Staffing Mix Efficiency and Economies of Scale in Nursing Homes

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A quantitative analysis of 14,209 U.S. nursing homes
CY2023 Q1 – CY2024 Q4

Why Study Facility Size & Staffing Mix?

- **Staffing Crisis**: RN/LPN shortages in nursing homes are unprecedented
- **Quality Driver**: Care quality directly depends on staffing composition
- **Budget Impact**: Staffing is 60–70% of operational costs
- **Policy Question**: Do larger facilities achieve better staffing efficiency?
- **Research Gap**: Size-staffing relationship unexplored in PBJ era

Theoretical Basis

Transaction Cost Economics predicts that larger organizations achieve economies of scale

Central Question: Does facility size predict more efficient staffing mix?

Our Two Hypotheses

H1: RN-to-LPN Ratio

Larger facilities have higher RN-to-LPN ratios

- Economies of scale enable specialization
- Prediction: Linear positive relationship
- Expected: 50% increase across facility sizes

H2: Contract CNA

Mid-sized facilities rely most on contract labor

- Mid-size = maximum structural vulnerability
- Prediction: Inverted-U relationship
- Expected: 8–10% peak at median size

Cross-Sectional Analysis of 14,209 Nursing Homes

- **Data Source:** CMS Payroll-Based Journal (PBJ), 8 quarters (CY2023–2024)
- **Sample:** 14,209 Medicare-certified U.S. nursing homes (94.9% retention after exclusions)
- **Primary Outcomes:**
  - RN-to-LPN ratio = RN hours per resident day ÷ LPN hours per resident day
  - Contract CNA proportion = Contract CNA hours ÷ Total CNA hours
- **Main Exposure:** Daily Resident Census (continuous measure of facility size)
- **Statistical Method:** Restricted Cubic Spline (RCS) regression with state fixed effects
- **Robustness Checks:** 6 pre-specified sensitivity analyses (outlier thresholds, minimum census variations)

Geographic Coverage: 52 states and territories; Mean facility size: 79.9 ± 38.6 residents/day

Study Sample Characteristics

Facility Size (Resident Census):

- Mean: 79.9 ± 38.6 residents/day
- Median: 75 [IQR: 51–101]
- Range: 20–276 residents/day

Staffing Hours per Resident Day:

- RN: 0.315 ± 0.229 hrs
- LPN: 0.636 ± 0.387 hrs
- CNA (Direct): 1.630 ± 0.853 hrs
- CNA (Contract): 0.115 ± 0.192 hrs

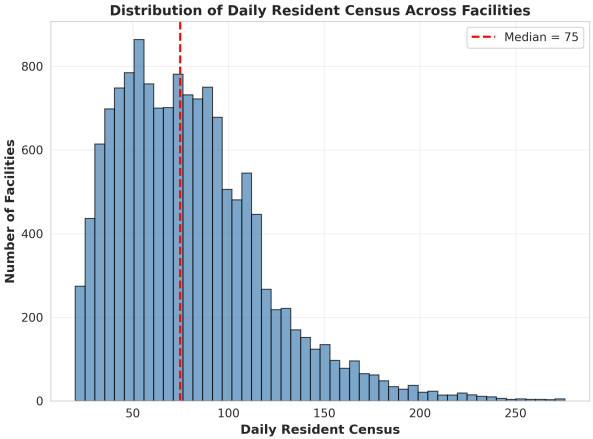

Figure: Distribution of Facility Size

H1 Results: RN-to-LPN Ratio by Facility Size

HYPOTHESIS CONTRADICTED

- Larger facilities have LOWER RN-to-LPN ratios (opposite of prediction)
- Coefficient: $\beta = -0.00697$ per 10-resident increase
- p-value: 0.005 (highly significant)
- 95% CI: $[-0.0122, -0.0017]$
- Interpretation: Larger facilities employ proportionally MORE LPNs relative to RNs

Robustness: STABLE across all 6 sensitivity analyses

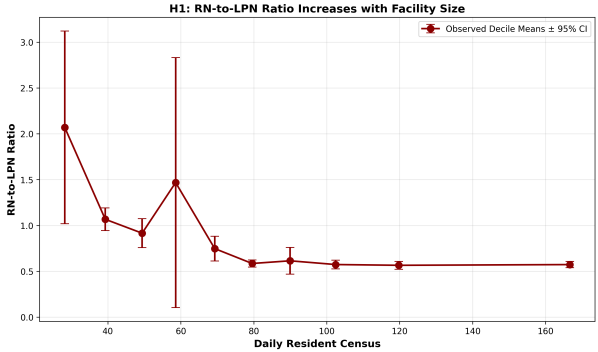

Figure: RN-to-LPN vs. Facility Size. Points = decile means; shaded = 95% CI

H2 Results: Contract CNA Proportion by Facility Size

NO INVERTED-U PATTERN OBSERVED

- Flat relationship: Contract CNA use unchanged by facility size
- Linear term: $\beta = -0.000050$ (p = 0.393, not significant)
- Quadratic term: $\beta = +0.0000003$ (p = 0.286, not significant)
- Pattern: Contract CNA approximately 5–6% across all deciles
- Implication: Facility size does NOT determine contract labor strategy

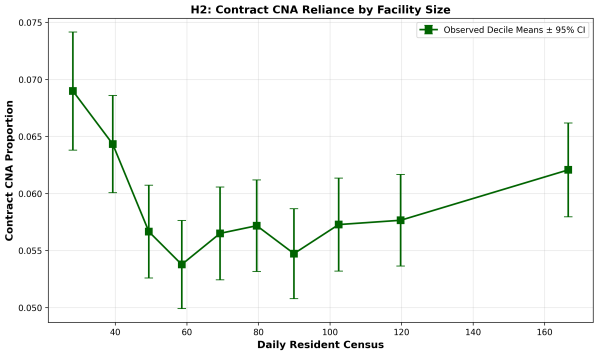

Figure: Contract CNA vs. Facility Size. Flat pattern across all sizes

Key Finding: State/geographic factors

Geographic Factors Dominate Facility Size

The Big Picture: State effects explain 11 times more variance than facility size

Variance Explained (R^2):

- Facility size alone: 3%
- State fixed effects: 12.2%
- State regulation » organizational scale

Regional Extremes (Contract CNA):

- Highest: Vermont (+10.9%)
- Maine (+6.7%), Massachusetts (+5.4%)
- Lowest: Arkansas (-6.7%)
- Range: 17.6 percentage points

State Policy Mechanisms:

- Medicaid reimbursement rates
- State staffing mandates
- Licensed labor supply constraints
- Union presence and collective bargaining
- Post-pandemic workforce dynamics

Implication: Geographic policy matters far more than facility consolidation

Discussion: Why Did Our Hypotheses Fail?

1. **Theoretical Implications**
   - Transaction Cost Economics assumptions may not hold in regulated healthcare
   - External constraints (regulation, labor scarcity) override organizational optimization
2. **Policy Implications**
   - CMS minimum staffing standards effectively prevent size-based inequality
   - State-level Medicaid reimbursement dominates facility-level decisions
3. **Practice Implications**
   - Facility consolidation strategies cannot assume staffing efficiency gains
   - RN shortage is binding constraint; facility size insufficient to overcome it
   - Contract labor reliance determined by geography, not organizational scale
4. **Study Limitations**
   - Cross-sectional design: causality not established
   - No outcome linkage: staffing composition not linked to care quality in this analysis

Conclusion & Future Directions

What We Learned:

- External regulatory and policy constraints dominate facility-level characteristics
- Staffing composition is NOT driven by facility size or economies of scale
- Geographic variation (17.6 percentage points) far exceeds facility-size effects

Critical Next Steps:

- Link staffing composition to actual care quality and resident outcomes
- Investigate causal mechanisms: regulation or labor markets?
- Examine temporal trends: How have staffing patterns evolved post-pandemic?

Call to Action:

- Use findings to inform evidence-based workforce planning
- Recognize that consolidation alone cannot solve staffing challenges
- Target policy interventions at state/regional level, not facility consolidation

Research Question Answered: Facility size does NOT predict staffing efficiency.