The impact of nurse/physician collaboration on patient length of stay

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Aim This study examines the relationship between nurse/physician collaboration and patient length of stay (LOS).
Background The quality of nurse/physician relationships has been shown to have an impact on patient outcomes. As the acuity level of patients admitted to hospitals continue to rise, the need for collaboratively determined care is essential for avoiding errors and promoting quality.
Methods Data were collected on four units located in two Midwest hospitals. Nurses (n = 135) were asked to complete a survey seeking perceptions of nurse/physician collaboration. The survey data were then linked with patient (n = 310) data, including LOS, diagnostic-related groups (DRG) category and other patient-specific characteristics.
Results Perceptions of nurse/physician collaboration were positively linked with actual LOS ($P < 0.001$) and inversely related to deviation from expected LOS (i.e. patient stay longer than expected) ($P < 0.01$). Patients receiving care from nurses who perceived greater collaboration were elderly and had higher levels of acuity. Longer LOS for these patients may be a result of their higher acuity level.
Conclusions and implications for Nursing Management This study found that collaboratively determined care may result in longer LOS, but could prevent complications that may otherwise go untreated. Nurse administrators must implement strategies that foster the development of nurse/physician collaboration.

Keywords: nurse, nurse/physician collaboration, patient length of stay, patient outcomes

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Introduction

One primary aspect of health care involves the processes by which structural inputs are transformed into an end outcome. Although patient outcomes are determined by numerous process and structure-related variables, the act of communication between nurses and physicians is a central activity in health care, and a failure to communicate has been linked with poor quality and patient errors. In one study by Sutcliffe *et al.* (2004), residents cited communication and patient management as the two most common factors contributing to errors and near misses. Communication failures of one kind or another were an associated or contributory factor in 64 mishaps (91%). Thus, effective communication and collaboration among health care providers is pivotal for improved patient and professional outcomes. This study examined the association between nurse/physician collaboration and the patient outcome length of stay (LOS).

Literature review

Nurse/physician relationships have been shown to have an impact on patient outcomes (Aiken *et al.* 2002, Kramer & Schmalenberg 2003, Vahey *et al.* 2004). One classic study led by primary investigator Knaus *et al.* (1986) identified a significant relationship between the presence of excellent communication and nurse/physician collaboration, and patient mortality in intensive care units (ICU). Hospitals where nurse/physician collaboration was present reported a mortality rate 41% lower than the predicted number of patient deaths (*P* = 0.001). Conversely, hospitals noted for poor communication among health care professionals exceeded their predicted number of patient deaths by 58% (Knaus *et al.* 1986). Other research has also highlighted the impact of nurse/physician collaboration on patient and professional outcomes. Specifically, greater collaboration among nurses and physicians has been shown to result in increased patient and professional satisfaction (Boyle & Kochinda 2004, Hamric & Blackhall 2007), improved quality of care (Kramer & Schmalenberg 2003, Hamric & Blackhall 2007), lower nursing turnover (Boyle & Kochinda 2004) and lower job stress (Boyle & Kochinda 2004, Hamric & Blackhall 2007).

Current research has also identified a relationship between nurse/physician collaboration and patient LOS (Friedman *et al.* 2004, Cowan *et al.* 2006). In a comparative, two group quasi-experiment, Cowan *et al.* (2006) found care provided collaboratively by physicians and nurse practitioners, through daily rounds, resulted in a significant decrease in LOS. Meyer and Miers (2005), in a similar study, noted a decrease in LOS by 1.9 days and a cost reduction of $5039 per patient when care was collaboratively determined by a nurse practitioner and physician. Narasimhan *et al.* (2006) incorporated a daily standardized goals worksheet that was used to improve the effectiveness of communication among nurses and physicians. LOS decreased significantly (6.4–4.3 days, *P* = 0.02) with the inclusion of a daily worksheet that was collaboratively completed. Similarly, Pronovost *et al.* (2003) initiated a standardized goal sheet. Although only analysed descriptively, LOS declined from 2.2 days preintervention to 1.1 days post-intervention. Furthermore, Pronovost *et al.* (2003) noted that, at baseline, only 10% of staff knew the goals for patient care for the day whereas, after implementation, the number of staff knowing daily goals exceeded 95%.

Researchers support a positive association between nurse/physician collaboration and the patient outcome of LOS (Pronovost *et al.* 2003, Narasimhan *et al.* 2006). However, the studies to date have not considered time on the unit (actual LOS) in relation to what is expected. In other words, actual days on the unit do not accurately measure the 'effectiveness' of care. LOS for a patient who deviates from what is expected for that patient provides a better measure of effectiveness in care. This study incorporated two measures of LOS – actual LOS and deviation from expected LOS – as it examines the relationship between nurse/physician collaboration and patient LOS at the patient level of analysis.

Study framework

Donabedian's Quality Outcomes Model, which incorporates three components, structure, process and outcome, into a functional, linear model, was used as the foundation for this study (Donabedian 1980). According to Donabedian (1980), health outcomes can be predicted directly by identifying specific process variables associated with health care delivery or indirectly through assessment of the process variables associated with specific structural inputs. For the purpose of this study, the process and outcome components were used to identify the association between nurses' perceptions of nurse/physician collaboration (process variable) and patient LOS (outcome variable).

Methodology

This study used a cross-sectional, non-experimental design to identify the relationship between nurses' perceptions of nurse/physician collaboration and patient LOS. Specifically, it was hypothesized that nurses' perceptions of greater nurse/physician collaboration would be associated with a decrease in actual LOS and an increase in deviation from expected LOS (i.e. patients would be discharged sooner than expected). The unit of analysis was at the patient level. Therefore, unit level data (i.e. nurse-physician collaboration) were computed at the patient level.

Sample

The study sample consisted of nurses employed and patients admitted to one of four medical/surgical units located in two Midwestern hospitals, a 900-bed university hospital and a 230-bed community hospital. The units were selected based on a set of criteria, which included employing a mix of registered nurses (RNs), licensed, practiced nurses (LPNs) and

unlicensed assistive personnel (UAP); an average LOS for patients of more than 2 days; and an average daily census exceeding 80% capacity. The four units which met the above criteria ranged in size from 31 to 43 beds, with an average daily census of 28 to 39 patients.

A total of 161 RNs and 18 LPNs were eligible for inclusion in the study. Nurses excluded from the study were those who did not deliver direct patient care. Response rates for nurses on their respective units were as follows: Unit A had 40 nurses (82% response rate), Unit B had 34 nurses (79% response rate), Unit C had 32 nurses (73% response rate) and Unit D had 29 nurses (69% response rate). The total number of nurses was 135 (76% response rate) for the entire sample.

A total of 406 patients was eligible for inclusion in the study. Inclusion criteria required patients in the study to be directly admitted and discharged from the study units during the study timeframe. Patients were excluded from the study if they were discharged to another unit in the hospital or were cared for by nurses who did not participate in the study. In sum, a total of 310 patients were included in the study sample: Unit A (81 patients); Unit B (69 patients); Unit C (70 patients); Unit D (90 patients).

For the purpose of this study, RNs and LPNs were considered in sum for all analyses, as done in previous studies examining perceptions of collaboration and communication (Unruh 2003, Forbes-Thompson *et al.* 2006). Forbes-Thompson *et al.* (2006), while examining the relationship between nursing home staffs' perceptions of organizational processes (communication, teamwork, and leadership) with characteristics of the nursing home leaders, identified no differences in perceptions of communication and teamwork between RNs and LPNs. No difference in perceptions of collaboration was noted for this study sample [$F(2, 129) = 2.04$, $P = 0.14$].

Some research has identified an increase in adverse outcomes with greater LPN hours of care. Specifically, Hendrix and Foreman (2001) found a relationship of increased LPN spending with increased decubitus costs ($P < 0.001$). For this reason, Pearson's correlation coefficients were computed to determine the relationship between nursing job category (i.e. RN, LPN) and the dependent variable LOS for the study sample. According to the analysis, there was no significant relationship between job category and either of the LOS variables. This indicates that LOS for patients in the study sample was not affected by care being provided by RNs *vs.* LPNs.

Procedures

This study was part of a larger, non-experimental study design. The purpose of the larger study was to identify how the quantity and quality of nurse staffing (as measured by hours per patient day, skill mix, education, & expertise) affect both patient outcome (length of stay) and work processes (collaboration), while controlling for several unit (environmental context) and patient-related characteristics (age, gender, severity of illness, primary diagnosis and admission source). Primary data collection occurred over a 5-week timeframe and involved three phases: (i) baseline data collection from nurses, (ii) patient enrollment and staffing data collection and (iii) post study patient data retrieval. For the purpose of this study, the baseline survey data from the nurses were used to evaluate the link between perceptions of nurse-physician collaboration and LOS. The LOS data were collected in the third phase of the study (week 5) through the retrieval of patient-specific data including, age, gender, LOS, diagnostic-related groups (DRG) code, primary diagnosis and number of comorbid illnesses.

Measures of nurse/physician collaboration

Shortell *et al.* (1991) developed an organizational assessment tool, titled Organizational Management in the Intensive Care Units, to evaluate the organization and management practices of intensive care units and their relationship to patient-severity-adjusted outcomes. Shortell's Organizational Management of the ICU Questionnaire (OMICU), which includes questions regarding leadership, coordination, communication, conflict management, team cohesion and unit effectiveness, has been widely used in the literature. Concept validity of the tool has been previously established through factor analysis. A sample of nurses ($n = 1418$), physicians ($n = 790$), ward clerks ($n = 111$) and top managers ($n = 221$) in 40 different hospitals were used to test for criterion validity. Subjects were asked to complete the OMICU and the Organizational Cultural Inventory (OCI) (Cooke & Rousseau 1988) and findings supported validity of the tool (Shortell *et al.* 1991). Specifically, a team satisfaction culture was negatively associated with avoidance ($r = -0.24$, $P < 0.05$) and forcing ($r = -0.07$, $P < 0.05$) methods of problem-solving, thus supporting discriminant validity. Furthermore, the problem-solving subscale of the survey was positively correlated with coordination, communication and a team function culture ($r = 0.40$, $P < 0.05$). Internal consistency reliability was reported with

Cronbach's alpha values for the openness (alpha 0.88) and conflict resolution (alpha 0.82) subscales well within acceptable ranges.

For the purpose of this study, two subscales of the OMICU were used: perceptions of openness in communication and conflict resolution subscales. Communication openness refers to the 'degree to which physicians or nurses are able to "say what they mean" when speaking with members of the other group, without fear of repercussions or misunderstanding' (Shortell *et al.* 1991, p. 712). The communication openness subscale consisted of four questions evaluated on a seven-point Likert scale with anchors ranging from 'strongly agree' to 'strongly disagree'. Conflict resolution, the second empirical indicator of collaboration, refers to the 'degree to which parties to a disagreement between nurses and physicians communicate actively to make sure that all available expertise is brought to bear on a problem, and that the best possible solution is developed' (Shortell *et al.* 1991, p. 712). This subscale, consisting of four questions, was also measured on a seven-point Likert scale with anchors 'not at all likely' to 'almost certain'. The two subscales were combined into an overall nurse/physician collaboration score for each of the nurses. This value was then used to determine patient-specific indexes of nurse/physician collaboration. A patient's collaboration index was calculated as the average perception of collaboration by nurses providing direct patient care during the patient's episode of care. This was completed by computing a list of nurses with direct responsibility for each patient and then averaging their perception of nurse/physician collaboration.

Internal reliability was determined for the instrument to ensure consistency among the measured items. Cronbach's alpha values computed from this study sample for the openness and conflict resolution subscales (0.92 and 0.93, respectively) provided further evidence of internal consistency.

Measure of patient LOS and deviation from expected LOS

Actual LOS and deviation from expected LOS were the two indicators of the variable LOS. Actual LOS, calculated as the actual days the patient was admitted to the unit (hours), was also used to determine the deviation from expected LOS. Specifically, deviation from expected LOS was calculated as the actual days on the unit minus the predicated days on the unit. The predicted days on the unit were determined by DRG, which were developed to define hospital case mix by grouping patients with similar clinical attributes and utilization patterns (Fetter *et al.* 1980).

In 1996, Angus *et al.* (1996) found that four individual attributes accounted for 80% of the variance identified in LOS: diagnosis, number of comorbid illnesses, admission type and discharge status. DRGs consider three of the four attributes identified in Angus's study as being predictive of LOS. Thomas and Ashcraft (1989) completed a comparative evaluation of inter-rater reliability of DRGs and four other widely used severity measures through review of medical records and discharge abstracts for patients in five hospitals. In their study, the reliability statistics calculated for the DRGs [Cohen's *Kappa* (0.879), *inter-reliability coefficient* (0.892), *gamma* (0.972) and *Tau-B* (0.872)] were significantly higher than the other patient classification methodologies that utilized essentially the same data (Thomas & Ashcraft 1989).

To ensure accuracy, cumulative claims data are reviewed to ensure that the predicted LOS value for each DRG reflects current LOS trends (Medicare & Medicaid, 2004). For the purpose of this study, the expected geometric LOS value for each of the DRG categories were identified as the predicted LOS variable. DRG distributions do not typically resemble a bell-shaped curve. Therefore, the need for transformation is required. The geometric means, rather than arithmetic means, provide a stable measure of central tendency (i.e. typical value of a set of numbers) without the need to identify and remove specific cases as outliers. A geometric mean value would be calculated by multiplying the n values and taking the nth root of the result.

Prior to analysis, the data were examined to determine if the data points were distributed around an average value in a normal pattern (i.e. bell-shaped pattern). In order to assess for normality in distribution, two tests were used to estimate normality, including skewness, the degree to which a distribution is not symmetrical and kurtosis, a measure of the extent to which observations cluster around a central point (i.e. centrality). Findings from the analysis suggest that the distribution of actual LOS was not normal: skewness (1.67, SE ± 0.138) and kurtosis (4.03, SE ± 0.276). Therefore, a log transformation was used for the actual LOS variable, thus transforming the data into a normal distribution around a central point. The log transformed LOS variable was re-tested for normality and found to reflect a normal distribution (skewness 0.064, SE ± 0.138; kurtosis −0.833, SE ± 0.276) and therefore, was used in all further analysis.

Control measures

According to a review of the literature, several characteristics must be considered for isolation of the effect of nurse/physician collaboration on patient LOS. Patient-related characteristics, including age, gender and presence of comorbid illnesses, have been linked with patient LOS. LOS have been linked to several unit-related characteristics, including admission type, admission source and unit of admission. Prior to analysis, Pearson's correlation coefficients were computed to determine the significance (if applicable) between each of the control variables mentioned above and the variables of interest (nurse-physician collaboration, actual LOS and deviation from expected LOS). Admission source and admission type were significantly correlated with actual and deviation from expected LOS. Specifically, admission type (i.e. medical or surgical) was positively correlated with actual LOS ($r = 0.114$, $P = 0.015$) and negatively correlated with deviation from expected LOS ($r = -234$, $P < 0.001$). In contrast, admission source (i.e. location prior to admission) was negatively correlated with actual LOS ($r = -0.137$, $P = 0.016$) and positively correlated with deviation from expect LOS ($r = 0.123$, $P = 0.03$). Therefore, these two variables were included as control variables in all further analyses.

Results

Sample characteristics are contained in Table 1. The nurses participating in the study, which were equally distributed between the two hospitals, were RNs ($n = 119$, 88%) and LPNs ($n = 15$, 11%). Nurses were asked to respond to questions concerning levels of education and experience. Educational levels ranged from a diploma ($n = 21$, 16%) to a master's degree ($n = 7$, 5%), with the majority of nurses having an associate degree ($n = 52$, 39%) or baccalaureate degree in nursing ($n = 54$, 40%). Years of experience varied significantly ($P < 0.001$) between RNs, who averaged

Table 1
Study sample characteristics for nurses and physicians

	Patients	Nurses
Unit A	81	40
Unit B	69	34
Unit C	70	32
Unit D	90	29
Hospital A	150	74
Hospital B	160	61
Total	310	135

10.5 years (SD ± 9.7) and LPNs who had approximately 26.8 years experience (SD ± 13.8). Self-reports of expertise also varied significantly ($P = 0.01$), from an average rating of 6.8 (SD ± 2.0) for RNs to 8.4 (SD ± 1.3) for LPNs.

Of the patients in the study sample ($n = 310$), 135 (44%) were admitted with a medical diagnosis, and 175 (56%) for a surgical diagnosis. Admission location for the patient sample were distributed equally between Hospital A (48.3%) and Hospital B (51.7%). Gender of patients was equally distributed as well (156 females and 154 males, respectively). The mean age of the study sample was 55.9 years (SD ± 18.4), the youngest patient was 17 years and the oldest was 101 years of age.

Baseline statistics, contained in Table 2, were computed for the variables of interest: nurse/physician collaboration, actual LOS and deviation from expected LOS. The collaboration index for the patients ranged from 2.38 to 6.88, with an average value of 4.34 (SD ± 0.74). Patients admitted to Unit D were more likely to receive care that was not collaboratively determined by nurses and physicians, as noted by having the lowest average nurse/physician collaboration index of 3.91 (SD ± 0.51). In contrast, patients cared for on Unit B were more likely to have collaboratively determined care by both health care professionals ($x = 4.69$, SD ± 0.67). Actual LOS on the units ranged from 0.22 to 15.9 days, with the average LOS being 2.9 days (SD ± 2.3). Deviations from expected LOS for

Table 2
Mean values for nurse/physician collaboration and length of stay

Unit	RN/MD Coll.	Actual LOS	Deviation from expected LOS
A			
X	4.17	2.67	1.05
N	80	79	79
SD	0.65	2.2	1.7
B			
X	4.69	2.83	0.46
N	69	64	64
SD	0.67	2.1	2.3
C			
X	4.48	2.86	1.76
N	68	70	70
SD	0.44	2.2	2.3
D			
X	3.91	3.11	0.82
N	85	89	89
SD	0.51	2.6	2.6
Total			
X	4.34	2.9	1.0
N	310	305	305
SD	0.74	2.3	2.3

LOS, length of stay.

Table 3

Results of the regression analysis for nurse/physician collaboration and patient actual length of stay (LOS) and deviation from expected LOS

Dependent variables	Independent variables	OLS vegression voefficients	Standardized voefficients
Actual LOS (Log)	Collaboration	0.166 (0.029)**	0.225
	Unit	0.041 (0.016)*	0.145
	Adm. source	0.028 (0.008)**	−0.199
Deviation from expected LOS	Collaboration	−0.402 (0.244)	−0.093
	Unit	−0.141 (0.159)	−0.059
	Adm. type	−0.673 (0.147)**	−0.259
	Adm. source	0.145 (0.054)*	0.177

Figures in parentheses are standard errors.
*$P < 0.01$, **$P < 0.001$.

each of the units varied from a high on Unit C ($x = 1.76$, SD ± 2.3) to a low on Unit B ($x = 0.46$, SD ± 2.3). The average deviation from expected LOS for the entire sample of patients was 1.00 (SD ± 2.3), interpreted as approximately 1 day less than the expected LOS value.

Results of the regression analysis are depicted in Table 3. According to the analysis, perceptions of nurse/physician collaboration were positively related to actual LOS (log transformed) and inversely related to deviation from expected LOS. Specifically, an increase in perception of nurse/physician collaboration by one point will multiply the actual LOS (log) by 1.12 [95% CI(b) = 0.59–0.173]. Therefore, an increase in collaboration by one point will result in an increase in actual LOS by 12% ($P < 0.001$). In a second analysis (dependent variable deviation from expected LOS), an increase in collaboration by one point was linked with a decrease in deviation from expected value of 0.42 (i.e. patient on the unit longer than expected).

The collaboration variable in the first model (with dependent variable actual LOS-log) was significant ($P < 0.001$). Control variables in both of the models were significant predictors of LOS (i.e. unit, admission type and admission source) ($P < 0.01$). Variance in LOS explained by the models was 9% ($P < 0.001$) for actual LOS and 8.8% ($P < 0.001$) for deviation from expected LOS, respectively.

Discussion

The purpose of the study was to examine the relationship between perceptions of nurse/physician collaboration and patient LOS. Specifically, it was hypothesized that greater perceptions of nurse/physician collaboration would be associated with lower actual LOS and greater deviation from expected LOS (i.e. patients would be sent home sooner than expected). Findings from this study found nurse/physician collaboration to be a positive predictor of actual LOS, and a negative predictor of deviation from expected LOS (unfavourable outcome).

The hypothesized relationship between nurse/physician collaboration and actual LOS was not supported. Contradictory to what was hypothesized, nurse/physician collaboration was associated with an increase in actual LOS. Bivariate analysis revealed a positive link between age and days on the unit. A positive association was also drawn, using Pearson's Correlational Coefficients, between age and level of acuity ($r = 0.71$, $P = 0.01$). Based on these findings, patients in this study who had a greater LOS were more likely to be older and dealing with more than one comorbid condition. Patients who fitted into this category usually have more complicated care, requiring more interaction between nurses and physicians. The association between a higher number of days on the unit and greater perceptions of nurse/physician collaboration may be the result of caring for older, more acutely ill patients. This is supported by further testing of the sample. Specifically, a significantly higher number of patients who were older than the average age for this study (i.e. greater than 55 years of age) were cared for on Unit B – a highly collaborative unit – *vs.* Unit D – a lower collaborating unit [$t(154) = 3.64$, $P = 0.00$]. Therefore, the direction of association between LOS and nurse/physician collaboration was positive, which would be expected for elderly, more acutely ill patients.

The second part of the hypothesis tested in this association identified a positive link between nurse/physician collaboration and patient deviation from expected LOS (i.e. patients were on the unit longer than expected). This hypothesis was not supported by the study findings. Originally, it was believed that collaboration would result in more timely interventions (i.e. patient assessment is more extensive as health care professionals with varying educational backgrounds are communicating patient findings with one another; treatment implementation is timelier as there is no need for explanations regarding treatment choice).

In this study, an increase in perceptions of nurse/physician collaboration, on average, resulted in a decrease in the deviation from expected LOS value (i.e. negative outcome), when accounting for differences in admission type and source. When nurses and physicians collaboratively develop and implement treatment plans, patients may receive high quality of care (Nakanishi *et al.* 2006) and will return to their optimal level of well-being in a timely fashion (i.e. as predicted). When care is determined collaboratively by nurses and physicians, it is possible for earlier detection of potential complications that, if not treated may result in re-admission to the hospital. Greater insight would be gained by examining the relationship between nurse/physician collaboration and the development of specific complications (i.e. infection, falls, pressure ulcers), which may or may not impact LOS.

Limitations

Several limitations were identified in this analysis, including generalizability, inclusion of short stays and inability to identify actual levels of collaboration. Generalizability is limited to similar medical/surgical acute care units with similar nursing and patient characteristics, although study methodology and data collection were consistent among the study sites. Further research is needed for generalizing beyond the sampling frame.

Second, inclusion of patients who had very low LOS values is a limitation of the study. Sixty-five patients (21%) had a LOS of less than 1 day or less than 24 hours. Inclusion of patients with short stays may have skewed the findings.

The final limitation resulted from the inability to determine actual nurse/physician collaboration levels for each enrolled patient. The collaborative values identified for each patient are primarily **perceptions** of collaboration held by the nursing staff. Further research focusing on identifying **actual** collaborative interactions, although difficult to capture, would provide greater insight into its significance and role in improving patient and professional outcomes.

Summary and implications for nurse managers

Greater perceptions of nurse/physician collaboration were associated with longer actual LOS and greater deviation from expected LOS (negative outcome). The longer LOS may have been appropriate for the patients that were on the units longer as a result of their level of acuity and age. Discharging patients early may result in higher readmission rates (Dobrzanska & Newell 2006). Collaboration between nurses and physicians may foster earlier detection of complications that may result in an extra day in the hospital, but if not identified, would have resulted in a negative outcome for patients and a greater financial burden.

Nurses on the frontline must continue to use their time at the bedside efficiently, prioritizing direct care activities and openly communicating with other health care professionals. Current research has provided evidence that collaborative relations among nurses and physicians result in improved patient outcomes and less fragmentation of care. Nurse administrators will need to hire and retain nurses that share this commitment toward inter-disciplinary collaboration. Administrators will need to identify strategies aimed at eliminating barriers set by the current culture, and that expedite the development of a team-centred culture supporting collaborative relations among health care professionals. Only then, will the true benefits of collaborative relationships be seen.

Acknowledgements

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