

Opsporing af Hjertepatienter med Forhøjet Risiko for Angst og Depression

Detection of Anxiety and Depression in ICD-Patients using Machine Learning Algorithms

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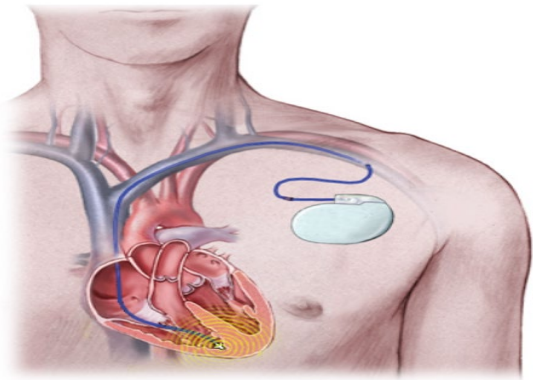
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Agenda

- Introduction
- Method
- Results
- Future Works

Introduction



- Implantable Cardioverter Defibrillator (ICD) is used as **primary** and **secondary prevention** of **sudden cardiac death**.
- Superior to anti-arrhythmic drugs in saving lives.
- The ICD can **shock** with up to **840 volts**.
 - “It’s like **getting kicked** in the **chest** by a big horse!”
 - Rated as a 6 on a 0–10-point pain scale.

Majority of patients are on home monitoring as a replacement for face-to-face in-clinic visits

- **Advantages:**
 - Efficient and **cost saving**
 - **Reduce medicalization** of patients.
- **Disadvantages:**
 - **Missed opportunities** for ICD patients / relatives to **ask questions** and **voice concerns** about their device and treatment
 - **Limited opportunities** to **spot vulnerable patients** and to provide information, care, and support that patients’ need for **successful adaptation**.

Risk of Anxiety and Depression

Introduction

Table 2 Patient-reported outcomes, cost-effectiveness and their assessment*

Construct	Scale acronym	Items	T ₀	T ₆	T ₁₂	T ₂₄
Health status (generic)	SF-12	12	X	X	X	X
Health status (HF specific)	KCCQ	12	X	X	X	X
Depression	PHQ-9	9	X	X	X	X
Anxiety	GAD-7	7	X	X	X	X
Expectations to ICD treatment	EXPECT-ICD	10	X			
Expectations to use of platform/app	EXPECT-APP	6	X			
Experience with use of platform/app	EXPERIENCE-APP	9		X	X	
ICD patient concerns	ICDC	8	X	X	X	X
ICD empowerment	ICD-EMPOWER	14	X	X	X	X
Illness perceptions	B-IPQ	9+1	X			
Adherence	MMAS-8	8	X	X	X	X
Type D personality	DS14	14	X			
Device acceptance	FPAS	18	X	X	X	X
Loneliness	UCLA	3	X	X	X	X
Cost of intervention program	€	Registry	X	X	X	X
Healthcare cost during observation period	€	Registry	X	X	X	X
Labour market absence	€	Registry	X	X	X	X
All-cause and cardiac-related mortality	Deaths	Registry	X	X	X	X
QALY	EQ-5D-5 L + VAS	6	X	X	X	X
Cost-effectiveness/utility (ICER)	€/QALY	-	X	X	X	X
Net-monetary benefit from health care and social perspective	€	-	X	X	X	X

T₀ = Baseline; T₆ = 6 months; T₁₂ = 12 months; T₂₄ = 24 months

*Both patients in the treatment group and usual care group will complete all measures at T₀, T₆, T₁₂, and T₂₄

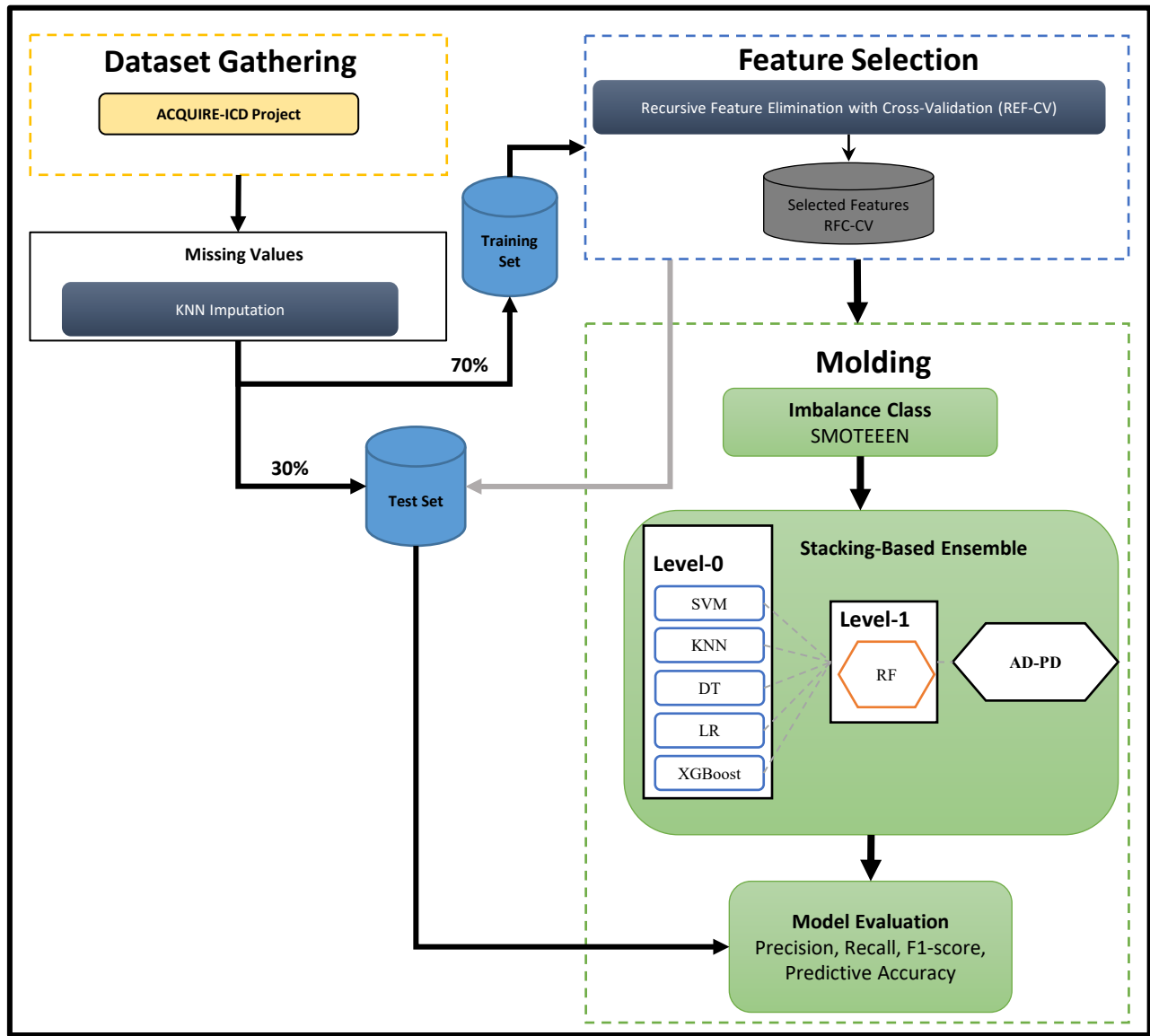
B-IPQ Brief Illness Perceptions Questionnaire, DS14 Type D Scale, EQ-5D-5 L EuroQoL, EXPECT-ICD Expectations to ICD treatment questionnaire, EXPECT-APP Expectations towards use of app, EXPERIENCE-APP Experience with use of app, FPAS Florida Patient Acceptance Survey, GAD Generalised Anxiety Disorder scale, ICD-EMPOWER ICD Empowerment Scale, ICDC ICD Patients' Concerns Questionnaire, KCCQ Kansas City Cardiomyopathy Questionnaire, MMAS-8 Morisky Medication Adherence Scale, PHQ-9 Patient Health Questionnaire, QALY quality adjusted life year, SF-12 Short Form Health Survey, UCLA UCLA Loneliness Scale, VAS visual analogue scale

A personalised and interactive web-based health care innovation to **AdvancE** the **QUality** of life and **caRE** of patients with an **Implantable Cardioverter Defibrillator (ACQUIRE-ICD)**

SS Pedersen et al. 2018

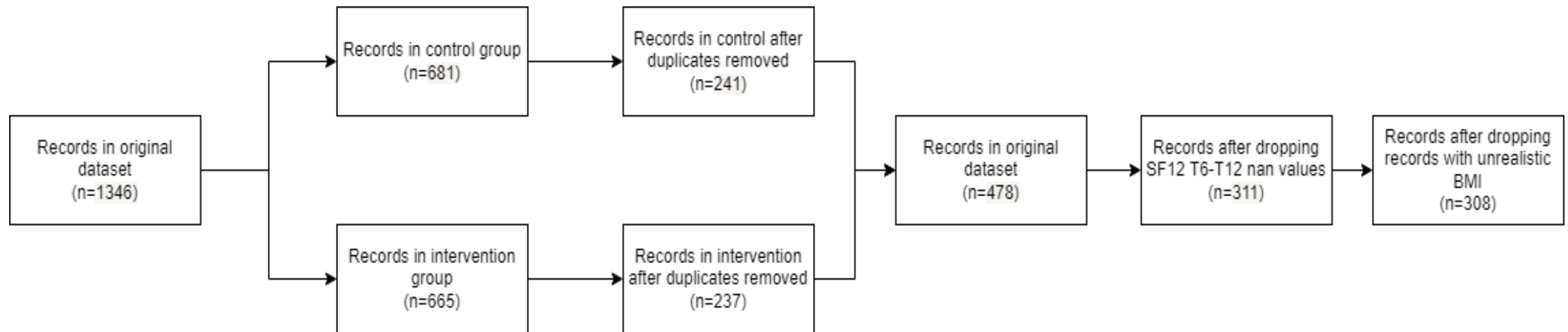
- To evaluate the efficacy of the eHealth intervention and aimed to screen **depression and anxiety** and offer treatment.

Based on the collected data from the ACQUIRE-ICD study, current project aims to **develop predictive models** based on machine learning to **track down cardiac patients** who are at increased risk of developing **anxiety and depression**.

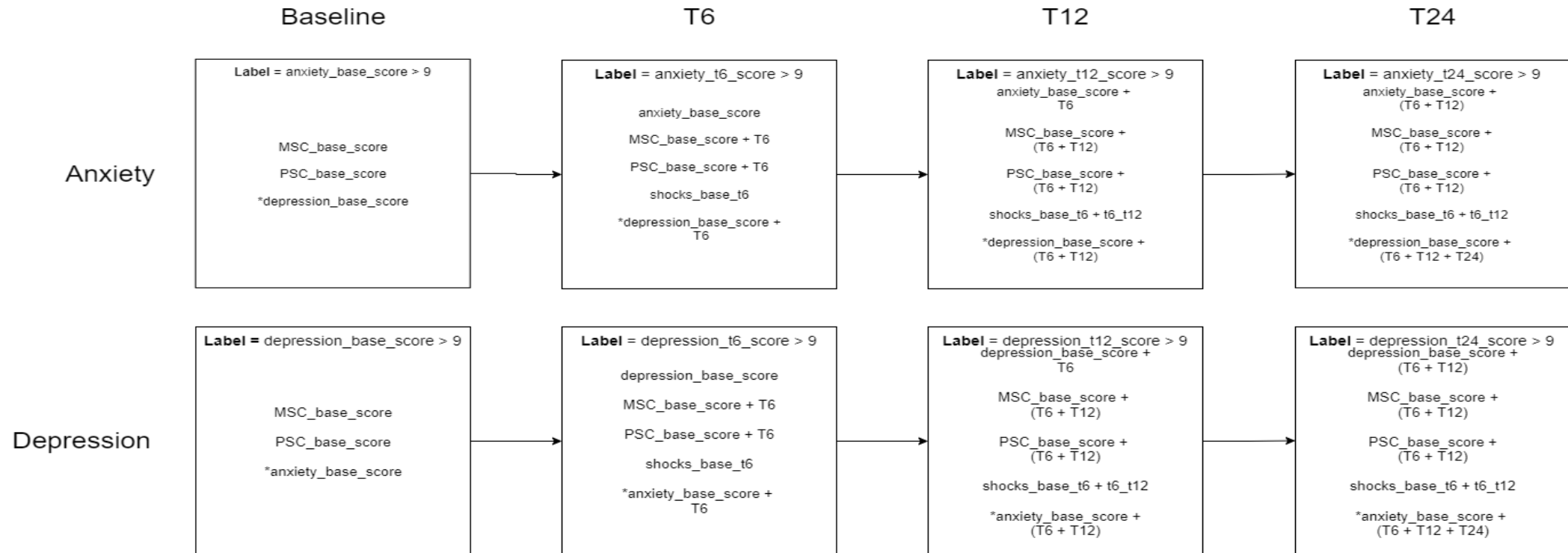


Method

Data Collection



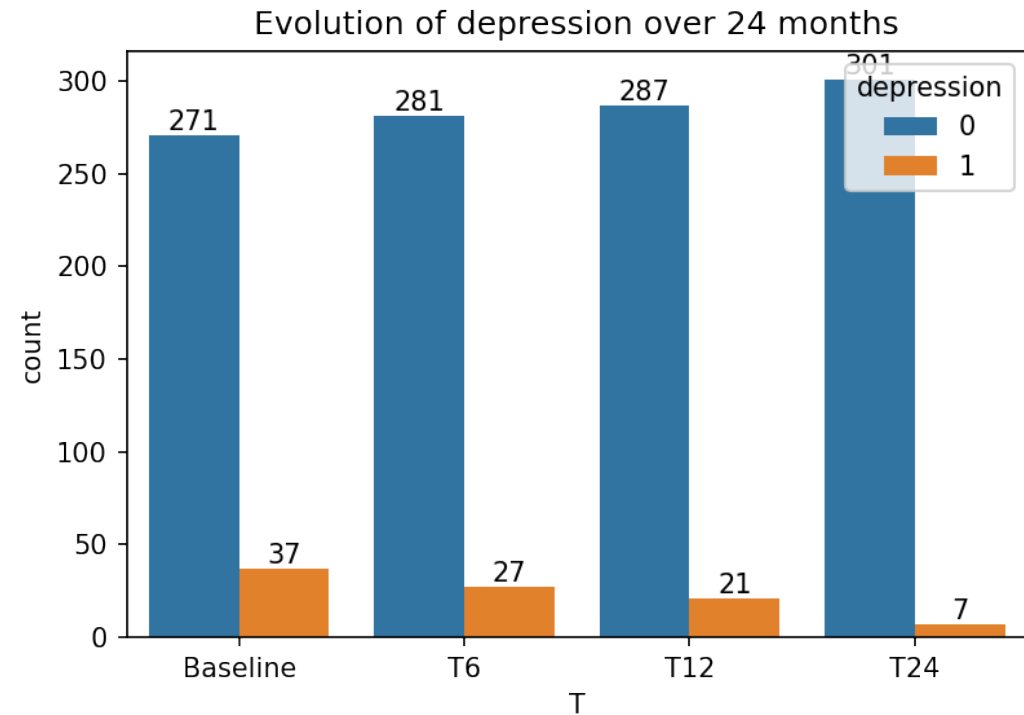
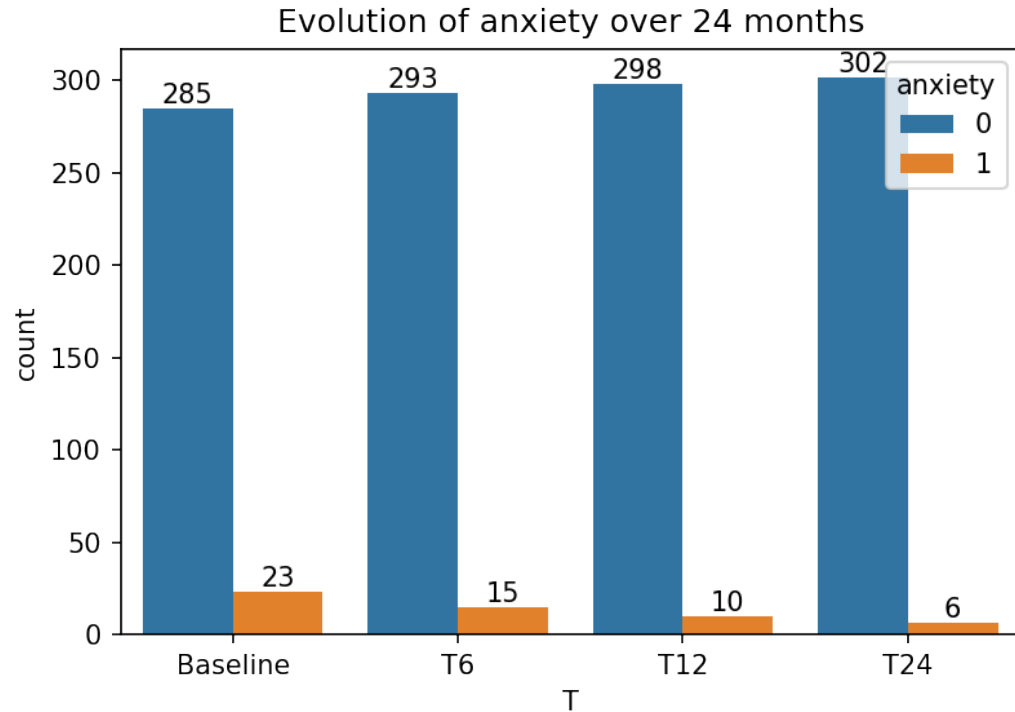
Data Collection



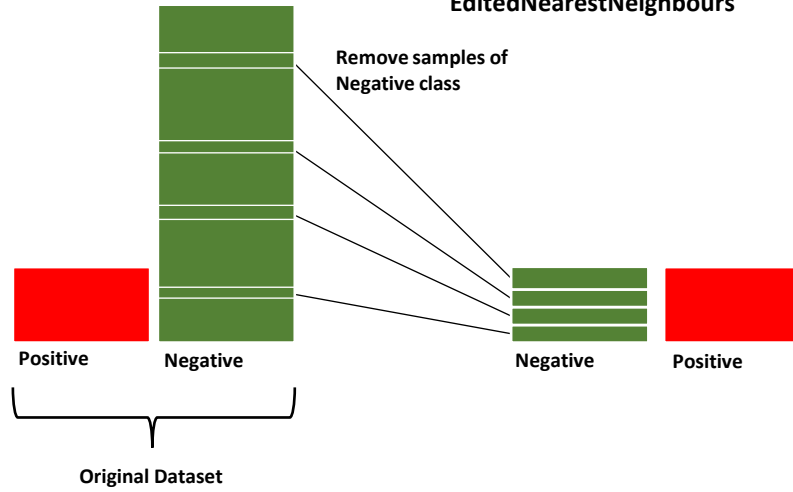
MSC = SF12 mental component

PSC = SF12 physical component

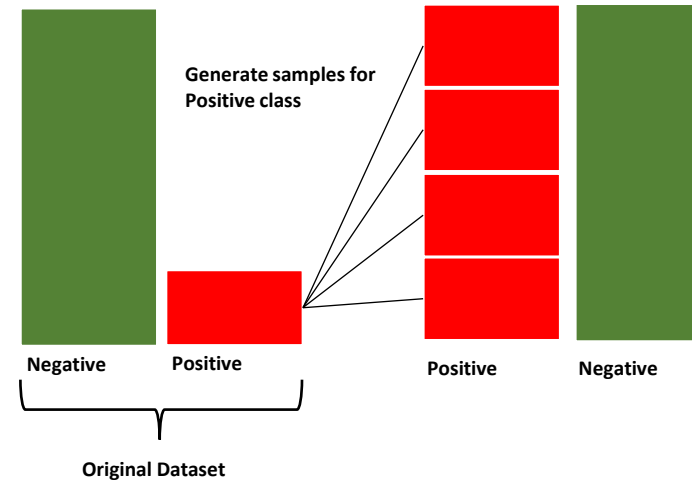
Imbalanced Class Distribution



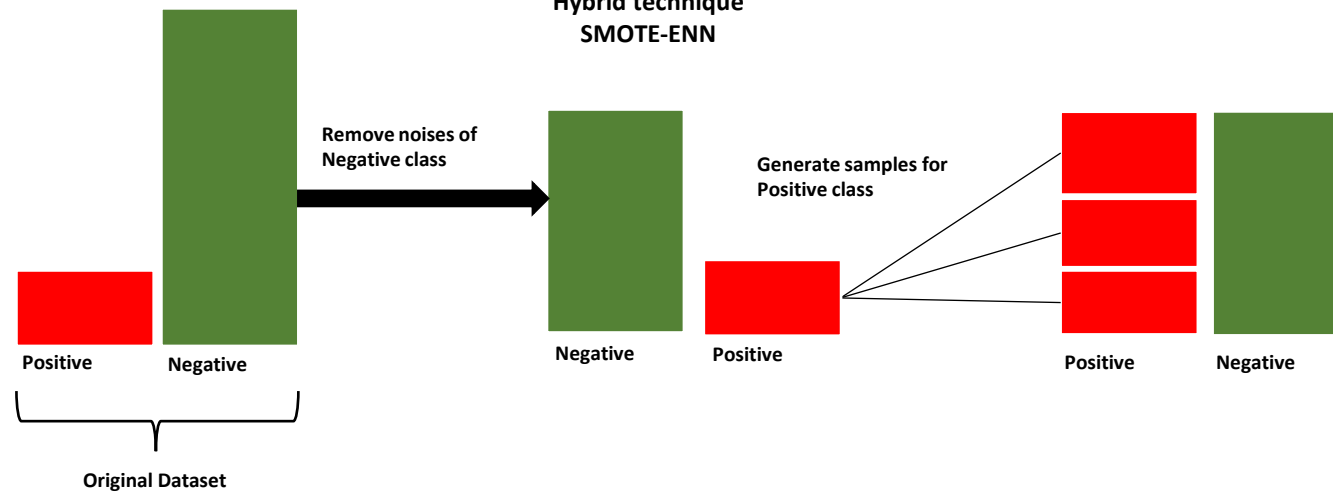
Under-Sampling techniques
NearMiss
EditedNearestNeighbours



Oversampling techniques
SMOTE
BorderlineSMOTE



Hybrid technique
SMOTE-ENN



Results

Classifier	T	target	sampler	AUC	accuracy	precision_pos	recall_pos	f1-score_pos	precision_neg	recall_neg	f1-score_neg
DT	Baseline	anxiety		0.60	0.86	0.20	0.29	0.24	0.94	0.91	0.92
DT	Baseline	anxiety	ENN	0.58	0.84	0.17	0.29	0.21	0.94	0.88	0.91
DT	T6	anxiety		0.60	0.96	1.00	0.20	0.33	0.96	1.00	0.98
DT	T6	anxiety	ENN	0.68	0.94	0.40	0.40	0.40	0.97	0.97	0.97
DT	T12	anxiety		0.66	0.97	0.50	0.33	0.40	0.98	0.99	0.98
DT	T12	anxiety	ENN	0.83	0.99	1.00	0.67	0.80	0.99	1.00	0.99
DT	T24	anxiety		0.73	0.96	0.25	0.50	0.33	0.99	0.97	0.98
DT	T24	anxiety	ENN	0.48	0.95	-	-	-	0.98	0.97	0.97
DT	Baseline	depression		0.79	0.90	0.58	0.64	0.61	0.95	0.94	0.94
DT	Baseline	depression	ENN	0.76	0.86	0.44	0.64	0.52	0.95	0.89	0.92
DT	T6	depression		0.74	0.94	0.67	0.50	0.57	0.95	0.98	0.97
DT	T6	depression	ENN	0.85	0.94	0.60	0.75	0.67	0.98	0.95	0.96
DT	T12	depression		0.73	0.94	0.50	0.50	0.50	0.97	0.97	0.97
DT	T12	depression	ENN	0.89	0.94	0.50	0.83	0.63	0.99	0.94	0.96
DT	T24	depression		0.75	0.99	1.00	0.50	0.67	0.99	1.00	0.99
DT	T24	depression	ENN	0.73	0.96	0.25	0.50	0.33	0.99	0.97	0.98

Results

Classifier	T	target	sampler	AUC	accuracy	precision_pos	recall_pos	f1-score_pos	precision_neg	recall_neg	f1-score_neg
KNN	Baseline	anxiety		0.97	0.96	1.00	0.43	0.60	0.96	1.00	0.98
KNN	Baseline	anxiety	ENN	0.95	0.95	0.75	0.43	0.55	0.96	0.99	0.97
KNN	T6	anxiety		0.87	0.96	1.00	0.20	0.33	0.96	1.00	0.98
KNN	T6	anxiety	ENN	0.88	0.96	0.67	0.40	0.50	0.97	0.99	0.98
KNN	T12	anxiety		0.64	0.97	-	-	-	0.97	1.00	0.98
KNN	T12	anxiety	ENN	0.64	0.98	1.00	0.33	0.50	0.98	1.00	0.99
KNN	T24	anxiety		0.95	0.96	-	-	-	0.98	0.98	0.98
KNN	T24	anxiety	ENN	0.96	0.95	-	-	-	0.98	0.97	0.97
KNN	Baseline	depression		0.73	0.92	0.83	0.45	0.59	0.93	0.99	0.96
KNN	Baseline	depression	ENN	0.74	0.91	0.67	0.55	0.60	0.94	0.96	0.95
KNN	T6	depression		0.91	0.95	1.00	0.38	0.55	0.94	1.00	0.97
KNN	T6	depression	ENN	0.92	0.95	0.64	0.88	0.74	0.99	0.95	0.97
KNN	T12	depression		0.71	0.92	0.33	0.17	0.22	0.94	0.98	0.96
KNN	T12	depression	ENN	0.79	0.94	0.50	0.33	0.40	0.96	0.98	0.97
KNN	T24	depression		0.72	0.98	-	-	-	0.98	1.00	0.99
KNN	T24	depression	ENN	0.72	0.97	-	-	-	0.98	0.99	0.98

Results

Classifier	T	target	sampler	AUC	accuracy	precision_pos	recall_pos	f1-score_pos	precision_neg	recall_neg	f1-score_neg
XGBoost	Baseline	anxiety		0.90	0.91	0.40	0.29	0.33	0.94	0.97	0.95
XGBoost	Baseline	anxiety	ENN	0.93	0.89	0.33	0.43	0.38	0.95	0.93	0.94
XGBoost	T6	anxiety		0.96	0.96	1.00	0.20	0.33	0.96	1.00	0.98
XGBoost	T6	anxiety	ENN	0.92	0.96	0.67	0.40	0.50	0.97	0.99	0.98
XGBoost	T12	anxiety		0.98	0.97	0.50	0.33	0.40	0.98	0.99	0.98
XGBoost	T12	anxiety	ENN	0.99	0.98	0.67	0.67	0.67	0.99	0.99	0.99
XGBoost	T24	anxiety		0.93	0.96	-	-	-	0.98	0.98	0.98
XGBoost	T24	anxiety	ENN	0.96	0.98	-	-	-	0.98	1.00	0.99
XGBoost	Baseline	depression		0.92	0.90	0.58	0.64	0.61	0.95	0.94	0.94
XGBoost	Baseline	depression	ENN	0.93	0.89	0.53	0.73	0.62	0.96	0.91	0.94
XGBoost	T6	depression		0.99	0.98	1.00	0.75	0.86	0.98	1.00	0.99
XGBoost	T6	depression	ENN	0.99	0.97	0.78	0.88	0.82	0.99	0.98	0.98
XGBoost	T12	depression		0.96	0.96	0.67	0.67	0.67	0.98	0.98	0.98
XGBoost	T12	depression	ENN	0.96	0.95	0.57	0.67	0.62	0.98	0.97	0.97
XGBoost	T24	depression		0.88	0.98	-	-	-	0.98	1.00	0.99
XGBoost	T24	depression	ENN	0.91	0.98	-	-	-	0.98	1.00	0.99

Future Work

- Improve Predictive Accuracy
- Apply Imputation Technique
- Apply Feature Selection Method
- Explainability and Interpretability.

