# Health AI Suite- Intelligent Analytics For Patient care

# INTRODUCTION

This  project ,Health AI system demonstrates how multiple AI techniques can improve clinical decision support , patient engagement, and hospital efficiency.

We explored 10 use cases across healthcare：

1. Classification : Early disease detection
2. Regression : Hospital stay prediction
3. Clustering : Patient segmentation
4. Association Rules :Risk pattern discovery
5. CNN : Imaging diagnostics
6. RNN\LSTM : patient vitals forecasting
7. Pretrained Models : Clinical text analysis
8. Chatbot : Patient vitals forecasting
9. Translator : Multilingual doctor - patient support
10. Sentiment Analysis : patient feedback insights

All use cases are integrated into  a streamlined AI platform with a chatbot interface for seamless interaction.‘

# Risk stratification [ Classification]

Applied supervised machine learning classification models (Logistic Regression,Random Forest,XGBoost,K Neighbours,SVM)

OUTCOME :-

Best model achieved 🤖 = 98.7 % accuracy📊

Strong predictive power for easily risk detection.

IMPACT 📈 :-

Helps clinicians identify high-risk patients earlier, enabling faster treatment,optimied resource allocation, and improved patient outcomes.

# Length of stay prediction [Regression]

APPROACH :-

Trained multiple regression model ( Linear regression, Ridge regression, Random forest , Gradient boosting, Lasso regression, kNN Regressor , SVM)

OUTCOME :

Bestmodel 🤖 : Random Forest 📊

R2 score :- ~0.97

RMSE : ~0.58

MAE : ~0.17

IMPACT 📈 :- Better bed & staff allocation

Improved hospital efficiency

Reduced operational costs while maintaining patient care.

# Patient segmentation [Clustering]

APPROACH : -

K-means clustering on patient s into meaningful cohorts ( demographics , vitals, comorbidities).

OUTCOME :-

Identified 3-5 distinct patient clusters

Each cluster shows unique risk \ behaviour patterns

IMPACT 📈:-

Enables personalized treatment, targeted resource allocation, and improved patient outcomes .

# Medical Association ( Association Rules )

APPROACH :-

Apriori algorithm + Association Rule Mining ( support , confidence , lift ).

OUTCOME : -

- Found frequent links like medication (infusion), Allergy (medication)
- Confidence upto 92% lift >1

IMPACT 📈 :-

Helps clinicians anticipate  co-occuring conditions, improve , treatment planning, and support preventive care.

# IMAGING DIAGNOSTICS (CNN)

APPROACH :-

Applied Convolutional Neural Network (CNN) with VCG16 Transfer Learning and fine-tuning .

OUTCOME :-

Achieved ~95% validation accuracy in distinguishing Normal vs Pneumonia cases.

IMPACT 📈 : -

Supports radiologists by providing faster, reliable screening , improving early detection

And patient care.

# Sequence Modelling (RNN \ LSTM)

APPROACH : -

Applied RNN \ LSTM on time - series data ( heart rate , BP , spo2 , labs)

OUTCOME : -

Model achieved AUC = 0.765 showing good ability to distinguish high-risk vs stable patients.

IMPACT📈 : -

Enables early warning systems - doctors can intervene sooner , reduce complications , and improve patient survival.

# PRETRAINED MODEL USING CLINICAL BERT / BIOBERT

APPROACH :-

USE biobert \ clinical bert , pretrained on biomedical & clinical corpora, then fine - tuned for tasks like classification , entity recognition , and relation extraction .

OUTCOME : -

15-20 % higher accuracy in clinical NLP tasks compared to general BERT .

Improved detection of diagnoses , medications and adverse events .

IMPACT 📈:-

Enables faster understanding of patient records , supports clinical decision- making , and improves patient safety.

Health Care chatbot

APPROACH :-

RAG- based chatbot using pretrained models (BioBERT / Clinical BERT for medical text)+ FAQ & guideline corpus.

OUTCOME :

Provides relevant answers with <5 % error , latency ~27s, evaluated by relevance & faithfulness scores .

IMPACT 📈 :-

Improves patient triage , reduces staff workload , and  enhances access to healthcare information.

# Translator

APPROACH :-

Pretrained NLP Models (Helsinki - NLP Marian MT for English  to regional languages )

OUTCOMES :- High - quality translations (BLEU~35-40 for many indian languages).

IMPACT 📈 :-

Improves doctor - patient communication, ensures better treatment adherence , and reduces medical misunderstandings.

# Sentiment analysis

APPROACH :- NLP- based sentiment analysis using VADER (unsupervised sentiment analyzer) on patient notes .

Text preprocessing : cleaning, normalization, and tokenization.

Classified notes as positive, negative,or neutral.

OUTCOMES :-

Each note labeled with sentiment.

Distribution summary : eg: 45% positive,35% neutral, 20% negative.

IMPACT :-

Provides actionable insights from patient feedback .

Helps hospitals identify strengths and areas needing improvement.

Improves patient experience and overall healthcare quality .

Healthcare platform - Streamlit dashboard

PURPOSES -

- Provides a single platform for all 10 AI- driven healthcare use cases.
- Enables interactive exploration of models and realtime healthcare insights.

KEY FEATURES :

- Navigation sidebar : Easy access to all modules.
- Interactive inputs : Sliders , text boxes , file uploads for predictions.
- Dynamic outputs : Charts, tables, metrics, and embeddings.

DEMO EXAMPLES:

- Chatbot for patient queries
- Length of Stay prediction using clinical data
- Patient segmentation (PCA / Clustering)
- Medical association rules discovery
- Imaging diagnostics (X-ray / CT)
- NLP embeddings & similarity demo (BioBERT/ClinicalBERT)

# CONCLUSION

Unified Platform: All 10 AI use cases are integrated in one Streamlit dashboard.

Scalable: Can expand to new use cases or datasets.

Practical Impact: Helps doctors, hospitals, and patients with decision support.

Future Scope: Improve accuracy with larger datasets and deploy for real-time use.

# IMPACT

- Demonstrates end to end integration of AI models.
- Supports clinical decision-making.
- Simplifies healthcare analytics for patients and providers