



A Data-Driven Case Study of Lowell General Hospital's Key Metrics

IMPROVING PATIENT CARE & OPTIMIZING
HOSPITAL PERFORMANCE

-HARI CHANDANA KESARI

INTRODUCTION

Problem Statement

Lowell General Hospital faces challenges in balancing patient care quality with resource efficiency, particularly with rising patient falls, staff responsiveness, and bed occupancy trends.

Business Impact

This impacts patient safety (falls), satisfaction (HCAHPS), and operational efficiency (bed occupancy).

Key Objectives

- Identify trends in KPIs.
- Explore correlations between occupancy, responsiveness, and falls.
- Determine statistical significance and develop data-driven recommendations.



Data Overview

DATA SOURCES

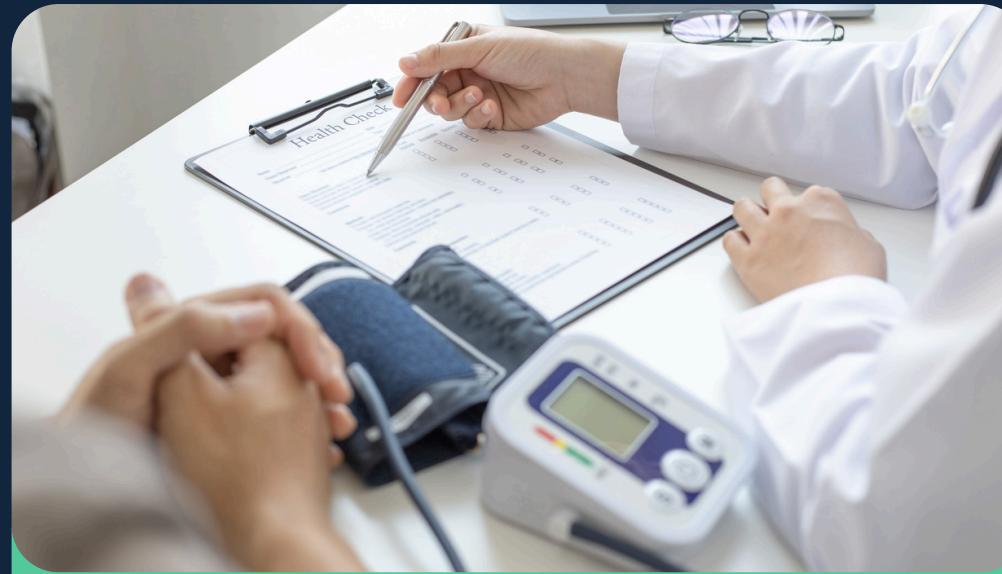
- Internal hospital records
- HCAHPS Survey (Staff Responsiveness)
- National Database of Nursing Quality Indicators (Unassisted Falls)
- Time Period Covered : January 2020 to December 2024, covering a total of 60 months of continuous tracking.

KEY PERFORMANCE METRICS



Average Occupancy Rate

The percentage of licensed beds occupied, which reflects hospital bed utilization.



Staff Responsiveness Top Box Score

percentage of patients who answered "Always" to questions about receiving immediate help when they pressed the call button or needed assistance .



Unassisted Falls per 1,000 Patient Days

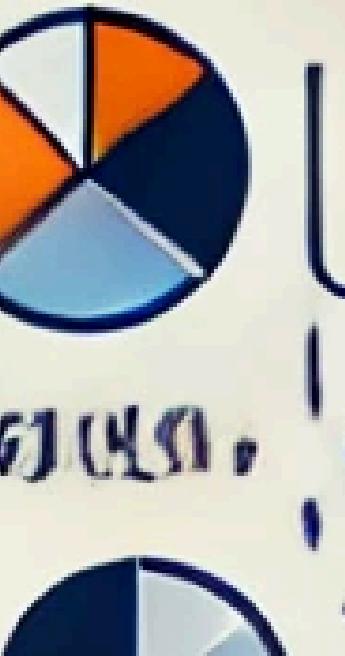
rate of unassisted falls, calculated as the number of falls per 1,000 patient days where no staff member was present.

DATA PREPARATION

- LOADING DATA
- CLEAN DATA
- HANDLE MISSING VALUES



EDA EXPLORATIVE



EXPLOITIVE
DATA SATTAS
CORRALATION
INCINISTICS

METHODOLOGY

1. Data Cleaning

- Normalization of Percentage Columns
- Handling Missing Values

2. Exploratory Data Analysis (EDA)

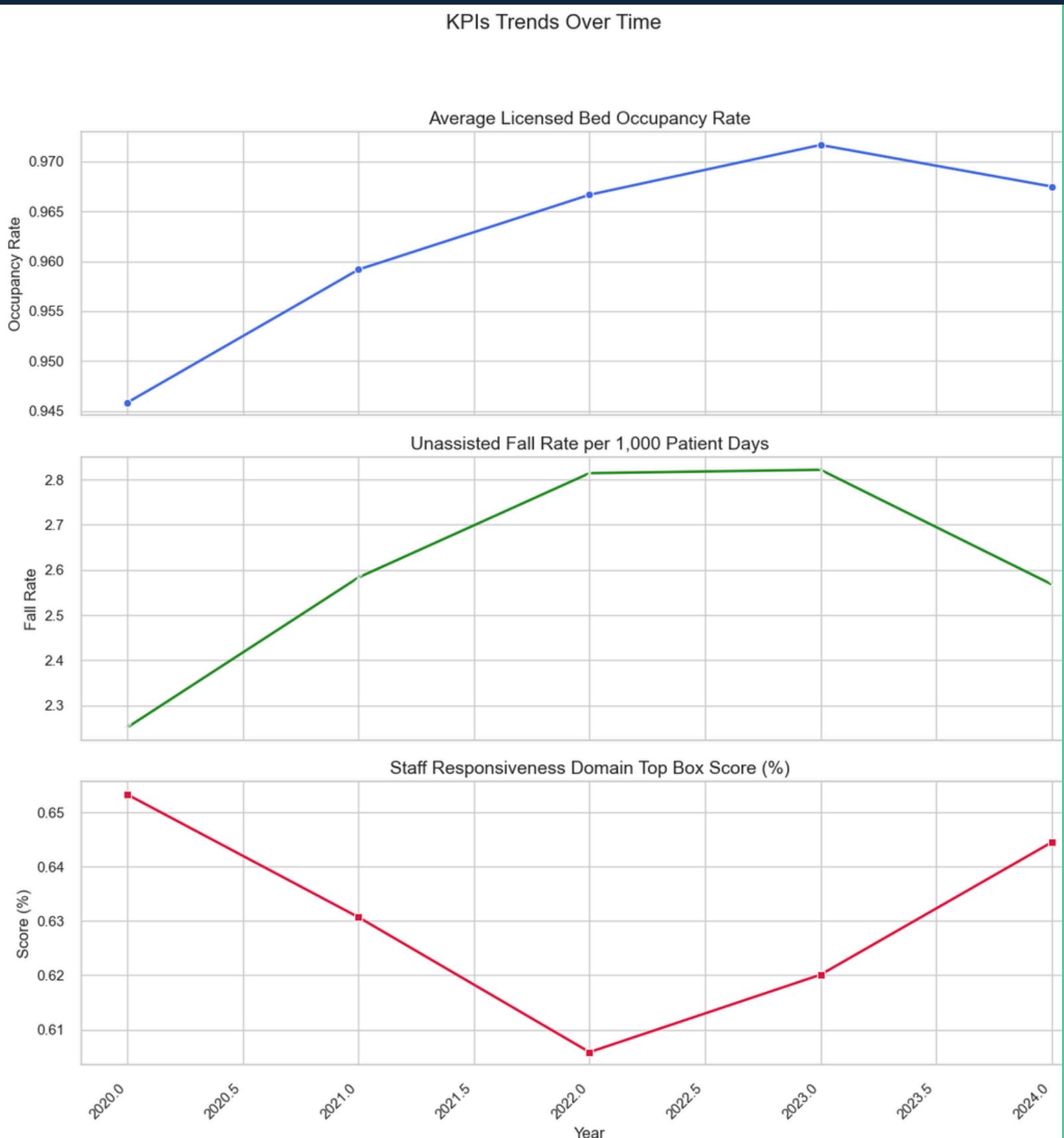
- Descriptive Statistics
- Trend Visualization

3. Statistical Methods

- Correlation Analysis (Pearson & Spearman)
- Heatmap Visualization
- Regression Analysis and Scatter Plot Visualization

Expected Relation between KPI's

Variable 1	Variable 2	Expected Relationship
Staff Responsiveness	Unassisted Falls	Better responsiveness reduces falls. (inverse)
Staff Responsiveness	Bed Occupancy	Higher occupancy may reduce responsiveness.(inverse)
Unassisted Falls	Bed Occupancy	Higher occupancy may increase falls.(direct)



KPI Trends Over Time

Bed Occupancy Rate

Steady increase from 94.5% to 97%, showing improved facility utilization but approaching capacity limits

Patient Safety

Unassisted fall rates initially increased from 2.3 to 2.8 per 1,000 patient days, but showed improvement after 2023, indicating successful safety interventions

Staff Performance

Staff responsiveness scores experienced a dip between 2020-2022 (65% to 61%) but showed recovery towards 64% by 2024, suggesting effective staff management initiatives and inverse relation between responsiveness and falls.

STATISTICAL ANALYSIS

Median and Standard Deviation of Key Metrics (2020-2024)

Year	Median of Bed Occupancy Rate	Median of Staff Responsiveness	Median of Unassisted Fall %	Std. Dev. of Bed Occupancy Rate	Std. Dev. of Staff Responsiveness	Std. Dev. of Unassisted Fall %
2020	0.95	0.67	2.26	0.05	0.06	0.64
2021	0.95	0.64	2.5	0.02	0.05	0.43
2022	0.96	0.61	2.86	0.02	0.02	0.41
2023	0.98	0.62	2.94	0.02	0.03	0.38
2024	0.96	0.65	2.67	0.02	0.02	0.45
Total	0.96	0.64	2.67	0.03	0.04	0.46

Bed Occupancy

Consistently high with minimal fluctuations (0.95–0.98, Std. Dev. 0.03).

Unassisted Falls

Steady rise, peaking in 2023 (2.26% → 2.94%) with high variability (Std. Dev. 0.46).

Staff Responsiveness

Declining trend, showing irregular recovery (0.67 → 0.61 → 0.65, Std. Dev. 0.04).

YEARLY % CHANGES OF KPI METRICS

- **BED OCCUPANCY:** SLIGHT INCREASE (+1.58%), HOSPITALS RUNNING NEAR FULL CAPACITY.
- **UNASSISTED FALLS:** SHARP RISE (+18.14%), HIGHLIGHTING MAJOR SAFETY CONCERNS.
- **STAFF RESPONSIVENESS:** DECLINED (-3.03%), WITH INCONSISTENT IMPROVEMENTS.



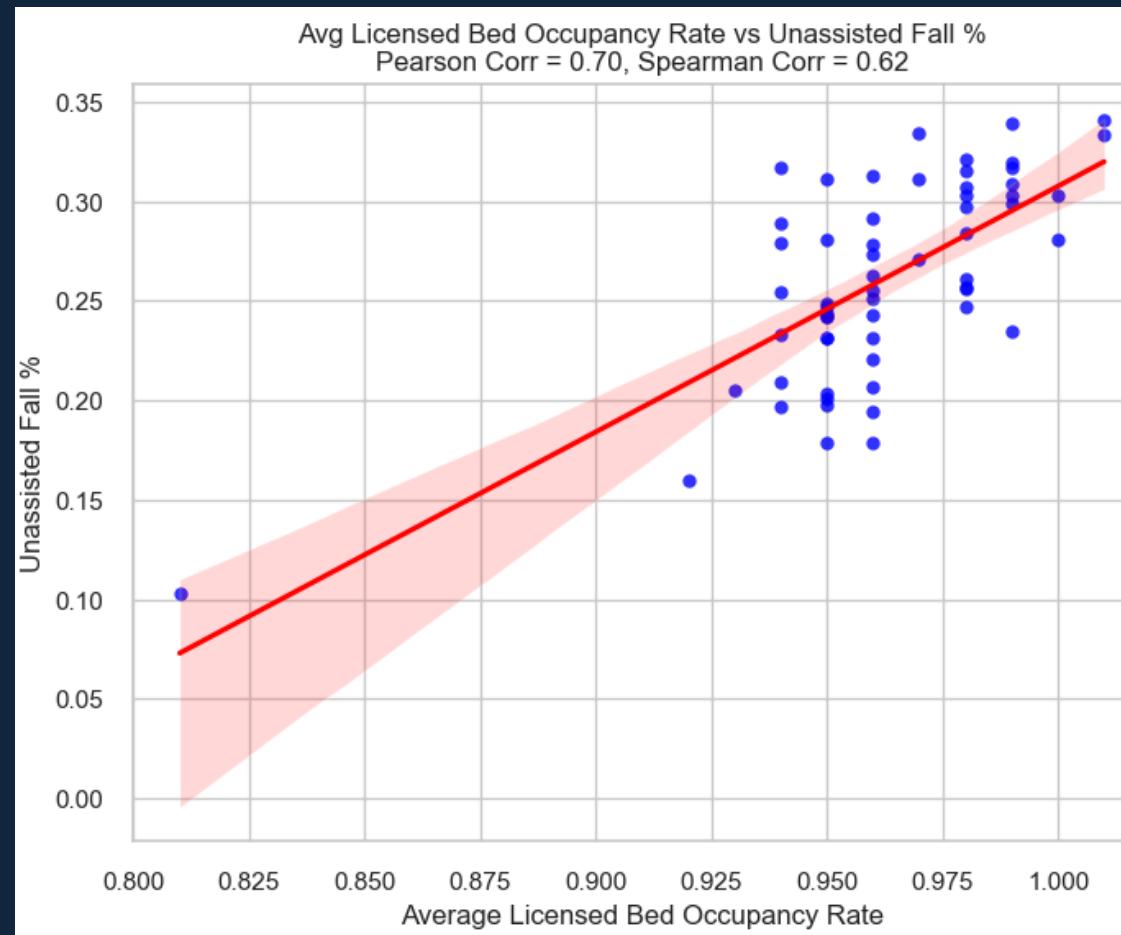
Year	Bed Occupancy Rate	Unassisted Fall %	Staff Responsiveness %
2020	0.95	2.26	0.67
2021	0.95 (+0.53%)	2.50 (+10.84%)	0.64 (-4.88%)
2022	0.96 (+0.52%)	2.86 (+14.17%)	0.61 (-5.34%)
2023	0.98 (+2.08%)	2.94 (+2.80%)	0.62 (+2.57%)
2024	0.96 (-1.53%)	2.67 (-9.18%)	0.65 (+4.99%)

KPI	Total Change (2020-2024)	Trend
Bed Occupancy Rate	1.58%	Increased
Staff Responsiveness	-3.03%	Decreased
Unassisted Fall %	18.14%	Increased significantly

ANNUAL PERCENTAGE CHANGE IN KPI'S

Overall Trends (2020-2024)

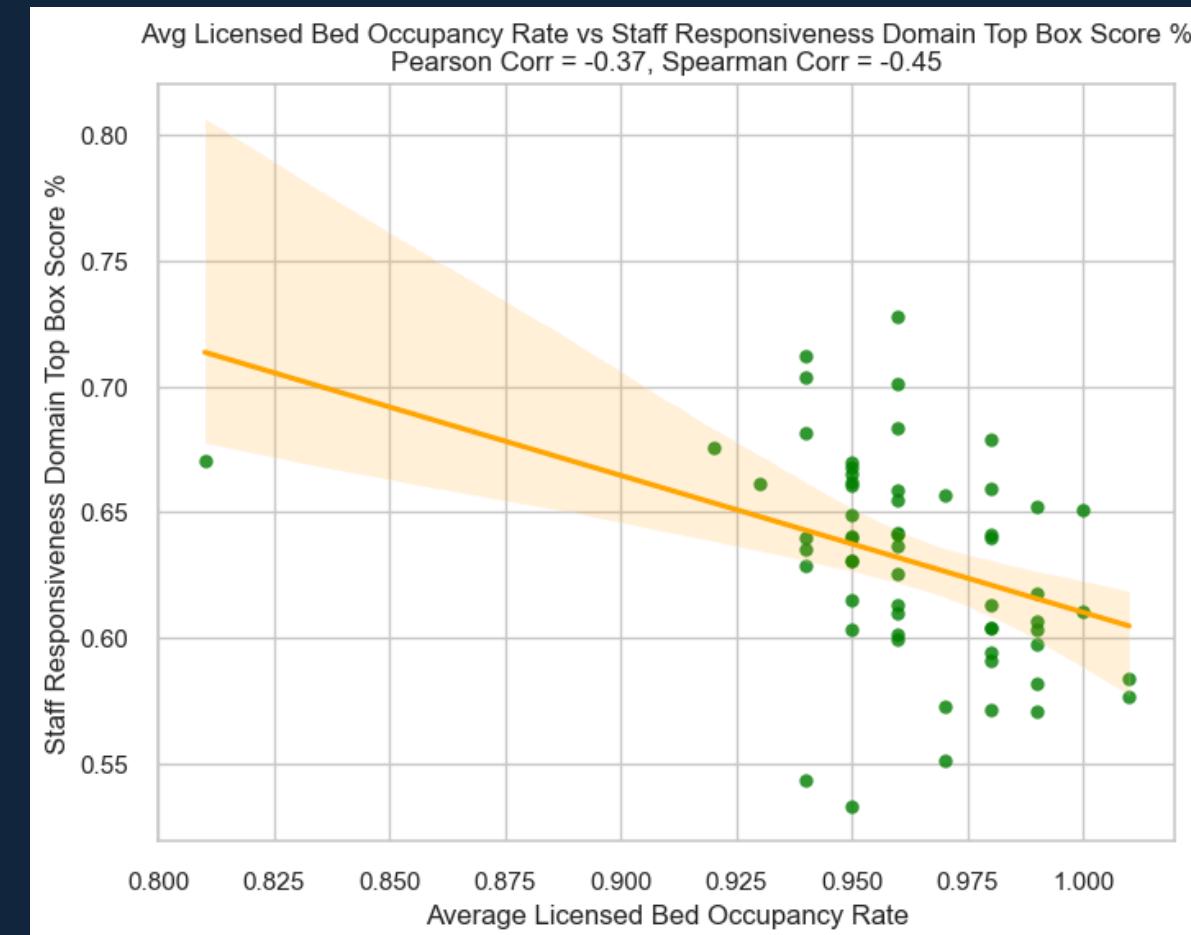
CORRELATION ANALYSIS



**Bed Occupancy vs Unassisted Falls
Positive Correlation**

Pearson (r) 0.70 | Spearman (ρ) 0.62

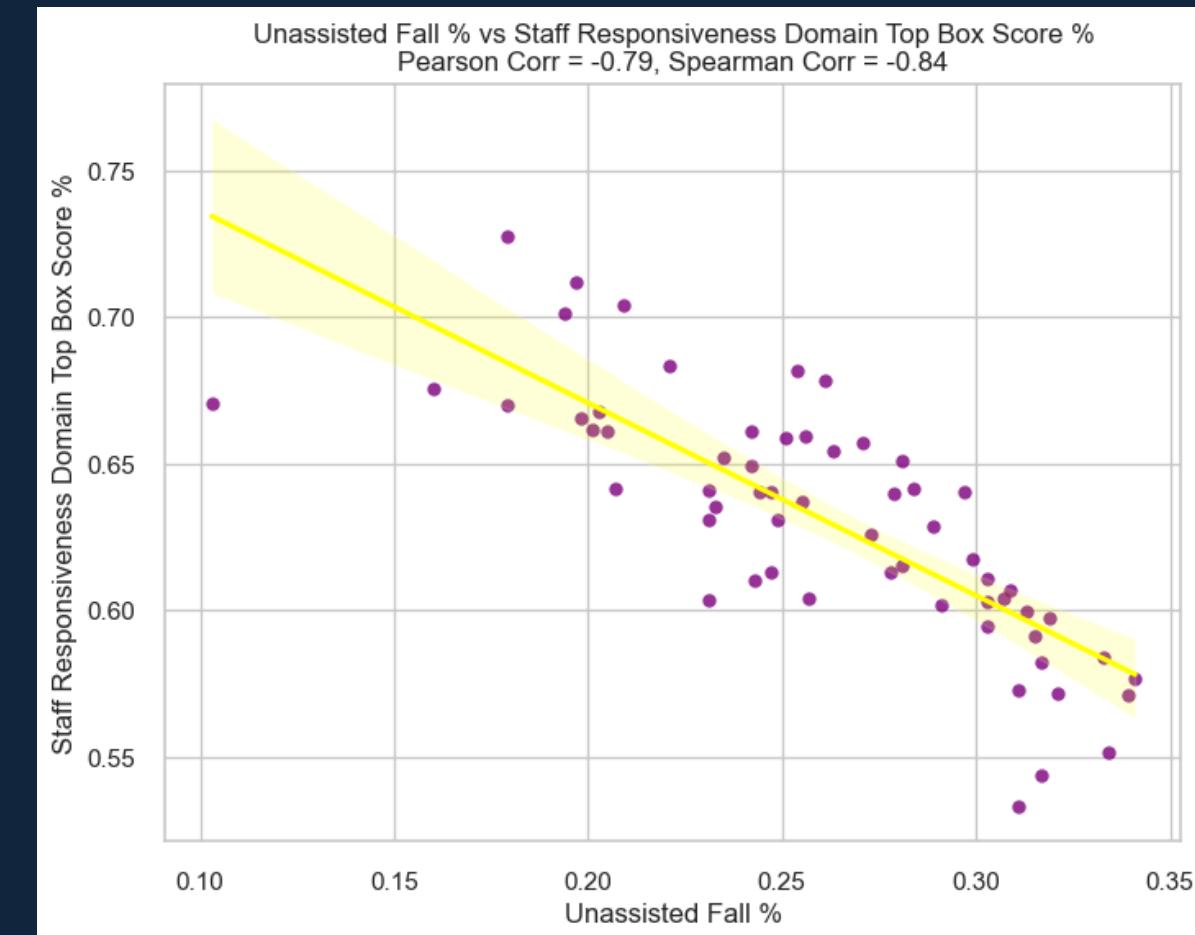
Higher occupancy rates associated with increased fall incidents



**Bed Occupancy vs Staff
Responsiveness
Moderate Negative Correlation**

Pearson (r) -0.37 | Spearman (ρ)
-0.45

Staff responsiveness slightly decreases as occupancy increases

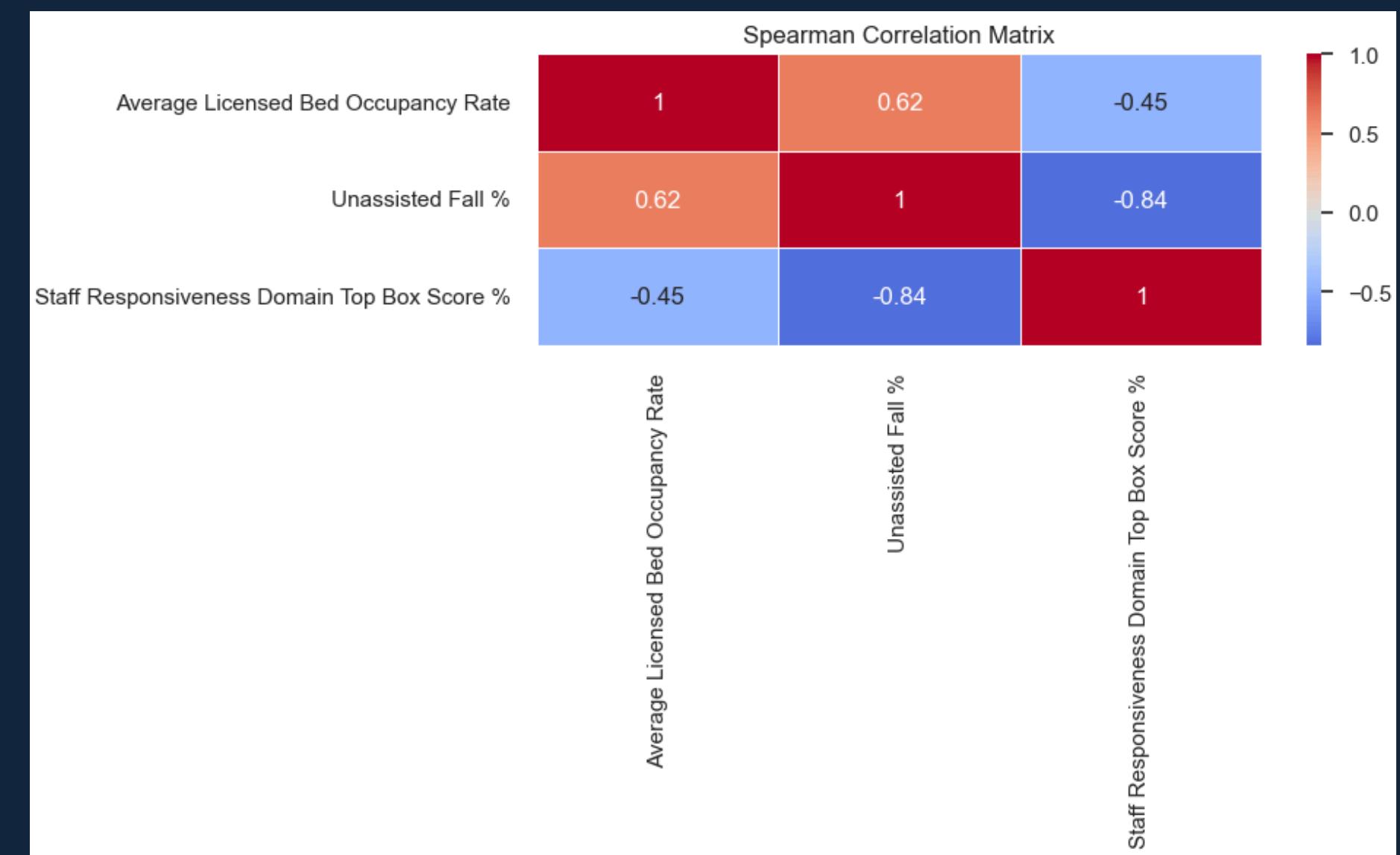
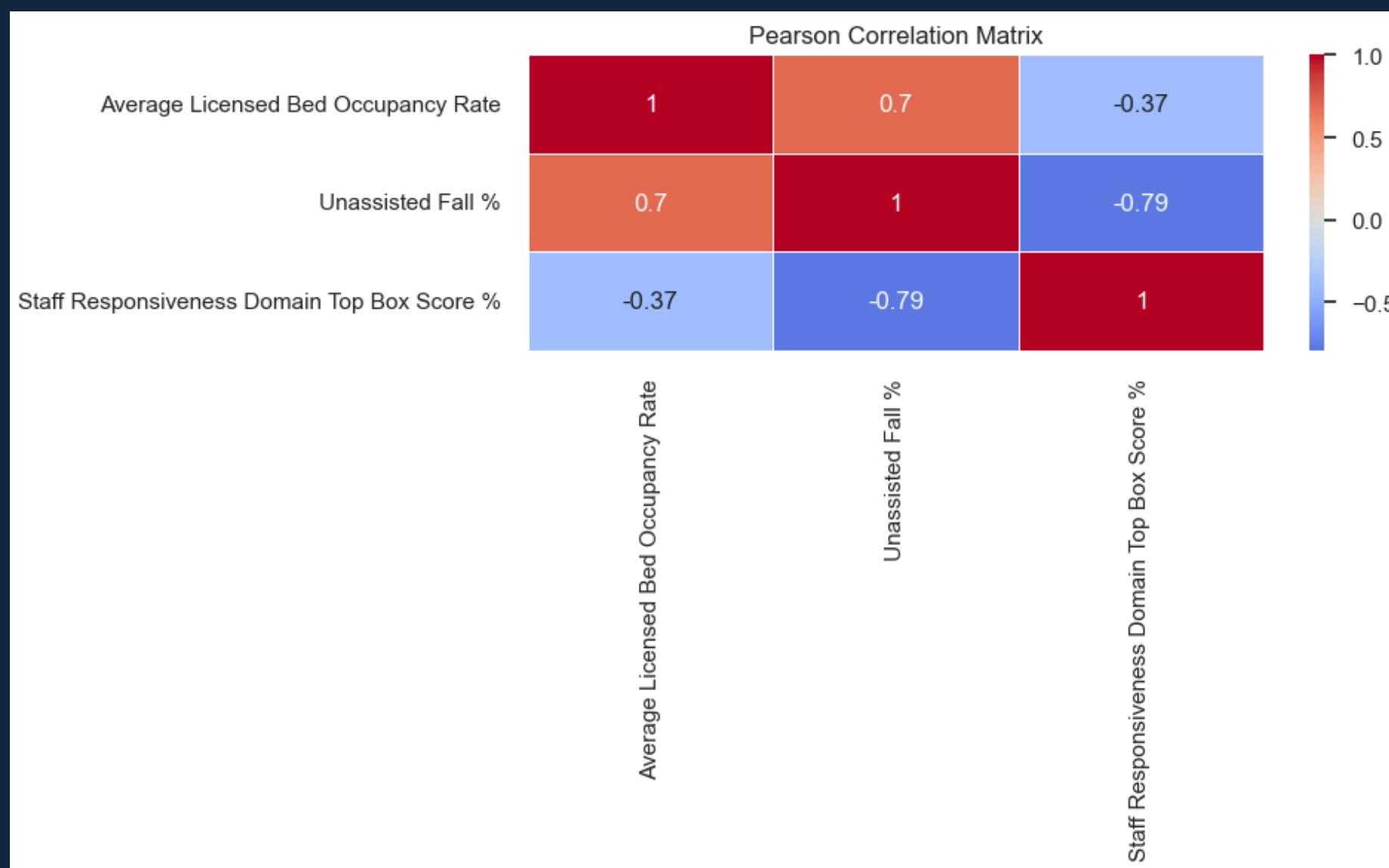


**Staff Responsiveness vs Unassisted
Falls
Strong Negative Correlation**

Pearson (r) -0.79 | Spearman (ρ)
-0.84

Higher staff responsiveness strongly associated with lower fall rates

HEAT MAP VISUALIZATIONS



Recommendations & Action Plan



Immediate Priority Actions

- Implement dynamic staffing model based on occupancy rates
- Install bed exit alarms in high-risk patient rooms
- Establish hourly rounding protocol during peak occupancy periods

Staff Enhancement Strategies

- Develop targeted training programs for fall prevention
- Create staff response time monitoring system
- Implement staff fatigue management during high occupancy

Long-term System Improvements

- Invest in patient monitoring technology
- Develop predictive analytics for fall risk assessment
- Create automated staff allocation system based on occupancy patterns

Monitoring & Evaluation Plan

- Weekly review of staff responsiveness metrics
- Monthly analysis of fall rates against occupancy levels
- Quarterly assessment of intervention effectiveness

THANK YOU