# **Metrics Documentation Report**

## **Overview**

Our analysis of temporary staffing in nursing homes is structured around five SMART questions. For each question, we have defined specific metrics (with formulas) to ensure that our analysis is both reproducible and data‐driven. This document details the formulas and data fields we will use, along with any assumptions from our domain research.

## **Question 1: Refined RN Staffing Analysis**

**SMART Question:** "What is the ratio of contract hours versus employee hours for Registered Nurses (RNs) in Q2 2024 in facilities with fewer than 120 residents?"

### **Key Metrics:**

1. **RN Temporary Staffing Ratio:** RN Ratio=Hrs\_RN\_ctrHrs\_RN\_emp+Hrs\_RN\_ctr\text{RN Ratio} = \frac{\text{Hrs\\_RN\\_ctr}}{\text{Hrs\\_RN\\_emp} + \text{Hrs\\_RN\\_ctr}}
   * *Data Fields:*
     + hrs\_rn\_ctr: Contract hours for RNs
     + hrs\_rn\_emp: Employee hours for RNs
   * *Notes:* This ratio will be computed only for facilities where the resident census (mdscensus) is less than 120.
2. **Facility Filter:** Select facility if MDScensus<120\text{Select facility if } \text{MDScensus} < 120

## **Question 2: Intra-Quarter Variation for CNAs**

**SMART Question:** "What are the short-term (within Q2 2024) changes in the ratio of temporary versus permanent staffing for Certified Nursing Assistants (CNAs), and how do these changes relate to fluctuations in the number of residents?"

### **Key Metrics:**

1. **CNA Temporary Staffing Ratio (Daily):** CNA Ratiod=Hrs\_CNA\_ctrdHrs\_CNA\_empd+Hrs\_CNA\_ctrd\text{CNA Ratio}\_d = \frac{\text{Hrs\\_CNA\\_ctr}\_d}{\text{Hrs\\_CNA\\_emp}\_d + \text{Hrs\\_CNA\\_ctr}\_d}
   * *Data Fields:*
     + hrs\_cna\_ctr: Contract hours for CNAs
     + hrs\_cna\_emp: Employee hours for CNAs
     + The subscript dd indicates that this ratio is computed on a daily (or week-by-week) basis.
2. **Resident Census Variation:**
   * *Data Field:*
     + mdscensus: Daily resident census
   * *Analysis:* Examine the correlation between the daily CNA ratio and the resident census to see if temporary staffing increases on days with higher census.

## **Question 3: Comparative Trend and Cost Correlation Analysis**

**SMART Question:** "Over Q2 2024, how do temporary staffing trends differ between direct care (nursing) and support (non-nursing) roles, and what correlations exist between these trends and extra costs such as overtime expenses, temporary staffing fees, and penalties?"

### **Key Metrics:**

1. **Temporary Staffing Ratio for Direct Care (Nursing):** Nursing Ratio=Total Nursing Contract HoursTotal Nursing Hours (Employee + Contract)\text{Nursing Ratio} = \frac{\text{Total Nursing Contract Hours}}{\text{Total Nursing Hours (Employee + Contract)}}
   * *Data Fields (example for RNs):*
     + hrs\_rn\_ctr and hrs\_rn\_emp
   * *Note:* You may also incorporate other direct care roles (e.g., LPNs, CNAs) by summing their respective contract and employee hours.
2. **Temporary Staffing Ratio for Support (Non-Nursing):** Non-Nursing Ratio=Sum of Contract Hours for Support RolesSum of (Employee + Contract) Hours for Support Roles\text{Non-Nursing Ratio} = \frac{\text{Sum of Contract Hours for Support Roles}}{\text{Sum of (Employee + Contract) Hours for Support Roles}}
   * *Data Fields:*
     + Use the non-nursing dataset fields (e.g., hrs\_admin\_ctr, hrs\_admin\_emp, etc.).
3. **Cost Correlation Metrics:**
   * **Cost Metric:** Although our current PBJ datasets do not include explicit cost fields, we plan to integrate external cost data (e.g., overtime expenses, agency fees, penalty amounts).
   * **Correlation Coefficient:** Corr=corr(Temporary Staffing Ratio,Cost Metric)\text{Corr} = \text{corr}(\text{Temporary Staffing Ratio}, \text{Cost Metric})
   * *Notes:* This metric will be computed separately once the cost data are merged from external CMS datasets.

## **Question 4: Cost Implication Forecasting**

**SMART Question:** "What are the cost differences in Q2 2024 between facilities with over 50% temporary staffing versus those with less than 50% for both nursing and non-nursing roles, and how would a 10% reduction in temporary staffing affect overall staffing costs?"

### **Key Metrics:**

1. **Facility Temporary Staffing Percentage:** Temp%=Total Temporary HoursTotal Staffing Hours (Employee + Contract)\text{Temp\%} = \frac{\text{Total Temporary Hours}}{\text{Total Staffing Hours (Employee + Contract)}}
   * *Data Fields:*
     + For each facility, sum the relevant contract and employee hours (separately for nursing and non-nursing).
2. **Grouping Facilities:**
   * Group 1: Facilities with Temp%>50%\text{Temp\%} > 50\%
   * Group 2: Facilities with Temp%≤50%\text{Temp\%} \leq 50\%
3. **Average Staffing Cost:**
   * Average Cost=mean(Staffing Cost)\text{Average Cost} = \text{mean}(\text{Staffing Cost}) per group
   * *Data Fields:*
     + Derived from external cost datasets (overtime, fees, penalties).
4. **Forecasted Cost Savings (10% Reduction):** Forecast Savings=Current Staffing Cost×Temp%×0.10\text{Forecast Savings} = \text{Current Staffing Cost} \times \text{Temp\%} \times 0.10
   * *Notes:* This formula estimates savings based on reducing the temporary staffing component by 10%.

## **Question 5: Intra-Quarter Staffing Pattern Analysis**

**SMART Question:** "What are the short-term (within Q2 2024) variations in temporary staffing levels for both nursing and support roles, and do these patterns show predictable times when staffing gaps occur?"

### **Key Metrics:**

1. **Daily Temporary Staffing Ratio (For Each Role):** Daily Ratiod=Temporary HoursdTotal Hoursd\text{Daily Ratio}\_d = \frac{\text{Temporary Hours}\_d}{\text{Total Hours}\_d}
   * *Data Fields:*
     + For nursing roles: e.g., hrs\_rn\_ctr, hrs\_rn\_emp (and similar for LPNs, CNAs)
     + For support roles: sum corresponding temporary and employee hours.
2. **Variation Metrics:**
   * **Standard Deviation (σ):** σ=1n∑d=1n(Daily Ratiod−Daily Ratio‾)2\sigma = \sqrt{\frac{1}{n} \sum\_{d=1}^{n} (\text{Daily Ratio}\_d - \overline{\text{Daily Ratio}})^2}
     + Measures day-to-day variability in the temporary staffing ratio.
   * **Time Series Analysis:**
     + Identify peak periods or predictable dips by analyzing the trend over time (e.g., using moving averages or time-series decomposition).
3. **Gap Identification:**
   * Define a "staffing gap" as a day where the temporary staffing ratio exceeds a certain threshold relative to the facility’s average or expected staffing levels.
   * *Metric Example:* Gap Indicatord={1if Daily Ratiod>Daily Ratio‾+kσ0otherwise\text{Gap Indicator}\_d = \begin{cases} 1 & \text{if } \text{Daily Ratio}\_d > \overline{\text{Daily Ratio}} + k\sigma \\ 0 & \text{otherwise} \end{cases}
     + Where kk is a threshold constant (e.g., 1 or 2).