A Data Analytics Perspective on Hospital Readmissions

ViZit

Background

The *Hospital Readmission* dataset represents ten years of clinical care at 130 US hospitals and integrated delivery networks. This report analyzes a dataset of 25,000 hospital records to identify risk factors associated with readmission. The study examined 17 variables in each record, with the primary outcome being readmission for any cause.

Why this dataset ?

- **Hospital readmissions:** Patients are discharged but are often readmitted within a short time, around 30 days
- **Problems associated:**
  - Costly process,
  - adversely affects patients' health and quality of life
- **Our Research:**
  - Machine learning, AI predict high-risk patients enabling proactive interventions to reduce readmissions.

Question 1

What are the key **demographic** and **clinical factors** that influence hospital readmission rates?
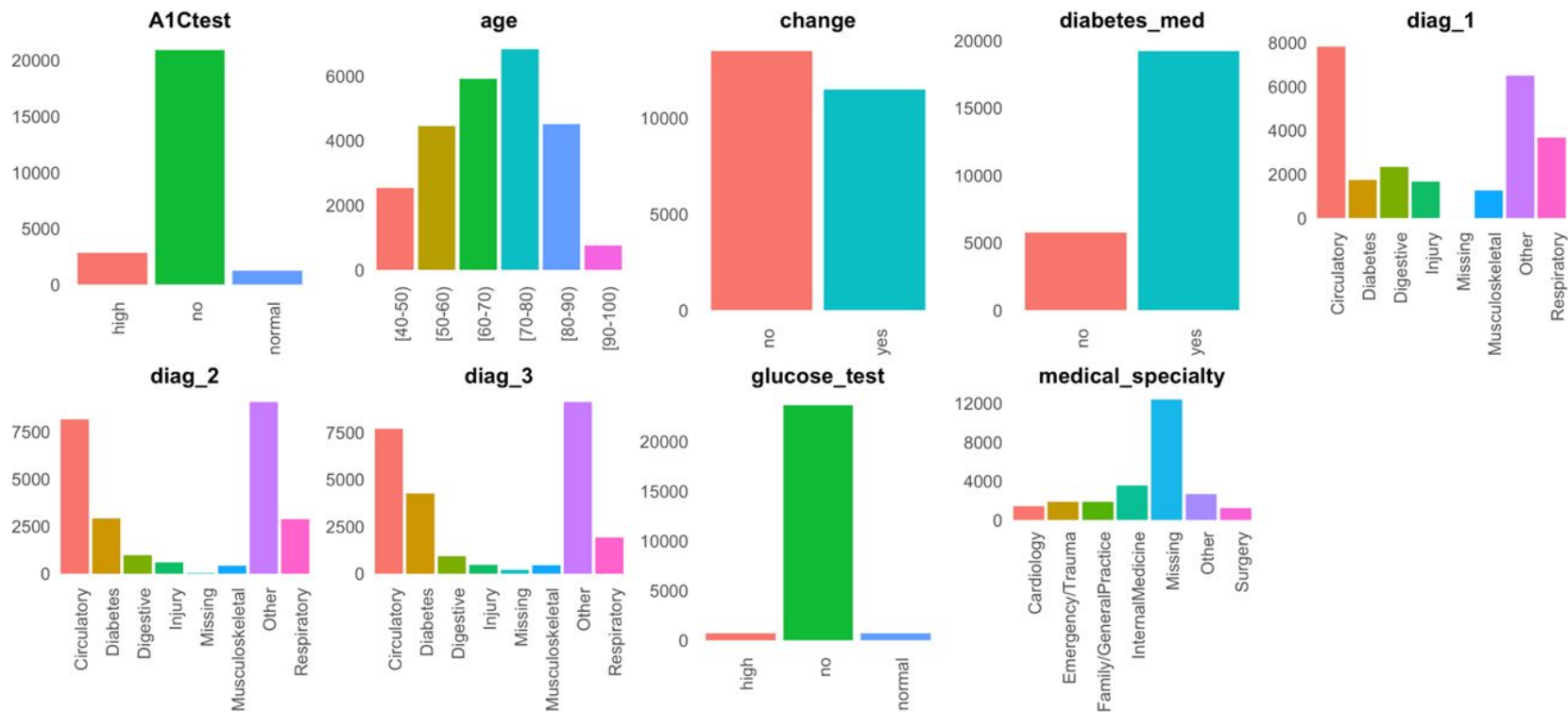
Analysis based on the previous plot

Non-Diabetes-Related Variables:

- Most frequent diagnoses:
  - **Primary/Secondary**: Circulatory issues.
  - **Others**: Respiratory and diabetes.
- Age group: Majority were **60–90 years old**.
- Patient management categories:
  - Mostly **missing** data.
 - Frequent mentions of **internal medicine**.

Diabetes-Related Variables:

- **A1C Tests**: Majority showed **elevated values**.
- **Blood Glucose Tests**: Few performed; equal split between **elevated** and **normal**.
- **Medication**:
  - **50%** had medication changed.
  - **75%** prescribed diabetes-specific medication.

Question 1

What are the key **demographic** and **clinical factors** that influence hospital readmission rates?

- Most variables showed outliers, with a higher frequency in medical services (inpatient, outpatient, emergency) and number of medications.

- The average length of hospital stay was 4.45 days.

- The average number of laboratory procedures was 43.24.

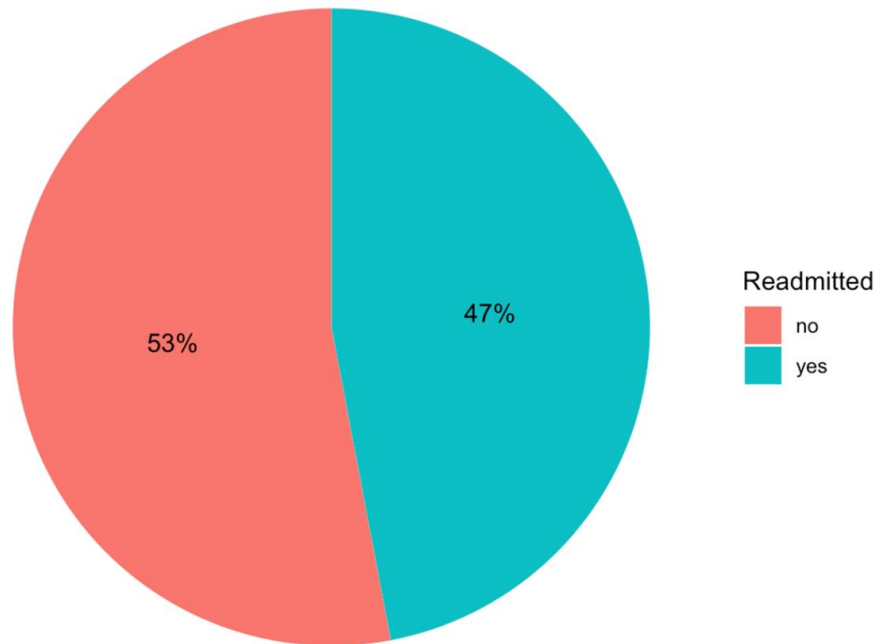- The average number of medications used was 16.25.
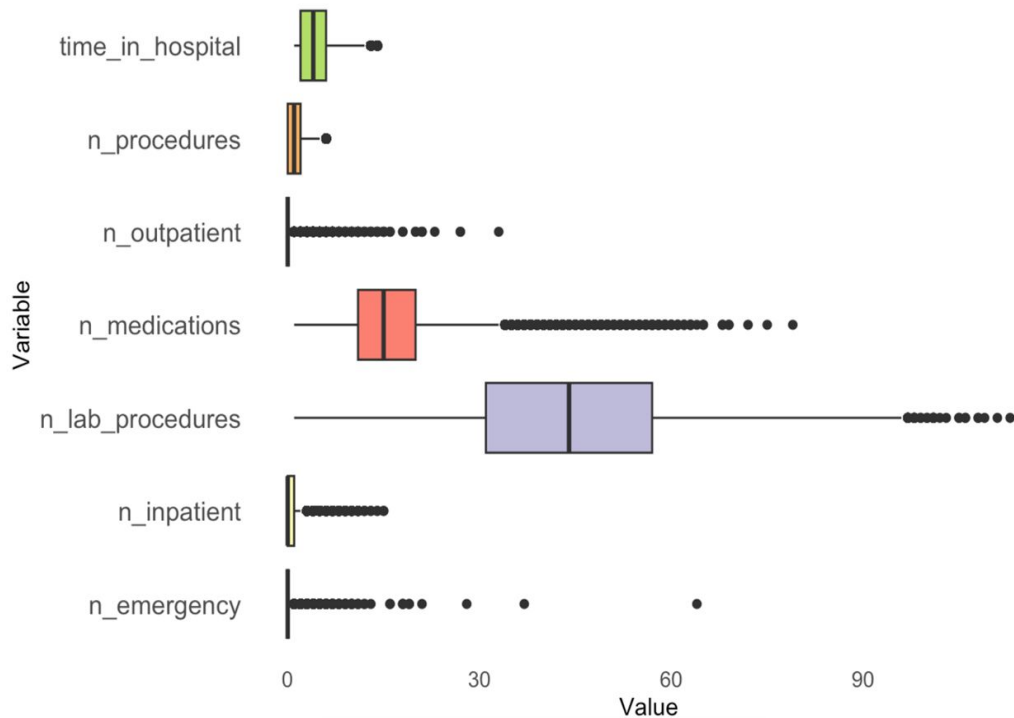
Question 1 - Pie Chart for Readmission

What are the key **demographic** and **clinical factors** that influence hospital readmission rates?
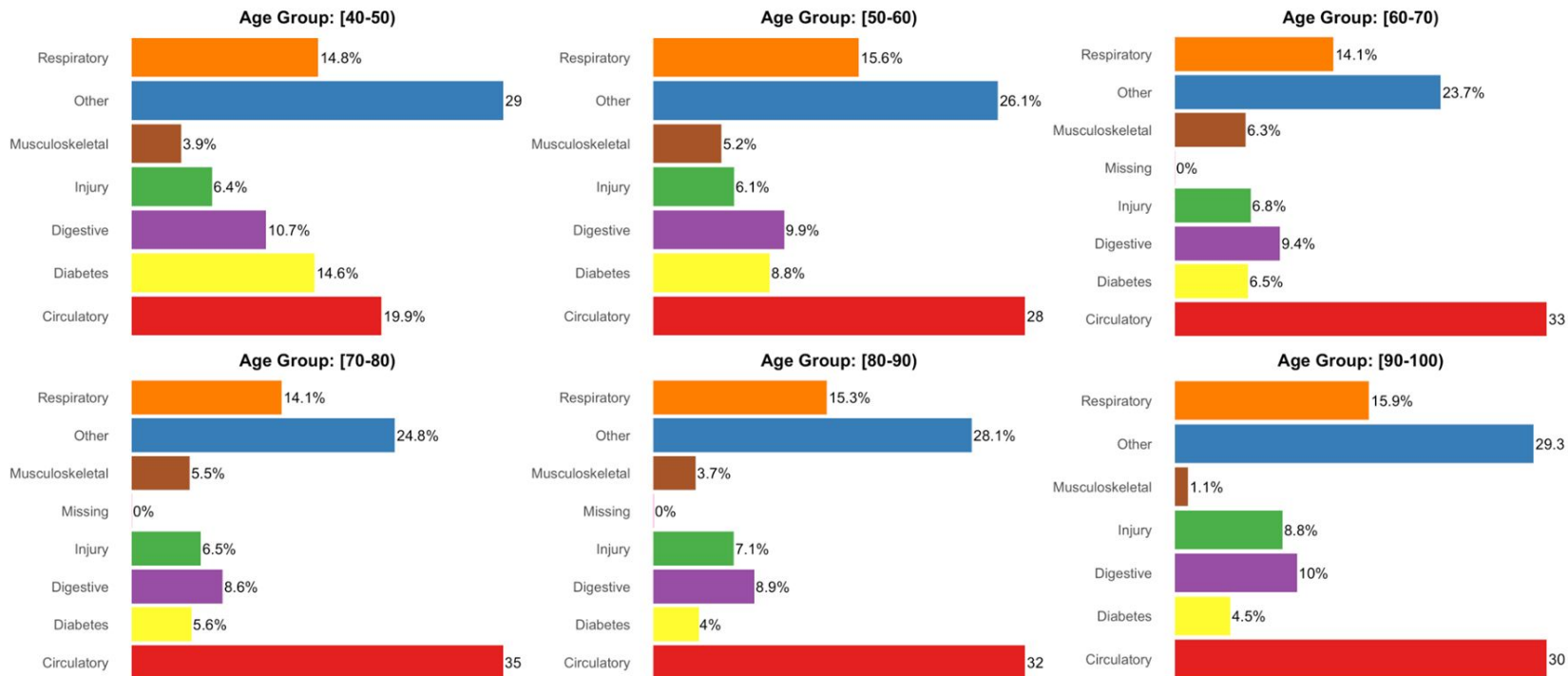
Pie Chart of Readmitted

Around **47%** of the patients are readmitted

Readmitted

no

yes

53%

47%

Question 1 - Primary Diagnosis by Age Group

What are the key **demographic** and **clinical factors** that influence hospital readmission rates?

Primary Diagnosis by Age Group (%)

Question 1 - Final Analysis and Conclusion

It is shown that the main diagnoses for all age groups are circulatory and others.

However:

- **40-50:** other, circulatory, respiratory, diabetes, digestive.
- **50-60:** circulatory, other, respiratory, digestive, diabetes.
- **60-100:** circulatory, other, respiratory, digestive, trauma (wounds).

The patient population is **predominantly elderly**, admitted mainly for **circulatory and unspecified causes**.

Glucose and A1C testing was conducted for **only a small fraction** of patients.

Patients showed a **high average of laboratory procedures** and **medications administered** relative to their hospital stay.

Evidence suggests a **high prevalence of comorbidities** and **polypharmacy**, potentially contributing to the observed **elevated readmission rates**.
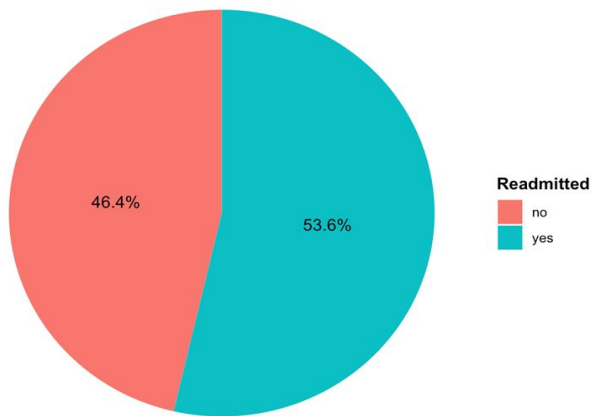
Question 2

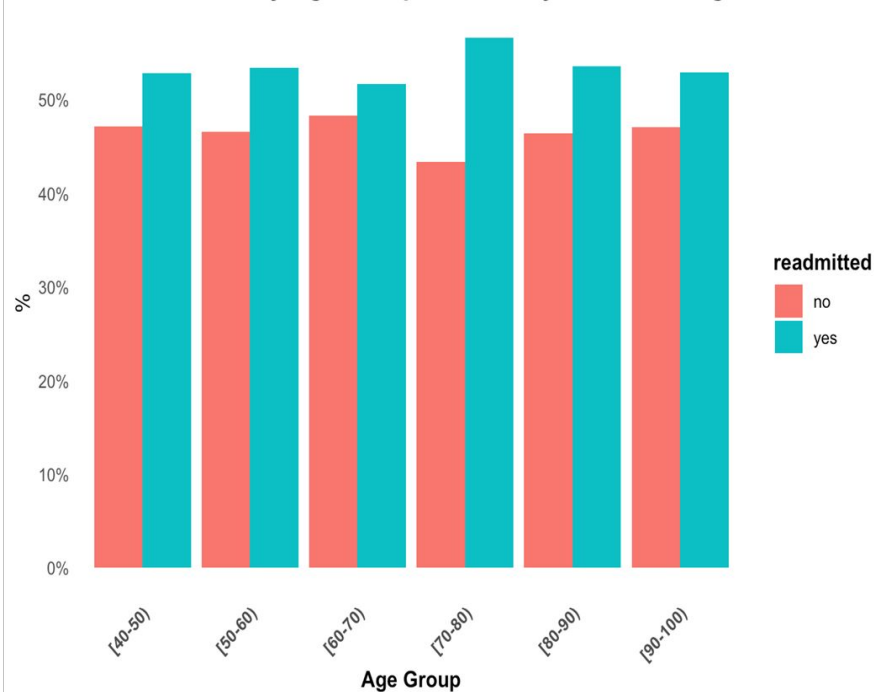What are the effects of **diabetes diagnosis** (primary) on readmission rates ?

Counts of Patients by Primary Diabetes Diagnosis and Readmission

	Readmission Status	
Diabetes or Not	Not Been Readmitted	Has Been Readmitted
Diabetes	810	937
No Diabetes	12,436	10,817

Readmission Status of Patients with Primary Diabetes Diagnosis

46.4% 53.6%

Readmitted
- no
- yes

Readmitted Status by Age Group for Primary Diabetes Diagnosis

readmitted
- no
- yes

Age Group: [40-50), [50-60), [60-70), [70-80), [80-90), [90-100)

Question 2

What are the effects of **diabetes diagnosis** (secondary) on readmission rates ?

Counts of Patients by Secondary Diabetes Diagnosis and Readmission

	Readmission Status	
Diabetes or Not	Not Been Readmitted	Has Been Readmitted
Diabetes	1,623	1,283
No Diabetes	11,623	10,471

Readmission Status of Patients with Secondary Diabetes Diagnosis

55.8%

44.2%
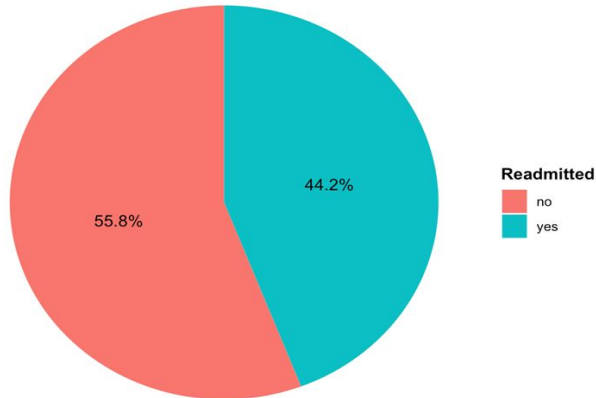
Readmitted
- no
- yes

Readmitted Status by Age Group for Secondary Diabetes Diagnosis

readmitted
- no
- yes
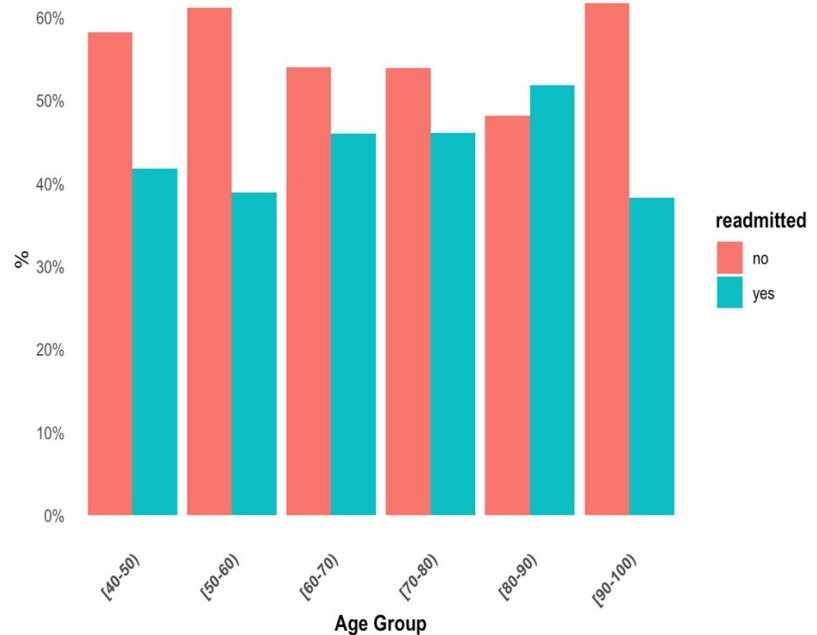
Question 2 - Analysis

- A **connection exists** between hospital readmissions and patients with **primary or secondary diabetes conditions**.

- **Readmission rates** are **higher for primary diabetes diagnoses (53.6%)** compared to **secondary diabetes diagnoses (44.2%)**.

- Patients aged **70-80** experience the **highest readmission rates** for primary diagnoses.

- Patients aged **80-90** are the most frequently **readmitted** for secondary diagnoses.

Question 3

How do **patient characteristics** and **prior healthcare** use impact readmissions, and which groups need prioritized **follow-up care**?

- Risk factors for readmission were identified through univariate analysis using logistic regression the **higher the factor the greater the likelihood of being readmitted**

- Key risk factors for readmission are:

  - **Prior hospitalizations**
  - **ER visits**
  - **Primary diagnosis of diabetes**
  - **Diabetes medication prescriptions**
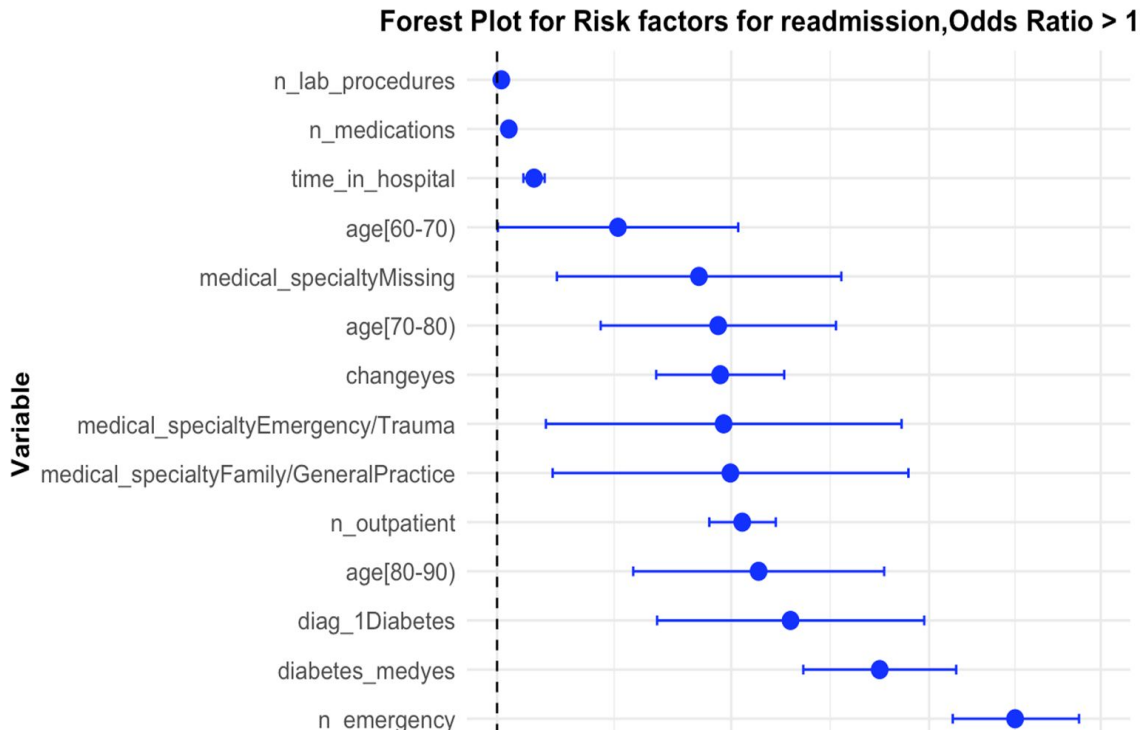
Forest Plot for Risk factors for readmission,Odds Ratio > 1

Question 3

How do **patient characteristics** and **prior healthcare** use impact readmissions, and which groups need prioritized **follow-up care**?
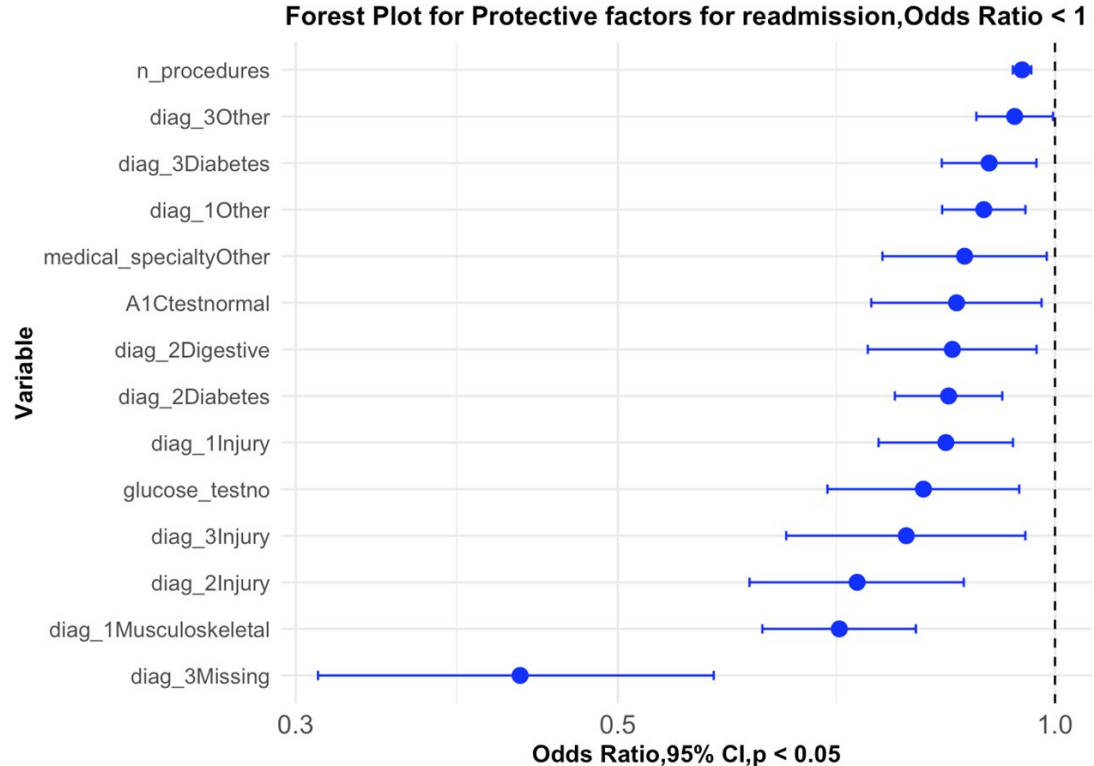
- Protective factors for readmission were identified through univariate analysis using logistic regression the **smaller the factor the greater the likelihood of not being readmitted**

- Fewer comorbidities (1-2 diagnoses) are associated with lower readmission risk

- **Protective factors:**
  - primary musculoskeletal diagnosis
  - secondary injury diagnosis

Forest Plot for Protective factors for readmission,Odds Ratio < 1

Question 3

How do **patient characteristics** and **prior healthcare** use impact readmissions, and which groups need prioritized **follow-up care**?
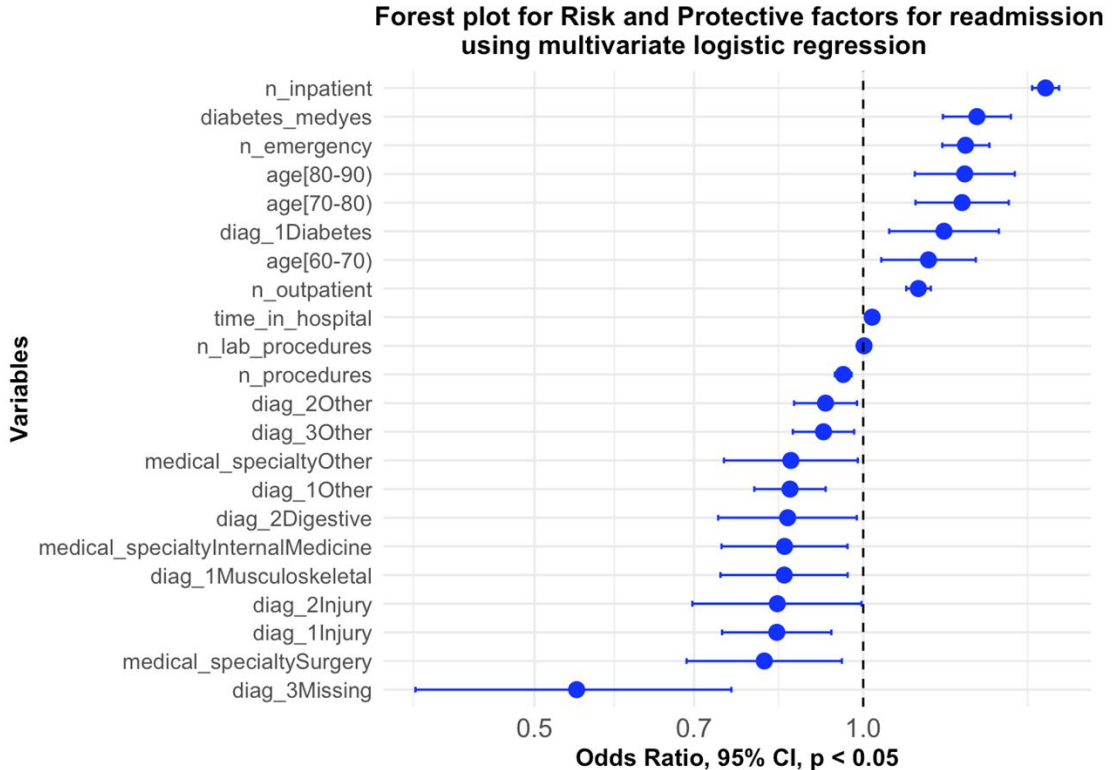
- **Multivariate analysis** using Logistic regression to find some risk and protective factors for readmission in our population

- **Key risk factors:** prior healthcare use, diabetes as primary diagnosis, and diabetes medication prescriptions.

- Ages **70-90** face higher readmission risk.

- **Protective factors:** missing tertiary diagnosis and general surgery specialty.

Forest plot for Risk and Protective factors for readmission using multivariate logistic regression

Variables (top to bottom):
n_inpatient, diabetes_medyes, n_emergency, age[80-90), age[70-80), diag_1Diabetes, age[60-70), n_outpatient, time_in_hospital, n_lab_procedures, n_procedures, diag_2Other, diag_3Other, medical_specialtyOther, diag_1Other, diag_2Digestive, medical_specialtyInternalMedicine, diag_1Musculoskeletal, diag_2Injury, diag_1Injury, medical_specialtySurgery, diag_3Missing

X-axis: Odds Ratio, 95% CI, $p < 0.05$ (0.5, 0.7, 1.0)

Conclusion

In conclusion, our findings highlight key factors influencing hospital readmissions, emphasizing the importance of targeted interventions and improved care strategies to reduce readmission rates

- **Readmission rate**: Around 47.01% (11,754 patients)

- **Top 3 primary diagnoses by age group**:
  - **40-50:** Other, circulatory, respiratory, diabetes, digestive
  - **50-60:** Circulatory, other, respiratory, digestive, diabetes
  - **60-100:** Circulatory, other, respiratory, digestive, trauma (wounds)
- **Diabetes and readmissions**:
  - Primary diabetes diagnosis: 53.6% readmitted.
  - Secondary diabetes diagnosis: 44.2% readmitted.
- **Higher readmission risk**:
  - Previous year visits to inpatient/emergency services.
  - Primary diabetes diagnosis with prescribed medications at discharge.
  - Age group 70-90.
- **Lower readmission risk**:
  - Treated by internal medicine, surgery, or other services.
  - Primary diagnosis of other, injury, or musculoskeletal issues.

Thank You

Team ViZit