



# **PREDICTING HOSPITAL READMISSIONS: A DATA-DRIVEN APPROACH**



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# OUTLINE

- HOSPITAL READMISSIONS: A CRITICAL HEALTHCARE CHALLENGE
- THE PROCESS
- MODELLING APPROACH
- PERFORMANCE METRICS
- KEY INSIGHTS
- REAL WORLD IMPLICATIONS
- CONCLUSION

# HOSPITAL READMISSIONS: A CRITICAL HEALTHCARE CHALLENGE

## HOW DO WE DEFINE HOSPITAL READMISSION?

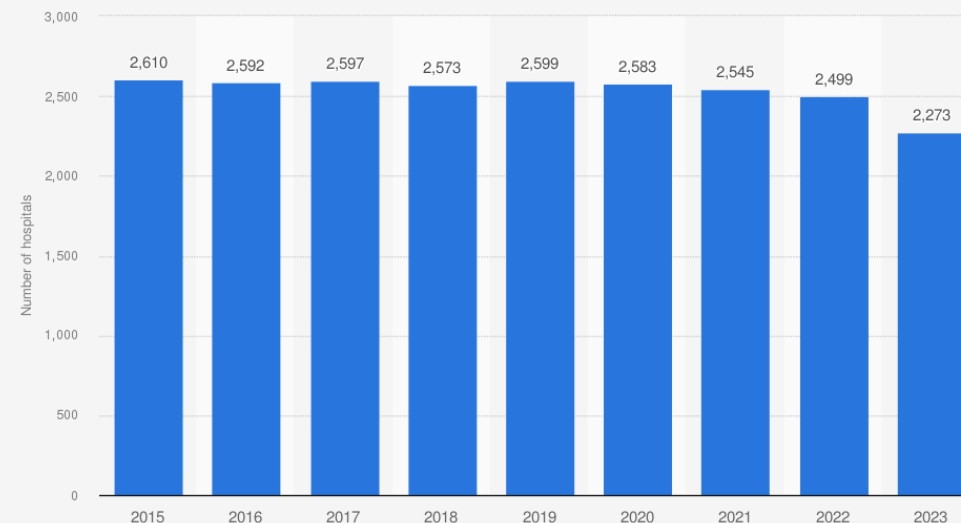


### OBJECTIVE:

To predict hospital readmissions using machine learning techniques

## WHY IS IT SUCH A PROBLEM?

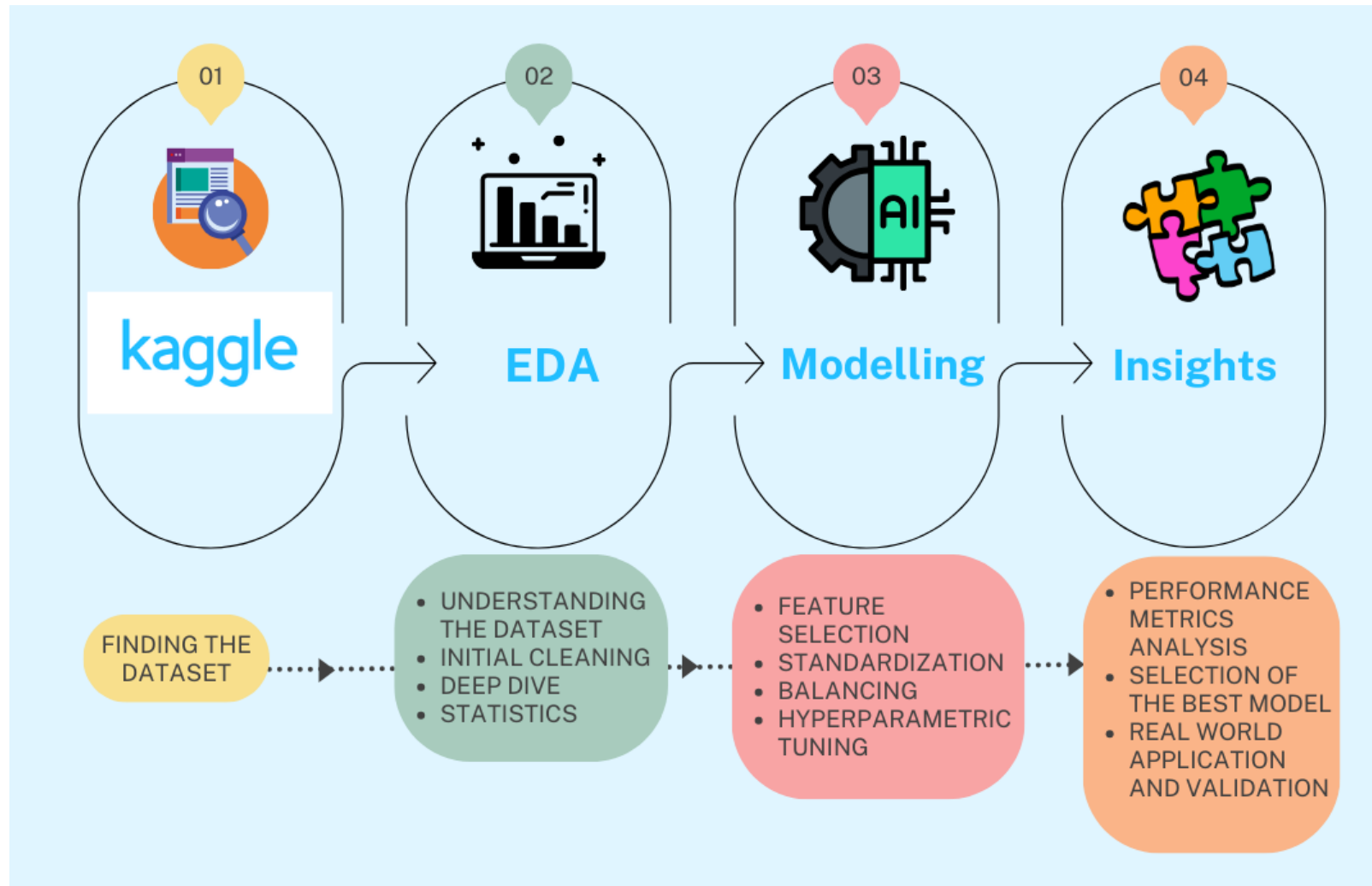
Number of hospitals in the United States that Medicare punished for high readmission from FY2015 to FY2023



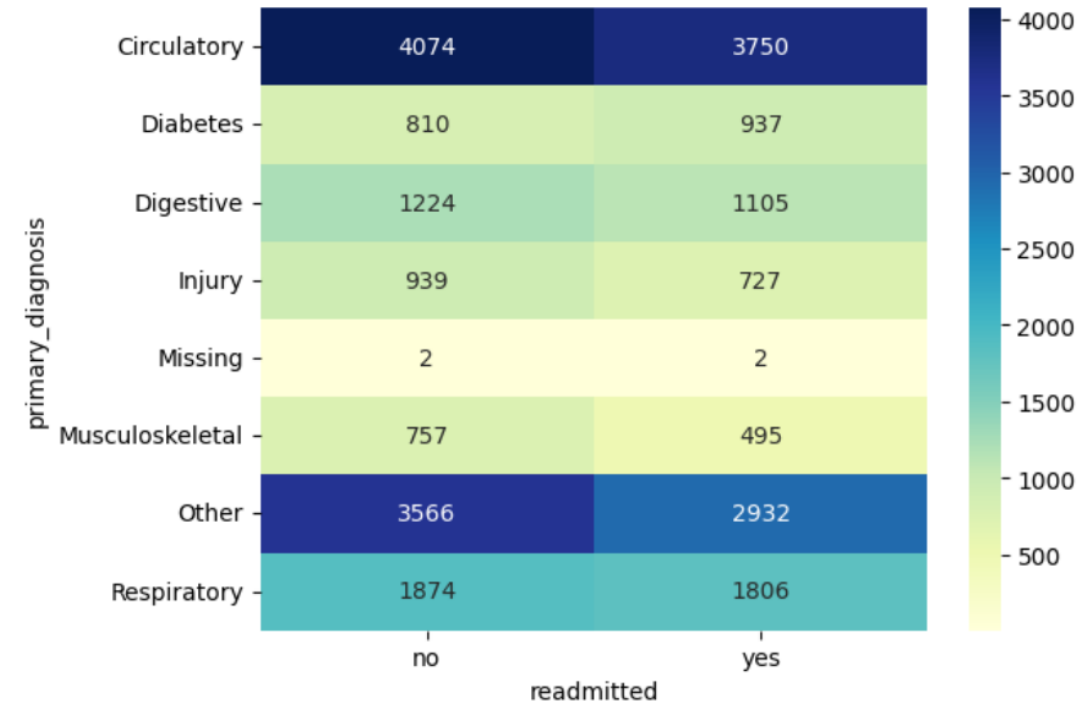
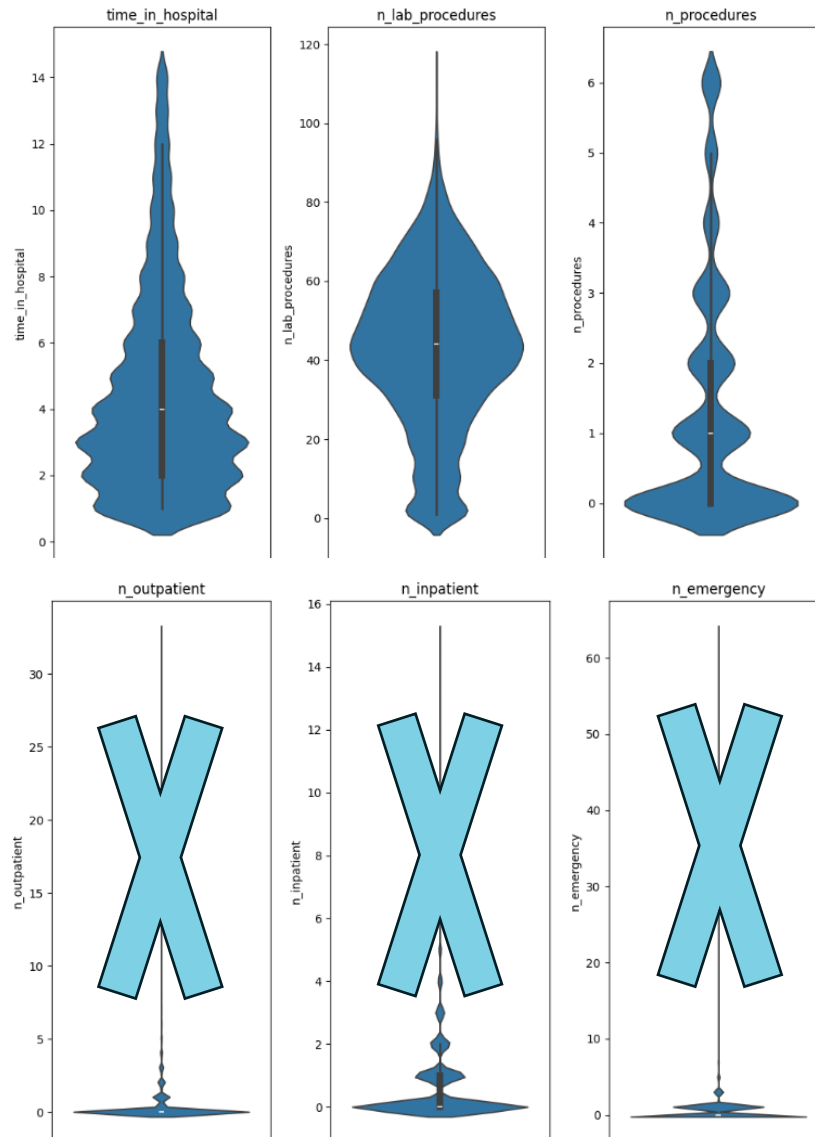
Sources  
Kaiser Family Foundation (KHN); CMS  
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Additional Information:  
United States, FY2015 to FY2023

# THE PROCESS



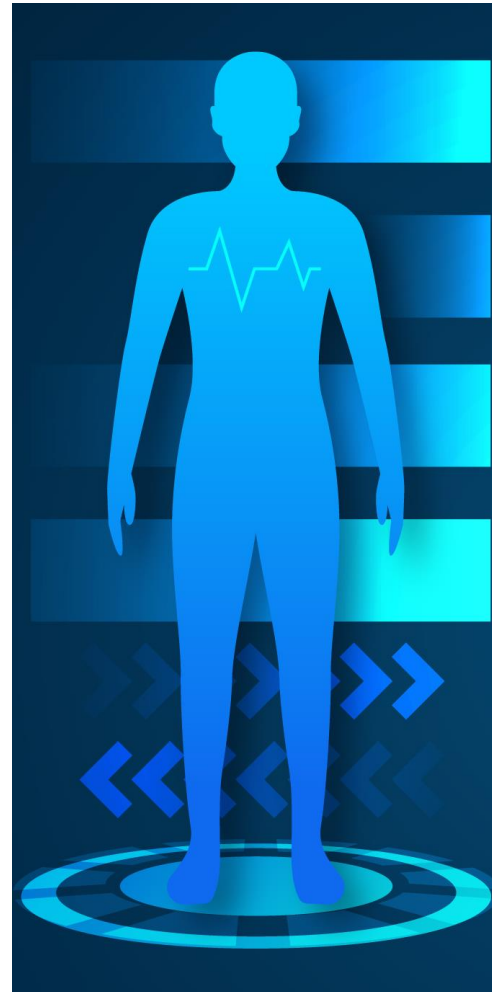
# THE PROCESS – INITIAL EXPLORATION





# THE PROCESS – DEEP DIVE

25,000 RECORDS  
7 COLUMNS



Time Spent in Hospital (n)



Number of Lab Procedures (n)  
Additional Procedures (n)



Age in Ranges (c)



Primary Diagnosis (c)  
Secondary Diagnosis (c)



Readmitted (yes/no)

# THE PROCESS – STATISTICS

| Variable                 | Test              | Statistic        | p-value               | Significance | Interpretation  |
|--------------------------|-------------------|------------------|-----------------------|--------------|---|
| Time in Hospital         | Two-Sample T-test | $t = 6.83$       | 0                     | ***          | Readmitted patients spent more time in the hospital.          |
| Number of Lab Procedures | Two-Sample T-test | $t = 5.23$       | $1.75 \times 10^{-7}$ | ***          | Readmitted patients had more lab procedures.                  |
| Additional Procedures    | Two-Sample T-test | $t = -7.05$      | 0                     | ***          | Readmitted patients had fewer procedures.                     |
| Age                      | Chi-Square Test   | $\chi^2 = 48.79$ | 0                     | ***          | Strong association between age and readmission.               |
| Primary Diagnosis        | Chi-Square Test   | $\chi^2 = 84.91$ | 0                     | ***          | Strong association between primary diagnosis and readmission. |
| Secondary Diagnosis      | Chi-Square Test   | $\chi^2 = 33.14$ | $2.50 \times 10^{-5}$ | ***          | Significant, but weaker association with readmission.         |

■ – Features selected    \*\*\* - extremely significant

# MODELLING APPROACH

**ENCODING  
STANDARDIZATION**

**BASE**

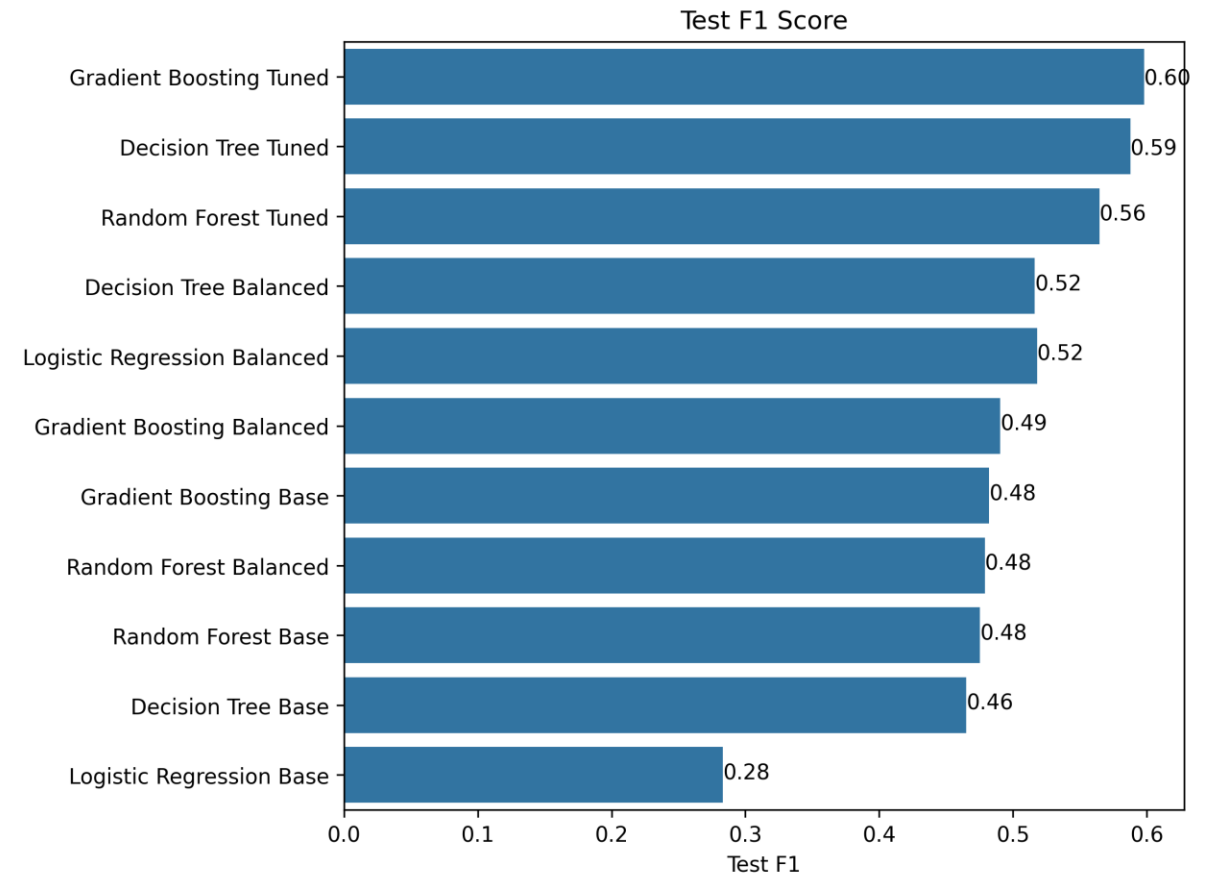
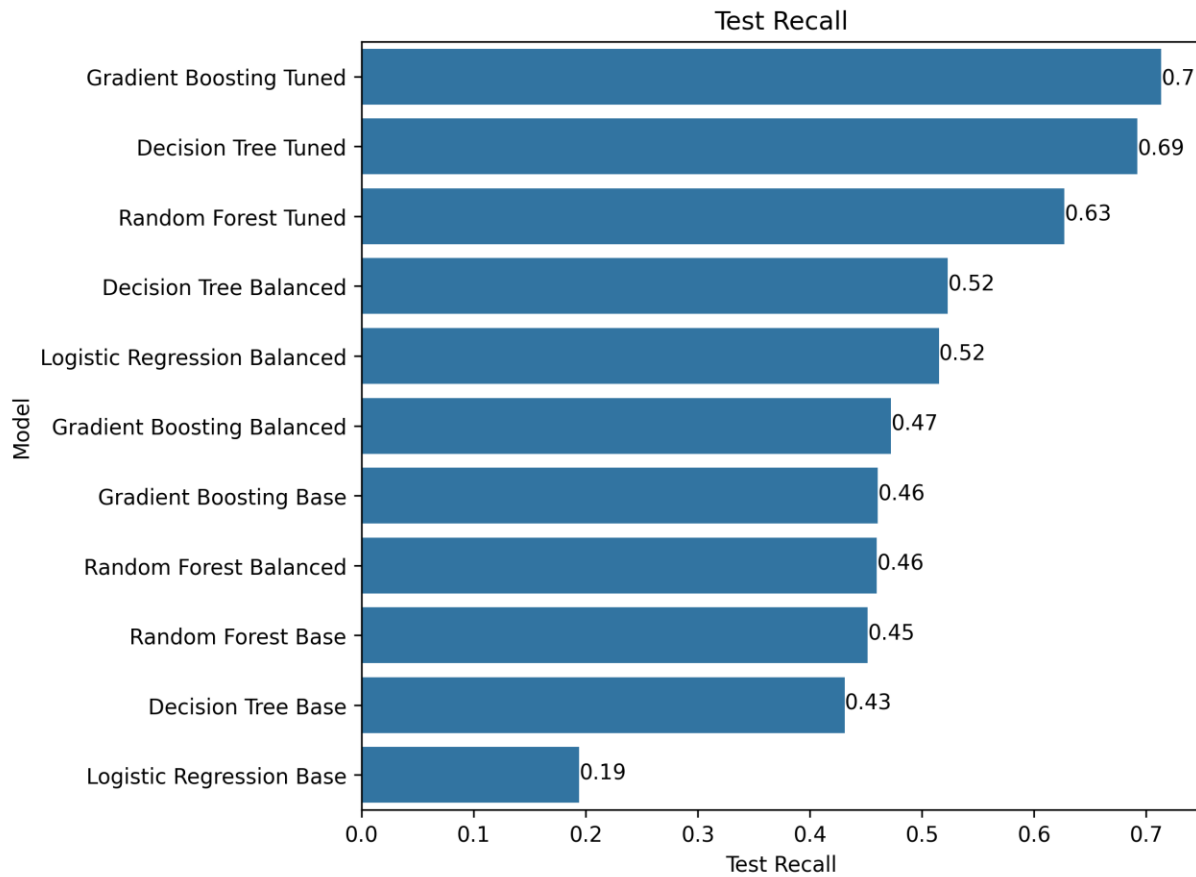
**BALANCED**

**TUNED**

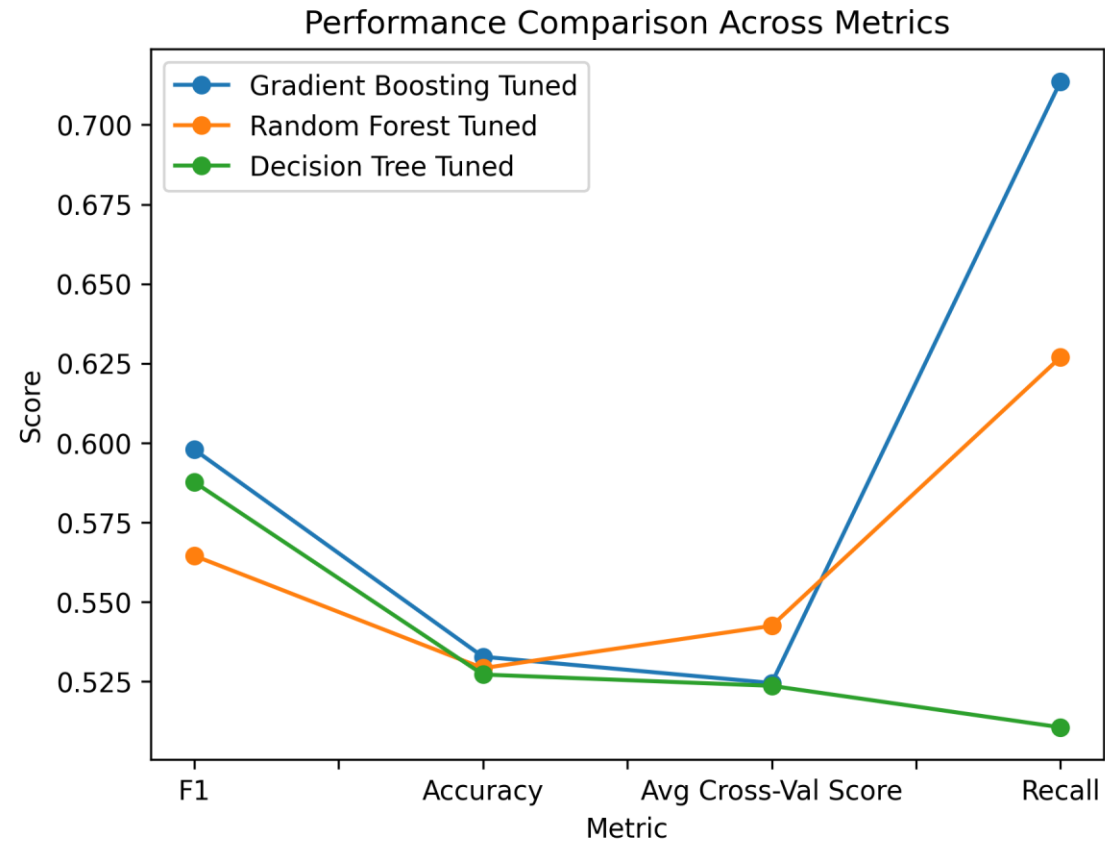
**11**



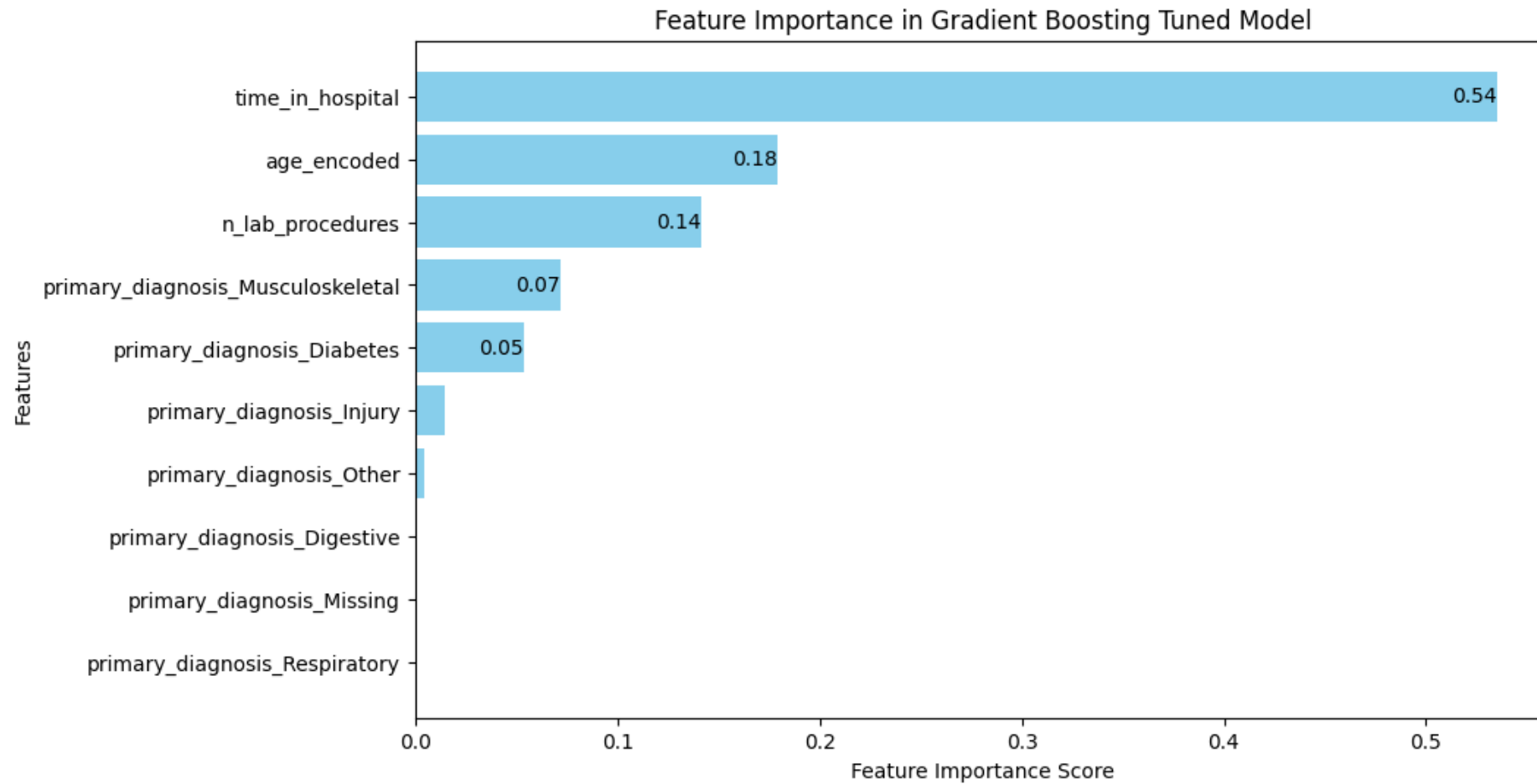
# PERFORMANCE METRICS



# PERFORMANCE METRICS



# KEY INSIGHTS




# REAL WORLD IMPLICATIONS

 OPEN ACCESS  PEER-REVIEWED

RESEARCH ARTICLE

PLOS ONE

## Predicting 30-day hospital readmissions using artificial neural networks with medical code embedding

Wenshuo Liu, Cooper Stansbury, Karandeep Singh, Andrew M. Ryan, Devraj Sukul, Elham Mahmoudi, Akbar Waljee, Ji Zhu, Brahmajee K. Nallamothu 

Published: April 15, 2020 • <https://doi.org/10.1371/journal.pone.0221606>



RESEARCH, PATIENT CARE, PRESS RELEASES | JUNE 7, 2023



## New 'AI Doctor' Predicts Hospital Readmission & Other Health Outcomes

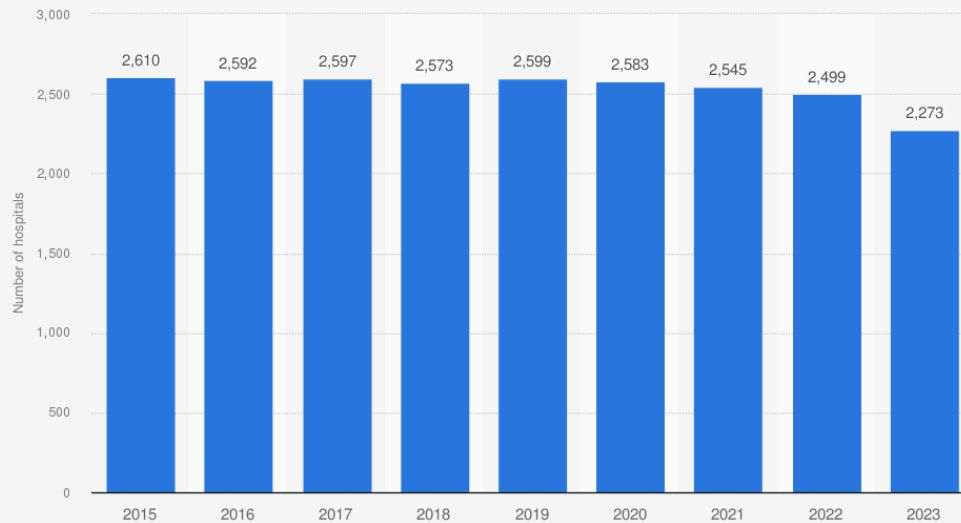
NYUTron Designed to Smooth Hospital Operations for Better Patient Care

Source: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7159221/>  
<https://nyulangone.org/news/new-ai-doctor-predicts-hospital-readmission-other-health-outcomes>

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# REAL WORLD IMPLICATIONS

Number of hospitals in the United States that Medicare punished for high readmission from FY2015 to FY2023



Sources  
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Additional Information:  
United States; FY2015 to FY2023

## Hospital Readmissions Reduction Program (HRRP)

The Hospital Readmissions Reduction Program (HRRP) is a Medicare value-based purchasing program that, for example, encourages hospitals to improve communication and care coordination to better engage patients and caregivers in discharge plans and, in turn, reduce avoidable readmissions. The program supports the national goal of improving health care for Americans by linking payment to the quality of hospital care.

**CMS.gov** Centers for Medicare & Medicaid Services

Source: <https://www.cms.gov/medicare/payment/prospective-payment-systems/acute-inpatient-pps/hospital-readmissions-reduction-program-hrrp>

# CONCLUSION



CLOSE THE GAP



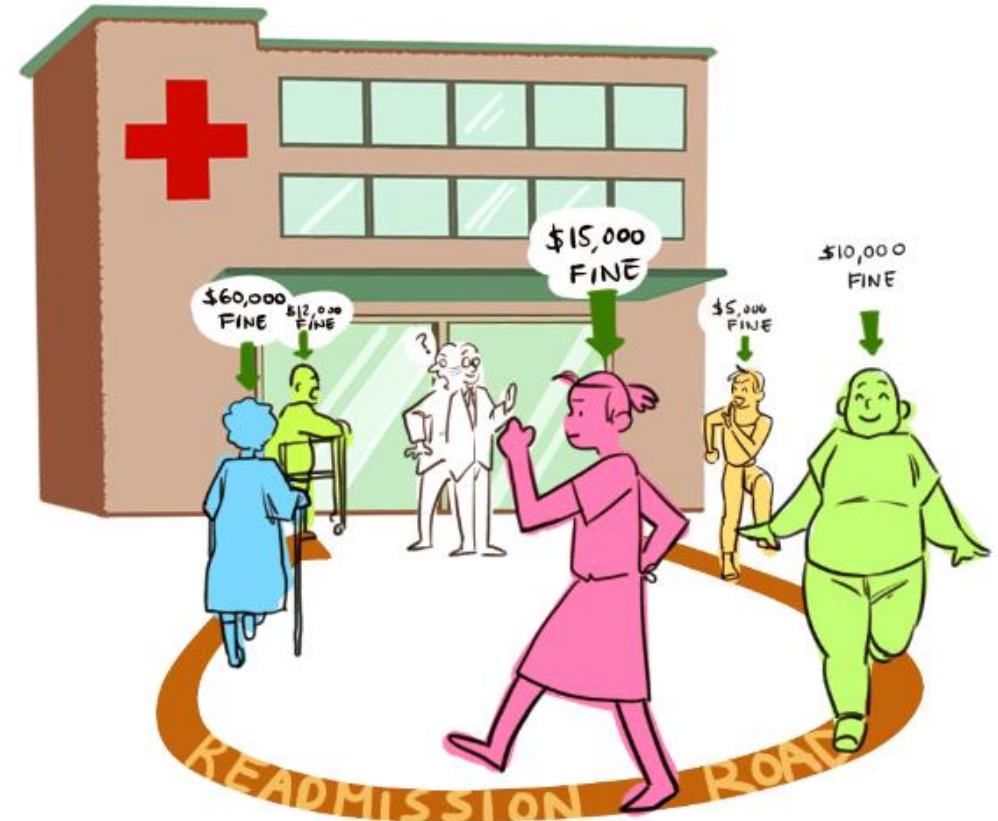
COST SAVINGS



AID POLICY MAKERS AND  
MEDICAL PROFESSIONALS



SCALE TO OTHER AREAS





# THANK YOU

Nicole Maria Pinto

Ironhack – Data Analytics  
Bootcamp

October 2024

