

# 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)

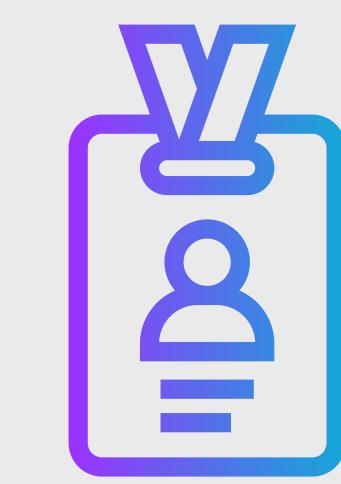
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## TEAM MEMBER

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3. Faris Rizky Andika



## AFFILIATION

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2. IYKRA: Solver Society Program

## PROBLEM STATEMENT

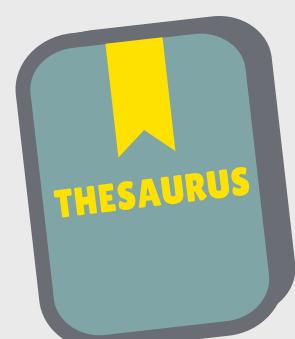
Kidney disease is one of the chronic diseases in Indonesia which is the 18th largest contributor to death in the world and is currently increasing.

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/>

# Prediction Models for Chronic Kidney Disease - Literature Review

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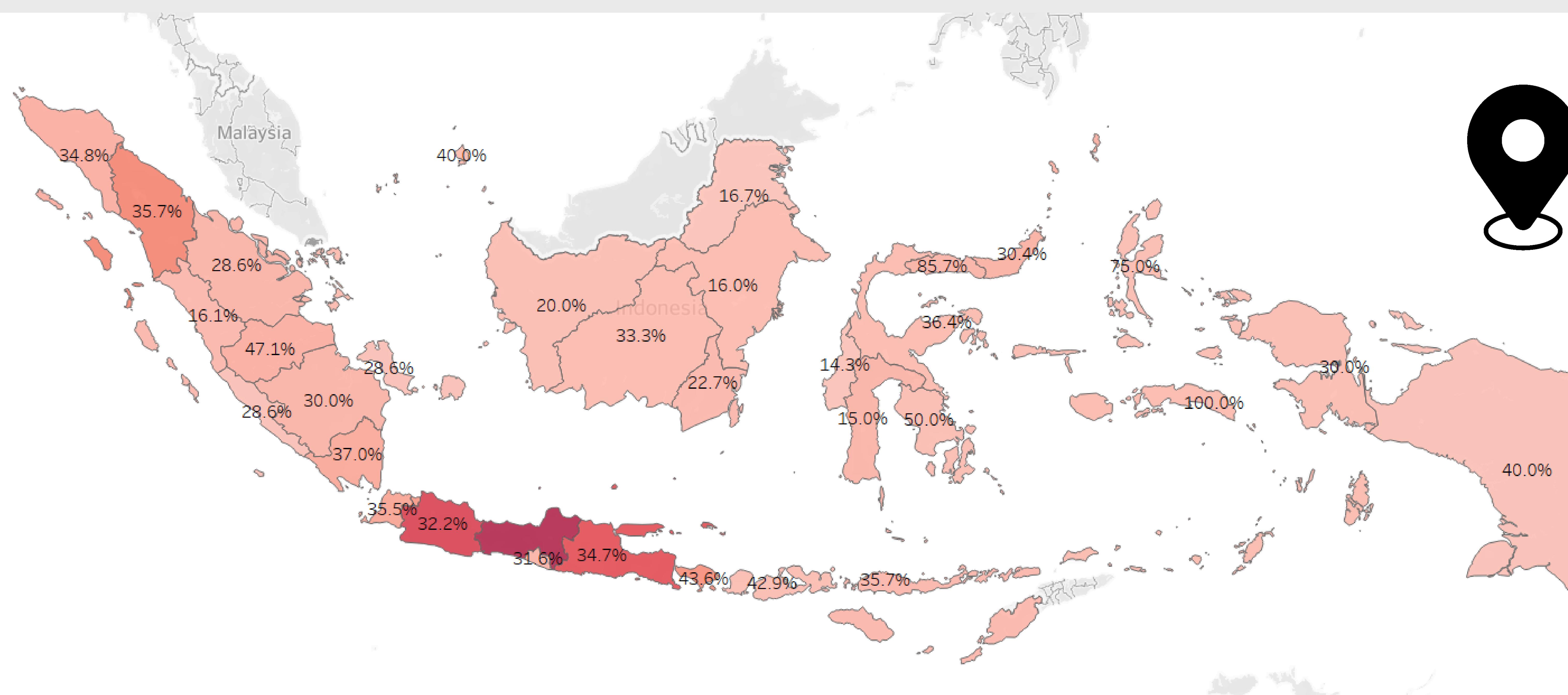
Kemenkes RI. Situasi penyakit ginjal kronis. InfoDATIN. Pusat Data dan Informasi Kementerian Kesehatan RI. Jakarta.

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

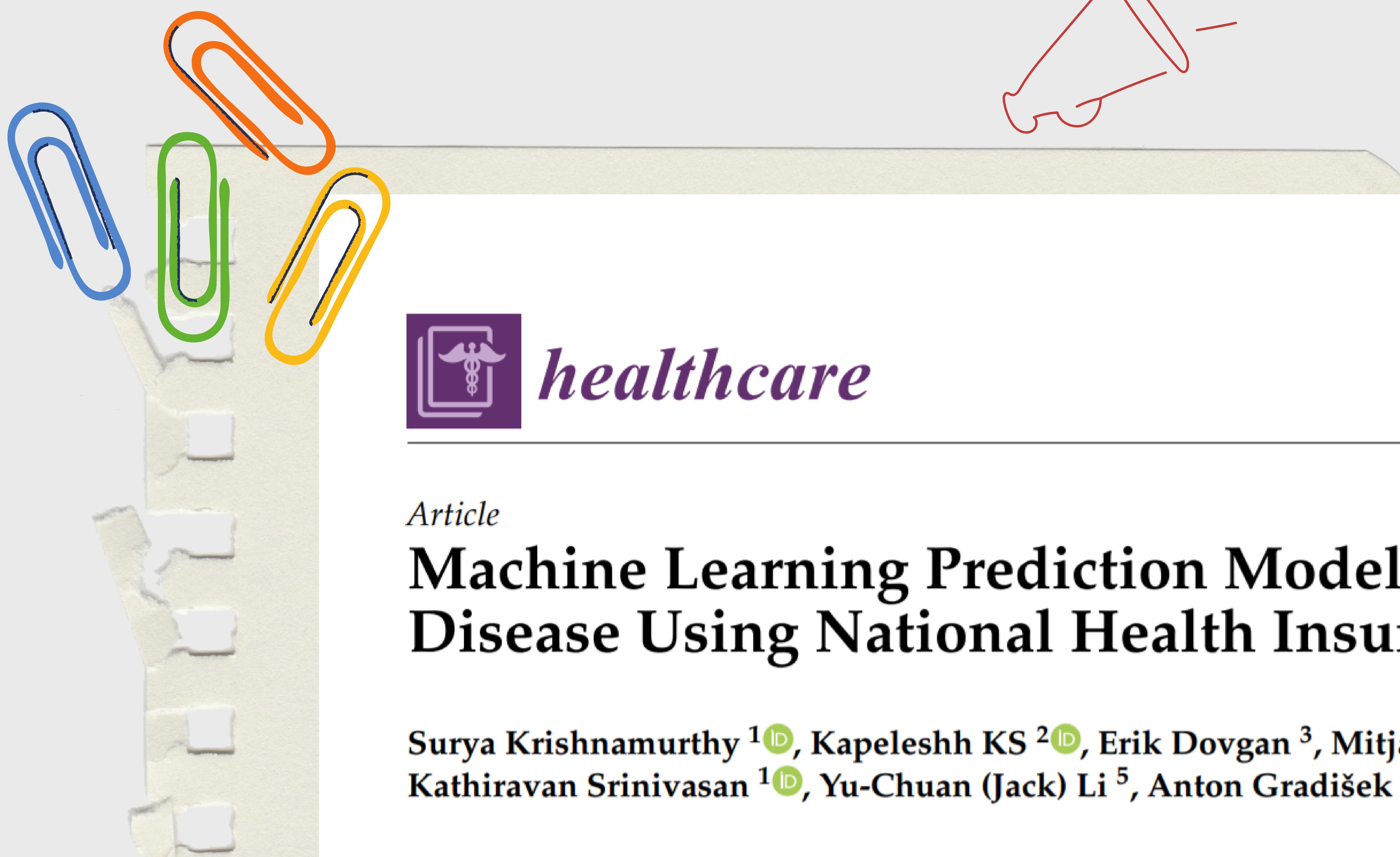
# Prediction Models for Chronic Kidney Disease - Literature Review

<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



Article

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

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

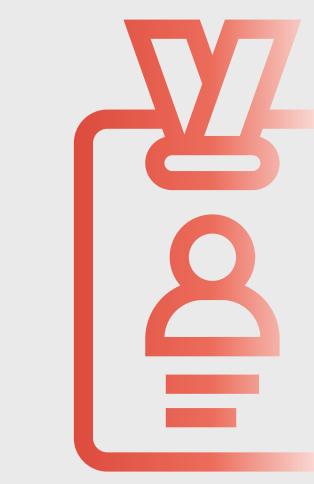
# Prediction Models for Chronic Kidney Disease Trajectories Using BPJS Health Insurance Claim Data

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Team Member

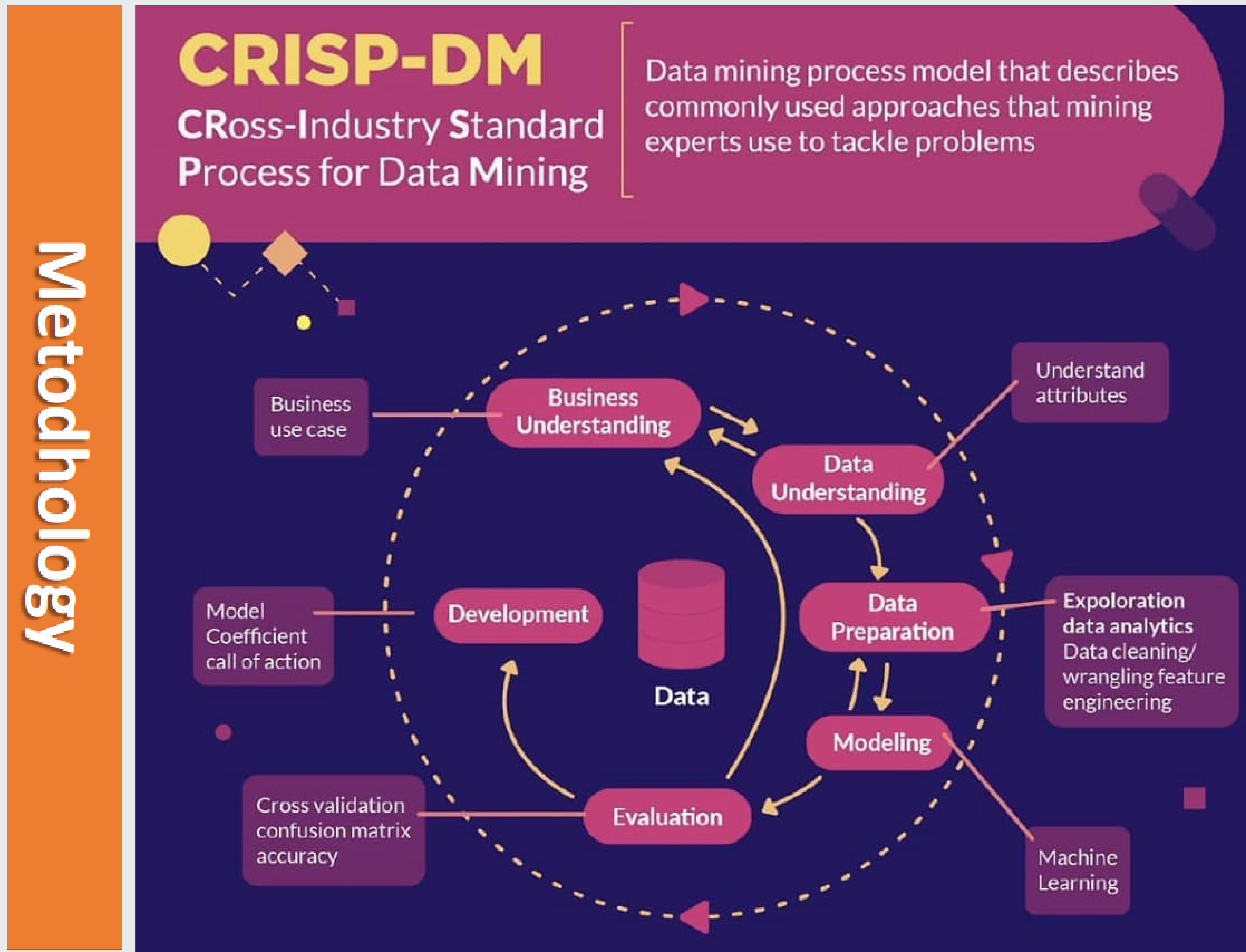
1. Ari Sulistyowati
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Affiliation

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## Methodology



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By IYKRA

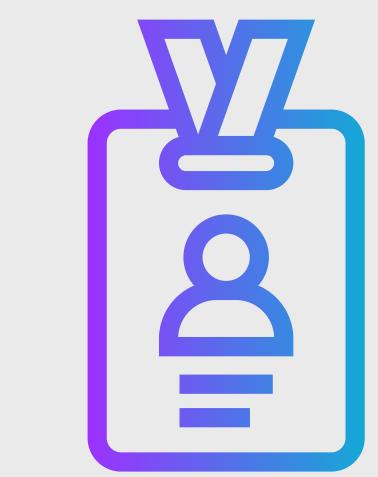
# Prediction Models for Chronic Kidney Disease Trajectories Using BPJS Health Insurance Claim Data

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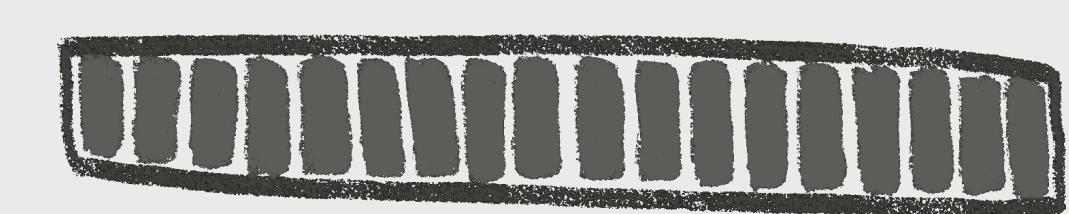
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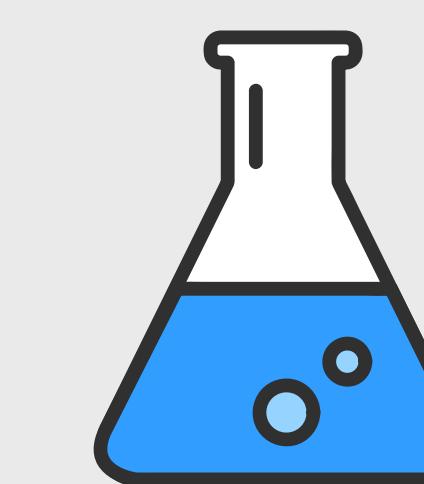
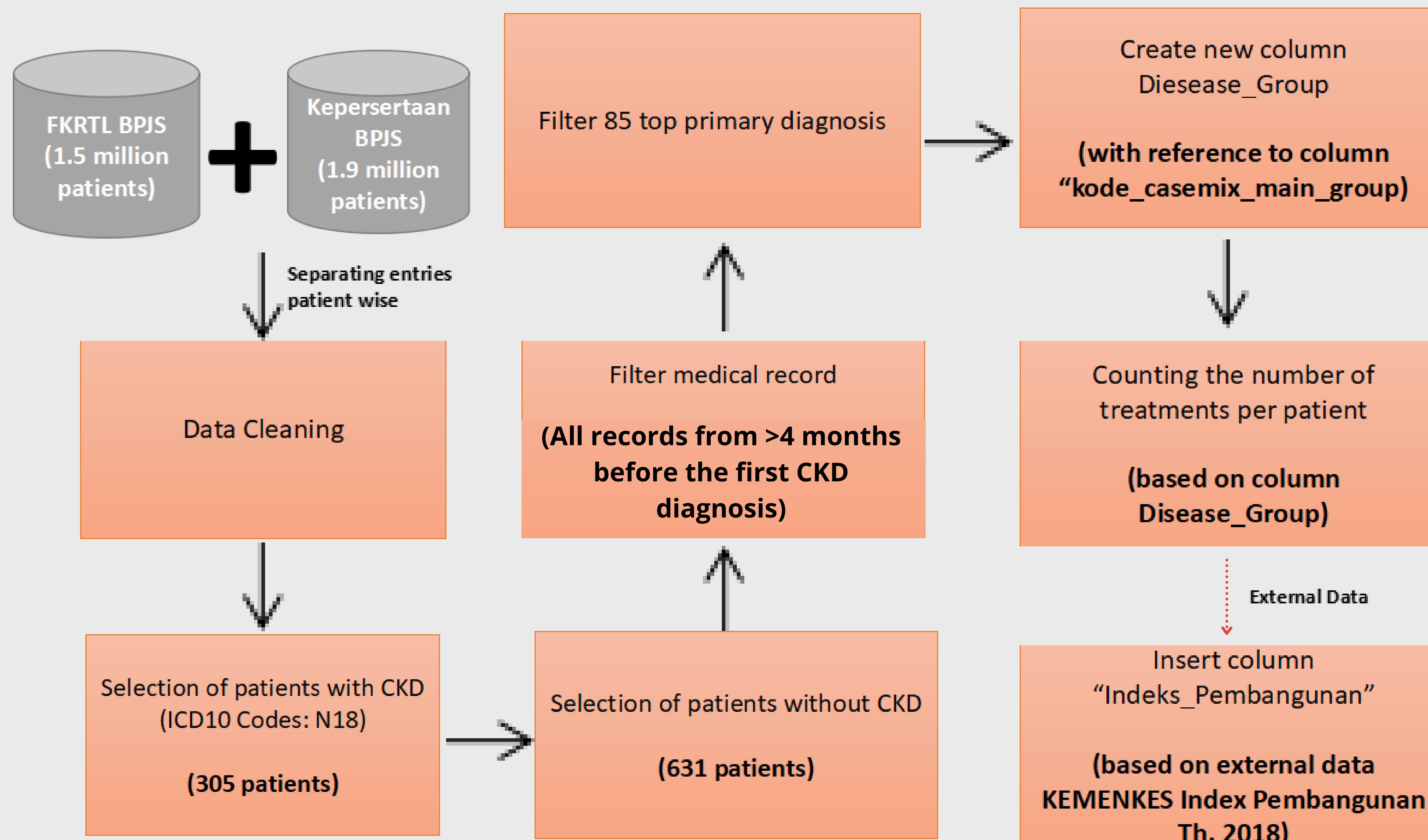


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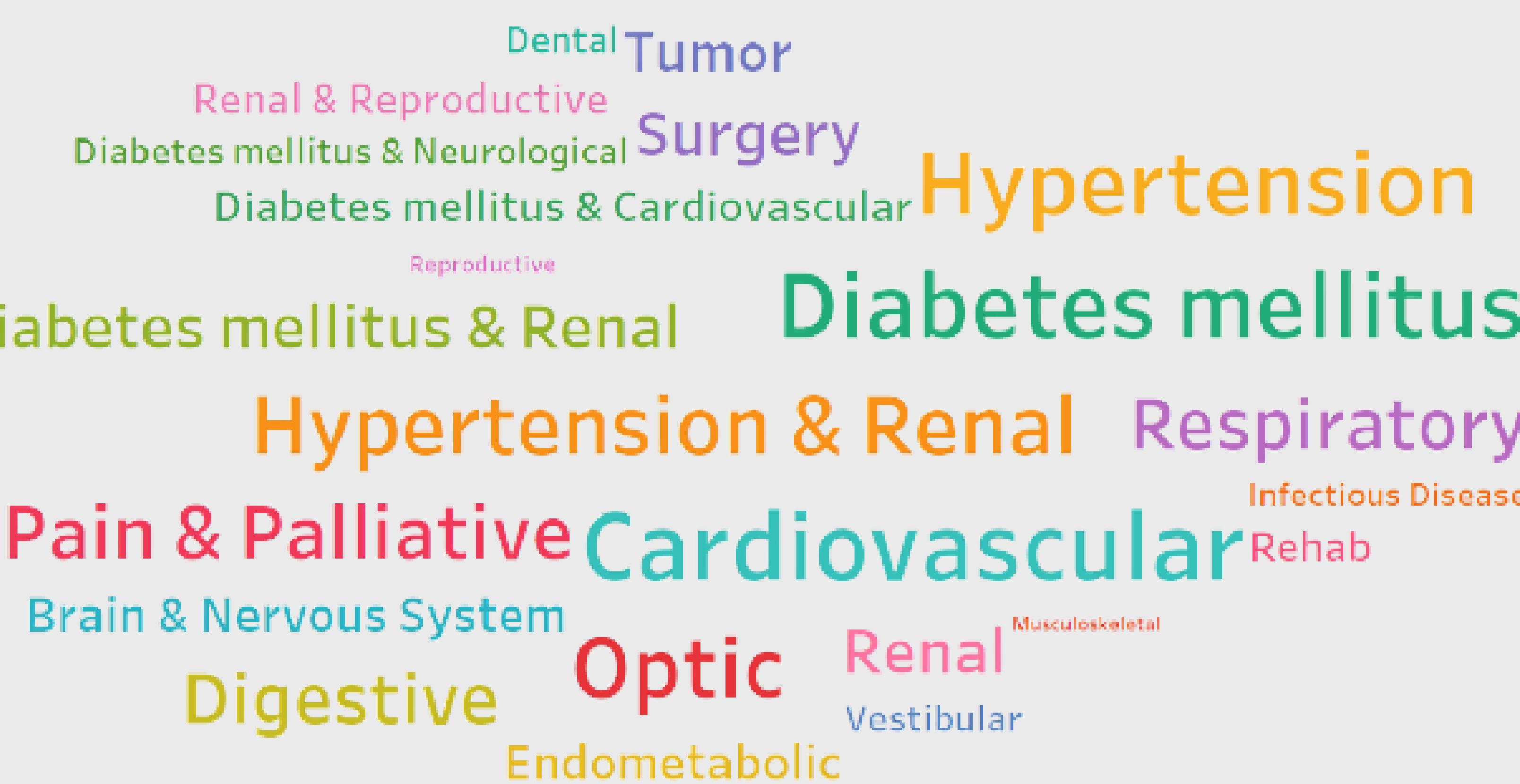


## DATA PREPROCESSING



## PREDICTORS

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



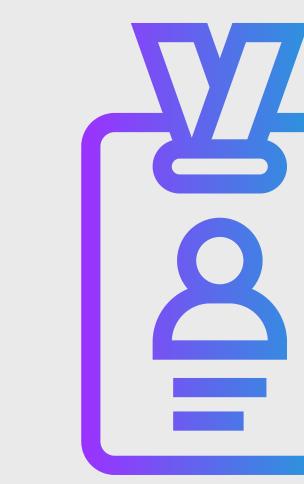
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# Data Overview Patient Chronic Kidney Disease According to BPJS Health Insurance Claim Data 2016 - 2018



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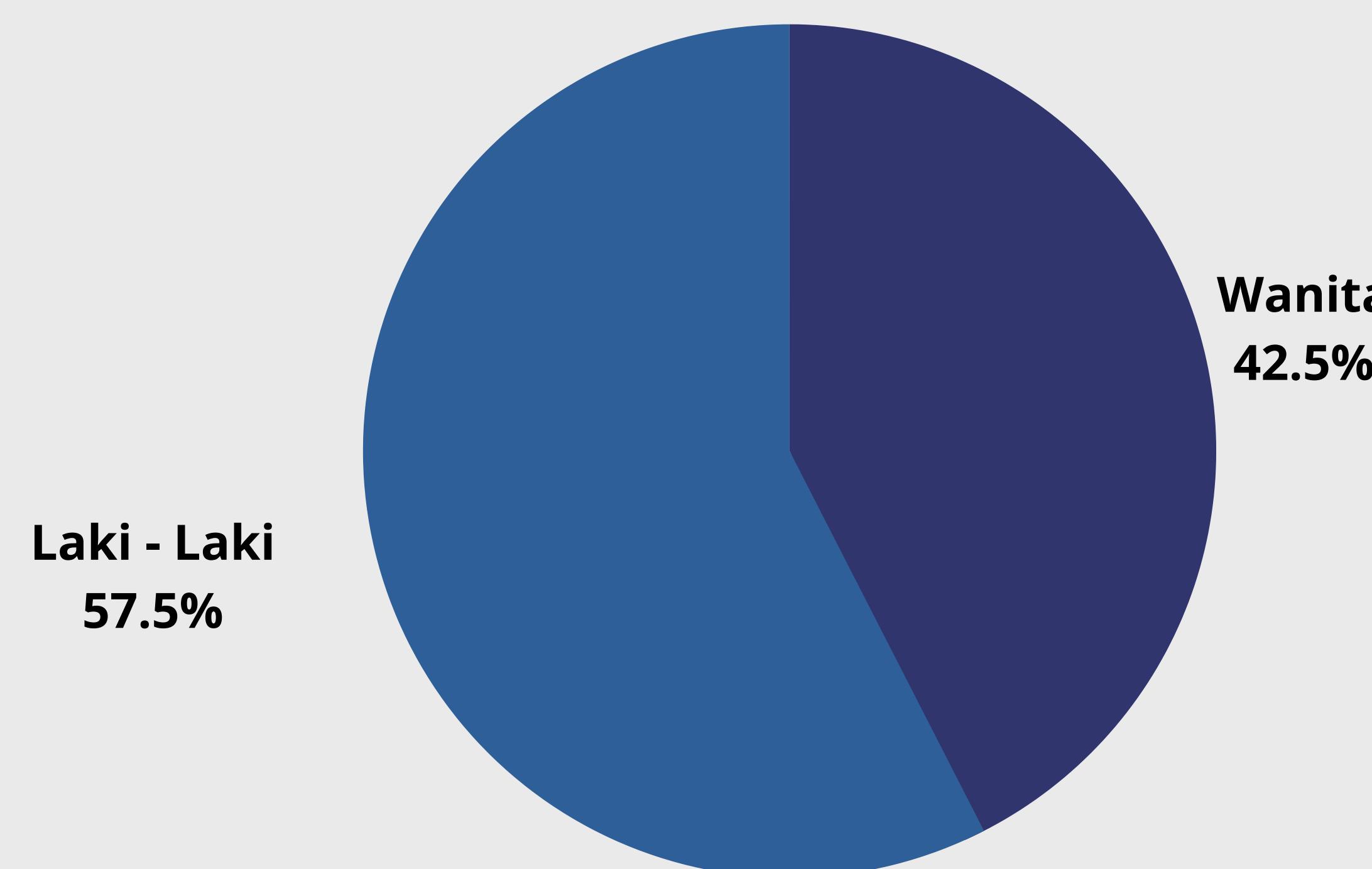


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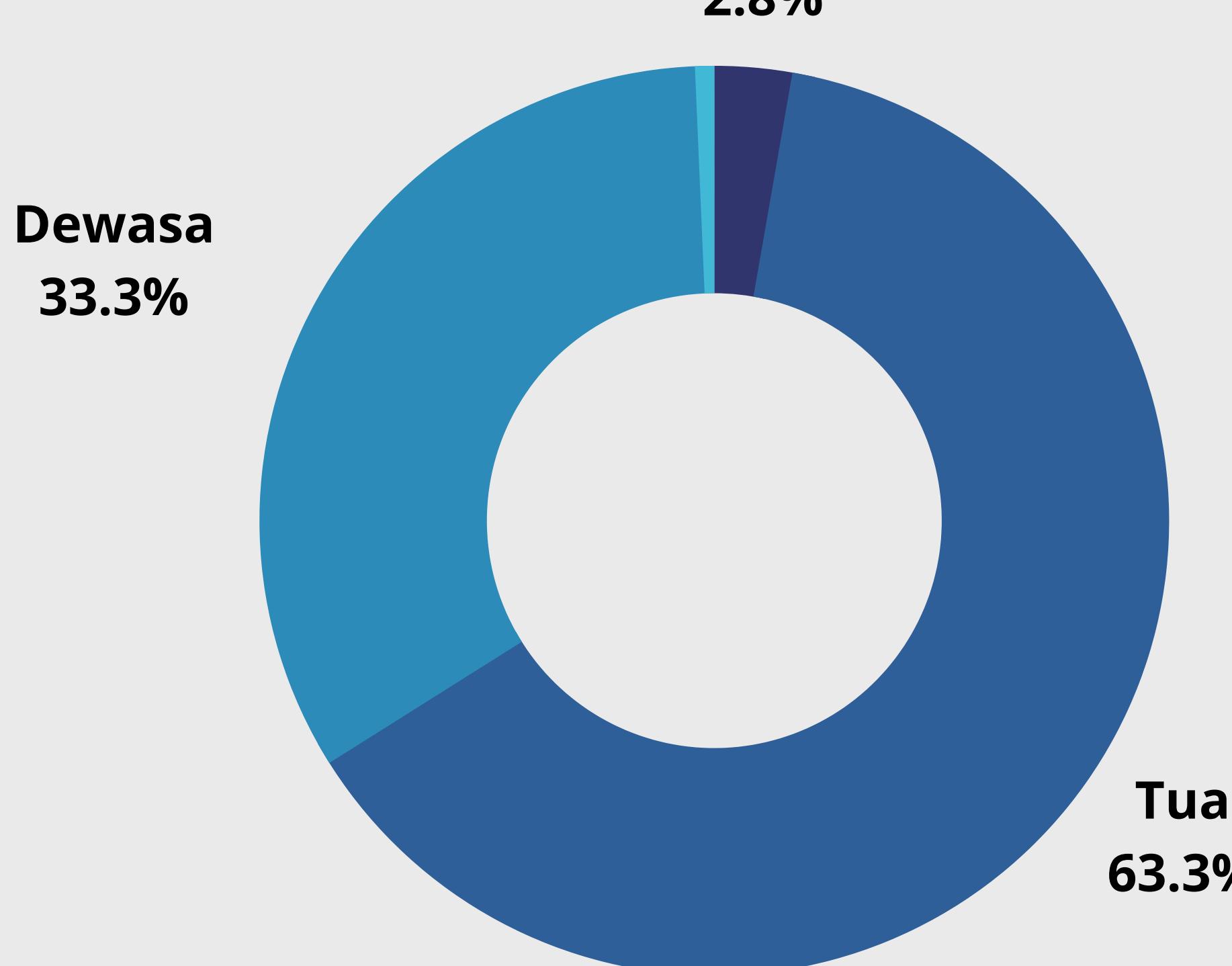
### GENDER



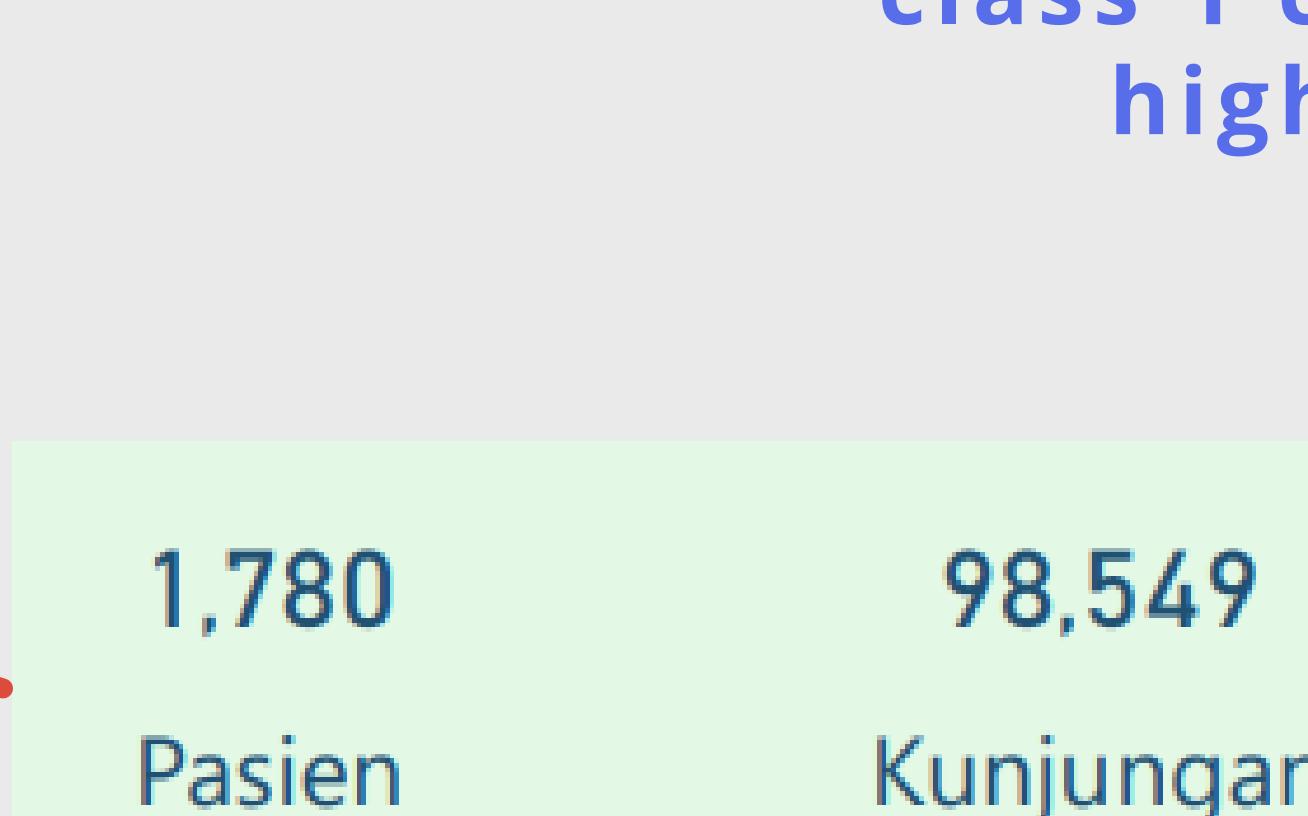
This shows that the proportion of men with CKD is greater than of women

CKD patients in BPJS class 1 category are highest rank

### SEGMENTASI UMUR PESERTA

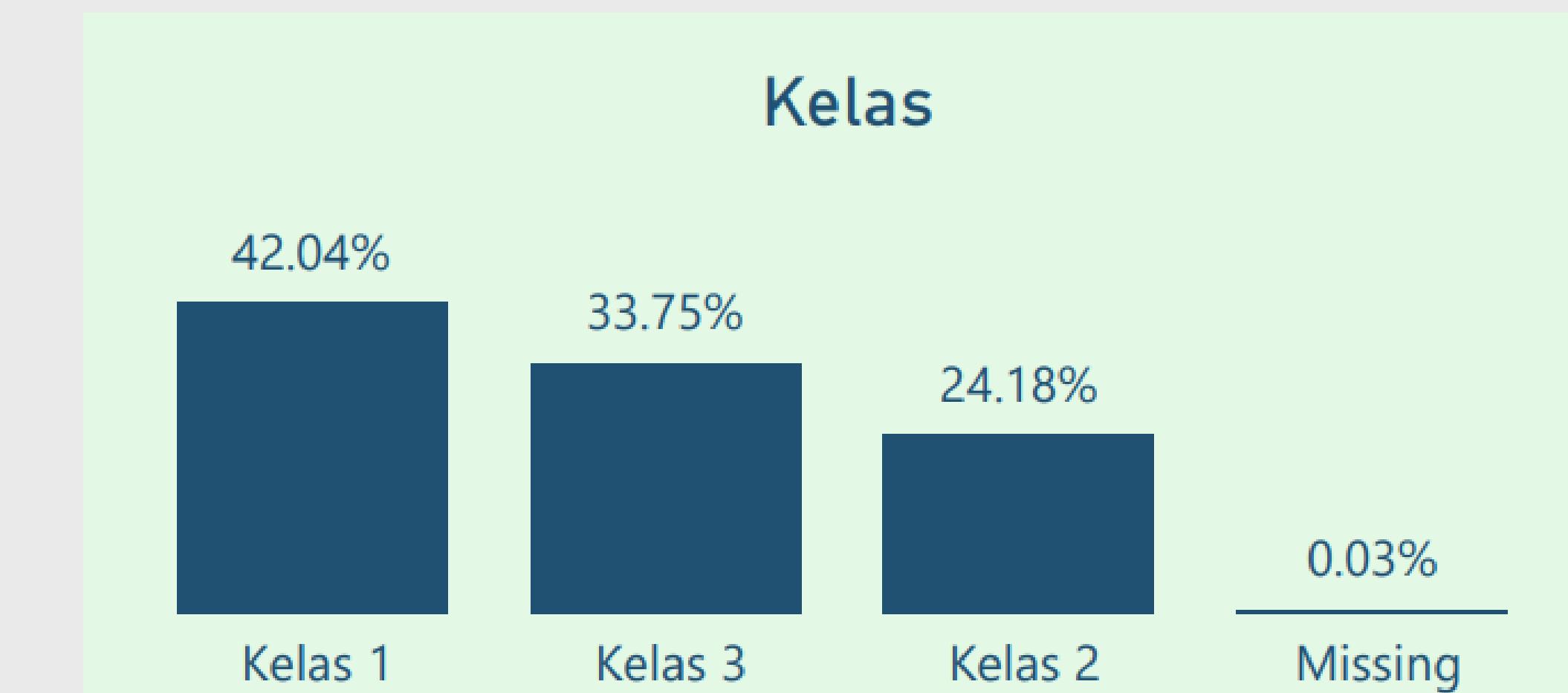


Segmentation with the Old category with a range between 30 years to 50 years ranks at the top.

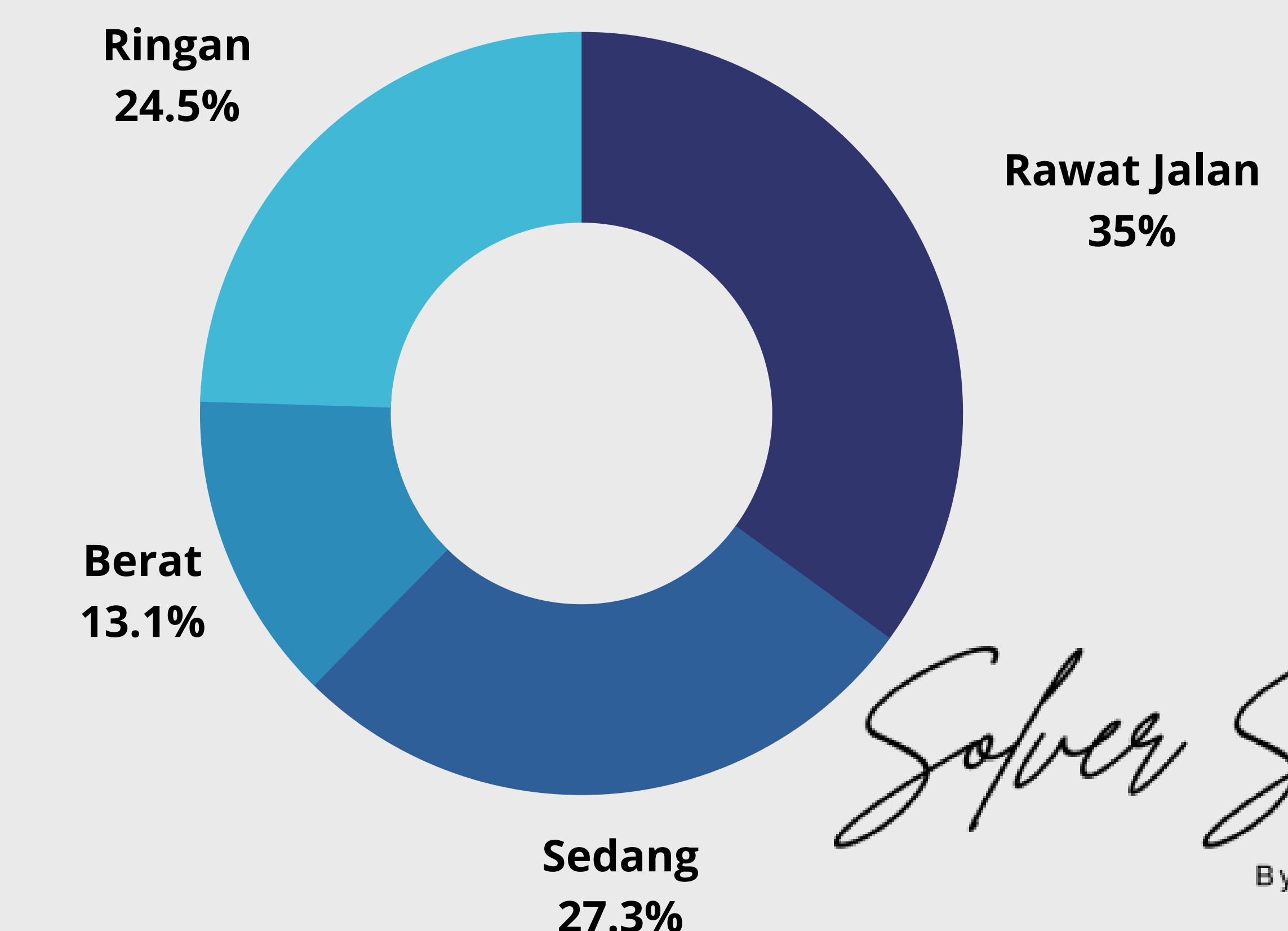


Most CKD patients are treated on an outpatient basis

### KELAS KEPERSERTAAN BPJS



### TINGKAT KEPARAHAN



*Solver Society*  
By IYKRA

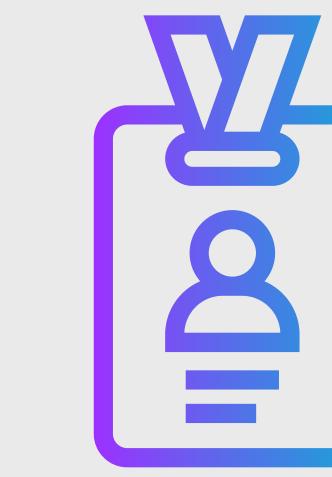
# Chronic Kidney Disease Prediction According to BPJS Health Insurance Claim Data 2016 - 2018

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## TEAM MEMBER

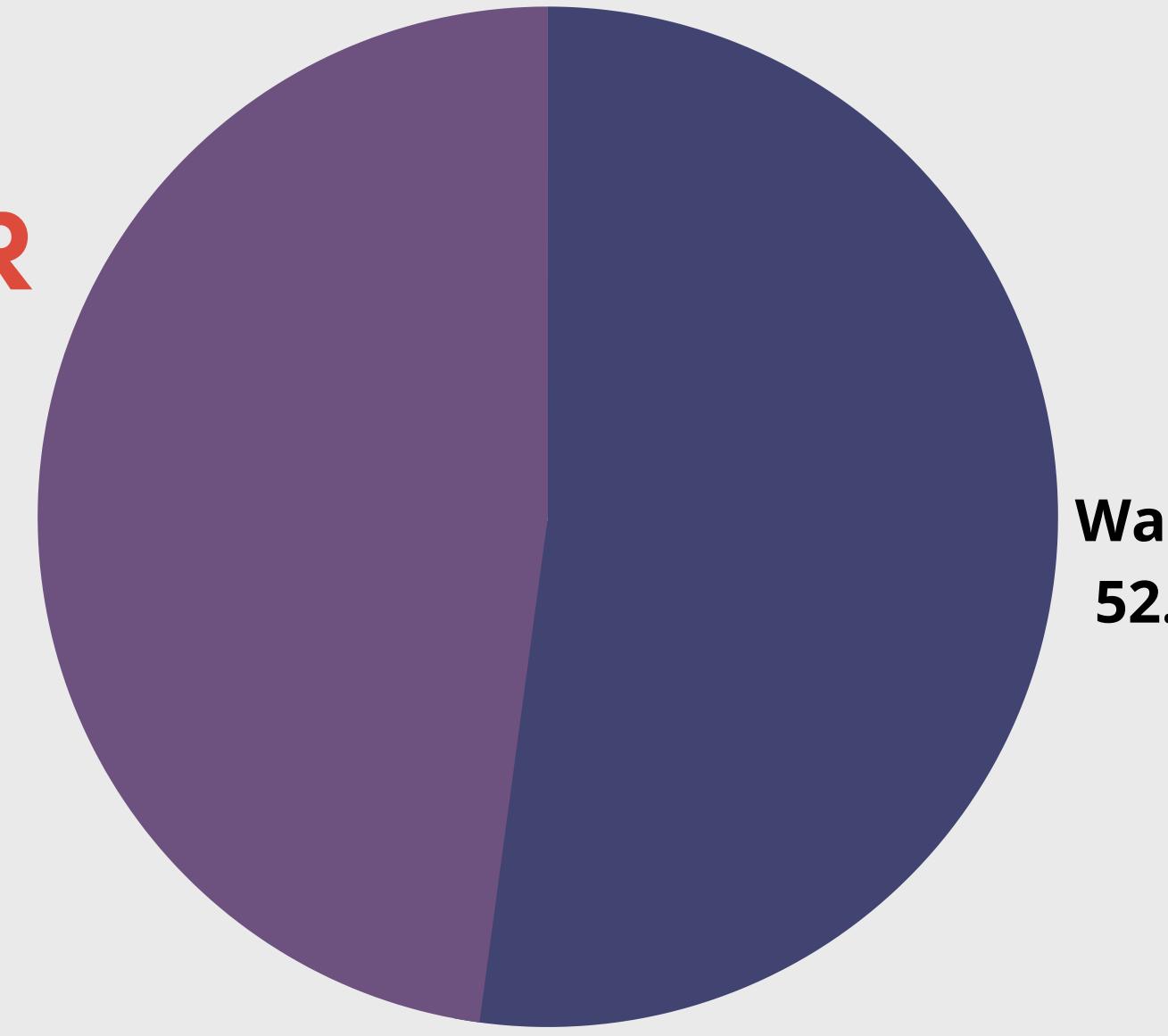
1. Ari Sulistyowati
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## AFILIATION

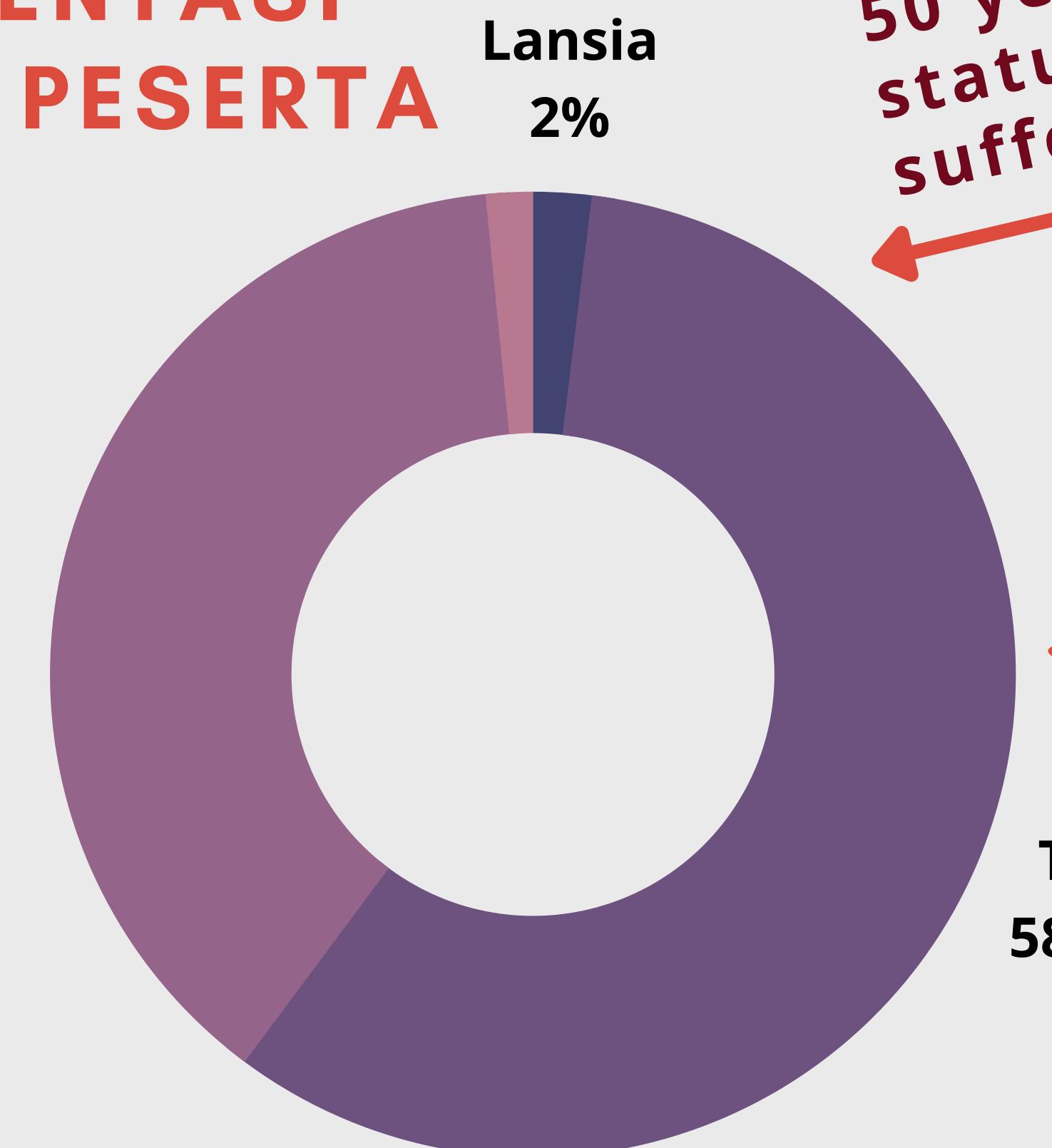
1. Mentor: Hapsari Amira
2. IYKRA: Solver Society Program

### GENDER



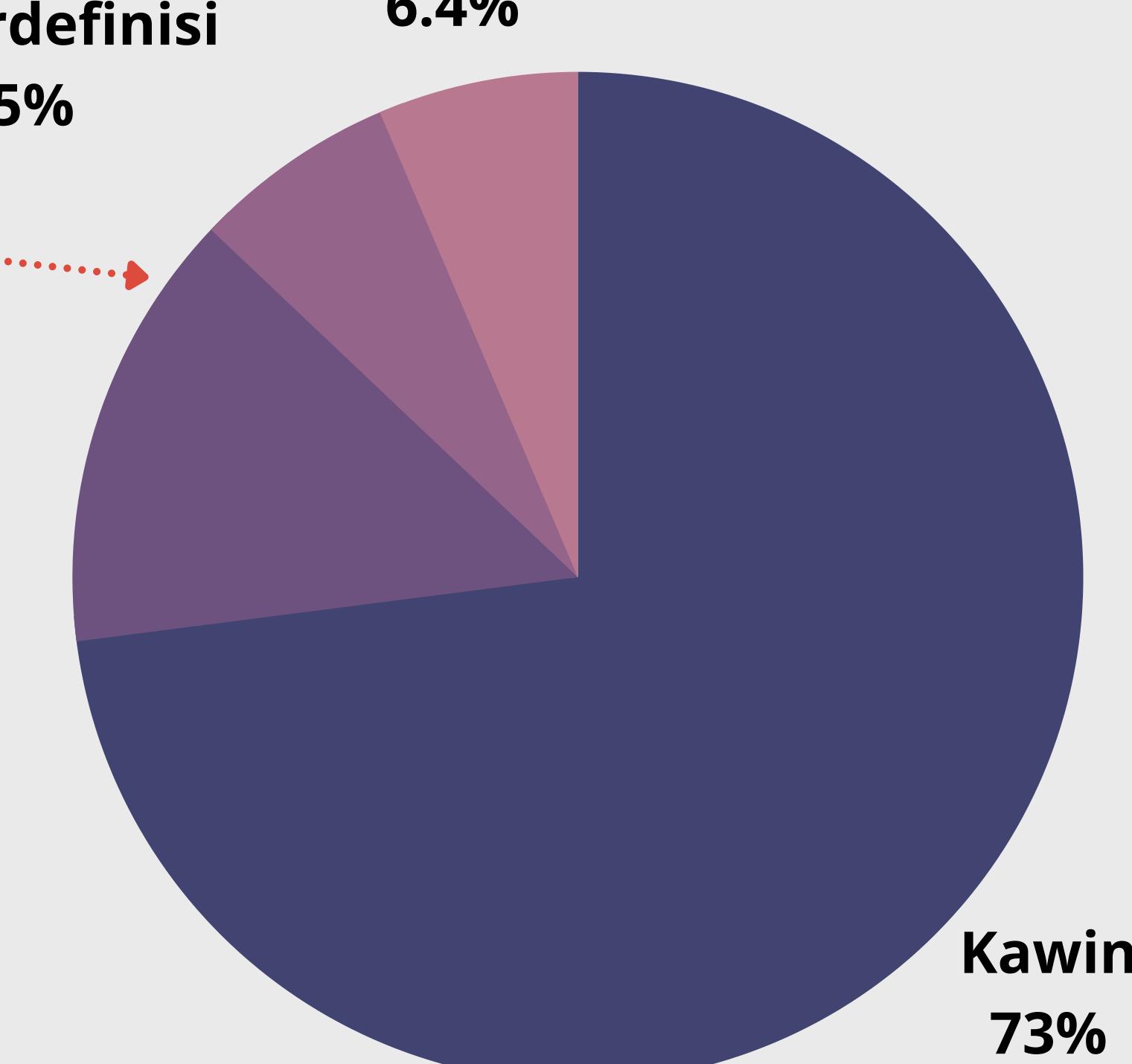
*Predictive data show a higher tendency in women to suffer from CKD than men*

### SEGMENTASI UMUR PESERTA



*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*

### STATUS PERKAWINAN

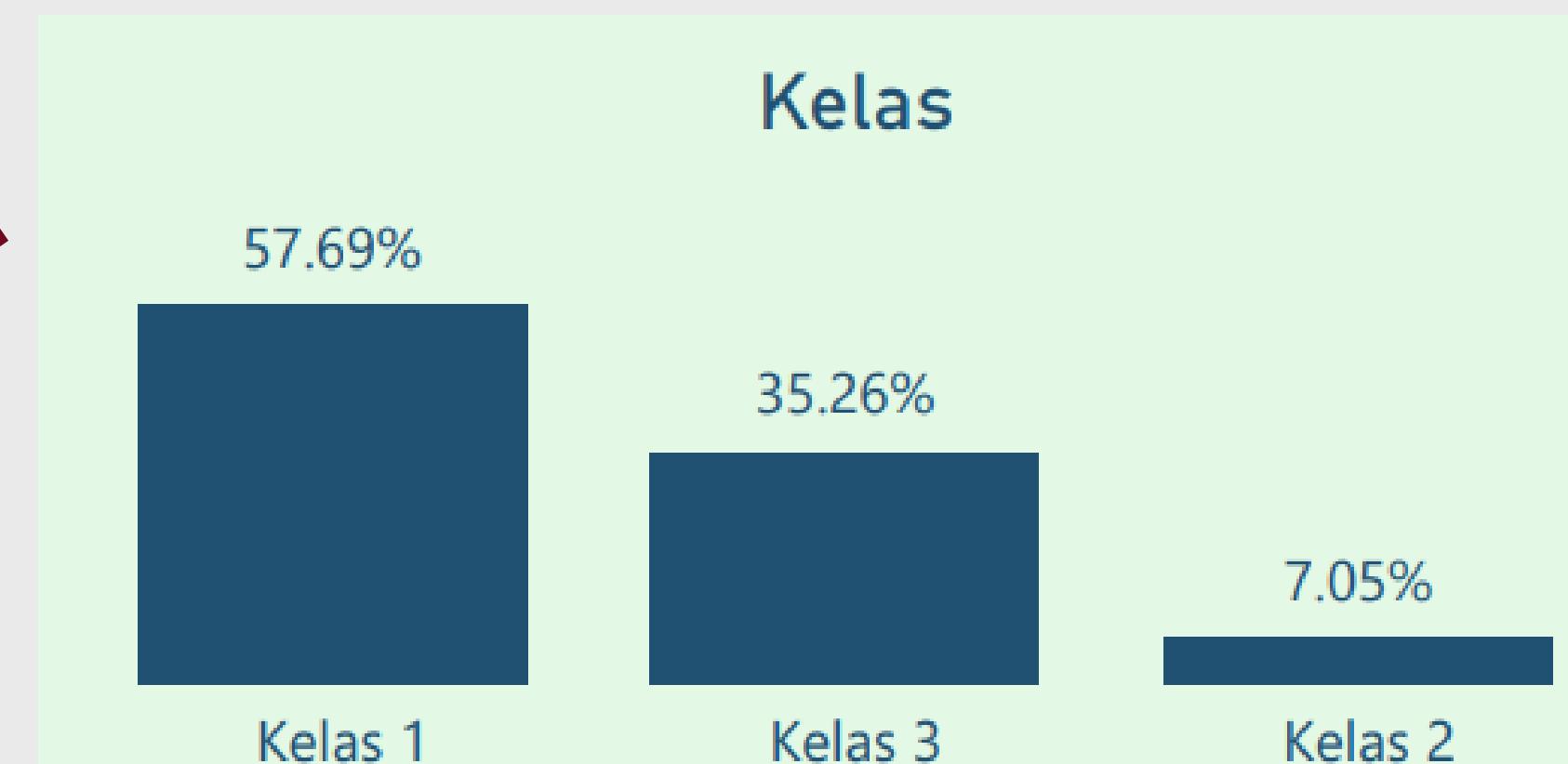


**936**  
Pasien

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

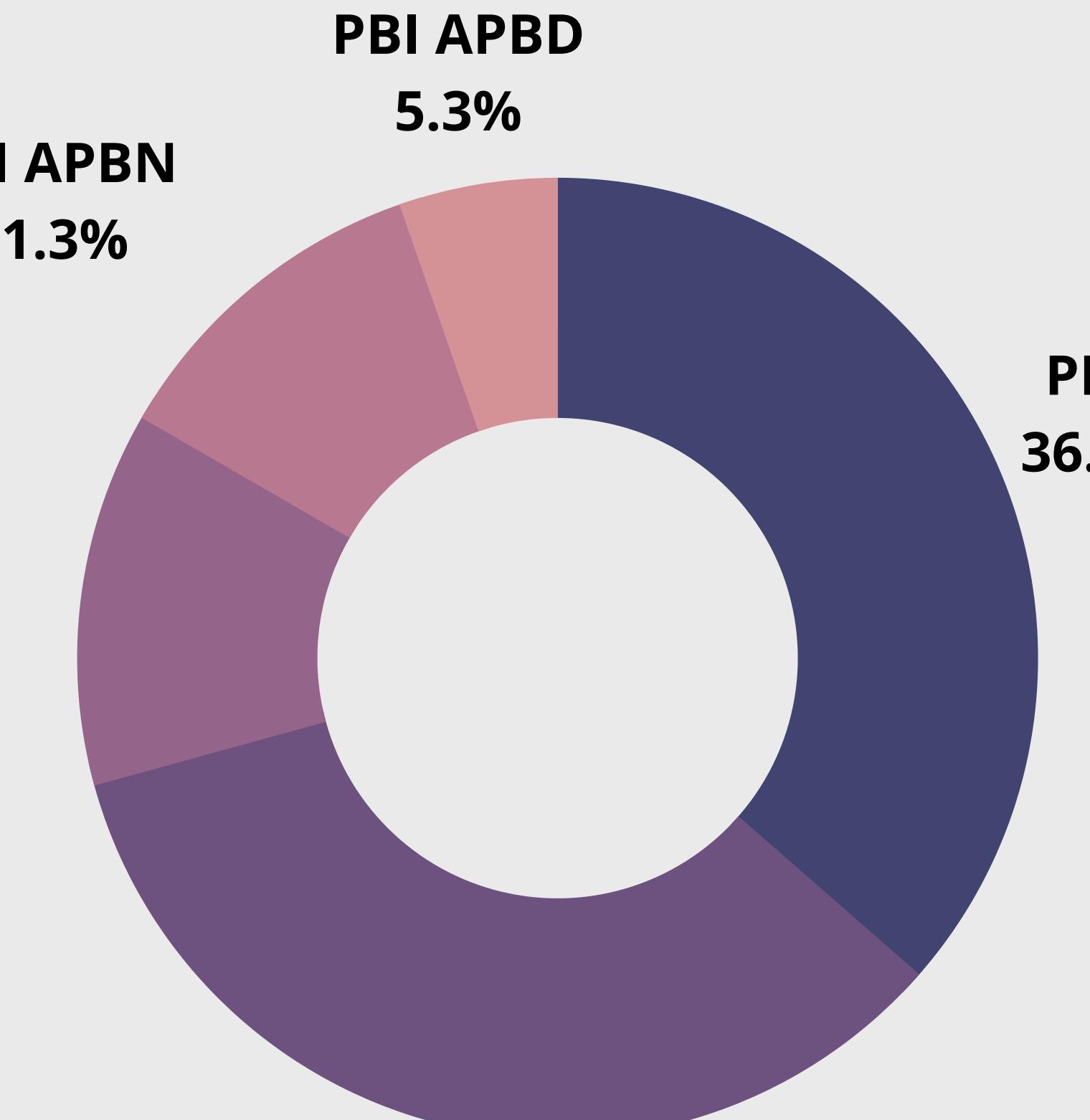
*Based on the graph above, it can be said that CKD patients indicated to have mild CKD*

### KELAS KEPERSERTAAN BPJS

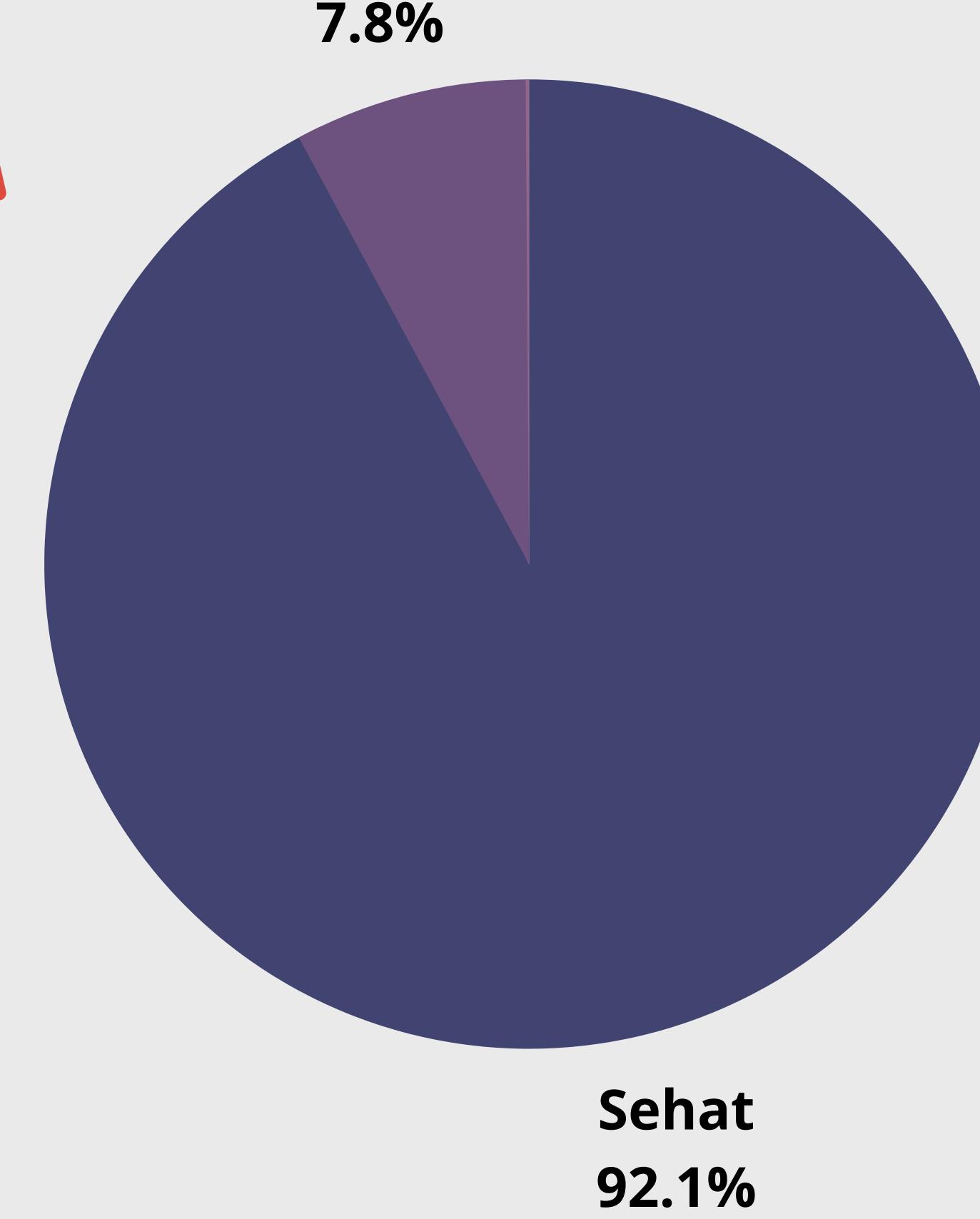


*Bukan Pekerja 12.6%*

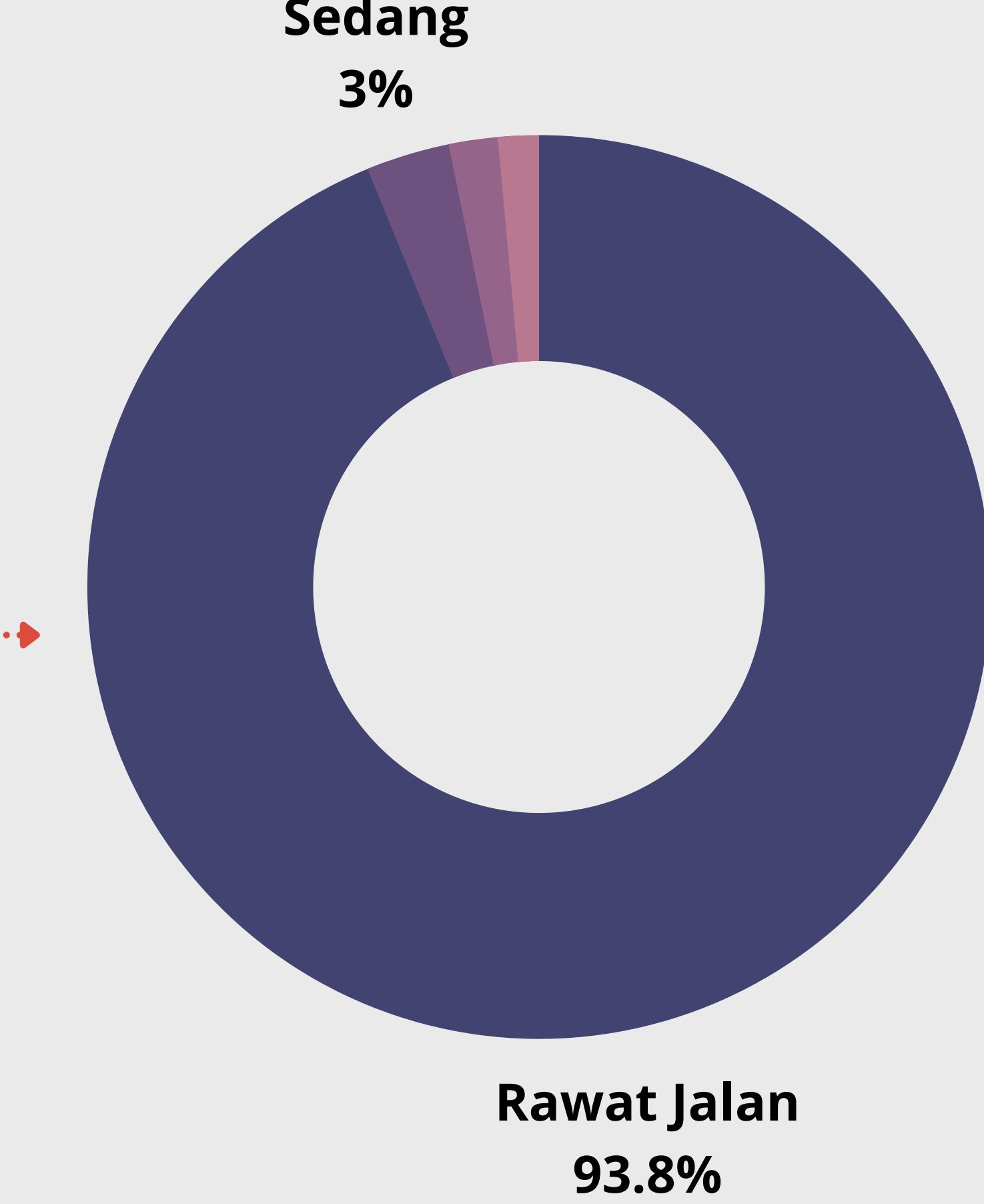
### SEGMENTASI PEMBAYARAN BPJS



### STATUS PASIEN



### TINGKAT KEPARAHAN



*Solver Society*  
By IYKRA

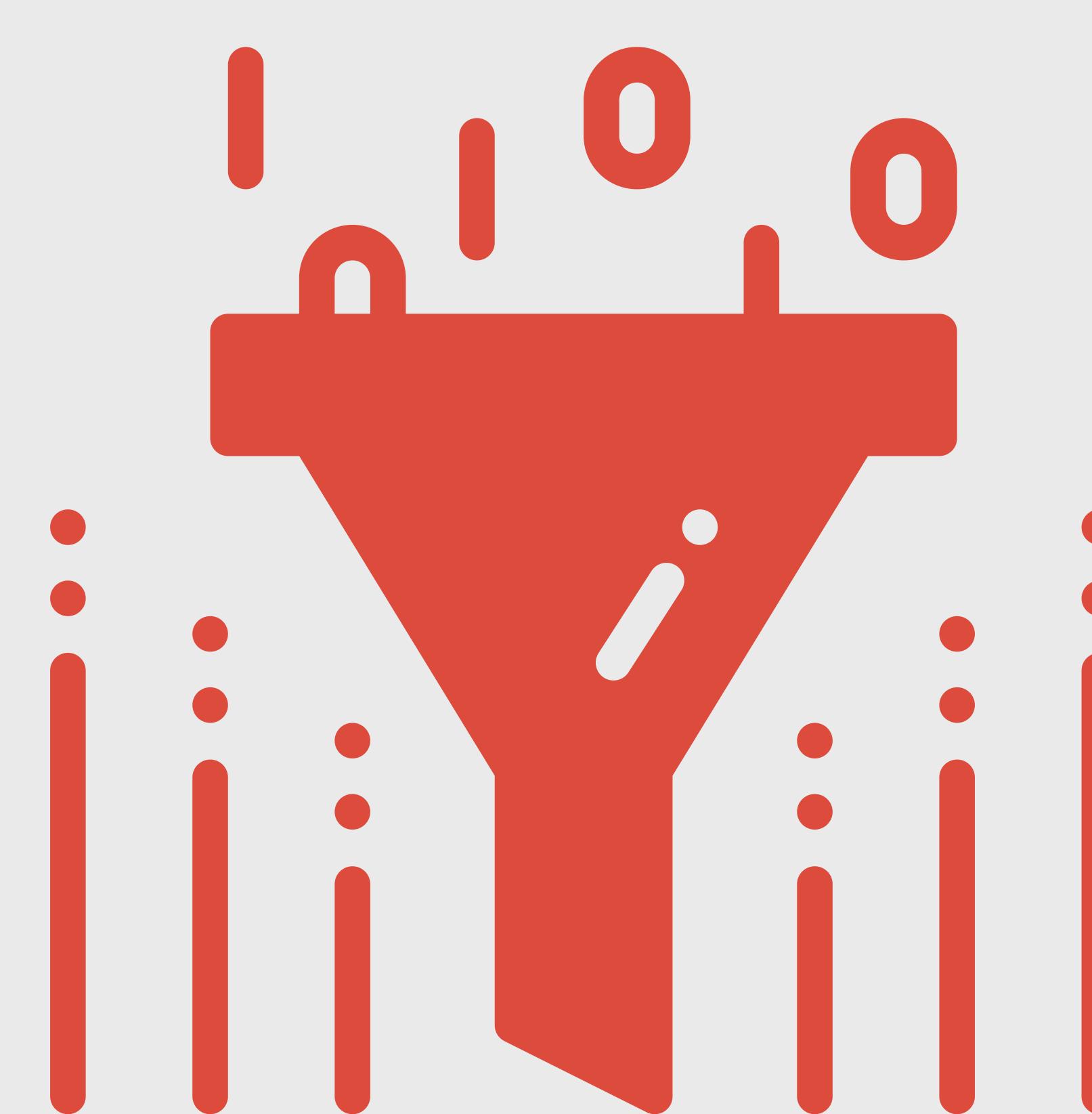
Hypertension Essential (primary) hypertension	Digestive Dyspepsia	Diabetes mellitus Unspecified diabetes mellitus without complications	Hypertension Hypertensive heart disease with (congestive) heart failure	Optic Astigmatism	Tumor Radiotherapy session	Optic Senile nuclear cataract	Tumor Follow-up	Renal	Pain & Palliative Other specified counselling	Surgery Other specified surgical follow-up care	Pain & Palliative Palliative care	Optic Senile cataract, unspecified	
Hypertension & Renal Hypertensive renal disease with renal failure	Cardiovascular Personal history of diseases of the circulatory system	Cardiovascular Anaemia, unspecified	Cardiovascular Atherosclerotic heart disease	Pain & Palliative Other and unspecified abdominal pain	Tumor Chemotherapy session for neoplasm	Cardiovascular Chronic ischaemic heart disease,	Tumor Malignant neoplasm of cervix uteri,	Diabetes mellitus	Diabetes mellitus &	Diabetes mellitus & Renal	Optic Other senile cataract	Renal Urinary tract infection, site not specified	
						Respiratory Chronic obstructive pulmonary disease,	Pain & Palliative Counselling, unspecified	Respiratory Acute upper respiratory	Renal Nephrotic	Diabetes mellitus	Vestibular Other peripheral verti		
Diabetes mellitus Non-insulin-dependent diabetes mellitus without complications	Diabetes mellitus & Renal Non-insulin-dependent diabetes mellitus with renal complications	Optic Cataract, unspecified	Rehab Other physical therapy	Hypertension & Renal Hypertensive heart and renal disease with both (congestive)	Hypertension Essential primary hypertension	Brain & Nervous System	Infectious Disease	Dental Necrosis of	Optic Senile incipient cataract	Optic Vitreous	Diabetes mellitus Special screening		
						Renal & Reproductive Personal history of diseases of the genitourinary system	Hypertension & Renal Hypertensive heart and renal disease with renal failure	Respiratory Bronchitis, not specified as	Brain & Nervous System Cerebral	Infectious Disease	Pain &		
Cardiovascular Congestive heart failure	Surgery Attention to surgical dressings and sutures	Optic Examination of eyes and vision	Hypertension Hypertensive heart disease without (congestive) heart failure	Diabetes mellitus & Neurological	Diabetes mellitus & Neurological	Diabetes mellitus & Neurological	Hypertension & Renal Hypertensive	Cardiovascular Acute	Diabetes mellitus	Optic Senile incipient cataract	Optic Vitreous	Diabetes mellitus Special screening	
							Hypertension & Renal Hypertensive heart	Endometabolic Fever, unspecified	Brain & Nervous System Cerebral	Dental Necrosis of	Pain &		
	Optic Presence of intraocular lens	Tumor Follow-up examination after other treatment for malignant neoplasm	Endometabolic Personal history of endocrine, nutritional and metabolic diseases	Diabetes mellitus Noninsulindependent diabetes mellitus without complications	Diabetes mellitus Noninsulindependent diabetes mellitus without complications	Diabetes mellitus Noninsulindependent diabetes mellitus without complications	Hypertension & Renal Hypertensive	Cardiovascular Acute	Pain & Palliative	Optic Senile incipient cataract	Optic Vitreous	Diabetes mellitus Special screening	
							Hypertension & Renal Hypertensive heart	Endometabolic Hypoglycaemia, unspecified	Brain & Nervous System Cerebral	Dental Necrosis of	Pain &		
		Digestive Gastroenteritis and colitis of unspecified origin	Diabetes mellitus & Cardiovascular Unspecified diabetes mellitus with peripheral	Brain & Nervous System Personal history of diseases of the	Pain & Palliative Low back pain	Pain & Palliative Low back pain	Respiratory Bronchitis not	Endometabolic Personal	Optic Senile incipient cataract	Optic Senile incipient cataract	Optic Vitreous	Diabetes mellitus Special screening	
							Respiratory Bronchitis not	Endometabolic Personal					

Distinct .. 0

36

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

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



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



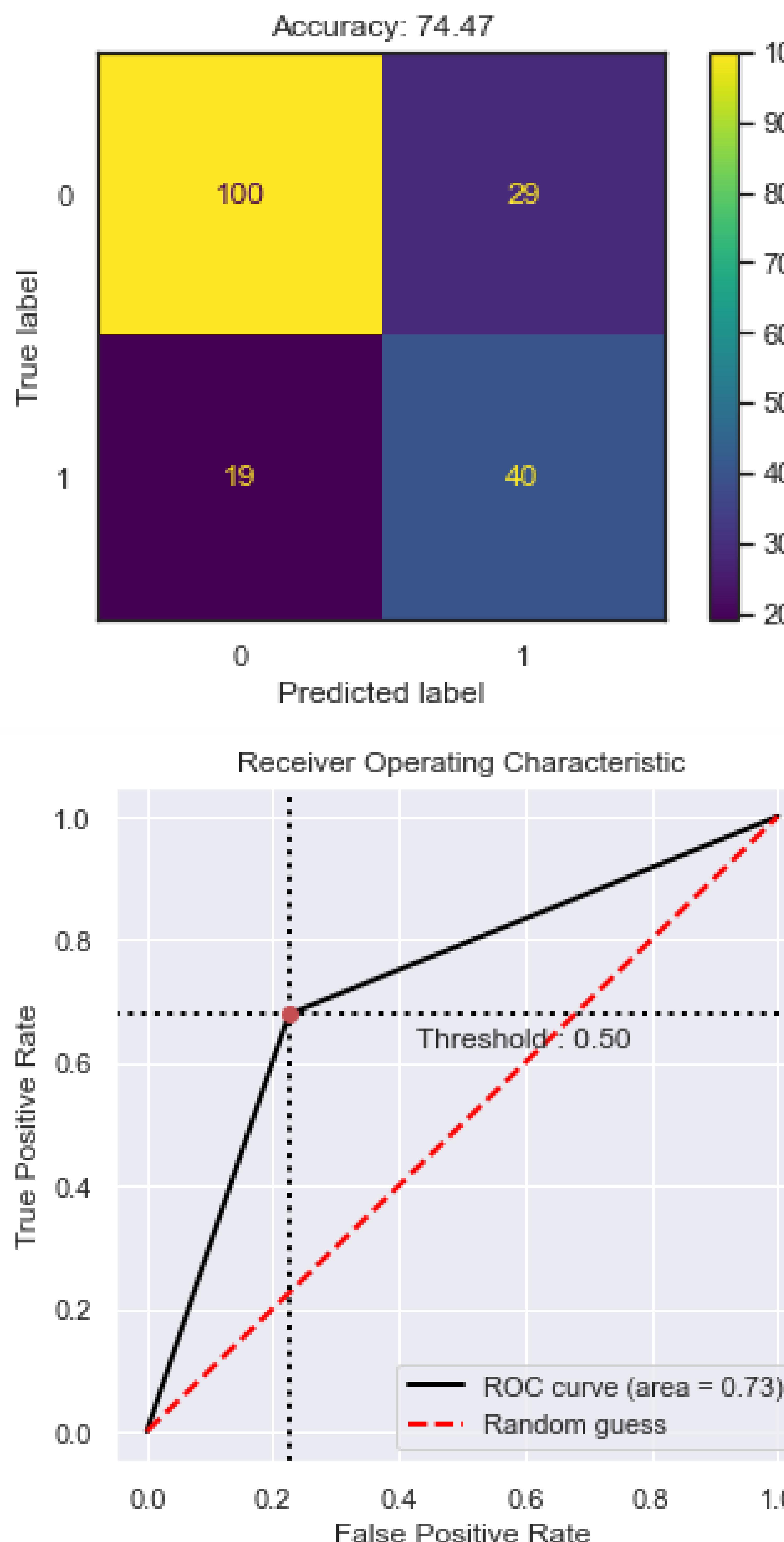
Observation Period of  
Patient's Medical Record

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

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

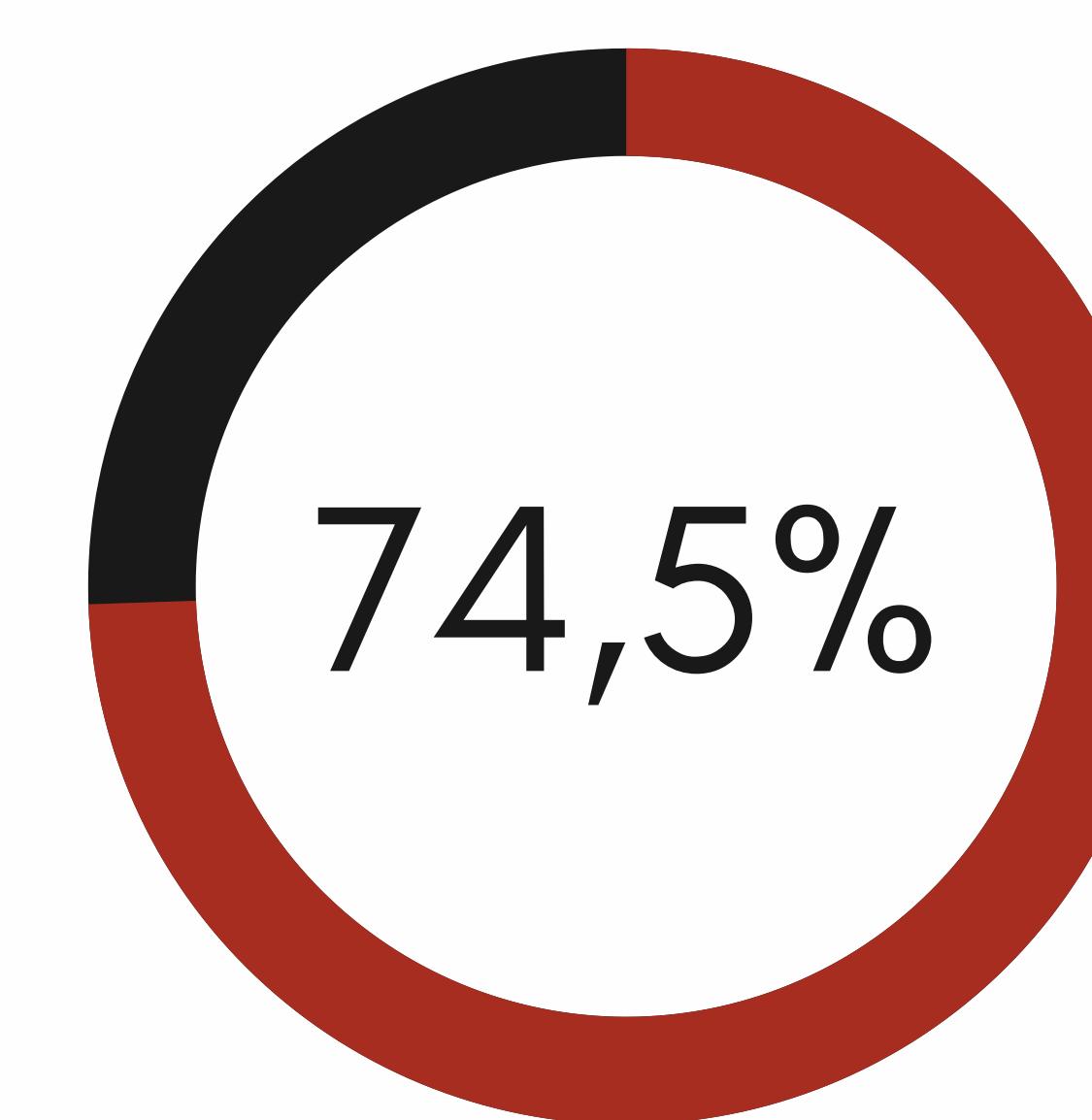
**We observed patients record until a certain time where we would be able to predict CKD no CKD at least four months after the observation period.**

# Modeling using Gradient Boosting Classifier

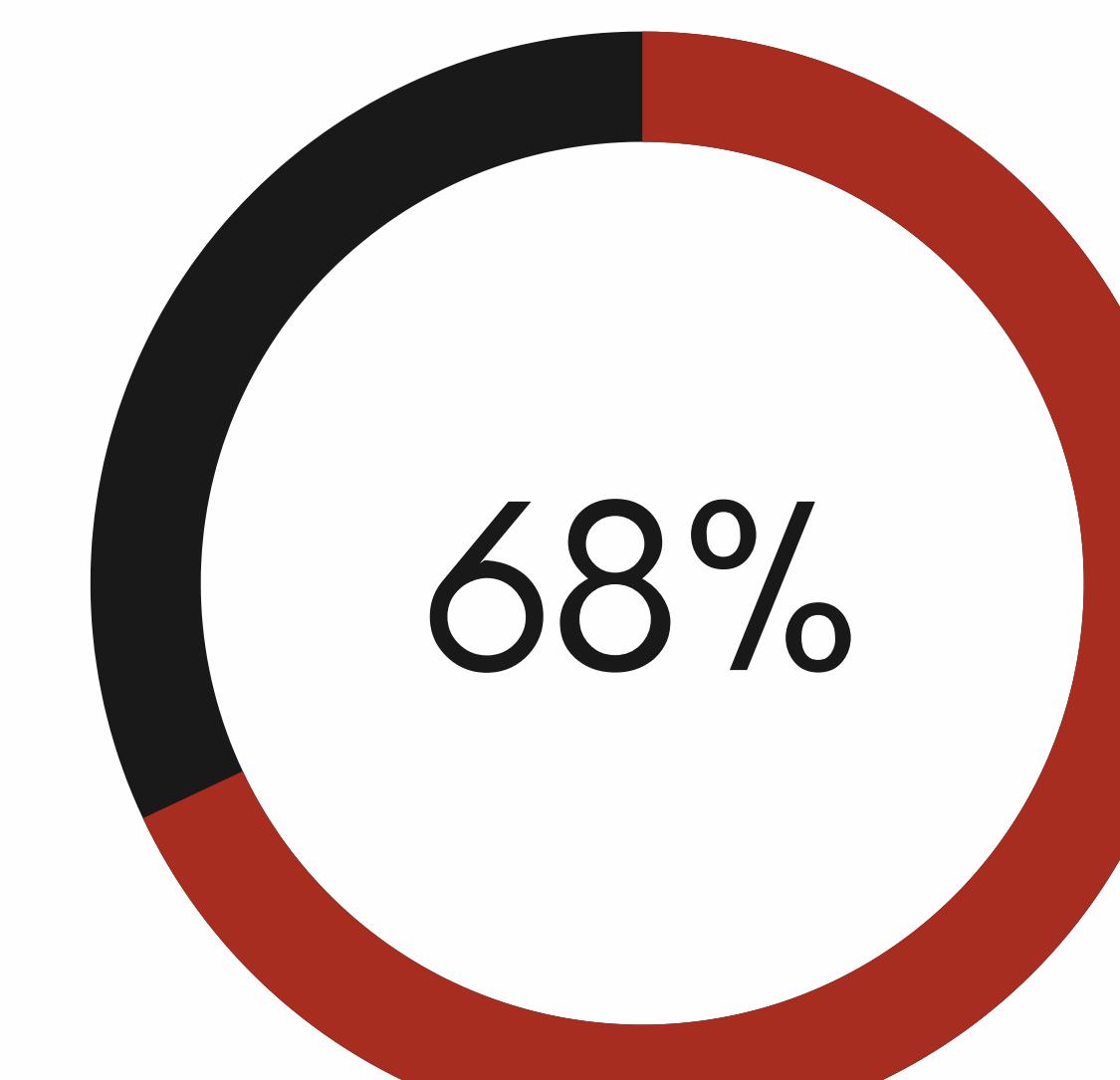


0: No Chronic Kidney Disease  
1: Chronic Kidney Disease

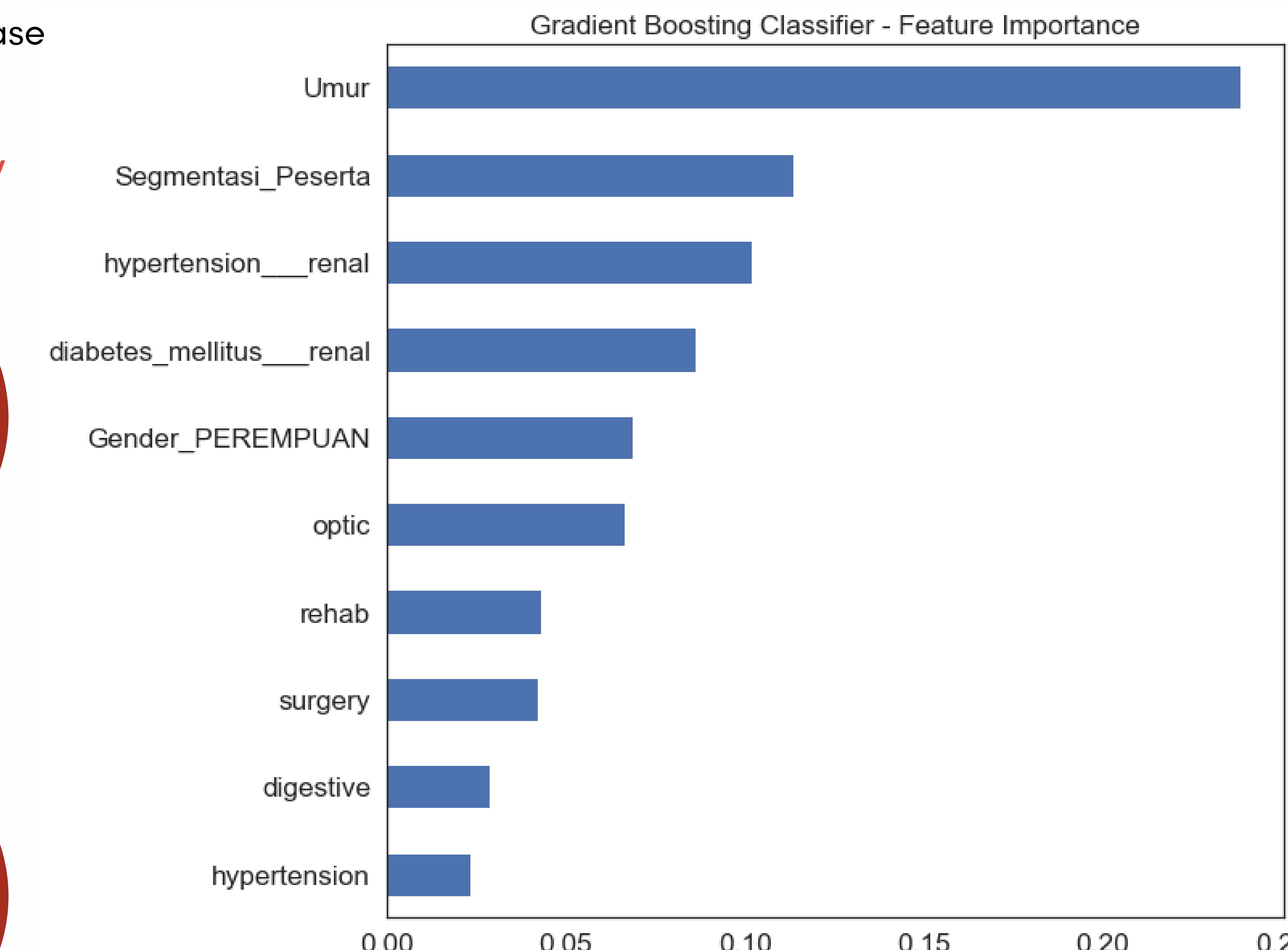
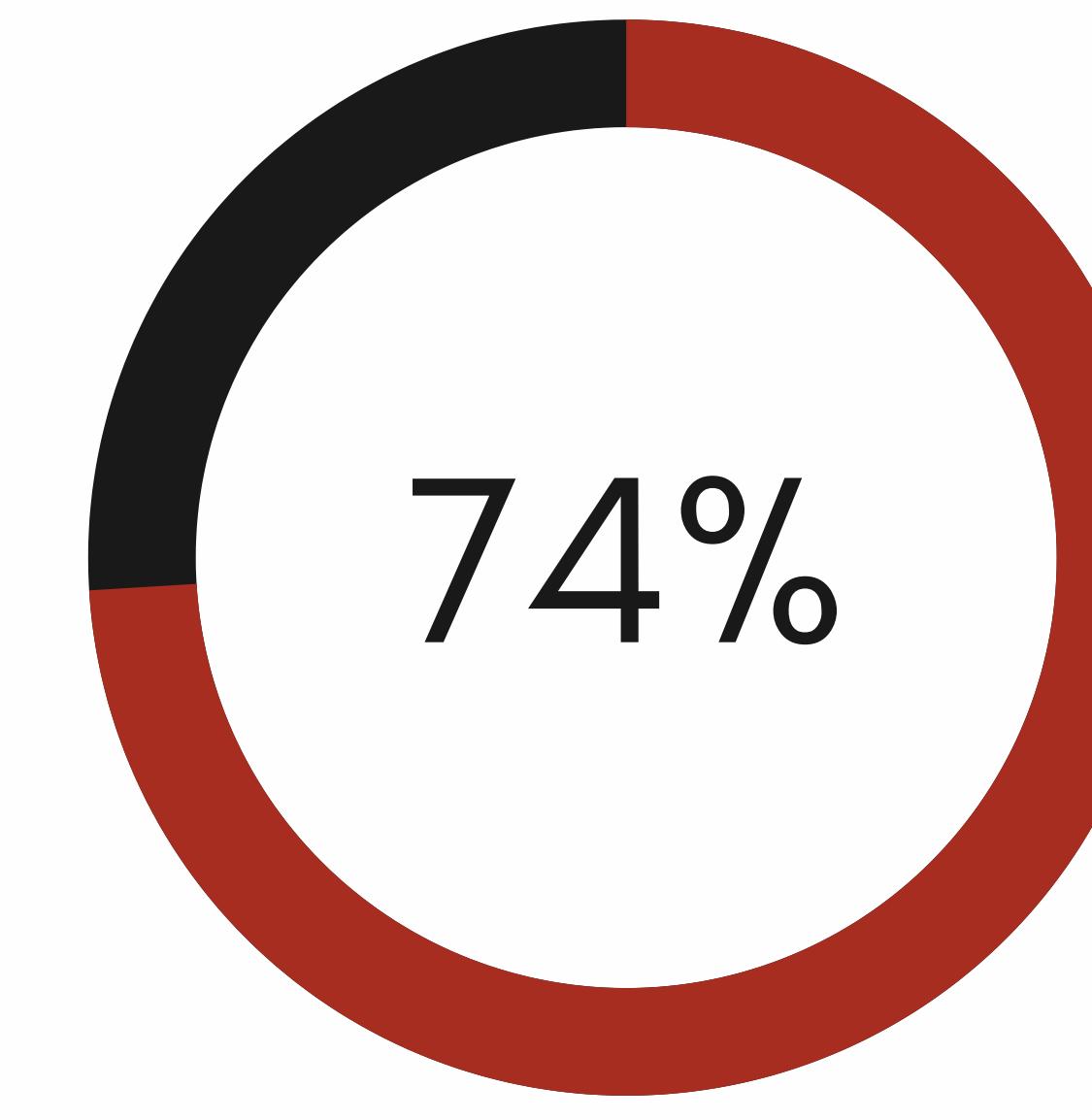
Accuracy



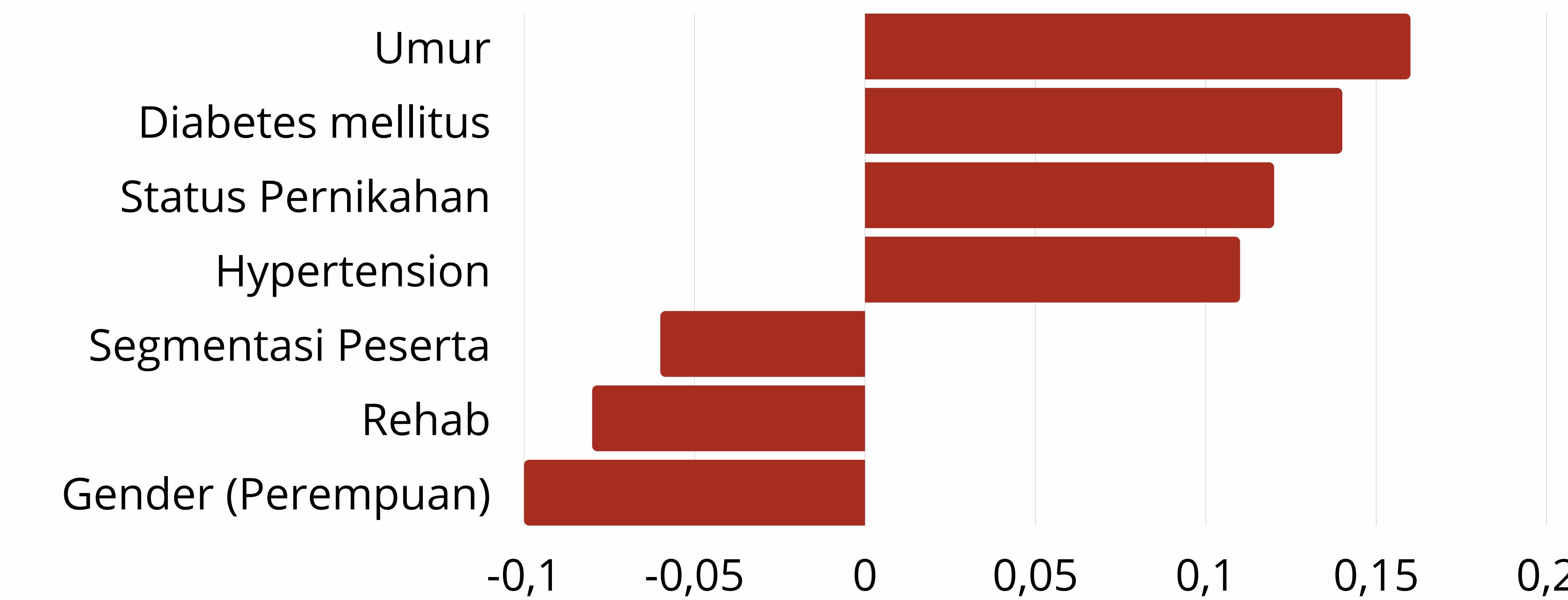
Recall



5-fold CV



Correlation with CKD



# Insights from Modeling

Solver Society  
By IYKRA

- **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



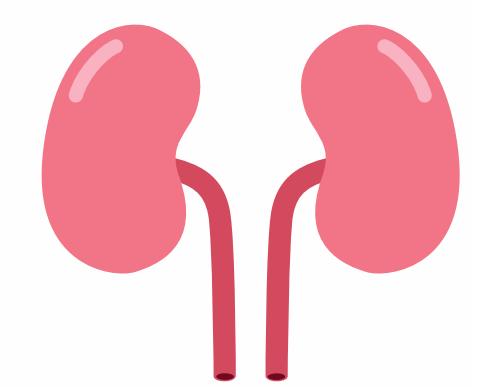
# Preventive Chronic Kidney Disease

Solver Society  
By IYKRA

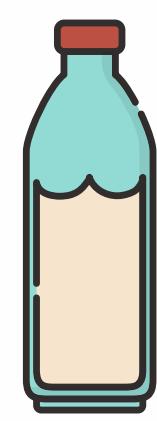
Kidney disease are silent killers, which will largely affect your quality of life. There are however several easy ways to reduce the risk of developing kidney disease

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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 urine test to check if there is any protein in your urine,  
or
  - a blood test to measure the level of creatinine in your blood

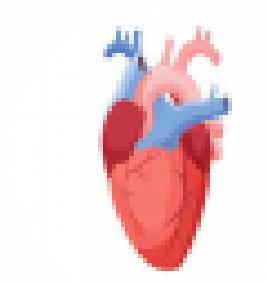


Signs of advancing CKD include: swollen ankles, fatigue, difficulty concentrating, decreased appetite, and foamy urine.

The Eight Golden Rules  
To Reduce The Risk

1. Keep fit, be active
2. Eat a healthy 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 family history of kidney disease?



4. Do you smoke?



5. Are you over 50 years?



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

## DID YOU KNOW THAT YOUR KIDNEYS

