing more than 5% supplemental nurses.² Many other countries such as the United Kingdom, Australia, New Zealand, and Canada also use supplemental nurses to respond to nurse staffing issues.³

Despite the widespread use of supplemental nurses in hospitals, the practice remains controversial, with concerns raised about quality of care and cost issues.⁴ Use of supplemental nurses has been perceived as unsafe and a potential threat to patient safety.⁵ Empirical evidence on the impact of using supplemental nurses on patient outcomes is accumulating. Although the findings are somewhat mixed, the bulk of the evidence suggests that the use of supplemental nurses does

not negatively impact patient outcomes.^{2,6-10} Recent research has suggested that findings linking supplemental nurse use to negative patient outcomes¹¹⁻¹³ could be explained by poor work environments.^{2,6,10} Evidence in the United States has also shown that supplemental nurses and permanent nurses did not differ with regard to their educational qualifications,^{2,14} which has been demonstrated to be associated with patient outcomes.^{15,16}

Cost issues have not received as much research attention as quality issues. Although it is widely perceived that supplemental nurses cost hospitals more than permanent nurses, empirical evidence on the relative costs associated with using supplemental nurse is largely lacking. It is important to address these issues as hospitals face growing pressures to reduce costs and improve efficiency. The American Hospital Association reported that 1 urban hospital spent \$5 million to \$6 million on supplemental nurses in a year.¹⁷ A study in England showed that hospitals spent about \$1.7 billion on supplemental nurses in the fiscal year 2007-2008.³

Several studies have attempted to examine the cost of using supplemental nurses. Hurst and Smith³ found that the personnel cost per occupied bed per day in hospitals in England was \$26 higher in patient care units with both permanent and supplemental nurses than in units with only permanent nurses. In contrast, in an analysis of hospital-level data from 583 US hospitals, Bloom and colleagues,¹⁸ after controlling for organizational and environmental characteristics, found no difference in overall personnel costs between hospitals that used and did not use supplemental nurses. Different methods may have contributed to differences. The study of Hurst and Smith³ compared personnel cost per occupied bed, whereas Bloom and colleagues¹⁸ assessed the overall hospital-level personnel cost. The studies neither accounted for varying levels of supplemental nurse use nor accounted for the costs associated with other staffing strategies used by hospitals to fill vacant positions.

The true cost-efficiency of using supplemental nurses depends on a number of factors that must be considered in concert. On the one hand, hospitals generally pay a higher hourly wage for supplemental nurses than for permanent nurses; on the other hand, supplemental nurse hours can be managed more easily and related directly to current nurse staffing needs, thus minimizing overstaffing. Moreover, supplemental nurses do not receive costly hospital employee benefits. Hence, higher wages alone for supplemental nurses do not necessarily result in higher overall expenditures relative to exclusive use of permanent nurses to fill staffing need. Hospitals usually employ multiple strategies such as the use of overtime by permanent nurses or the use of supplemental nurses to address nurse staffing needs, and the cost of supplemental nurse staffing must be assessed within the context of these alternative strategies.

To address these issues, we examined nursing personnel costs, a major portion of hospitals' expenditure, from the perspective of a large university hospital over a 4-year period, to provide evidence on the relative cost of using supplemental nurses while controlling for other nursing staff costs. This study had 2 primary objectives: (1) compare the relative hourly nursing personnel costs per patient-day between supplemental nurses and permanent nurses (including benefits and overtime worked by permanent nurses), and (2) identify the cost-efficiency (inefficiency) threshold for nursing personnel costs with regard to using supplemental nurses compared with no use of supplemental nurses (use of only permanent nurses).

METHODS

Study design

We conducted a retrospective analysis using hospital administrative data collected from a large academic medical center located in upstate New York. The study was approved by the university research subjects review board. We collected data between July 2003 and

December 2006 and included all patient stays (N = 465 936) in a total of 19 adult patient care units including 15 medical, surgical, and step-down units and 4 intensive care units. Although the data were collected from a single medical center during a specific time period, our findings are relevant to the present day because the essential information in our analysis is the comparative cost-efficiency of using supplemental registered nurses (RNs) at various levels. While the relative costs of hiring supplemental RNs compared with permanent RNs might vary somewhat across institutions, such relative costs have changed little in the United States over the past years due to the economic recession. The longitudinal data utilized in our analysis captured substantial variation in the use of supplemental RNs across units over the 4-year study period and permitted the identification of cost thresholds for various levels of supplemental RN use.

Analysis was performed to assess the overall personnel cost of using supplemental RNs relative to permanent nurses, while accounting for overall staffing, overtime, and benefit costs. We collected data on patient demographics, primary insurance, principal diagnosis, up to 6 secondary diagnoses, and length of stay to describe the patient population for whom nursing care was provided. Data on nursing staffing characteristics included nurse educational level, nursing experience, nursing hours provided by supplemental RNs, permanent RNs, permanent licensed practical nurses (LPNs), permanent nursing assistants (NAs), and overtime hours worked by permanent RNs. We also obtained data on the actual cost of supplemental RNs, which was maintained by the hospital monthly by unit. We used annual average hourly wages and benefit rates for non-new graduate RNs, LPNs, and NAs in the hospital to construct the salary and benefit costs of permanent nursing staff. Hourly overtime payment was 1.5 times the annual average hourly wage without benefits.

Measures

All variables used in the cost analysis were measured on the same scale—per patient-

day—aggregated by the patient care unit by quarter. The dependent variable was the overall nursing personnel cost per patient-day, calculated by dividing the total nursing personnel cost by the total inpatient days for all hospitalizations occurring in a given unit during each quarter. The total nursing personnel cost was constructed by summarizing the cost of using supplemental RNs and the cost of nonovertime and overtime worked by permanent nursing staff including RNs, LPNs, and NAs. The nonovertime cost of permanent nursing staff was calculated as the total nursing hours per quarter multiplied by the annual average hourly wage and benefit rate for permanent RNs, LPNs, and NAs. Overtime cost was calculated as the total number of overtime hours multiplied by hourly overtime payment.

All supplemental RNs in this study provided direct patient care. Measurement of supplemental RN use was operationalized as a continuous variable consisting of nursing hours per patient-day (NHPPD) by supplemental RNs and was measured by direct patient care hours provided by supplemental RNs divided by the total inpatient days per unit per quarter. To examine the effects of varying levels of supplemental RN use on cost-efficiency, we created an interval categorical variable of supplemental RN use based on the continuous measure. Use of permanent RNs, LPNs, and NAs was measured by calculating the number of hours worked by RNs, LPNs, and NAs assigned to each unit (and who had direct patient care responsibilities for >50% of their regular shift) divided by the total inpatient days per unit per quarter. Overtime was almost exclusively worked by permanent RNs. We thus included overtime hours per patient-day by permanent RNs, which was measured as the number of overtime hours by permanent RNs divided by the total inpatient days per unit per quarter.

Statistical analysis

The unit of analysis is hospital care unit by quarter. The number of total observations is 265 (19 care units × 14 quarters). Descriptive statistics were calculated to describe

the patient sample, nurse staffing, and cost variables. Generalized estimating equation models were used in cost analysis to derive estimates of average hourly nursing personnel costs per patient-day for supplemental RNs, permanent RNs, permanent LPNs, and permanent NAs and overtime worked by permanent RNs, while adjusting for the clustering effect of unit data nested within repeated quarterly observations. Generalized estimating equation model coefficients were contrasted to directly compare the relative hourly costs of supplemental RNs and permanent RNs and overtime costs for permanent RNs. To identify the cost-efficiency (inefficiency) threshold for nursing personnel costs with regard to using supplemental RNs compared with no use of supplemental RNs, generalized estimating equation analyses were repeated (including the same set of covariates) with varying levels of supplemental RN use (the categorical measure of using supplemental RNs), set at intervals of 0.2 hours per patient-day. Statistical significance for all models was set at .05, with 2-sided tests. All analyses were performed using SAS (version 9.2; Cary, North Carolina).

RESULTS

Patient characteristics

Of the patients who were admitted to the hospital units during the study period, the mean age was 58.2 years. About 56% were men and 81% were white. Most patients were either insured under Medicare (34%) or had private insurance (46%). The major principal diagnosis among patients was circulatory diseases, followed by injury, neoplasm, and diseases of the digestive system. The characteristics of patients in this study were comparable with those of patients nationally.¹⁹

Nursing personnel cost and characteristics of nursing staff

The average overall nursing personnel cost per patient-day per unit per quarter was \$334.74 (Table). On average, permanent RNs

Table. Nursing Staff Characteristics, Hours Worked, and Personnel Cost

Variables	Mean (SD)
Nursing staff characteristics	
Nursing experience, y	9.38 (2.43)
Nurse educational level (% with baccalaureate or higher degree)	52.81 (11.69)
Nursing personnel cost per patient-day, US \$	334.74 (164.54)
Nursing hours per patient-day	
By permanent RNs	8.47 (4.64)
By supplemental RNs	0.42 (0.62)
By permanent LPNs	0.57 (0.54)
By permanent NAs	1.89 (0.56)
Overtime by permanent RNs	0.42 (0.31)

Abbreviations: LPN, licensed practical nurse; NA, nursing assistant; RN, registered nurse; SD, standard deviation.

provided 8.47 hours of nursing care per patient-day; supplemental RNs provided an average of 0.42 NHPPD; and LPNs and NAs provided an average of 0.57 and 1.89 NHPPD, respectively. Overtime worked by permanent RNs per patient-day was 0.42 hours. Average nursing experience was 9.38 years among nurses in all units. The proportion of nurses who had a baccalaureate degree or higher was 52.81%.

Comparison of nursing personnel costs for supplemental and permanent RNs

The estimate of nursing personnel cost for 1 NHPPD by supplemental RNs was \$51 (see Supplemental Digital Content, Table, available at: <http://links.lww.com/JNCQ/A142>), which means that the overall personnel cost increased by \$51 for each additional hour of supplemental RN use per patient-day. The cost estimate for 1 NHPPD was \$29 for permanent RNs, \$22 for LPNs, and \$18 for NAs. The cost for 1 overtime hour per patient-day by permanent RNs was \$44. Comparative analyses showed that 1 NHPPD by supplemental RNs (\$51) was significantly higher than the cost for 1 NHPPD by permanent

RNs (\$29) ($P = .05$), but the cost for 1 NHPPD by supplemental RNs (\$51) was not significantly different from the cost for 1 overtime hour per patient-day worked by permanent RNs (\$44) ($P = .69$).

Cost-efficiency thresholds with regard to using supplemental RNs

Of 265 unit quarters studied, supplemental RNs were not used in 112 unit quarters (42%), supplemental RNs were used more than 0 and 0.2 or less hours per patient-day in 22 unit quarters (8%), more than 0.2 and 0.4 or less hours per patient-day in 40 unit quarters (15%), and at the level of more than 0.4 to 0.6, more than 0.6 to 0.8, more than 0.8 to 1, and more than 1 hour per patient-day in 20 (8%), 22 (8%), 15 (6%), and 34 (13%) unit quarters, respectively. Our analysis indicated that nursing personnel costs changed as a function of the extent to which supplemental

RNs were used. We identified thresholds for cost-reduction, breakeven, and cost increase in nursing personnel cost for different levels of supplemental RN use (Figure). Compared with no use of supplemental RNs (use of only permanent RNs), when use of supplemental RNs was more than 0 and 0.2 or less hours per patient-day, the average overall nursing personnel cost per patient-day was decreased by \$6.03 (95% confidence interval, -11.64 to -0.42), which was statistically significant. When the use of supplemental RNs was more than 0.2 and 0.4 or less hours per patient-day, the average nursing personnel cost per patient-day was \$2.47 more (95% confidence interval, -3.06 to 8.01), which was not significantly different from no use of supplemental RNs. As shown in the Figure, compared with no use of supplemental RNs, use of supplemental RNs at levels above 0.4 hours per patient-day was associated with

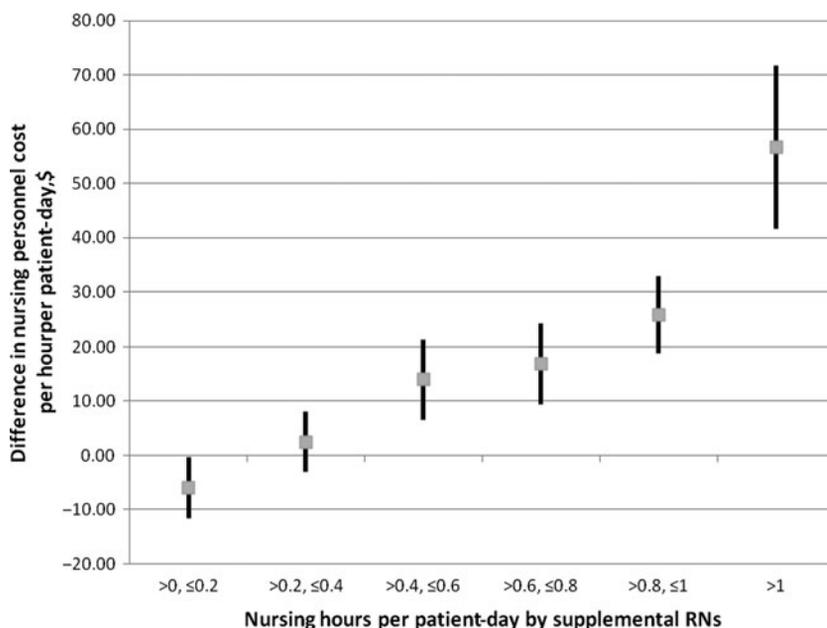


Figure. Analysis results showing point estimate and 95% confidence interval in the difference in overall nursing personnel cost (in US \$) between no use of supplemental nurses versus various levels of supplemental nurse use. Covariates included in the model are nursing hours per patient-day by permanent RNs, nursing hours per patient-day by permanent licensed practical nurses, nursing hours per patient-day by permanent nursing assistants, and overtime hours worked by permanent RNs. RN indicates registered nurse.

significant increases in overall nursing personnel costs.

DISCUSSION

This study examined the cost-efficiency of using supplemental RNs in a large academic medical center in the United States from 2003 to 2006. Although this is a single-institution study, the findings are relevant to other institutions. The proportion of total RN hours provided by supplemental RNs ranged from 0% to 30.4% across unit quarters, which was comparable with the levels of supplemental RN use reported in a national sample.²⁰ In addition, hourly personnel costs for supplemental RNs and permanent RNs in our study were aligned with the wage rate nationally.^{21,22}

To our knowledge, this is the first study to use longitudinal hospital unit-level data to systematically investigate the cost and cost-efficiency of using supplemental RNs. The results indicate that after controlling for other nursing staff personnel costs (including benefits and overtime), the average hourly nursing personnel cost of using supplemental RNs was \$21 higher than the average hourly cost of using permanent RNs across units in the study hospital during the data collection period. This finding is consistent with the long-held perception that the hourly wage for supplemental RNs is higher than for permanent nurses. Our analysis showed that this is the case even after factoring in benefit costs received by permanent RNs. The results also indicated that the point estimate for the average hourly cost per patient-day for supplemental RNs was slightly higher than for overtime worked by permanent RNs, with a difference of \$6.50; however, the difference did not reach statistical significance. Some hospitals prefer to use overtime among permanent RNs to meet staffing needs, but the use of overtime might not be a cost-effective strategy, as indicated by our nonsignificant results. Moreover, any slight savings in personnel cost might be offset by the high cost of poor nurse and patient outcomes associated with overtime, as extensive research has demonstrated that

overtime is associated with nurse burnout, turnover, and poor patient outcomes.²³

The findings of this study also shed light on the cost of using supplemental RNs from an institutional perspective. We identified cost thresholds for nursing personnel costs with regard to using supplemental nurses compared with no use of supplemental nurses (use of only permanent nurses). As demonstrated in our analysis, the cost-efficiency of using supplemental RNs depends to a large extent on how much hospitals use supplemental RNs. We found that the minimal use of supplemental RNs could reduce the overall nursing personnel cost. In our analysis, the use of supplemental RNs for more than 0 and 0.2 or less hours per patient-day (equivalent to 2.8% of total RN hours per unit per quarter) reduced overall nursing personnel costs by \$6.03 per patient-day. The minimal use of supplemental RNs, which we found to be cost-efficient, more likely occurs in scenarios due to temporary needs such as increased patient acuity, patient census fluctuations, or temporary leave of permanent RNs. These findings support the hypothetical scenario of Prescott²⁴ in which using supplemental RNs to a certain degree could be a financial gain to hospitals compared with hiring more permanent RNs.

We also identified the range within which the use of supplemental RNs would confer breakeven costs. When the threshold of using supplemental RNs was more than 0.2 and 0.4 or less hours per patient-day (2.8%-5.6% of total RN hours per unit per quarter), there was no statistically significant difference in the overall nursing personnel cost per patient-day compared with no use of supplemental RNs. This finding is consistent with that of the Bloom and colleagues¹⁸ study that the nursing personnel cost was not different between hospitals that used supplemental RNs and those that did not use supplemental RNs.

Moreover, our study suggests that the higher use of supplemental RNs would yield higher overall nursing personnel cost. The nursing personnel cost was higher than that for no use of supplemental RNs when the threshold of using supplemental RNs was

greater than 0.4 hours per patient-day (>5.6% of total RN hours per unit per quarter), which would occur when the cost of using supplemental RNs exceeds the cost of new hires or overtime use. Heavy reliance on supplemental RNs to meet staffing needs was not a cost-efficient strategy. This finding is consistent with that of Hurst and Smith,³ who found that nursing costs increased with the use of supplemental RNs. By demonstrating that the cost-efficiency of using supplemental nurses can be moderated by the extent of supplemental nurse use, our findings reconcile the mixed results reported in the literature on the comparative cost of supplemental nurses.

This study provides a method that can be used by hospitals to quantify cost thresholds for the use of supplemental RNs while taking into account the existing permanent nursing staff personnel costs (including benefits and overtime). This method could be easily adopted by hospital administrators to calculate thresholds for their own hospital. As there are variations on wage levels for permanent RNs and supplemental RNs across regions and hospitals, it will be most informative to conduct cost analysis on an individual institution basis.

Study limitations warrant mention. The study was conducted in 1 large academic medical center in the United States, and generalizability to other hospitals might be limited. In addition, our data were collected from 2003 to 2006 and although current relative costs of permanent and supplemental RNs have not changed dramatically, caution should be used when interpreting the quantitative cost findings in relation to present nursing personnel costs. Nonetheless, actual nursing personnel cost data by hospital unit over time, especially for supplemental RN use, is relatively rare in the literature, and this study provides informative benchmark estimates, as well as a method for calculating cost thresholds for supplemental RN use. The underlying reasons for different levels of supplemental RN use were not examined because of lack of such data. Understanding the conditions under which sup-

plemental RNs are used to varying degrees would help further elucidate the relationship between the use of supplemental RNs and hospital nursing personnel costs. Nonovertime personnel cost data for permanent nursing staff were constructed on the basis of nursing hours and the annual average hourly wage, and benefit rates and bias might exist as the actual costs for salary and benefit were not available. Furthermore, we did not have data to include in the analysis for orientation cost and administrative personnel cost that related to recruitment and retention for permanent RNs and supplemental RNs. Finally, our study was limited in statistical power to conduct separate analyses for different types of units. Thresholds for optimal cost-efficiency of supplemental RN use might be different among different types of patient care units.

In summary, several implications are noted for hospital and nurse administrators when considering the cost consequences of using supplemental RNs. First, although the hourly personnel cost might be higher for supplemental RNs than for permanent RNs, minimal to modest use of supplemental RNs for occasions of temporary increases in patient acuity or census or short-term permanent RN shortages could be cost-efficient or breakeven. Second, heavy reliance on supplemental RNs to meet staffing needs might not be cost-efficient. Third, the use of overtime by permanent RNs might also not be a cost-effective strategy compared with supplemental RN use. A more efficient alternative strategy to heavy use of supplemental RNs or extensive overtime would be to hire additional permanent RN staff members. As this study focused exclusively on the cost and cost-efficiency of using supplemental nurses, future research is needed to identify optimal approaches in the use of supplemental RNs that would yield both cost-efficient and high quality of nursing care in hospitals. Findings from this study help clarify inconsistent findings on the cost of supplemental RN use reported in the literature and generate new hypotheses on the cost of using supplemental nurses in future research.

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