Human Capital and Relational Capital in the Nursing Workforce: An Analysis of their Impacts on Patient Outcomes

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Background

- Relationship between hospital nurse staffing and quality of care is a significant concern for health services researchers, health services providers and policymakers.
- California mandates fixed unit-level minimum nurse-to-patient ratios (1:5). Other state legislatures are considering similar bills.
- Prior research has found evidence showing negative correlation between adverse patient outcomes and nurse staffing levels, but this literature has numerous limitations (discussed below). Evans and Kim (2005) concluded

that California law did not impact patient outcomes.

- **What Our Paper Contributes**
- Shifts focus from staffing levels
- Studies role played by human capital and relational capital in the nursing workforce
- Uses longitudinal nursing-unit-level data from hospitals belonging to the same organization (VA). Hence, variable definitions and data coding algorithms are nearly identical across the hospitals in our study.
- The first paper to use longitudinal data on nursing units
- **Overview of Prior Literature**
- Hospital-Level Analyses (Appendix Table A-1)
  - Generally find that nurse staffing levels are negatively correlated with adverse patient outcomes
  - BUT:

- Data do not distinguish between RNs involved in direct patient care and those employed in indirect or management roles or outpatient care
- Only two studies use longitudinal data
- Limited geographical scope (11 states at most)
- No measures of RN human capital

- **Overview of Prior Literature** (continued)
- Nursing Unit-Level Analyses (Appendix Table A-2)
  - Some evidence that nurse staffing levels are negatively correlated with adverse patient outcomes
  - BUT:
    - None of these studies used longitudinal data
    - Very limited in scope

- **Hypotheses We Test**
- RNs with more general human capital (education, experience) deliver higher quality nursing care

- RNs with more specific human capital (job tenure) deliver higher quality nursing care
- Relational capital (stability of nursing team) contributes to higher quality care because stable teams are better at sharing tacit knowledge and facilitating coordination.
- **What Are Nursing-Sensitive Patient Outcomes?**
- Agency for Healthcare Research and Quality (AHRQ)) identified nursing-sensitive patient safety indicators:
  - For ICU Patients:
    - Central line catheter-associated blood stream infection
    - Post-operative pulmonary embolism or deep vein thrombosis
    - Ventilator-associated pneumonia
  - Failure to rescue (for patients with treatable serious complications such as respiratory failure, sepsis, or pulmonary emboli)

- Decubitus ulcer (only for patients with LOS>=5 days)

Preliminary Findings

- General human capital (RNs vs LPNs) is negatively correlated with the rate of infections due to medical care
- Specific human capital (job tenure) is negatively correlated with the rate of infections due to medical care, the rate of pulmonary embolisms or deep vein thromboses, and failure to rescue rate. The first correlation holds even controlling for nursing-unit fixed effects.
- Data are only for intensive-care units and results are likely to be a lower bound on effects for more diverse units. Future work will add other types of nursing units.

Evidence on the Role of Job Tenure in Other Settings

- Black and Lynch (2001) used data on manufacturing establishments and

found that the proportion of employees with less than one year of tenure was negatively and significantly correlated with sales per production worker.

- Batt (2002) found that sales growth in service call centers in the telecommunications industry was higher in call centers with lower quit rates.
- **The Role of Relational Capital in Patient Care**
- In a study of joint-replacement patients in nine hospitals, Gittell (2002) found that *relational coordination* (an index measuring frequency, timeliness, accuracy and problem-solving nature of communication, as well as shared goals, shared knowledge and mutual respect) *was positively correlated with patient-perceived quality of care and negatively correlated with*

length of stay. Information on education and tenure of nursing staff was not provided in this study.

- **"Vignettes" Describe How RN Tenure Might Matter**
- Central line bloodstream infection
  - Inexperienced ICU nurse has difficulty assembling proper equipment in short period of time and does not remind resident to don sterile gown
- Post-operative DVT
  - Inexperienced ICU nurses do not remind physicians to write orders for certain treatments and they do not notice early warning signs of deep vein thrombosis.
- Failure to rescue
  - Inexperienced ICU nurse doesn't react quickly enough to patient's deteriorating condition.

- **Data Sources**

- Patient Safety Indicators calculated from VA discharge abstract data which have separate records for each "bed-section" stay
  - Selected Infections Due to Medical Care (assigned to first unit where diagnosis reported)
  - Post-operative pulmonary embolism or deep vein thrombosis (assigned to first unit where diagnosis reported)
  - Failure to Rescue
- Personnel and Accounting Integrated Data (PAID) System identifies nursing unit where each nurse works
  - RN hours per patient day
  - Non-RN hours per patient day
  - Percent of RN hours provided by RNs with at least a B.S.
  - Average RN tenure
  - Average RN age
  - Percent of RN hours provided by part-time RNs

Data Sources (continued)

- Patient Treatment File
  - Case-mix index based on Medicare DRG weights
  - Average age of patients
  - Number of patient-days
  - Number of discharges
  - Average length of stay in ICU

Empirical Model

$$PSI_{it} = \alpha_1(\text{RN Hrs PPD})_{it} + \alpha_2(\text{RN Hrs PPD}^2)_{it} + \alpha_3 HC_{it} + \alpha_4 \text{Non-RN Hours PPD}_{it} + \alpha_5 DRG_{it} + \alpha_6 AGE_{it} + \alpha_7 LOS_{it} + \alpha_8 \text{Discharges}_{it} + \text{Year} + \lambda_i + \varepsilon_{it}$$

HC is measured by percentage of RN hours provided by RNs with at least a B.S. degree, RN age ("experience"), RN tenure, and percentage of RN hours provided by part-time RNs.

Summary Statistics

- 2006 average rate of failure to rescue, by ICU bed section
- 2006 average rate of infection, by ICU bed section
- **Table 2**
  Correlations

- **Table 3**
  Dependent Variable: Rate of Infections
  OLS Regressions (Robust std. errors in parentheses)
- **Table 4**
  Dependent Variable: Failure to Rescue Rate
  OLS Regressions (Robust std. errors in parentheses)
- **Table 5**
  Dependent Variable: Rate Postop PE or DVT
  OLS Regressions (robust std. errors in parentheses)
- **Summary of OLS Results: Human Capital Variables**
- General human capital (completion of RN degree) is negatively correlated with the rate of infections
- Specific human capital (tenure) is negatively correlated with all three measures of patient outcomes. A one standard deviation increase in RN tenure is associated with a 18%

decrease in rate of infections, a 18% decrease in rate of PE/DVT, and 6% decrease in failure to rescue rate.

- **Summary of OLS Results: Other Variables**
- RN staffing has a negative but diminishing effect on infection rate.
- Non-RN hours has no effect
- Very low patient volume is associated with higher failure to rescue rate

- **Table 6:**
  Dependent Variable: Rate of Infections
  Fixed Effects Regressions (robust std. errors in parentheses)
- **Table 7**
  Dependent Variable: Failure to Rescue Rate
  Fixed Effects Regressions (robust std. errors in parentheses)
- **Table 8**
  Dependent Variable: Rate Postop PE or

DVT

Fixed Effects Regressions (robust std. errors in parentheses)

- **Summary of Fixed Effects Results**
- RN tenure negatively correlated with rate of infections and the measured impact is more than twice as large as the OLS effect.
- RN tenure is insignificant for the other two patient safety indicators.
- RN hours per patient day significant in rate of infections equation.
- **Plans for Future Work**
- Expand sample to include ICUs that have float nurses
- Expand sample to include other types of acute-care units
- Control for union membership
- Study other measures of health care quality such as 30-day mortality rate, re-admission rates and patient-assessed quality of care
- Add information from AHA survey
- Add information from RN satisfaction survey

- Construct measures of team stability to study relational capital
- Study determinants of RN turnover
- Distinguish specific human capital from job matching