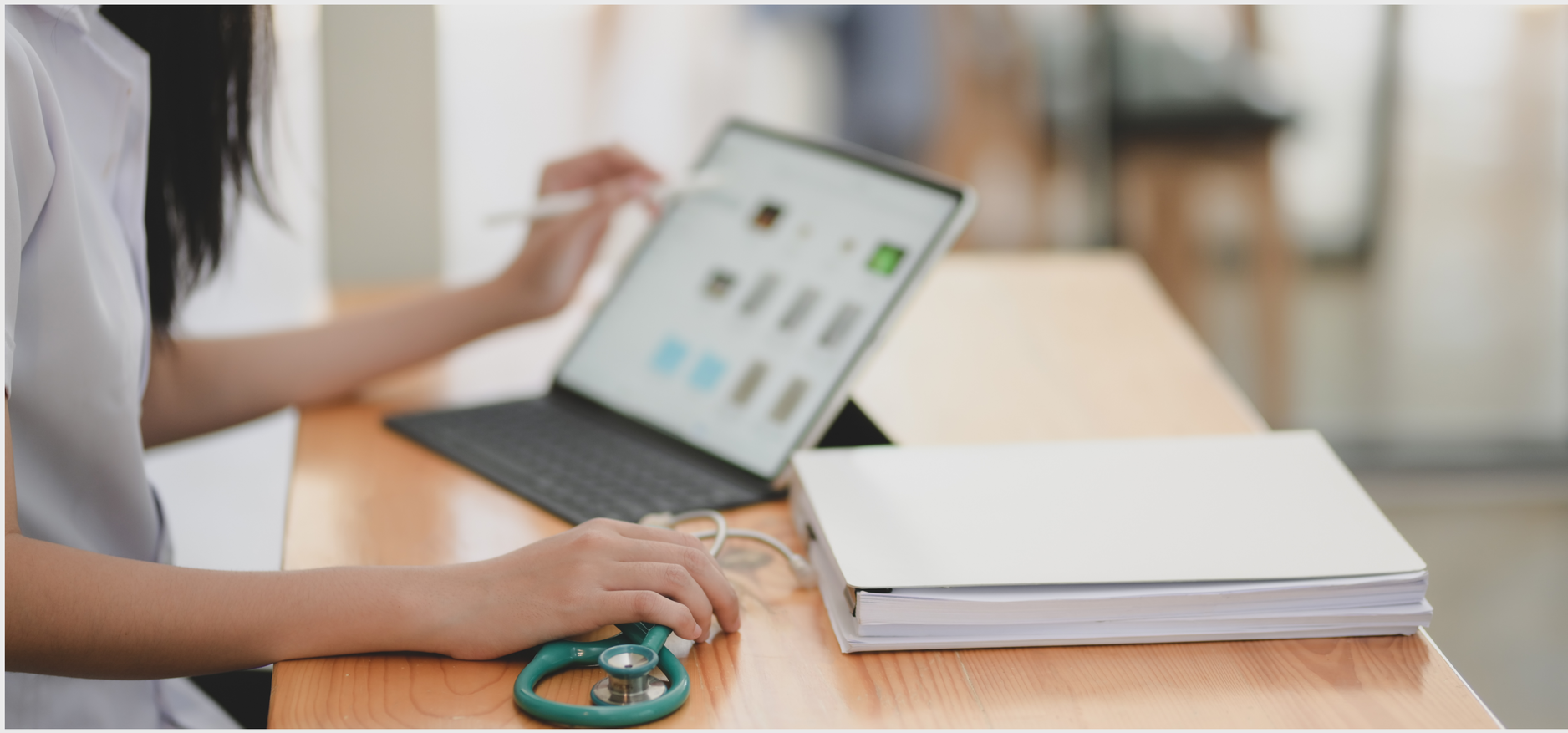
# Prediction Models for Chronic Kidney Disease Diagnosis Using BPJS Health Insurance Claim Data




by : MedCamp

Mentored by:
Hapsari Amira

Ari Sulistyowati (Preprocessing, Design)
Faris Rizky Andika (Preprocessing, Modeling, Design)
Arif Zainurrohman (Visualization)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## TEAM MEMBER

1. Ari Sulistyowati
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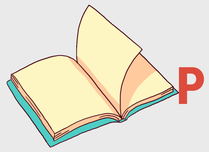
## AFFILIATION

1. Mentor: Hapsari Amira
2. IYKRA: Solver Society Program

## PROBLEM STATEMENT

Kidney disease is one of the chronic diseases in Indonesia which is the 18th largest contributor to death in the world and is currently increasing. Meanwhile in Indonesia, treatment of kidney disease is the second-largest in terms of financing for BPJS claims after heart disease.

## OBJECTIVES

1. Predicting the patient will suffer from chronic kidney disease (CKD) or not (*based on the patient's medical history data*)

2. Provide additional insight to related medical personnel regarding the medical records of CKD patients

3. Provide insight to non-patients chronic kidney disease  regarding the urgency of preventing chronic kidney disease (CKD) based on predictive results


## REFERENCES


1. infodatin-ginjal-2017.pdf
2. https://pubmed.ncbi.nlm.nih.gov/34067129/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# Prediction Models for Chronic Kidney Disease - Literature Review

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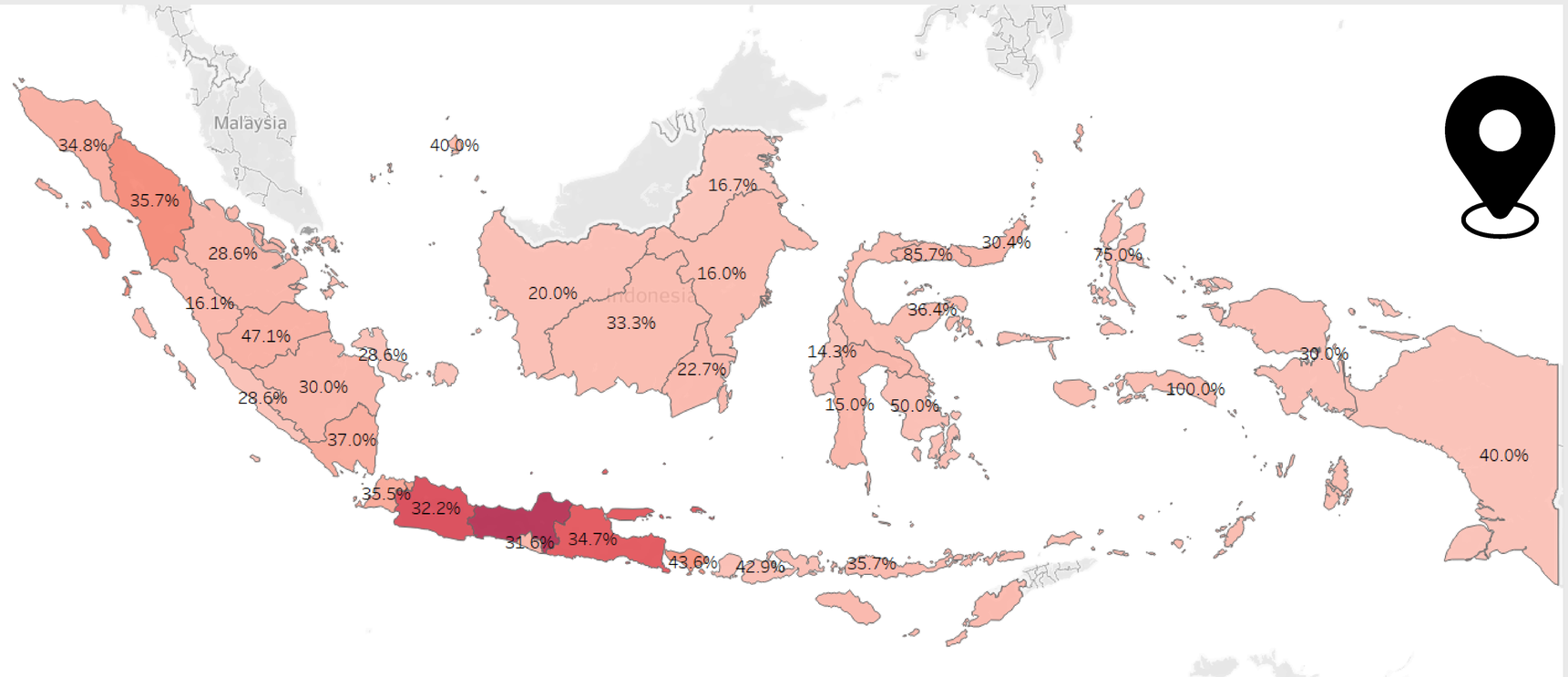
Kemenkes RI. Situasi penyakit ginjal kronis. InfoDATIN. Pusat Data dan Informasi Kementrian Kesehatan RI. Jakarta.
ISSN. 2017:2442-7659

- Age >50
- Diabetes
- Hypertension
- Smoking
- Obesity
- Familial history of kidney disease

- Rp 227 B
  (for Hemodialysis; 2012)
- Rp 2.68 T
  (for Kidney-related disease; 2014)
- 2nd only to Heart disease




Prevalence of Chronic Kidney Disease from the Dataset

# Prediction Models for Chronic Kidney Disease - Literature Review

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https://pubmed.ncbi.nlm.nih.gov/34067129/

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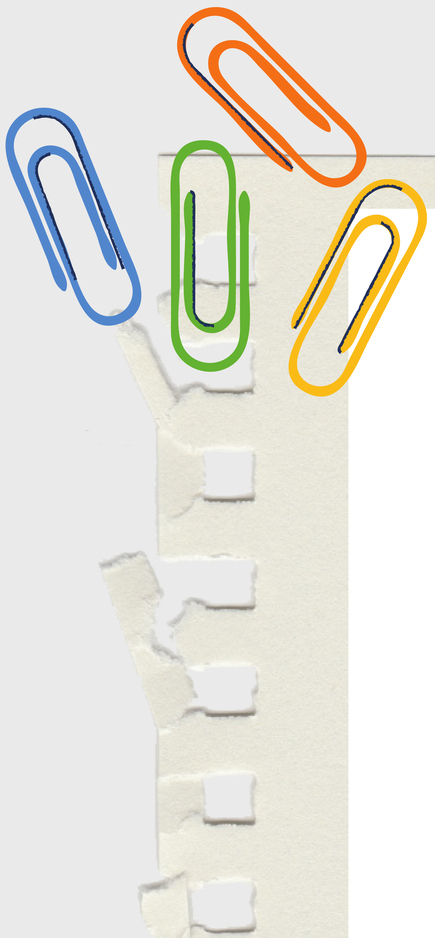
| Algorithm | Accuracy | F1 | Precision | Recall or Sensitivity |
|---|---|---|---|---|
| CNN | **0.89** | **0.773** | **0.657** | **0.94** |
| BLSTM | 0.87 | 0.735 | 0.624 | 0.893 |
| LightGBM | 0.751 | 0.525 | 0.426 | 0.685 |
| logistic | 0.736 | 0.503 | 0.405 | 0.664 |
| randomforest | 0.725 | 0.488 | 0.390 | 0.652 |
| decision tree | 0.732 | 0.483 | 0.395 | 0.622 |

Hypertension
Urinary tract
Sulfonamides
Renal disease
Angiotensin
Gout
Diabetes mellitus
Age
Antacids



*healthcare*

MDPI

*Article*

## Machine Learning Prediction Models for Chronic Kidney Disease Using National Health Insurance Claim Data in Taiwan

**Surya Krishnamurthy [1], Kapeleshh KS [2], Erik Dovgan [3], Mitja Luštrek [3], Barbara Gradišek Piletič [4], Kathiravan Srinivasan [1], Yu-Chuan (Jack) Li [5], Anton Gradišek [3,*] and Shabbir Syed-Abdul [5,*]**

# Prediction Models for Chronic Kidney Disease Trajectories Using BPJS Health Insurance Claim Data


Arrange by : MedCamp

Team Member

1. *Ari Sulistyowati*
2. *Arif Zainurrohman*
3. *Faris Rizky Andika*

Affiliation

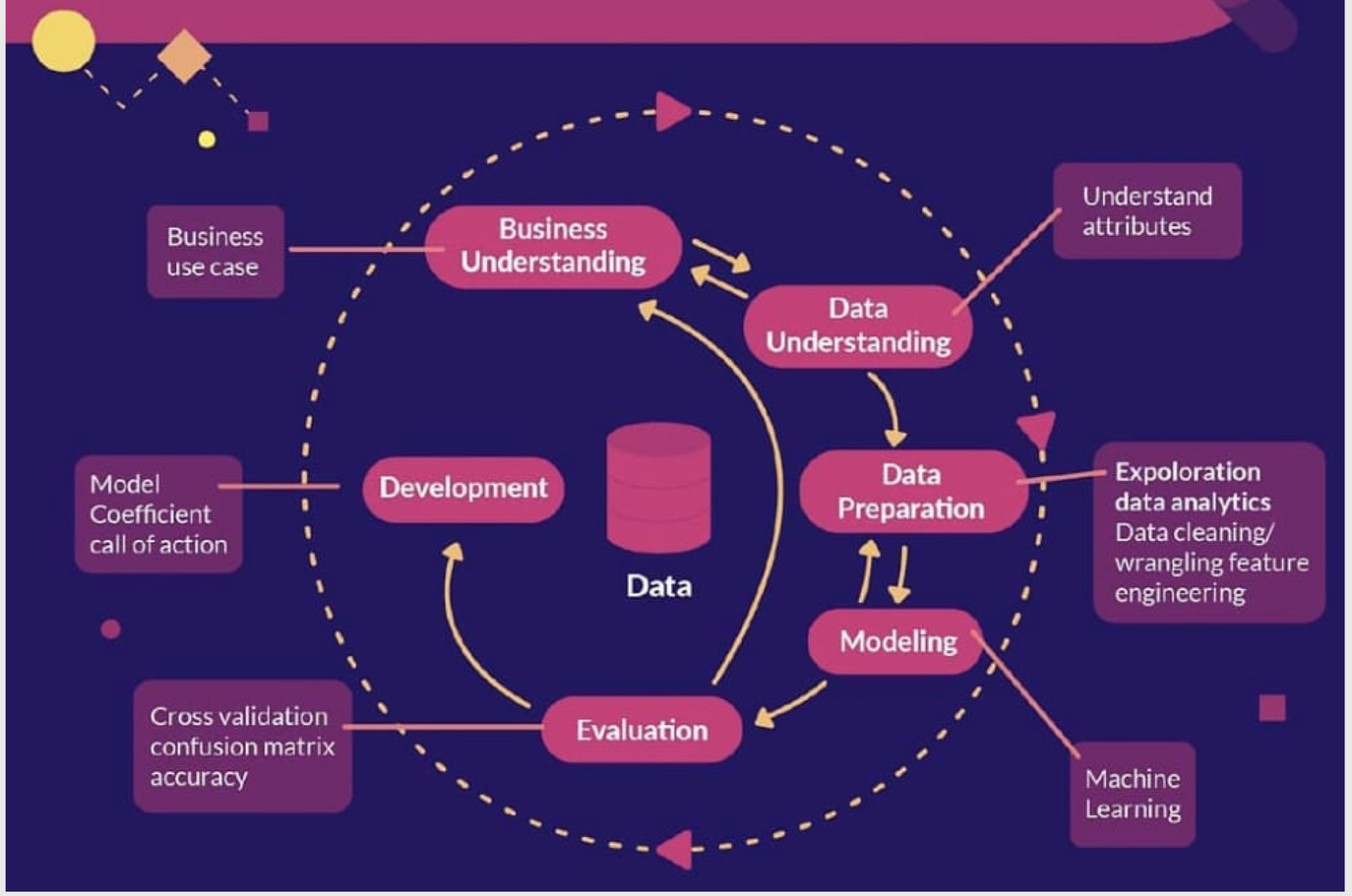
1. *Mentor: Hapsari*
2. *IYKRA: Solver Society Program*


## Metodhology

**CRISP-DM**

**C**Ross-**I**ndustry **S**tandard **P**rocess for Data **M**ining

Data mining process model that describes commonly used approaches that mining experts use to tackle problems

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# Prediction Models for Chronic Kidney Disease Trajectories Using BPJS Health Insurance Claim Data

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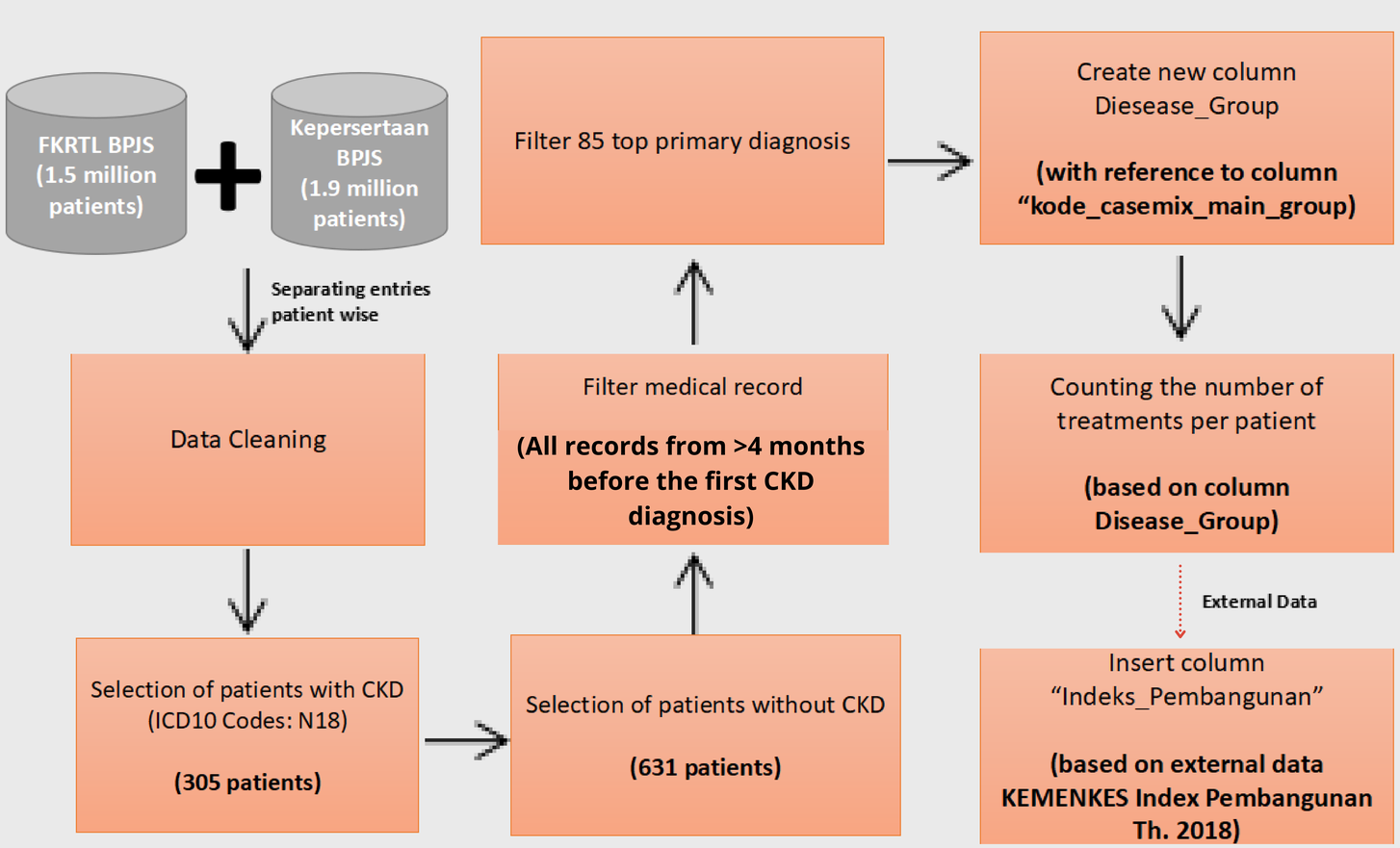
## AFILIATION

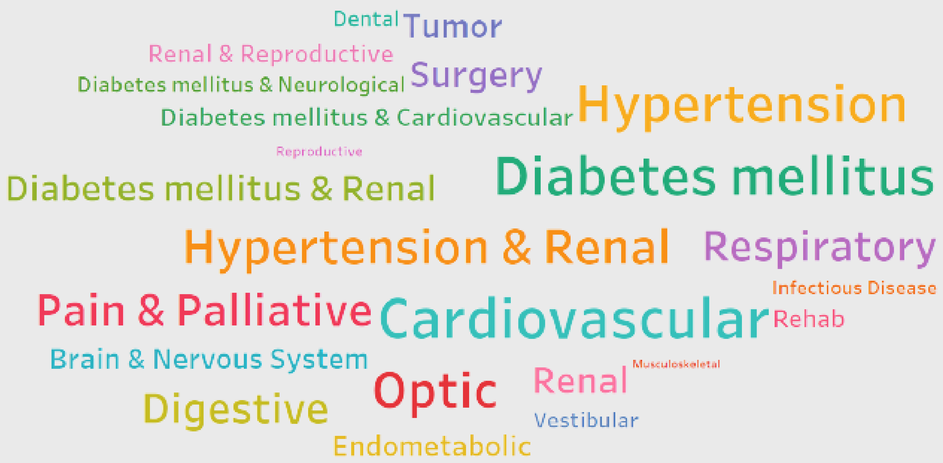
1. Mentor: Hapsari Amira
2. IYKRA: Solver Society Program


## DATA PREPROCESSING




## PREDICTORS

- **Age**
- **Gender**
- **Marital Status**
- **Occupational Category**
- **Historical Diagnosis Count:**

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# Data Overview Patient Chronic Kidney Disease According to BPJS Health Insurance Claim Data 2016 - 2018

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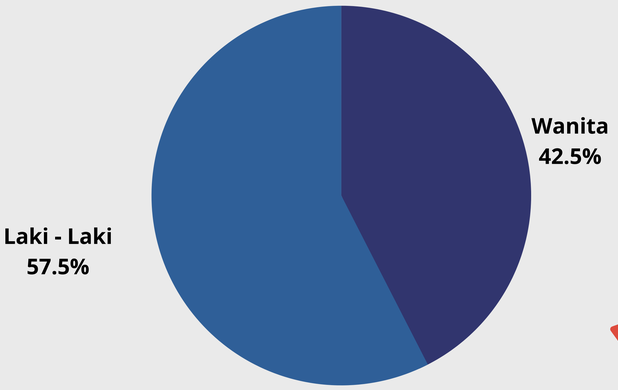
## TEAM MEMBER

1. Ari Sulistyowati
2. Arif Zainurrohman
3. Faris Rizky Andika

## AFILIATION

1. Mentor: Hapsari Amira
2. IYKRA: Solver Society Program


## GENDER

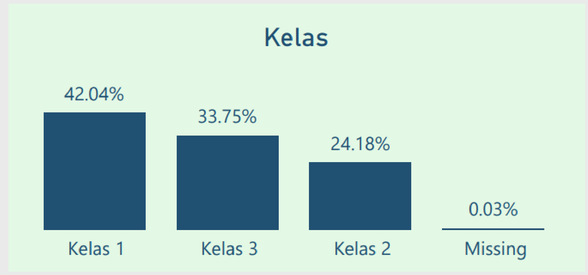



This shows that the proportion of men with CKD is greater than of women

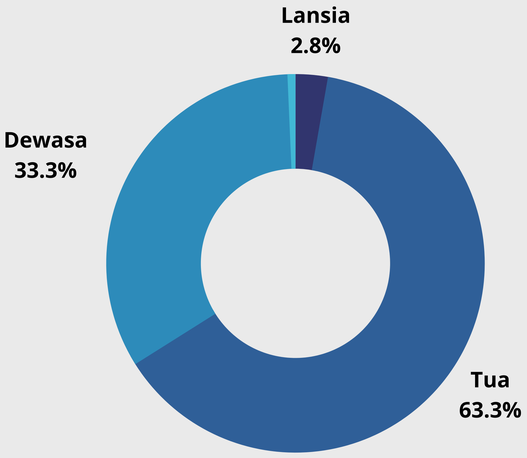
CKD patients in BPJS class 1 category are highest rank

| 1,780 | 98,549 |
|---|---|
| Pasien | Kunjungan |

## KELAS KEPERSERTAAN BPJS



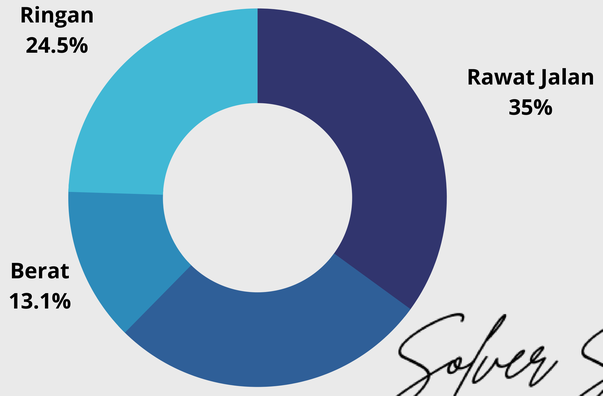

## SEGMENTASI UMUR PESERTA




Segmentation with the Old category with a range between 30 years to 50 years ranks at the top.

Most CKD patients are treated on an outpatient basis

## TINGKAT KEPARAHAN

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# Chronic Kidney Disease Prediction According to BPJS Health Insurance Claim Data 2016 - 2018

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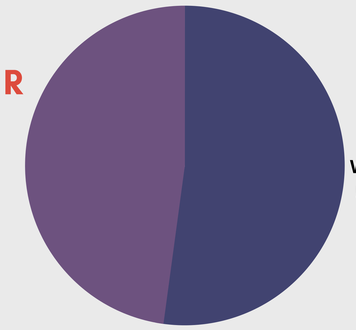
2. IYKRA: Solver Society Program


## GENDER



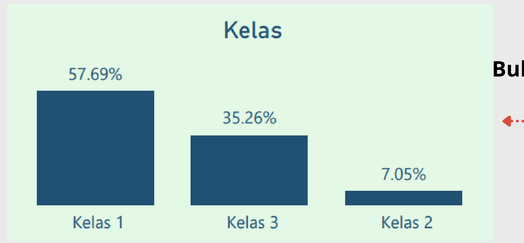

Predictive data show a higher tendency in women to suffer from CKD than men

936

Pasien

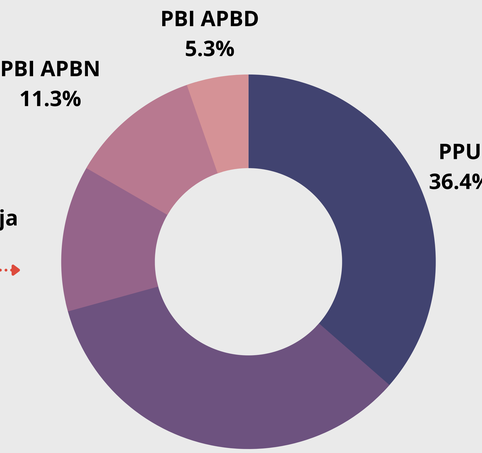
Lifestyle has a big influence on the risk of suffering from CKD

## KELAS KEPERSERTAAN BPJS



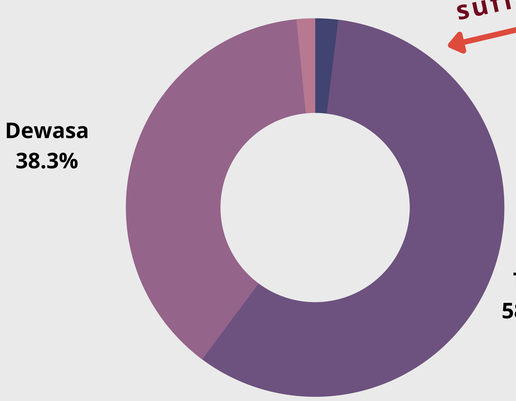

Bukan Pekerja
12.6%

## SEGMENTASI PEMBAYARAN BPJS

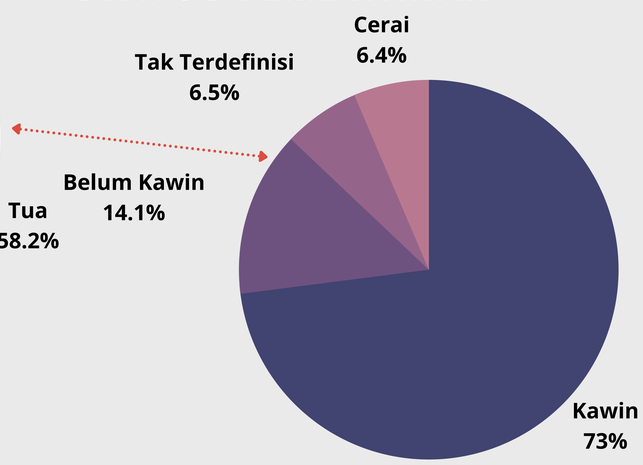



The tendency of someone who has the Old category (range 30-50 years) with married marital status has a high risk of suffering from CKD

## SEGMENTASI UMUR PESERTA

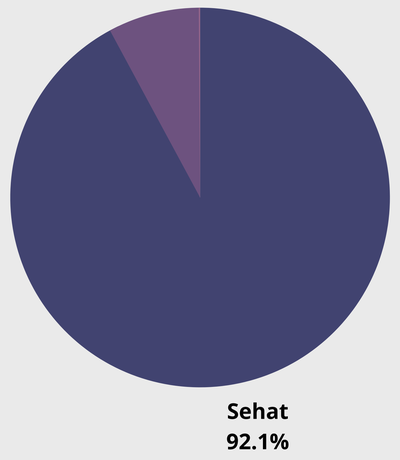



## STATUS PERKAWINAN

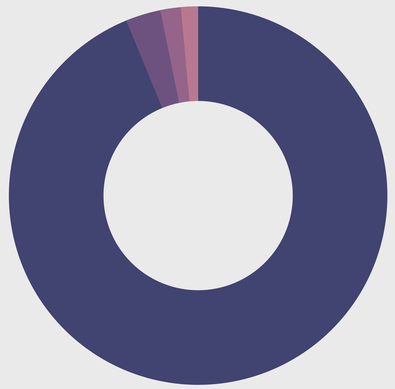



Based on the graph above, it can be said that the prediction of CKD patients is indicated to have mild CKD

## STATUS PASIEN




## TINGKAT KEPARAHAN

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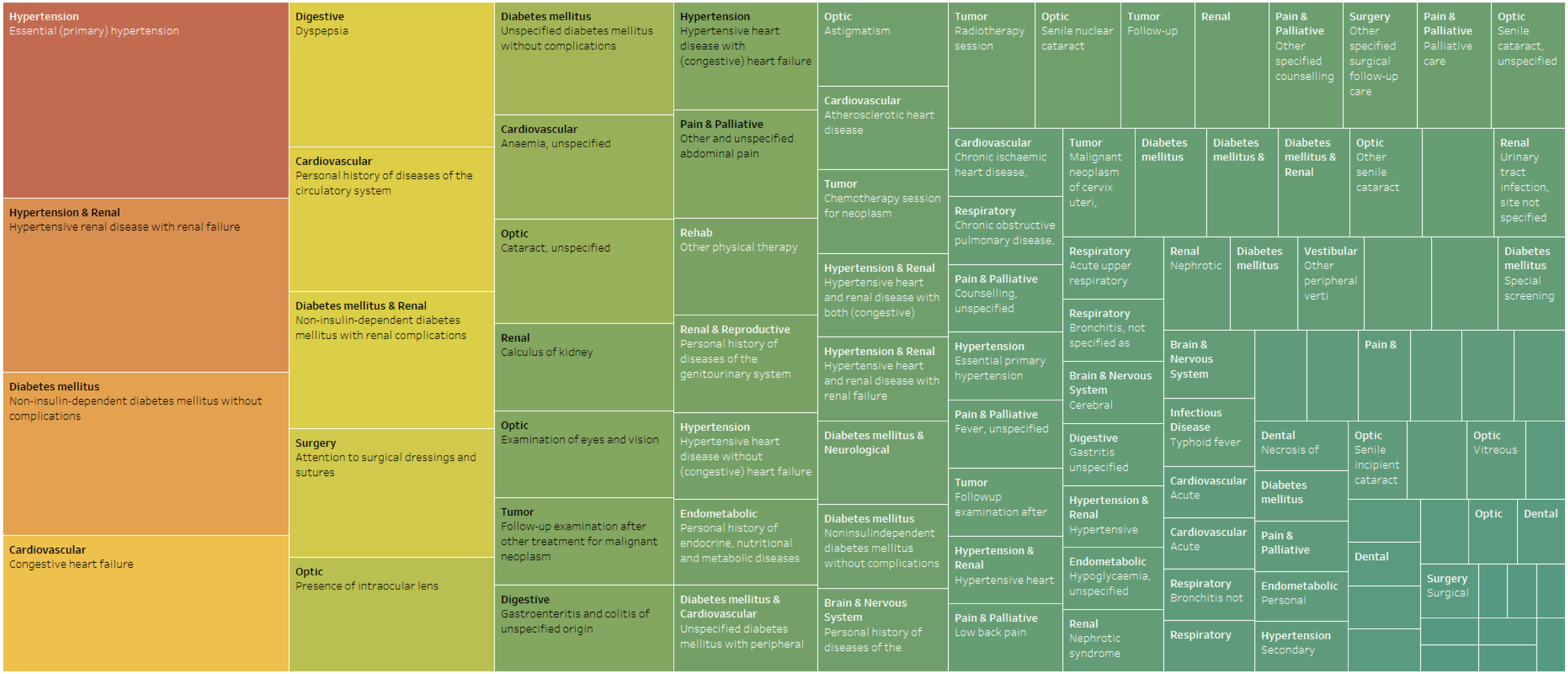


**CKD and Non-CKD Patients' Historical Data were filtered based on the diagnosis listed above**

**(approx. 110 diagnosis grouped into 23 diagnosis group)**

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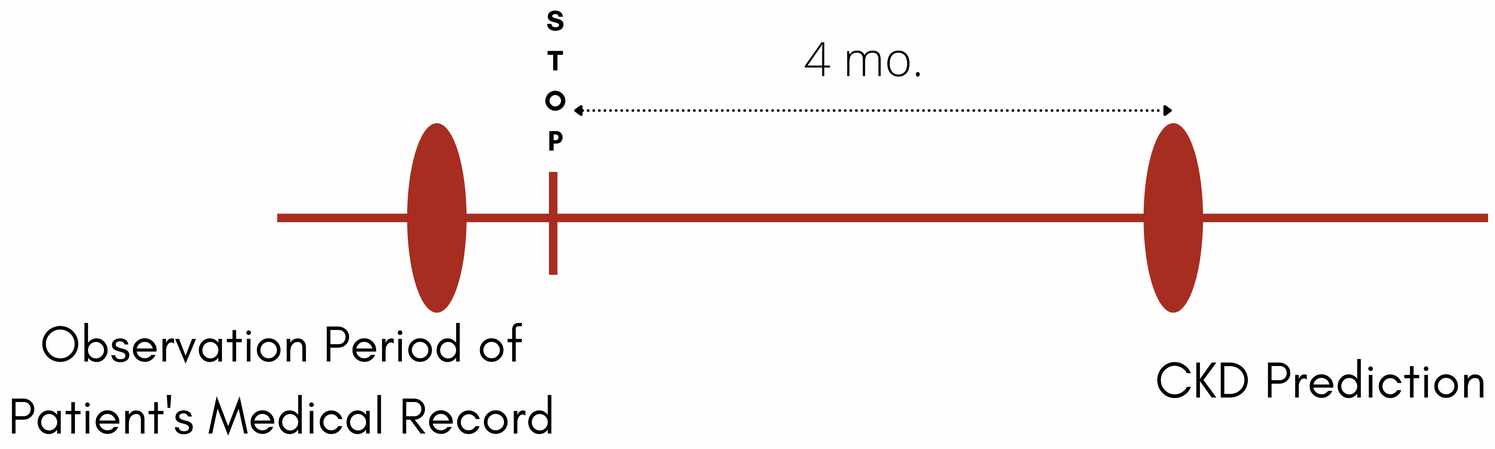
| Nama_Diagnosis_Masuk_FKRTL | Kode_Diagnosis_Primer_ICD10 | Nama_Diagnosis_Primer_FKRTL | Deskripsi_Kode_INACBGs | INACBGs_Kode_Casemix_Main_Group |
|---|---|---|---|---|
| Undefined | N20 | Calculus of kidney | PROSEDUR ULTRASOUND LAINLAIN | Z. Factors influencing health status & |
| Undefined | Z09 | Followup examination after other treatment for... | PENYAKIT KRONIS KECIL LAINLAIN | Q. Ambulatory Groups-Episodic |
| Calculus of kidney and ureter | Z09 | Followup examination after other treatment for... | PENYAKIT KRONIS KECIL LAINLAIN | Q. Ambulatory Groups-Episodic |
| Undefined | N20 | Calculus of kidney | PROSEDUR SALURAN URIN ATAS RINGAN | N. Nephro-urinary System Groups |
| Undefined | Z09 | Followup examination after other treatment for... | PENYAKIT KRONIS KECIL LAINLAIN | Q. Ambulatory Groups-Episodic |
| ... | ... | ... | ... | ... |
| Stroke, not specified as haemorrhage or infarc... | Z09 | Follow-up examination after other treatment fo... | PROSEDUR THERAPI FISIK DAN PROSEDUR KECIL MUSK... | M. Musculoskeletal system & connective |
| Stroke, not specified as haemorrhage or infarc... | Z09 | Follow-up examination after other treatment fo... | PROSEDUR THERAPI FISIK DAN PROSEDUR KECIL MUSK... | M. Musculoskeletal system & connective |
| Cerebral infarction, unspecified | Z09 | Follow-up examination after other treatment fo... | PENYAKIT KRONIS KECIL LAIN-LAIN | Q. Ambulatory Groups-Episodic |
| Chronic ischaemic heart disease, unspecified | I25 | Chronic ischaemic heart disease, unspecified | PENYAKIT KRONIS BESAR LAIN-LAIN | Q. Ambulatory Groups-Episodic |

| Id_Peserta | brain___nervous_system | cardiovascular | dental | diabetes_mellitus | diabetes_mellitus___cardiovascular | diabetes_mellitus___neurological | digestive |
|---|---|---|---|---|---|---|---|
| 70764718 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 |
| 55133751 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 |
| 80738221 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 |
| 81327309 | 0 | 0 | 0.0 | 0 | 0 | 0 | 1 |
| 53030313 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 |

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**Historical diagnosis received by patients were counted based on their respective disease group.**

**Data further transformed by grouping it based on Patient ID.**

**We observed patients record until a certain time where we would be able to predict CKD no CKD at least four months after the observation period.**

# Modeling using Gradient Boosting Classifier

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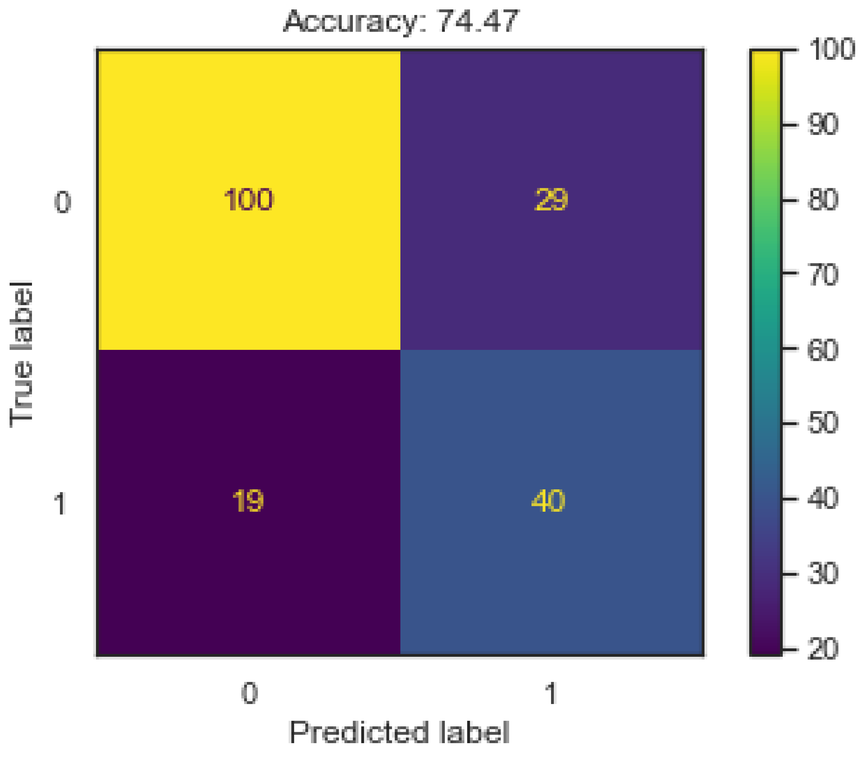
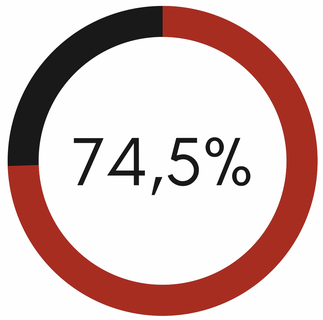


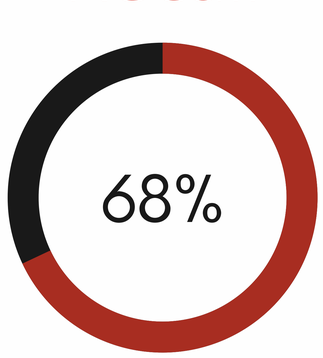

0: No Chronic Kidney Disease

1: Chronic Kidney Disease

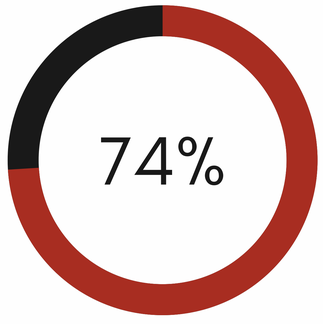
## Accuracy

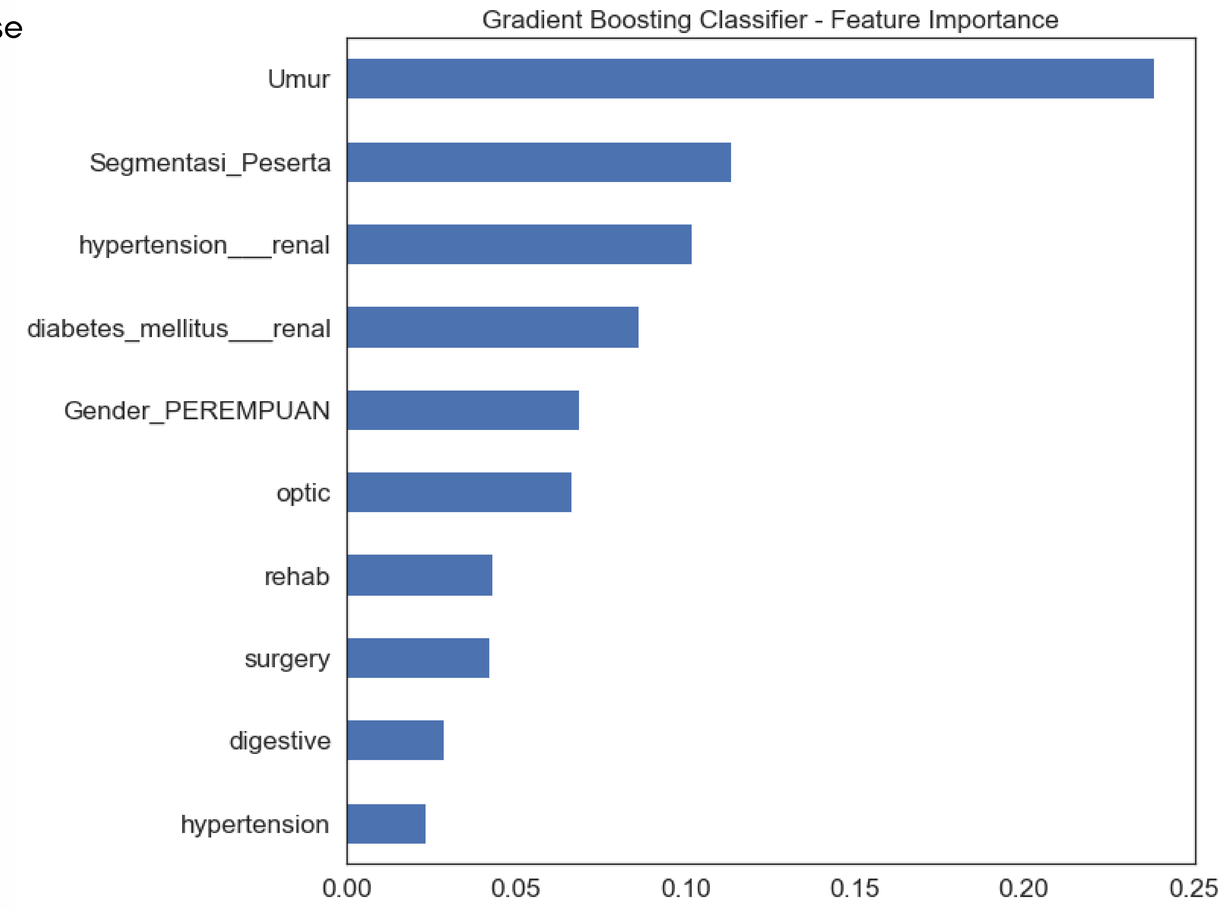


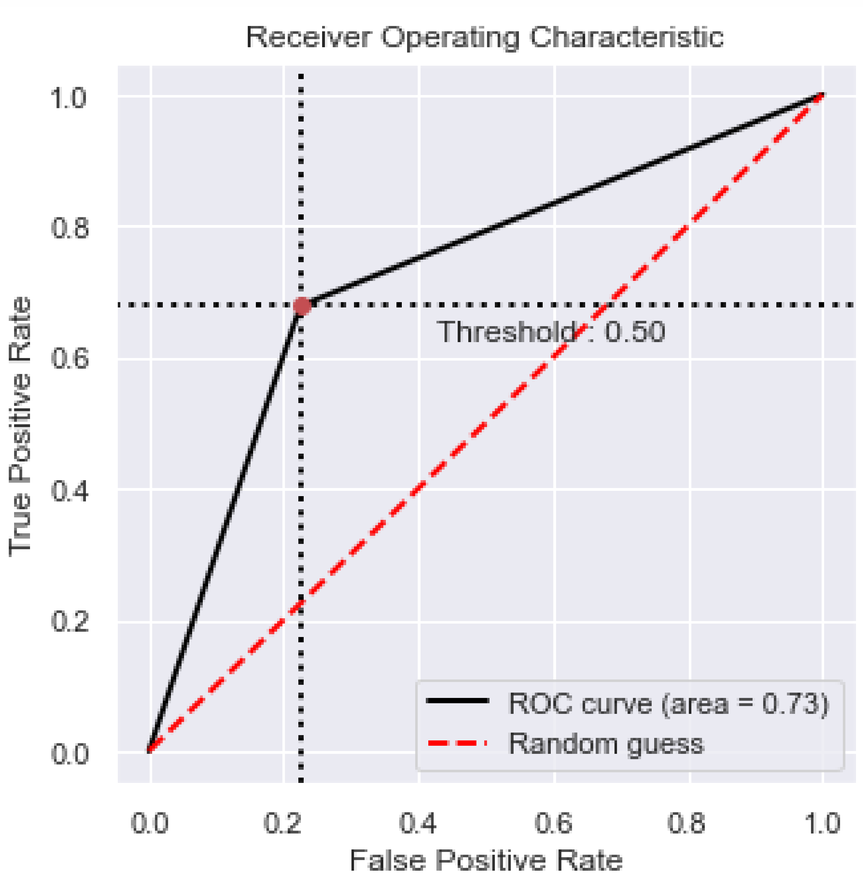

## Recall



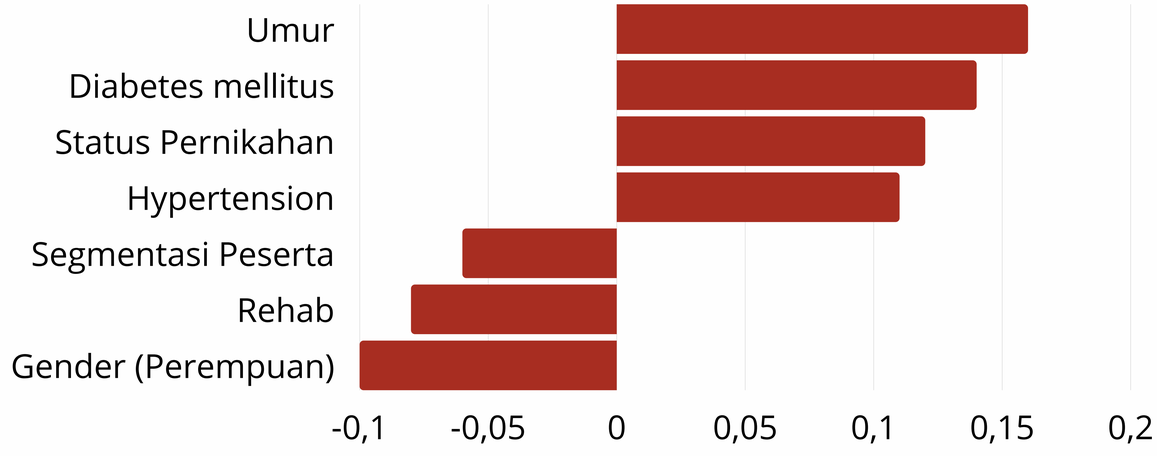

## 5-fold CV




## Correlation with CKD



# Insights from Modeling

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- **Age**, History of **renal disease**, **diabetes mellitus** and **Hypertension** influential
- Model gives predicted probability of developing CKD **at least 4 months before the onset** and can aid healthcare professionals in decision making
- **Future studies:**
  - Records from more patients and longer time window needed (dataset only contain 2 years of record)
  - Neural network modeling
  - Interactive view for direct input and prediction by users

# Preventive Chronic Kidney Disease

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Kidney disease are silent killers, which will largely affect your quality of life. There are however several easy ways to reduce the risk of developing kidney disease

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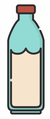
## HOW TO DETECT CKD?

Early CKD often has no sign or symptoms. A person can lose up to 90% of their kidney function before experiencing any signs.



But it can be detected by simple tests:
a. a urine test to check if there is any protein in your urine, or
b. a blood test to mesure the level of creatinine in your blood

Signs of advancing CKD include: swollen ankles, fatigue, difficulty concentrating, decreased appetie, and foamy urine.

## The Eight Golden Rules To Reduce The Risk

1. Keep fit, be active
2. Eat a healty diet
3. Check and control your blood sugar
4. Check and control your blood pressure
5. Take appropriate fluid intake
6. Don't smoke
7. Don't take over-the-counter anti-inflammatory/pain-killer pills regularly
8. Get your kidney function checked if you have one or more of the 'high risk' factors
   - You have diabetes
   - You have hypertension
   - You are obese

## ARE YOU AT RISK?

1. Do you have high blood pressure?

2. Do you suffer from diabetes?

3. Do you have a familiy history of kidney disease?

4. Do you smokes?

5. Are you over 50 years?

6. Are you African, Hispanic, Aboriginal or Asian origin?

## DID YOU KNOW THAT YOUR KIDNEYS

1. Make urine
2. Remove wastes and extra fluid from your blood
3. Control your body's chemical balance
4. Help control your blood pressure
5. Help keep your bones healty
6. Help you make red blood cells