Project Title: **Effects of Patient Turnover on Nursing Care and Patient Outcomes in Acute Care Hospital Settings**

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A. STRUCTURED ABSTRACT

Purpose: The purpose of the study was to examine the effects of patient turnover on nursing care and patient safety in various types of inpatient units and hospitals.

Scope: We performed data analyses using national samples, including 1,940 hospitals used for hospital-level analyses and 694 units in 107 hospitals used for unit-level analyses.

Methods: A correlational, descriptive design was used. We performed a secondary data analysis of observational, cross-sectional data from national samples of hospitals in the U.S. using 2018 data derived from the Centers for Medicare and Medicaid Services Hospital Compare, the American Hospital Association, and the National Database of Nursing Quality Indicators. We used descriptive statistics to assess patient turnover by hospital and unit characteristics. We also used multivariate regression to estimate the effects of patient turnover on work conditions, practice environments, and patient and nurse outcomes.

Results: We found that patient turnover significantly differed by hospital and unit characteristics. Hospital size, safety-net status, and unit type showed greater impacts on patient turnover at both hospital and unit levels. Units with high patient turnover showed poorer work conditions despite having more nurses who reported extra work hours due to their busy unit. In contrast to our hypothesis, higher patient turnover rates in hospitals were associated with better patient outcomes, better nurse outcomes, and better practice environment. We found that more RNs were needed when hospitals and units had high patient turnover. Higher RN staffing was associated with better job satisfaction and better perceived quality of care.

Key Words: Inpatients, patient turnover, patient safety, patient outcomes, nurses, workforce

B. PURPOSE

The overall purpose of the project was to examine the effects of patient turnover on nursing care and patient safety in various types of inpatient units and hospitals. The specific aims of the project are listed below.

Aim 1: To assess variations in hospital and unit characteristics (e.g., hospital size, teaching status, safety-net status, patient case mix, and unit type) and nurse staffing associated with hospital and unit patient turnover.

Aim 2: To determine the effects of unit patient turnover on unit nurses' work conditions, practice environments, and nurse outcomes after adjusting for other organizational factors (i.e., hospital/ unit characteristics and nurse staffing). For this aim, the following two hypotheses were tested.

- Hypothesis 1: Higher unit patient turnover will be associated with nurses' poorer work conditions (i.e., more overtime and higher workload) and poorer practice environments.
- Hypothesis 2: Higher unit patient turnover will be associated with poorer nurse outcomes (i.e., lower job satisfaction, higher intent to leave, more missed care activities, poorer care coordination, and poorer perceived quality of care).

Aim 3: To determine the effects of hospital and unit patient turnover on patient outcomes, after adjusting for other organizational factors. For this aim, the following two hypotheses were tested.

- Hypothesis 3: Higher hospital patient turnover will be associated with lower patient satisfaction and higher readmissions, mortality, and healthcare-associated infection rates.
- Hypothesis 4: Higher unit patient turnover will be associated with more pressure injuries and falls.

The overview of the conceptual framework used in this project is displayed in Figure 1.

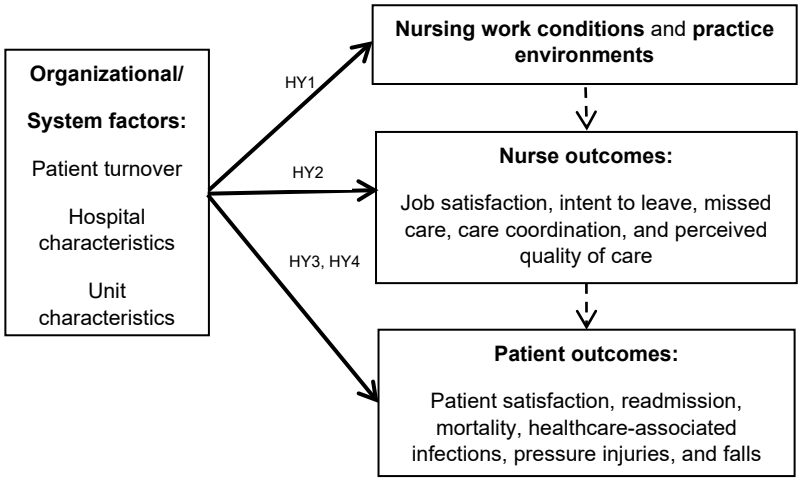

Figure 1. Conceptual framework of patient turnover and quality of care

C. SCOPE

C.1. Background and Context

Patient turnover refers to patient churn or throughput generated by admissions, discharges, and transfers (ADTs) of patients.[1,2] A high patient turnover rate on units or in hospitals increases care demands and the workload of nurses, thereby affecting patient safety and care quality. Therefore, hospital and nursing administrators, healthcare providers, policymakers, and researchers must pay more attention to the potential negative impact of higher patient turnover environments on patient safety and quality of nursing care.

Due to traditional volume-driven payment systems (e.g., fee-for-service and capitation payment models) as well as current financial penalties for poor performance and preventable hospital-acquired conditions, hospitals have faced overwhelming challenges in cost containment. In order to reduce costs and increase revenues, hospitals have improved operational efficiency and shortened the duration of patient stays, resulting in a greater patient turnover rate.[3,4] A study examining hospitals in Massachusetts showed an increase in patient volume accompanied by a consistent and significant rise in patient turnover.[5] As a result of the rising trend of patient turnover, hospitals will continue to be occupied by sicker patients who are treated and discharged more rapidly but have greater care needs.[3] Simultaneously, safety and quality of patient care will remain critical for this “sicker-and-quicker” patient population because payment systems, mostly initiated by the Centers for Medicare and Medicaid Services (CMS), continue to impose financial penalties on poorly performing hospitals in an effort to improve quality of care and patient safety and reduce preventable hospital-acquired complications and readmissions.[6]

Nurses comprise the largest group of healthcare providers in hospital settings. In addition, they are essential for enhancing patient safety and care quality.[7,8] Nurses are actively involved in care processes needed for completing ADTs, the components of patient turnover. According to a time-motion study, each ADT event added 1 to 1.5 hours to a nurse’s workload.[9] In a survey study[10] of 864 nurses, patient turnover had the second-highest impact on nursing workload, after work interruption. To admit, discharge, or transfer patients, nurses must perform several demanding activities in a short period of time.[11,12] For admissions, nurses typically perform a health history, patient assessment, and implementation of prescribers' orders, as well as patient and family education and orientation to the nursing unit. The process of discharge involves a substantial quantity of patient and family education regarding diet, activity, medications, equipment, and follow-up care plan. Nurses play a crucial role in coordinating care with other professionals and departments for the discharge and transfer processes. ADT processes also require time-consuming documentation.

Despite the increased demand for nursing care in situations of high patient turnover, hospital administrators and researchers have given little consideration to nursing workload resulting from these ADT activities when projecting nurse staffing levels necessary to provide safe and high-quality patient care.[13-15] During their shortened hospital stays (4.6 days on average[16]), patients experience an average of 2.26 transfers within the hospital,[17] indicating that unit-level length of patient stay would be shorter than 4.6 days. In addition, the number of observation patients on inpatient units is growing. The volume of patients for procedures or observational care on inpatient units contributes to an increase in patient turnover rates in inpatient settings. Observation patients frequently spend fewer than two midnights in hospitals for procedures or observational care (less than 24 to a maximum of 48 hours).[18]

According to a study analyzing data of 43,853 hospitalization stays at a single facility, approximately 10.4% of hospitalizations were observation patients.[19] These statistics indicate a high rate of patient turnover on units in inpatient settings as well as a potential increase in nursing workload to care for patients who stay on a unit for a short period of time, with rapid and frequent movements during their patient stays.

Concerns about the negative impact of high-turnover environments on the safety and efficacy of patient care are growing.[3] On units with high patient turnover, nurses provide a greater amount of care within shorter periods of time. High patient turnover requires that nurses complete ADTs while continuing to provide nursing care to their other assigned patients with ongoing care needs. Consequently, high patient turnover can result in interruptions and fragmentation of patient care for remaining patients, which may impact the safety and quality of care provided on these units. In other words, high patient turnover can eventually compromise the nurse's ability to provide safe and high-quality care,[10,20] for example, by failing to provide the remaining patients with adequate nursing care required for fall prevention and pressure injury (formerly known as ulcers) prevention and treatment due to lack of time or increased workload for nurses.

Researchers have emphasized that high patient turnover in hospitals or on units may have a negative impact on nursing workload, thereby reducing the ability to provide safe and high-quality patient care.[20-22] However, previous studies did not provide comprehensive understanding of patient turnover in hospital inpatient settings because they focused on limited outcome measures, were primarily quality improvement projects based on small sample sizes, or used data from a single or few units or hospital settings.[9,10,23] We found a lack of empirical evidence specifically on the effect of patient turnover on nursing work conditions, practice environments, and patient and nurse outcomes. Therefore, this study will contribute significantly to our body of knowledge by establishing empirical evidence on the effects of patient turnover at both the hospital and the unit levels using nationally collected data.

As noted, this study was to investigate the effects of patient turnover on nursing care and patient safety in inpatient units and hospitals with the following specific aims:

- Aim 1: To assess variations in hospital and unit characteristics and nurse staffing associated with hospital and unit patient turnover.
- Aim 2: To determine the effects of unit patient turnover on unit nurses' work conditions, practice environments, and nurse outcomes after adjusting for other organizational factors.
- Aim 3: To determine the effects of hospital and unit patient turnover on patient outcomes after adjusting for other organizational factors.

C.2. Settings and Participants

We focused on inpatient care settings while excluding outpatient care settings, such as emergency departments and ambulatory care settings, because this study was aimed at examining patient turnover in inpatient care settings, and our patient outcome indicators obtained from the CMS Hospital Compare were specific to inpatient care. The CMS patient outcomes indicators used in this study were captured from adult inpatients and acute care hospitals. Thus, we focused on acute care general hospitals while excluding children's, special, long-term, and psychiatric hospitals.

For unit-level analyses, we focused on five major unit types for adult patient care: critical care, step-down, medical, surgical, and medical-surgical combined units, which accounted for approximately 90% of adult care units in the National Database of Nursing Quality Indicators (NDNQI).

In this study, we used (a) hospitals (N = 3,449) that provided data to the American Hospital Association (AHA) Annual Survey of Hospitals and CMS Hospital Compare for hospital-level data analyses (Aims 1 and 3) and (b) units and hospitals (N = 862 units in 139 hospitals) that provided data to the AHA and NDNQI for unit-level analyses (Aims 1 to 3). Due to the large number of study variables, distinct subsets of the samples were used for each analysis. In this report, we will discuss the results from the samples used for multivariate regression modeling after performing listwise deletion. The samples consisted of (a) 1,940 hospitals used for hospital-level analyses (Aims 1 and 3) and (b) 694 units in 107 hospitals used for unit-level analyses (Aims 1 to 3).

D. METHODS

D.1. Study Design

A correlational, descriptive design was used. We performed a secondary data analysis of observational, cross-sectional data from national samples of hospitals in the U.S. using 2018 data derived from the CMS Hospital Compare database, the AHA Annual Survey of Hospitals, and the NDNQI database.

D.2. Data Sources/Collection

CMS Hospital Compare. Hospital Compare provides data on quality of hospital care that is publicly available and downloadable on the Hospital Compare website at https://data.medicare.gov/data/hospital-compare. Hospital Compare contains information on over 4,000 Medicare-certified hospitals in the U.S. and includes various measures of hospital care quality, utilization, and costs. We used various measures provided on the Hospital Compare website, including (1) hospital survey of patient satisfaction measured by the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) Patient Survey; (2) 30-day readmissions; (3) mortality; and (4) healthcare-associated infections (HAI) measures. CMS Hospital Compare receives readmission and mortality data from Medicare enrollment and claims data and HAI data from the Centers for Disease Control and Prevention's National Healthcare Safety Network.

AHA Annual Survey of Hospitals. The AHA Annual Survey of Hospitals is a reliable, comprehensive source for health services research, providing hospital-specific data on organizational structure, hospital facilities and services, utilization, staffing, and financial performance. We used the AHA data to obtain information on facility (hospital) characteristics, length of inpatient stay, and nurse staffing at the hospital level. For example, the data elements that were used for analyses include AHA identification number, hospital region code, state code, zip code, number of hospital beds, number of hospital inpatient days, number of admissions, hospital revenue, and full-time equivalents of nursing personnel.

NDNQI Database. Established by the American Nurses Association in 1998, NDNQI is a national repository of unit-level data for nursing environmental factors as well as indicators of patient and nurse outcomes. About 2,000 hospitals with over 21,000 units voluntarily join and participate in the NDNQI program with the goal of improving the quality of patient care as well

as their nursing work environments. Since its inception, the NDNQI has collected data on nursing-sensitive structure, process, and outcomes on a monthly and/or quarterly basis. Along with the collection of nursing quality and structure indicators, NDNQI annually surveys more than 300,000 RNs who provide direct patient care and evaluates their practice environments and nurse outcomes. We extracted unit-level patient turnover data from NDNQI database. We also obtained unit-level data on unit characteristics, nurse staffing, nurse outcomes, nursing practice environments and work conditions, and patient outcomes.

D.3. Measures

Definitions of variables and data sources are shown in Table 1. We performed hospital- and unit-level analyses. Thus, variables were measured at the hospital level or unit level or both.

Table 1. Definitions of Variables and Sources of Data

Variable	Level of Analysis	Operational Definition	Data Source
Patient turnover	Unit	Sum of the number of admissions, discharges, transfers in to the unit, and transfers out/Number of patient days with the adjustment for short-stay patients.	NDNQI
	Hospital	Inverse of the length of patient stays.	AHA
Nurse staffing	Unit	• Nursing hours per patient days; RN hours per patient days • RN skill mix measured by the proportion of nursing hours provided by RNs.	NDNQI
	Hospital	• Nursing hours per patient days; RN hours per patient days • RN skill mix. (FTEs were converted into hours while assuming 1 FTE = 40 hours per week X 52 weeks = 2,080 nursing hours).	AHA
Nursing work conditions	Unit	• Overtime: Measured as the mean self-reported overtime hours (Hours worked – Hours scheduled) and reasons that RNs worked extra hours. • Workload: Measured as the mean for the survey item “My patient care assignment was appropriate, considering both the number of patients and the care they required,” scored on a 6-point Likert scale (strongly agree to strongly disagree).	NDNQI RN survey
Nursing practice environment	Unit	Means for the overall PES-NWI and means for each PES-NWI subscale.	NDNQI RN survey
Nurse outcomes	Unit	• Job satisfaction: Mean for the Job Enjoyment Scale. • Intent to leave: Proportion of RNs who intend to leave the unit next year. • Missed care: Proportion of RNs who reported missed care for any one of 16 activities. • Perceived quality of care: Mean score of perceived quality of care.	NDNQI RN survey
		• Care coordination: Proportions of patients who received education and instructions for discharge (pending diagnostic test results, follow-up instructions, and reconciled medication). *Note. Due to insufficient sample sizes, the measures cannot be included in the regression models.*	NDNQI

Patient outcomes			
Patient falls	Unit	Total and injury fall rates measured by the number of falls per 1,000 patient days.	NDNQI
Unit-acquired pressure injury	Unit	Number of patients who acquired a pressure ulcer after arrival to the unit/total number of patients assessed in the pressure ulcer survey.	
Patient satisfaction	Hospital	Means for the nine HCAHPS measures: communication with hospital staff (nurses and doctors), responsiveness of hospital staff, pain management, communication about medicines, discharge information, and transition of care.	CMS Hospital Compare
Readmission	Hospital	30-day unplanned risk-adjusted readmission rates: Overall rates and readmission rates for five medical conditions (acute myocardial infarction, heart failure, pneumonia, chronic obstructive pulmonary disease, and stroke) and two surgical procedures (hip or knee replacement and coronary artery bypass graft).	
Mortality	Hospital	30-day risk-adjusted mortality rates: Overall rates and readmission rates for five medical conditions (acute myocardial infarction, heart failure, pneumonia, chronic obstructive pulmonary disease, and stroke) and two surgical procedures (hip or knee replacement and coronary artery bypass graft).	
Healthcare-associated infections (HAI)	Hospital	Infection rates of five HAI measures for central line-associated bloodstream infections (CLABSI), catheter-associated urinary tract infections, surgical site infections, methicillin-resistant *Staphylococcus aureus* bacteremia, and C. *difficile* laboratory-identified events.	
Hospital and unit characteristics			
Hospital size	Hospital	Categorized into small, medium, and large based on the number of licensed beds.	AHA
Location	Hospital	Urban or rural.	
Ownership	Hospital	Not-for-profit, for-profit, or government-owned hospital.	
Safety-net status	Hospital	Safety-net or non-safety-net (defined as “hospitals with an annual Medicaid caseload greater than one standard deviation above their state’s mean private hospital Medicaid caseload” [24])	
Teaching status	Hospital	Major, minor, or non-teaching	
High technology status	Hospital	Hospitals performing or not performing major organ transplants and/or open-heart surgery.	
Patient Case mix	Hospital	Sum of DRG weights for inpatient discharges divided by the number of discharges.	CMS Impact File
Magnet status	Hospital	Magnet-designated hospital vs non-magnet hospital	ANCC
Unit type	Unit	Critical care, step-down, medical, surgical, or medical-surgical. (NDNQI categorizes unit type based on acuity or type of service provided).	NDNQI

D.4. Data Analyses

Using common hospital identifiers (i.e., Medicare Provider Number and AHA Hospital Identification Number), we created two datasets: (a) a matched hospital-level dataset with hospitals in both AHA (hospital-level patient turnover, nurse staffing, and hospital characteristics data) and CMS Hospital Compare (patient outcomes); and (b) a matched unit-level dataset with hospitals in both NDNQI (unit-level patient turnover data, unit characteristics, nurse staffing, and RN survey data) and AHA (hospital characteristics).

We stripped out all identifiers after merging datasets. Before conducting analyses, data cleaning procedures were performed to ensure data accuracy and completeness. Sample characteristics (hospital and unit characteristics) were described in comparison to characteristics of all NDNQI hospitals, all hospitals in the AHA data, and all hospitals in the CMS Hospital Compare. Two-tailed tests with statistical significance set at .05 were performed. Data preparation and analyses were performed using SAS version 9.3 (SAS Institute Inc.) and Stata version 14.0 (StataCorp LP) statistical software.

Aim 1: Hospital-level patient turnover rates were described by hospital characteristics (i.e., hospital size, location, ownership, teaching status, safety-net status, high technology status, patient severity reflected in the CMI, magnet status, and hospital-level nurse staffing). Unit-level patient turnover rates were summarized by unit types (e.g., critical care, step-down, medical, surgical, medical-surgical), unit-level staffing, and hospital characteristics. Along with the overall rates of patient turnover, we conducted exploratory descriptive summaries regarding each component of patient turnover (i.e., the number of admissions, discharges, transfers on, and transfers out (ADTs)), at the unit level. Summary statistics, such as mean, median, range, and standard deviation, were used to describe patient turnover by hospital and unit characteristics. For the comparison of patient turnover by hospital and unit characteristics as well as nurse staffing (HPPDs and skill mix) correlation, t-test, ANOVA, and mixed-effects ANOVA (for unit-level analysis to take into account correlations among units within a hospital) were used. We also grouped hospitals and units into quartiles based on patient turnover levels to provide a descriptive understanding of organizational attributes that tend to characterize high-patient-turnover environments. Chi-squared tests were used to compare hospital and unit characteristics and nurse staffing across patient turnover quartiles. We performed multivariate regression to examine whether each of the hospital and unit characteristics was associated with hospital- and unit-level patient turnover after adjusting for other hospital/unit characteristics.

Aim 2: Prior to performing multivariate analyses, we described bivariate correlations between patient turnover (overall rates as well as ADTs), work conditions, practice environments, and nurse outcomes. We also conducted ANOVA to compare work conditions, practice environments, and nurse outcomes across patient turnover quartiles. Using generalized mixed models (to account for nesting of units within hospitals), we determined whether patient turnover on units was significantly associated with work conditions, practice environments, and nurse outcomes perceived by unit nurses, adjusting for covariates. We also conducted mediation analysis to examine whether work conditions and practice environments serve as mediators for the association between patient turnover and nurse outcomes. This mediation analysis was only tested when significant associations between patient turnover, work conditions and practice environments, and nurse outcomes (HY1 and HY2) were found. Along with an ordinary linear approach, we explored potential non-linear associations using quartiles of patient turnover while checking the interactions prior to performing non-linear models with smoothing splines. However, we could not find meaningful and significant results from non-linear associations.

Aim 3: Hospital-level and unit-level patient outcome indicators were examined. Prior to regression analyses with multiple independent variables, we conducted bivariate correlations between patient outcomes and patent turnover and used ANOVA to compare patient outcomes across patient turnover quartiles. We checked distributions of patient outcome indicators. Linear regression models were used to examine associations of patient outcomes with patient turnover rates if outcome indicators were normally distributed. Poisson regression models were used for count data such as falls and infections, which were reported by count of falls and infections during total patient days. Logistic regression models were used for count data (e.g., pressure injuries, which are reported by number of patients with pressure injuries among a total number of patients).

For unit-level analysis, Poisson regression modeling for falls and injury falls and logistic regression modeling for pressure injuries were used. We planned to conduct mediation analysis for unit-level patient outcome indicators to examine whether nurse outcomes served as mediators for the association between patient turnover (overall rates and ADTs) and patient outcomes. However, the mediation analysis was not tested, because associations between patient turnover, nurse outcomes, and patient outcomes (HY2 and HY4) were not significant.

D.5. Limitations

This study included the following limitations. The cross-sectional nature of the study would restrict our ability to make causal inferences among study variables. The results of unit-level data analyses with NDNQI data might not be representative of all U.S. hospitals, because NDNQI hospitals are more focused on quality improvements than non-member hospitals are. The measures of care coordination could not be analyzed due to the small sample sizes for their measures. Although we used patient Case Mix Index (CMI) as a covariate to control for differences in disease severity across hospitals, it was the only indicator for risk adjustment at the hospital level. Because the AHA data do not include information on transfers, hospital-level patient turnover was calculated using the inverse of length of patient stay (LOS) rather than being calculated based on the number of ADT elements. Although the inverse of LOS is commonly used to measure hospital-level patient turnover and shows a high correlation and substantial agreement with the measure of ADTs per daily census, which is our unit-level patient turnover, hospital-level patient turnover measured by the inverse of LOS might not capture and explain transfers within the hospital.

E. RESULTS

E.1. Principal Findings

We present results by aims.

E.1.1. Aim 1: Variations in hospital and unit characteristics and nurse staffing associated with hospital and unit patient turnover.

The means for patient turnover at the hospital level were 0.24 (SD = 0.06) and at the unit level were 0.63 (SD = 0.22). Table 2 displays a descriptive summary of patient turnover rates by hospital and unit characteristics.

Table 2. Patient Turnover Rates by Hospital and Unit Characteristics

Characteristics	Hospital-level sample (N = 1,940 hospitals)		Unit-level sample (N = 694 units)	
	M (SD)	p value	M (SD)	p value
Hospital Size				
Small	0.29 (0.07)	<.001	0.78 (0.25)	<.0001
Medium	0.23 (0.04)		0.74 (0.24)	
Large	0.20 (0.04)		0.58 (0.19)	
Location				
Urban	0.23 (0.06)	<.001	0.62 (0.21)	<.0001
Non-Urban	0.27 (0.07)		0.78 (0.29)	
Ownership				
Not For Profit	0.24 (0.06)	<.001	0.64 (0.22)	0.0248
For Profit	0.26 (0.07)		0.62 (0.06)	

Characteristics	Hospital-level sample (N = 1,940 hospitals)		Unit-level sample (N = 694 units)	
	M (SD)	p value	M (SD)	p value
Government	0.23 (0.07)		0.57 (0.24)	
Safety-Net Status				
No	0.25 (0.06)	<.001	0.66 (0.21)	<.0001
Yes	0.22 (0.06)		0.57 (0.23)	
Teaching Status				
Non-Teaching	0.27 (0.07)	<.001	0.73 (0.22)	<.0001
Minor	0.23 (0.05)		0.67 (0.23)	
Major	0.18 (0.04)		0.55 (0.19)	
High-Technology				
No	0.26 (0.07)	<.001	0.70 (0.27)	<.0001
Yes	0.21 (0.04)		0.61 (0.20)	
Magnet Status				
No	0.25 (0.06)	<.001	0.64 (0.23)	0.5390
Yes	0.22 (0.05)		0.62 (0.21)	
Hospitalist Staffing				
1st Tertile	0.22 (0.07)	<.001	0.68 (0.32)	<.0001
2nd Tertile	0.23 (0.05)		0.60 (0.21)	
3rd Tertile	0.27 (0.06)		0.72 (0.21)	
Unit Type				
Adult Critical Care			0.71 (0.25)	<.0001
Adult Step Down			0.65 (0.22)	
Adult Medical			0.52 (0.15)	
Adult Surgical			0.73 (0.25)	
Adult Med-Surg			0.61 (0.19)	
	r	p-value	r	p-value
Case Mix Index	-.35	<.001	-.14	<.001
Nursing Hours Per Patient Day	.11	<.001	.14	<.001
RN Skill Mix	-.0005	.984	.29	<.001

For the hospital-level sample, small hospitals (M=0.29, SD=0.07) had higher rates of patient turnover than large hospitals (M=0.20, SD=0.04) and medium hospitals (M=0.23, SD=0.04). Non-teaching hospitals (M=0.27, SD=0.07) had higher patient turnover rates than major teaching hospitals (M=0.18, SD=0.04). Non-safety-net hospitals, rural hospitals, and hospitals without high technology had significantly higher rates of patient turnover. Hospitals with higher patient turnover had fewer acute patients (i.e., lower case mix index scores) and higher nurse staffing levels.

Overall, the results at the unit level were consistent with those at the hospital level. However, findings regarding hospital ownership, magnet status, and hospitalist staffing were inconsistent at the hospital and unit levels. Patient turnover rates differed by unit type. Critical care (M=0.71, SD=0.25) and surgical (M=0.73, SD=0.25) units had higher rates of patient turnover than medical units (M=0.52, SD=0.15). Regarding the ADT elements, medical and surgical units had more admissions than other unit types. Critical care, step down, and surgical units had more transfers in and out. Higher RN skill mix was associated with more discharges and transfers in.

After adjusting for all other hospital characteristics, hospital size, location, safety-net status, high-technology status, and teaching status remained significant in the regression model with the hospital-level sample. For the unit-level sample, unit type, hospital size, and safety-net status were significantly associated with patient turnover after adjusting for other hospital and unit characteristics. RN skill mix was positively associated with both hospital- and unit-level patient turnover when holding other hospital and unit characteristics in the models constant.

In summary, we found that patient turnover rates significantly differed by hospital and unit characteristics; most notably, hospital size, safety-net status, and unit type (medical vs. surgical) showed greater and consistent impacts on patient turnover rates at the hospital and unit levels.

E.1.2. Aim 2: Effects of unit patient turnover on unit nurses' work conditions, practice environments, and nurse outcomes.

For this aim, we analyzed the unit-level sample and tested our hypotheses that higher unit patient turnover is associated with nurses' poorer work conditions (i.e., more overtime and increased workload), poorer practice environment, and poorer nurse outcomes (i.e., lower job satisfaction, higher intent to leave, more missed care activities, poorer care coordination, and poorer perceived quality of care). Multivariate regression models were used to examine the associations of work conditions, practice environment, and nurse outcomes with unit-level patient turnover rates, controlling for other hospital and unit characteristics.

We found mixed results. Work conditions partially supported our hypothesis; however, practice environment and nurse outcomes did not support our hypothesis, demonstrating associations in the opposite direction. As hypothesized, units with high patient turnover showed worse work conditions while having more nurses who reported working extra hours due to their busy unit. Compared to other unit types, critical care units had a greater proportion of nurses who reported working extra hours due to high patient turnover. Units with high patient turnover had more nurses who worked overtime, perceived poorer relations with managers and physicians, and perceived their unit as having a poorer practice environment; these associations were not statistically significant. Contrary to our hypothesis, nurses on units with high patient turnover reported a better practice environment in terms of the adequacy of staffing and resources. Furthermore, they perceived better job satisfaction, less missed care, and better perceived quality of care.

In the regression models, higher RN staffing levels were significantly associated with better job satisfaction and better perceived quality of care, when holding other hospital and unit characteristics and patient turnover rates constant.

E.1.3. Aim 3: Effects of hospital and unit patient turnover on patient outcomes.

We hypothesized that higher patient turnover is associated with poorer patient outcomes --- such as lower patient satisfaction and higher readmissions, mortality, and healthcare-associated infection rates at the hospital level --- and with more pressure injuries and falls at the unit level.

Thirty patient outcome indicators, downloaded from the CMS Hospital Compare website, were analyzed for Aim 3. They were risk-adjusted measures of patient outcomes that were aggregated to the hospital level, including (a) patient satisfaction measured by the HCAHPS Patient Survey; (b) 30-day readmissions; (c) mortality; and (d) healthcare-associated infections (HAI) measures. We performed multivariate regression models to examine the associations of

patient outcomes with patient turnover rates, controlling for other hospital characteristics. Overall, higher patient turnover rates in hospitals were significantly associated with lower HAI rates, lower readmission rates, and better patient satisfaction. Notably, hospital-level patient turnover rates had greater and consistent impacts on all the indicators of patient satisfaction and readmissions that were measured and reported by the CMS Hospital Compare. The associations between patient turnover and mortality were mixed, showing negative associations with mortality for acute myocardial infarction and hip/knee surgery but a positive association with heart failure mortality. In the regression models, RN staffing was not strongly associated with HAIs, mortality, and readmissions but was positively related to patient satisfaction as measured by the HCAHPS indicators.

In addition to hospital-level patient outcomes indicators, we examined unit-level patient outcomes, such as falls, injury falls, and pressure injuries, as reported by NDNQI. We found that unit-level patient outcomes were not significantly associated with patient turnover.

In summary, contrary to our hypotheses, we found that higher patient turnover rates in hospitals were associated with fewer hospital-acquired infections, fewer readmissions, and greater patient satisfaction. Hospitals with higher patient turnover showed better patient outcomes rather than signs of reduced quality of care, even after adjusting for all other hospital characteristics.

E.1.4. Additional Analysis: Effect of patient turnover on RN staffing

When analyzing the variables of our study, we found that patient turnover was more strongly associated with staffing levels for RNs than with other nursing personnel, such as non-RNs. Thus, we conducted additional analyses to determine the effect of patient turnover on RN staffing, as measured by RN hours per patient day. Higher patient turnover rates were associated with higher RN staffing levels after adjusting for hospital and unit characteristics. For each 1-standard deviation increase in patient turnover rates at the hospital level (SD = 0.06), we found an increase of 1.10 RN hours per patient day. The significant associations exist between patient turnover and RN staffing at both the hospital and unit levels. Our findings support that more RNs are required when hospitals and units have high patient turnover.

E.2. Discussion

We examined the effects of patient turnover on nursing care and patient safety in inpatient units and hospitals, using both hospital- and unit-level approaches. In this section, we will discuss our major findings and relevant strengths and limitations.

For Aim 1, we found that patient turnover rates were significantly different by unit types as well as hospital characteristics. Our descriptive and bivariate analyses consistently showed that small, rural, non-safety-net, non-teaching, non-high technology, and non-magnet hospitals had higher patient turnover rates at both the hospital and unit levels. Hospitals that typically have higher patient acuity levels (i.e., greater CMI scores), such as large hospitals, major teaching hospitals, and hospitals with high technology, showed lower rates of patient turnover. Our data support this relationship while demonstrating a moderate negative correlation between patient turnover and CMI scores (for example, higher patient acuity was associated with lower patient turnover). Hospital size and safety-net status showed greater and consistent impacts on patient turnover at both the hospital and unit levels, even after adjusting for other organizational characteristics. Unit type was another important characteristic affecting unit-level patient turnover rates. NDNQI classifies inpatient unit types based on patient acuity and population

served on a given unit. Thus, the significant effect of unit type on unit-level patient turnover might be related to patient acuity, like our findings regarding CMI and hospital characteristics and their effects on hospital-level patient turnover.

Our findings for Aim 1 help fill a knowledge gap, because little is known about how hospital and unit characteristics affect the variation in patient turnover rates. It is important to assess patient turnover rates in various types of inpatient care settings. Furthermore, it is critical to focus attention toward hospitals and units with increased patient turnover and resultant increases in care demand and nursing workload.

For Aim 2, we analyzed our unit-level data obtained from NDNQI. Importantly, we found that units with high patient turnover had worse work conditions, and nurses perceived that they worked significantly more hours because their unit was busy. This finding suggests that hospital and unit administrators should focus on nurses in units with high patient turnover to reduce their extra working hours by allocating more resources and providing better system support. However, Aim 2 hypotheses were not completely supported by our findings, because we found that higher patient turnover rates were associated with better practice environment (e.g., staffing and resource adequacy) and better nurse outcomes (e.g., job satisfaction and perceived quality of care).

Similarly, Aim 3 hypotheses were not fully supported by our findings. As hypothesized, we found that higher patient turnover rates in hospitals were associated with higher heart failure mortality rates. However, higher patient turnover rates were associated with better patient outcomes, such as hospital-acquired infections, readmissions, and patient satisfaction. Unit-level patient outcomes of falls, injury falls, and pressure injuries were not statistically significant. Patient turnover measured at the hospital level and aggregated with annual unit-level data might be less effective in capturing turnover-related demand for care and its impact on care quality. We suggest that investigating shift-level or patient-level data could be helpful for hospital administrators to better understand if patients receive care in the context of increased nursing workload resulting from high patient turnover.

Our mixed findings for Aims 2 and 3 suggest that the regression models with covariates of unit type and hospital-level CMI may not be sufficient for controlling for patient acuity levels. For this secondary data analysis study, the AHA Annual Survey of Hospitals, the CMS Hospital Compare, and the NDNQ database were used as data sources. The hospital-level analyses were based on data from 1,940 hospitals, whereas the unit-level analyses were limited to 694 units in 107 hospitals. The unit-level sample size was considerably smaller than the hospital-level sample size. In addition, hospitals and units used for unit-level analyses were NDNQI members pursuing quality improvement and who participated voluntarily in the collection of patient turnover data. Because the data collection of patient turnover indicators is not a requirement for NDNQI hospitals and units, our unit-level sample might include hospital units that were interested in the data collection due to their high patient turnover and/or existing patient turnover-related issues. Thus, our unit-level sample might not be representative to all U.S. hospitals, and it might be difficult to capture a wide range of workload, care delivery, and resource allocation issues associated with high patient turnover.

Consistent with the literature, our findings show that higher RN staffing is significantly and positively associated with patient satisfaction, job satisfaction, and perceived quality of care. Our findings also support the important role of RNs in hospitals and units with high patient turnover.

When hospitals and units have high patient turnover, increases in RN staffing rather than non-RN staffing would be beneficial. High patient turnover requires more resources, especially RNs, due to the increased demand of ADT care. Therefore, understanding patient turnover rates across hospital settings will assist hospital/unit administrators and policymakers in developing strategies to improve better care delivery and resource allocation.

E.3. Conclusions

We examined which hospital and unit characteristics were associated with hospital- and unit-level patient turnover rates. We found that patient turnover rates varied considerably by hospital and unit characteristics, especially hospital size, safety-net status, and unit type (medical versus surgical). Because their units were very busy, nurses working in units with high patient turnover were more likely to report working extra hours than were those working in lower-patient-turnover units. We also found a significant association between higher patient turnover and higher RN staffing levels. Therefore, administrators in hospitals and units should determine RN staffing levels in consideration of their patient turnover rates.

E.4. Significance and Implications

The findings from this study are important, because nurses are the key healthcare professionals for providing safe and high-quality care, a priority area at the Agency for Healthcare Research and Quality (AHRQ).[25] Even in situations having high patient turnover, nurses should be able to provide safe and high-quality care. There are growing concerns about the harmful effect of high-patient-turnover environments. However, patient turnover effects in hospital inpatient settings are understudied, and little is known empirically about these effects. Hospitals have shown a steady and significant increase in patient turnover over the past decades, and nurses have provided care services to sicker patients, who are treated more quickly despite their greater demands on care. As the first known study in this area, our study was robust and descriptive as well as important and fundamental. Our findings provided descriptions of patient turnover in hospital inpatient settings that facilitated identification of gaps in nursing care delivery, practice environment, and resource allocation for high-patient-turnover environments. Furthermore, our findings support the importance of RNs' roles in hospitals and in units with high patient turnover, as well as the importance of improving patient satisfaction, job satisfaction, and quality of care.

F. PUBLICATIONS AND PRODUCTS FROM THE GRANT

Manuscripts In Preparation:

Park, Shin Hye, Clark, Lauren, He, Jianghua., Olds, Danielle, Wambach, Karen. (2023). Hospital and unit Characteristics associated with patient turnover in acute care hospitals. Health Services Research. (In Preparation; Not Yet Submitted).

Park, Shin Hye, Clark, Lauren, He, Jianghua., Olds, Danielle, Wambach, Karen. (2023). Nursing work conditions on high patient turnover units. Journal of Nursing Management. (In Preparation; Not Yet Submitted).

Park, Shin Hye, Clark, Lauren, He, Jianghua., Olds, Danielle, Wambach, Karen. (2023). RN staffing levels associated with patient turnover in acute care hospital settings. Journal undetermined as yet (In Preparation; Not Yet Submitted).

Park, Shin Hye, Clark, Lauren, He, Jianghua, Olds, Danielle, Wambach, Karen. (2023). Effect of patient turnover on patient outcomes in acute care hospitals. Journal undetermined as yet (In Preparation; Not Yet Submitted).

Presentations:

Park, S. H., Clark, L., He, J., Olds, D. M., Wambach, K. A. (June 2022), AcademyHealth Annual Research, "Effect of patient turnover on patient outcomes in acute care hospitals," AcademyHealth, Washington, DC, United States. Poster

Park, S. H., Clark, L., He, J., Olds, D., Wambach, K. (April 2022), Midwest Nursing Research Society Annual Research Conference, "Effect of patient turnover on patient outcomes in acute care hospitals," Midwest Nursing Research Society, Schaumburg, IL, United States. Poster

Park, S. H., Clark, L., He, J., Olds, D. M., Wambach, K. A. (June 2021), AcademyHealth Annual Research, "Effect of hospital characteristics on patient turnover in acute care hospitals," AcademyHealth, United States. Poster

Park, S. H., Olds, D. M., He, J., Clark, L., Wambach, K. A. (August 2020), AcademyHealth Annual Research, "Characteristics of hospital units with high patient turnover," AcademyHealth, Boston, MA, United States. Poster

Park, S. H., Olds, D., Clark, L., He, J., Wambach, K. (April 2020), Midwest Nursing Research Society Annual Research Conference, "Hospital and unit characteristics associated with high patient turnover," Midwest Nursing Research Society, Schaumburg, IL, United States. Oral Presentation

Invited Talk:

Park, S. H. (May 2023), Center for Nursing Leadership, Healthcare Systems and Workforce, “Does High Patient Turnover Matter in Acute Care Inpatient Settings?” University of Kansas Medical Center School of Nursing & Hospitals and Organizations Affiliated with the Center. Oral Presentation.

Park, S. H. (May 2021), Asian Pacific Islander American (APIA) Heritage Month Research Day, "Hospital Characteristics Associated with Patient Turnover in Acute Care Settings," University of Kansas Medical Center. Oral Presentation.

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