

ASSIGNMENT

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**COURSE :** **ARTIFICIAL INTELLIGENCE**

**PROGRAM : BSCS (MORNING)**

**SECTION :** **6TH ‘C’**

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COMPARATIVE ANALYSIS OF RESEARCH PAPERS

INTRODUCTION:

The Importance of improving heart failure (HF) prediction models. It dives deeper into HF itself, highlighting its prevalence, mortality rate, and limitations of current models and also takes a broader approach, discussing cardiovascular diseases (CVD) with HF as a major contributor, emphasizing the economic burden of CVD. & Acknowledge the need for AI-based models but they emphasizes explain-ability for clinicians, while they also highlights the challenges of explain-ability versus accuracy and ethical considerations.

FOCUS:

Its Specifically on Heart Failure (HF) and the limitations of current prediction models. And Also Focuses on Cardiovascular Diseases (CVD) with HF as a significant contributor. It emphasizes the economic burden and the need for early detection.

**BACKGROUND:**

It Provide statistics on HF prevalence, mortality, and hospitalization rates & also statistics on CVD deaths and costs, highlighting the global impact.

**CURRENT LIMITATION:**

The limitation of traditional statistical models (e.g., GWTG-HF, MAGGIC) in capturing complex relationships between variable & Highlights the limitations of current practices like angiography due to cost and the need for more accessible prediction models. Additionally, it mentions the lack of explain-ability in some ML models, hindering their adoption by clinicians.

**PROPOSED SOLUTION:**

It Using Machine Learning (ML) algorithms to develop more accurate and individualized prediction models for HF patients & Proposes developing two explainable prediction models for HF survival, one using survival analysis and another using classification. It emphasizes the importance of achieving a balance between accuracy and explain-ability.

COMPREHENSIVE ANALYSIS OF THE RESEARCH PAPER “AN ARTIFICIAL INTELLIGENCE APPROACH TO GUIDING THE MANAGEMENT OF HEART FAILURE PATIENTS USING PREDICTIVE MODELS : A SYSTEMATIC REVIEW”.

* **Citation Details:** The article is a systematic review titled “An Artificial Intelligence Approach to Guiding the Management of Heart Failure Patients Using Predictive Models” by Błaziak et al., published in Biomedicines 2022.
* **Heart Failure & AI:** It discusses the use of machine learning (ML) techniques to predict outcomes in heart failure (HF) patients, highlighting the potential of AI in improving HF management.
* **Predictive Model Analysis**: The review focuses on externally validated predictive models based on ML, comparing them to traditional statistical predictive scores.
* **Key Findings**: ML models demonstrated higher accuracy (AUCs ranging from 0.6494 to 0.913) in predicting mortality and readmission risks compared to conventional scores (AUCs from 0.622 to 0.806).
* **Over-fitting in Predictive Models:** Discusses the issue of over-fitting, which can limit a model’s ability to generalize to other populations. Suggests external validation as a solution.
* **Model Interpretability**: Highlights the importance of understanding how models make classifications. [Mentions LIME and SHAP as methods for interpreting black-box models1](https://edgeservices.bing.com/edgesvc/chat?udsframed=1&form=SHORUN&clientscopes=chat,noheader,udsedgeshop,channelstable,ntpquery,devtoolsapi,udsinwin10,udsdlpconsent,udscstart,cspgrd,&shellsig=857a2703b13dfdc014f8a3c27507203065336bd7&setlang=en-US&lightschemeovr=1#sjevt%7CDiscover.Chat.SydneyClickPageCitation%7Cadpclick%7C0%7C95d05d07-fe22-4a2b-acfc-c69571655a74).
* [**Performance Metrics Table:** Contains a table (Table 3) comparing performance metrics for machine learning algorithms and conventional risk scores in heart failure management2](https://edgeservices.bing.com/edgesvc/chat?udsframed=1&form=SHORUN&clientscopes=chat,noheader,udsedgeshop,channelstable,ntpquery,devtoolsapi,udsinwin10,udsdlpconsent,udscstart,cspgrd,&shellsig=857a2703b13dfdc014f8a3c27507203065336bd7&setlang=en-US&lightschemeovr=1#sjevt%7CDiscover.Chat.SydneyClickPageCitation%7Cadpclick%7C1%7C95d05d07-fe22-4a2b-acfc-c69571655a74).
* **Model Variables**: Notes that the models only used variables from the datasets they were trained on, and suggests that including additional prognostic factors could improve performance.

**COMPREHENSIVE ANALYSIS OF THE RESEARCH PAPER “ IMPROVEMENT OF A PREDICTION MODEL FOR HEART FAILURE SURVIVAL THROUGH EXPLAINABLE ARTIFICIAL INTELLIGENCE”:**

* **Study Focus**: The document discusses the **improvement of a prediction model for heart failure survival** using **explainable artificial intelligence (XAI)**.
* **Key Contribution**: It presents an **explain-ability-driven approach** to select the best heart failure survival prediction model, balancing **prediction performance and explain-ability**.
* **Significant Findings**: The most balanced explainable prediction models identified are the **Survival Gradient Boosting model** and the **Random Forest** for classification, with notable features like; **Serum creatinine** and **ejection-fraction**.
* **Clinical Impact**: The improved models aim to provide doctors with insights to better understand AI clinical solutions, leading to more **data-driven decisions** in patient care.
* [**Feature Selection**: The document discusses the selection of numerical and categorical features for various classifiers like Random Forests, Extra Trees, Ada-Boost, Gradient Boosting, and XGBoost](https://edgeservices.bing.com/edgesvc/chat?udsframed=1&form=SHORUN&clientscopes=chat,noheader,udsedgeshop,channelstable,ntpquery,devtoolsapi,udsinwin10,udsdlpconsent,udsmrefresh,cspgrd,&shellsig=be5cd1d62ef719f1a6fde4f8593ebd1d2a45a181&setlang=en-US&lightschemeovr=1#sjevt%7CDiscover.Chat.SydneyClickPageCitation%7Cadpclick%7C0%7C779bda3a-1150-4f04-bab8-d1e509e5128c)[1](https://edgeservices.bing.com/edgesvc/chat?udsframed=1&form=SHORUN&clientscopes=chat,noheader,udsedgeshop,channelstable,ntpquery,devtoolsapi,udsinwin10,udsdlpconsent,udsmrefresh,cspgrd,&shellsig=be5cd1d62ef719f1a6fde4f8593ebd1d2a45a181&setlang=en-US&lightschemeovr=1#sjevt%7CDiscover.Chat.SydneyClickPageCitation%7Cadpclick%7C0%7C779bda3a-1150-4f04-bab8-d1e509e5128c). Methods like ANOVA and mutual information are used for feature selection.
* [**Model Evaluation**: It evaluates models using metrics like c-index, c-index IPCW, and AUCD-ROC](https://edgeservices.bing.com/edgesvc/chat?udsframed=1&form=SHORUN&clientscopes=chat,noheader,udsedgeshop,channelstable,ntpquery,devtoolsapi,udsinwin10,udsdlpconsent,udsmrefresh,cspgrd,&shellsig=be5cd1d62ef719f1a6fde4f8593ebd1d2a45a181&setlang=en-US&lightschemeovr=1#sjevt%7CDiscover.Chat.SydneyClickPageCitation%7Cadpclick%7C1%7C779bda3a-1150-4f04-bab8-d1e509e5128c)[2](https://edgeservices.bing.com/edgesvc/chat?udsframed=1&form=SHORUN&clientscopes=chat,noheader,udsedgeshop,channelstable,ntpquery,devtoolsapi,udsinwin10,udsdlpconsent,udsmrefresh,cspgrd,&shellsig=be5cd1d62ef719f1a6fde4f8593ebd1d2a45a181&setlang=en-US&lightschemeovr=1#sjevt%7CDiscover.Chat.SydneyClickPageCitation%7Cadpclick%7C1%7C779bda3a-1150-4f04-bab8-d1e509e5128c). Gradient Boosting models are highlighted for their performance, although with low interpretability concordance index.
* [**Explain-ability Analysis**: The importance of features like “serum-creatinine,” “ejection-fraction,” and “sex” is analyzed using techniques like feature permutation and PDP plots](https://edgeservices.bing.com/edgesvc/chat?udsframed=1&form=SHORUN&clientscopes=chat,noheader,udsedgeshop,channelstable,ntpquery,devtoolsapi,udsinwin10,udsdlpconsent,udsmrefresh,cspgrd,&shellsig=be5cd1d62ef719f1a6fde4f8593ebd1d2a45a181&setlang=en-US&lightschemeovr=1#sjevt%7CDiscover.Chat.SydneyClickPageCitation%7Cadpclick%7C2%7C779bda3a-1150-4f04-bab8-d1e509e5128c)[3](https://edgeservices.bing.com/edgesvc/chat?udsframed=1&form=SHORUN&clientscopes=chat,noheader,udsedgeshop,channelstable,ntpquery,devtoolsapi,udsinwin10,udsdlpconsent,udsmrefresh,cspgrd,&shellsig=be5cd1d62ef719f1a6fde4f8593ebd1d2a45a181&setlang=en-US&lightschemeovr=1#sjevt%7CDiscover.Chat.SydneyClickPageCitation%7Cadpclick%7C2%7C779bda3a-1150-4f04-bab8-d1e509e5128c).
* [**Balanced Model**: A more balanced model with two numerical features and two categorical features is identified, showing a good balance between interpretability and prediction performance](https://edgeservices.bing.com/edgesvc/chat?udsframed=1&form=SHORUN&clientscopes=chat,noheader,udsedgeshop,channelstable,ntpquery,devtoolsapi,udsinwin10,udsdlpconsent,udsmrefresh,cspgrd,&shellsig=be5cd1d62ef719f1a6fde4f8593ebd1d2a45a181&setlang=en-US&lightschemeovr=1#sjevt%7CDiscover.Chat.SydneyClickPageCitation%7Cadpclick%7C3%7C779bda3a-1150-4f04-bab8-d1e509e5128c)[4](https://edgeservices.bing.com/edgesvc/chat?udsframed=1&form=SHORUN&clientscopes=chat,noheader,udsedgeshop,channelstable,ntpquery,devtoolsapi,udsinwin10,udsdlpconsent,udsmrefresh,cspgrd,&shellsig=be5cd1d62ef719f1a6fde4f8593ebd1d2a45a181&setlang=en-US&lightschemeovr=1#sjevt%7CDiscover.Chat.SydneyClickPageCitation%7Cadpclick%7C3%7C779bda3a-1150-4f04-bab8-d1e509e5128c).

**“Predicting Heart Failure Survival** **Using Machine Learning Algorithms”**

* **Machine Learning in Cardiology**: The section lists numerous research articles that explore the use of **machine learning models** to predict survival rates and outcomes for heart failure patients.
* **Predictive Analytics**: It highlights studies that have developed **predictive models** using various machine learning techniques, such as **random forests**, **ensemble methods**, and **survival analysis**.
* **Data Mining and Algorithms**: There’s a focus on how **data mining** and different **algorithms** can improve the accuracy of heart failure survival predictions.
* **References**: The part contains a comprehensive list of references, indicating a well-researched document with multiple contributions to the field of **heart failure survival prediction**.

They Efforts in applying machine learning to improve prognostic models in cardiology.

**CONCLUSION OF COMPARATIVE ANALYSIS:**

The potential of artificial intelligence in managing heart failure And emphasizes the early stage of AI implementation, the need for further evaluation of predictive algorithms, and the promise of data-driven models in handling large volumes of medical data for patient-level management & focuses on the development and evaluation of explainable prediction models for heart failure survival. It underscores the importance of balancing classification performance and explain-ability in machine learning models for clinical practice. The models identified key features for prediction and emphasized the novelty of the explain-ability approach, which could help clinicians make data-driven decisions and potentially prevent adverse outcomes. Future work includes testing the model in a clinical setting and gathering feedback on the model’s explain-ability.

References:

Research Paper 1:

Link : [Biomedicines | Free Full-Text | An Artificial Intelligence Approach to Guiding the Management of Heart Failure Patients Using Predictive Models: A Systematic Review (mdpi.com)](https://www.mdpi.com/2227-9059/10/9/2188)

Research Paper 2:

Link : [Frontiers | Improvement of a prediction model for heart failure survival through explainable artificial intelligence (frontiersin.org)](https://www.frontiersin.org/articles/10.3389/fcvm.2023.1219586/full)

GitHub:

Link : <https://github.com/Uzi130/heart-failure-dataset>