Healthcare Utilization Analytics & Quality Improvement

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Introduction

Dataset Overview

* Time Period: October 1, 2015 – December 31, 2016
* Content:
  * Patient, nurse, and nephrologist details
  * Hospital admissions and clinic information
  * All data anonymized for privacy

Objectives

1. **Analyze Data:**
   * Use software tools (e.g., MS Excel, Python, R) for analysis
   * Apply appropriate statistical techniques

2. **Data Cleaning:**
   * Check for duplicates, missing values, and outliers

3. **Key Questions:**
   * Calculate admit and readmit rates
   * Identify factors influencing admit/readmit rates
   * Assess data quality and sample size
   * Propose operational or clinical changes
   * Determine data quality issues

Methodology

Objective: Analyze factors affecting admit and readmit rates using statistical techniques.

Software:

✶ Excel: Data Cleaning, Validation, Calculation of Admit Rate and Readmit rates.

✶ Minitab: In-Depth Analysis of Variance (ANOVA) for factors affecting admit and readmit rates

Analysis Process:

1. Rate Calculation (Pivot Tables in Excel)

   ✶ Admit Rate =
   Number of Admissions/Number of Member Months

   ✶ Readmit Rate =
   Number of Readmits/Number of Admits

2. Statistical Analysis (ANOVA in Minitab)

   ✶ ANOVA can be used to evaluate how different categorical factors affect the mean admit and readmit rates across different groups.

   ✶ ANOVA can analyze the influence of multiple factors such as modality, active access and clinic ID on the admit and readmit rates, understanding their individual and combined effects.

   ✶ ANOVA, you can ascertain whether differences in admit rates are significant among different clinics or modalities

Study Design:

✶ Control Variables: Controlled For:

   ✶ Modality, Active Access, Nurse ID, Clinic ID, SIG Level, MVP Flag

✶ Desired Factors:

   ✶ Patient Protocol Adherence Data: Adherence to medication, nutrition, treatment

   ✶ Patient Demographics: Age, gender, socioeconomic status.

   ✶ Health Conditions: Presence of other health conditions that might affect admit/readmit rates.

   ✶ Treatment Compliance: Adherence to prescribed treatment regimens.

   ✶ Insurance Type: Variations in coverage that might influence access to care.

   ✶ Geographic Location: Detailed geographic regions or differences in regional healthcare quality.

✶ Sample Size: 43,609 records

✶ Insights and Recommendations

Data Quality Issues

Data Cleaning

- Multiple empty rows (Action: Removed)

- Birth Year Discrepancies (Action: Resolved)

- Death Date Discrepancies (Action: Resolved)

- Schedule Discrepancies (Action: Resolved)

- Note: Patient ID 4 (Nurse ID & Clinic ID is increasing sequentially)

- Readmit Rule (Action: Filtered records where readmit rule was broken)

- Duplicate Records (Action: Removed duplicates) – [Patient ID 4]

- Missing Data (Action: Filtered Records)

- Patient Record 17th Shift (Action: Changed to Unknown)

Data Outliers

- Records Outside of Program Date (Action: Filtered Records)

- Records with Birth Year Outlier (Action: Filtered Records) – [1800s & 2018/2024]

- Records with Death Prior to Program (Action: Filtered records)

- Admit Outliers (Action: Filtered records)

- Readmit Outliers (Action: Kept) – [Most readmit outliers were lower numbers and were accompanied by a number of admits, indicating potential health issues with the patient]

Impact

- Re-run analysis including various outliers

- Check if data quality errors were intentionally produced

- Try "fixing" outliers or data with "errors" to check if analyses are impacted
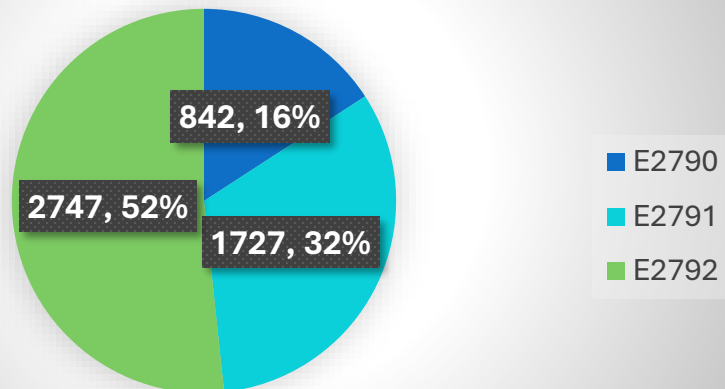
Admit Rate & Readmit Rate

Admit Rate Per Member Per Year

Geography	Sum of Admits	Sum of MM	Admit Rate
E2790	842	8315	1.22
E2791	1727	12407	1.67
E2792	2747	22887	1.44
Grand Total	5316	43609	1.46

Readmit Rate as Percentage

Geography	Sum of Admits	Sum of Readmits	Readmit %
E2790	842	197	23.40%
E2791	1727	527	30.52%
E2792	2747	833	30.32%
Grand Total	5316	1557	29.29%

Admits by Geography

- 842, 16% — E2790
- 1727, 32% — E2791
- 2747, 52% — E2792

Readmits by Geography

- 197, 13% — E2790
- 527, 34% — E2791
- 833, 53% — E2792
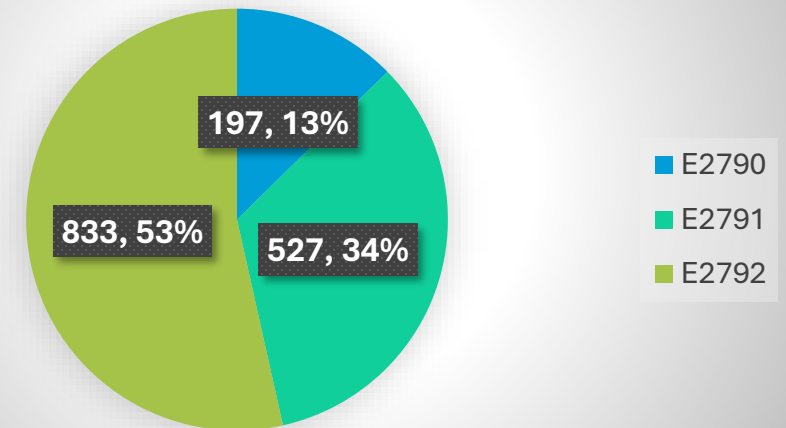
Influential Factors – Admit Rate

Significant Factors:

1. **Modality**
   - F-Value: 12.34
   - P-Value: 0.000
   - Explanation: Dialysis modality impacts admit rates due to variations in treatment complexity.

2. **Active Access**
   - F-Value: 14.08
   - P-Value: 0.000
   - Explanation: Different types of access (e.g., CVC, Fistula) influence admit rates, potentially due to management complications.

3. **Nurse ID**
   - F-Value: 2.01
   - P-Value: 0.000
   - Explanation: Variability in nurse practices affects patient admissions, possibly due to differences in care quality.

4. **Clinic ID**
   - F-Value: 1.93
   - P-Value: 0.000
   - Explanation: Clinics with different resources and practices show varying admit rates.

5. **SIG Level**
   - F-Value: 131.71
   - P-Value: 0.000
   - Explanation: Higher SIG Levels (severity) lead to more frequent admissions.

6. **MVP Flag**
   - F-Value: 1422.15
   - P-Value: 0.000
   - Explanation: MVP status significantly affects admission rates, reflecting patient vulnerability.

Model Summary:
- R-squared: 8.42%
- Adjusted R-squared: 7.88%

Key Coefficients:
- HHD (Modality): Coef: -0.839, P-Value: 0.000 (Negative Predictor)
- CVC (Active Access): Coef: 0.465, P-Value: 0.004 (Positive Predictor)
- Significant Nurse IDs: VHNID008, VHNID010
- Significant Clinic IDs: FID00008, FID00015, FID00027
- MVP Flag: Coef: 26978.8, P-Value: 0.000 (Strong Predictor)

Influential Factors – Readmit Rate

Significant Factors:

1. **Modality**
   - ✶ F-Value: 5.83
   - ✶ P-Value: 0.003
   - ✶ Explanation: Different modalities (e.g., HHD, ICHD) impact readmit rates.

2. **Active Access**
   - ✶ F-Value: 3.02
   - ✶ P-Value: 0.017
   - ✶ Explanation: Access types affect readmit rates due to complications or management needs.

3. **Nurse ID**
   - ✶ F-Value: 2.33
   - ✶ P-Value: 0.000
   - ✶ Explanation: Nurse practices impact readmission rates, reflecting differences in care.

4. **Clinic ID**
   - ✶ F-Value: 2.10
   - ✶ P-Value: 0.000
   - ✶ Explanation: Clinics vary in readmit rates due to differences in practices or resources.

5. **SIG Level**
   - ✶ F-Value: 107.03
   - ✶ P-Value: 0.000
   - ✶ Explanation: Higher SIG Levels (severity) lead to higher readmit rates.

6. **MVP Flag**
   - ✶ F-Value: 1198.86
   - ✶ P-Value: 0.000
   - ✶ Explanation: MVP status strongly impacts readmission rates, indicating high vulnerability.

Model Summary:

- ✶ R-squared: 6.94%
- ✶ Adjusted R-squared: 6.39%

Key Coefficients:

- ✶ HHD (Modality): Coef: -0.171, P-Value: 0.090 (Marginal Predictor)
- ✶ Active Access: CVC, FISTULA, GRAFT (Positive Predictors)
- ✶ Significant Nurse IDs: VHNID007, VHNID010, VHNID011, VHNID015, VHNID016, VHNID019, VHNID021, VHNID022, VHNID028, VHNID030, VHNID031, VHNID045, VHNID046, VHNID051
- ✶ MVP Flag: Coef: 4035.81, P-Value: 0.000 (Strong Predictor)

Quality Index for Enhancing Training and Protocols

Rationale: Nurse ID and Clinic ID significantly influence admit and readmit rates. Refining training programs and standardizing care protocols can reduce care quality variability and enhance patient outcomes.

Purpose: Evaluate the effectiveness of enhanced training programs and standardized protocols to improve patient outcomes and reduce variability in admit/readmit rates.

Component	Metric	Target	Measurement
Training Compliance Score (TCS)	Percentage of staff completing training	100% within 6 months	Track training completion rates and audit compliance quarterly
Protocol Adherence Rate (PAR)	Adherence to new clinical protocols	98% within 12 months	Regular compliance assessments, audits, and feedback surveys
Admit Rate Reduction (ARR)	Reduction in admit rate	10% within 12 months	Analyze admit rates by clinic and compare with baseline data
Readmit Rate Reduction (RRR)	Reduction in readmit rate	15% within 12 months	Analyze readmit rates by clinic and compare with baseline data
Clinical Outcome Improvement (COI)	Improvement in clinical outcomes	25% in high-variability clinics	Track and compare admit/readmit rates before and after protocol implementation
Geographic Performance Improvement (GPI)	Reduction in admit/readmit rate variability	20% in targeted geographies	Evaluate changes in admit/readmit rates and compare with baseline data

Implementation and Monitoring:
- **Monthly Reporting:** Track performance on each metric and report to stakeholders.
- **Quarterly Reviews:** Assess progress, identify improvement areas, and adjust strategies.
- **Continuous Improvement:** Use data to drive ongoing improvements in training programs and clinical protocols.

Quality Index for Enhancing Patient Protocol Adherence

Rationale: Monitoring and ensuring that patients adhere to their treatment schedules, attend clinic visits, manage their nutrition, and take their medication properly can significantly improve patient outcomes and reduce admit/readmit rates.

Purpose: To evaluate the effectiveness of initiatives aimed at improving patient adherence to treatment protocols, ensuring enhanced patient outcomes and reduced variability in health metrics.

Component	Metric	Target	Measurement
Treatment Schedule Adherence (TSA)	Percentage of patients adhering to treatment schedule	90% within 12 months	Track patient attendance and completion of scheduled treatments monthly
Clinic Visit Compliance (CVC)	Percentage of patients attending scheduled visits	95% within 12 months	Monitor and record attendance rates for scheduled clinic visits
Nutrition Management Score (NMS)	Percentage of patients following nutrition plans	85% within 12 months	Regular assessments and surveys to track compliance with nutrition plans
Medication Adherence Rate (MAR)	Percentage of patients taking prescribed medications	90% within 12 months	Utilize pharmacy refill data and patient self-reports to monitor medication adherence
Patient Education and Engagement (PEE)	Level of patient engagement in educational programs	100% participation in 6 months	Track attendance and participation rates in educational sessions
Self-Management Capability (SMC)	Improvement in patients' self-management skills	20% improvement in 12 months	Use patient surveys and assessments to measure changes in self-management capabilities

Implementation and Monitoring:
* **Monthly Reporting:** Track performance on each metric and provide detailed reports to stakeholders.
* **Quarterly Reviews:** Assess progress, identify areas for improvement, and adjust strategies as needed.
* **Continuous Improvement:** Use data from these metrics to drive continuous improvement in patient adherence initiatives.