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ANALYSING KIDNEY FUNCTION USING BLOOD & URINE PARAMETER

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ABSTRACT— The GFR rate are often used as a powerful discriminating classifier for tasks in medical diagnosis of kidney failure. Acute and Chronic Renal failures or Kidney Diseases (CKD) are being observed as a serious challenge to the field of Medical and health industry with its impact on a mass population of the world. This project presents an efficient and effective method of forecast and classification of functional abnormalities of kidney functions. Glomerular Filtration Rate (GFR) which can indicate the efficiency of functionality of kidneys is arrived using Modification of Diet in Renal Disease (MDRD) formula, CKD formula and the data's are analyzed by using statistic algorithm.

KEYWORDS— Glomerular Filtration Rate (GFR), Chronic Kidney Diseases (CKD), Modification of Diet in Renal Disease (MDRD).

I. INTRODUCTION

Identifying and stratifying patients at risk for renal disease are integral parts of clinical nephrology. These tasks are performed in part by measuring the GFR, which is generally considered to be the best marker of renal function in healthy and diseased states [1].

The chronic kidney disease is a worldwide public health problem, a social calamity and economic catastrophe. Based on the current Indian population of 1.2 billion, even a conservative estimate of ESRD burden in India would suggest that about 1,650,000 to 2,200,000 people develop ESRD every year. Out of these, only about 10% or less receives renal replacement therapy.

If the current situation prevails, the global ESRD population will exceed 2 million by 2010. The average incidence of ESRD in developing countries is 175 per million populations, which is lower than what is reported in the developed world. This has been attributed to racial and ethnic diversity, which is also reflected in the disparity in the incidence of ESRD between different populations within the developed nations. Renal failures or dysfunction of kidneys are resulting from the reduced efficiency of Kidneys to perform the process of excretion by means of filtering the body wastes from the blood [1].

Renal failures may be permanent (Chronic) or temporary (Acute) or a progressive disease which may depend on the possible therapeutic procedures [2]. CKD is a widespread physiological condition on a massive population that may get coupled with

influenced risks of Cardio Vascular Disease (CVD). Most of the renal failures are avoidable when detected in their earlier stages of infections by proper identification and proper therapeutic procedures [3-4]. As people's life level become more and more modernized and life span becomes longer in our society, Chronic Kidney Disease (CKD) becomes more common which may result in developing different levels of ill function and damage of patient kidneys. In case of the renal or kidney failures, the capacity of the kidneys to filter the body waste products from the blood (urine) is highly affected due to the death of renal cells (nephrons) and the body fails to maintain the normal fluidic balance. This results in the accumulation of toxic elements and products in the blood, targeting the vital organs like brain, heart etc. leading to loss of life.

Renal failures fall into two categories viz., Acute and Chronic. Acute failures are recoverable and last for shorter periods of life as it is originated from dehydration or some other common infections. Chronic or permanent failures are dreadful ending up with loss of life and have their origin as abusing of certain pain killer medications like ibuprofen, acetaminophen etc. Chronic failures are very common in cases of long term clinical conditions such as Hypertension and Diabetes mellitus. The problem of chronic failures are that they were not diagnosed at an earlier stage of inflammation due to the lack of observed clinical symptoms and makes the condition to get worsen delaying the therapeutic decisions [5].

The function of kidneys are influenced by the two factors estimated glomerular Filtration Rate (eGFR) and Urinary protein (Albumin). Glomeruli are small filters made of blood vessels. One million such glomeruli are there in each kidney. An estimation of the amount of blood filtered by the glomeruli per minute gives a measure of the kidney function. From the amount of waste product, Creatinine present in the blood eGFR is calculated. Creatinine content of blood is inversely proportional to eGFR. When eGFR falls less than 60 ml/L, it is an indication of kidney disease. The ratio between albumin and creatinine in the excreted urine is a direct measure of kidney function

II. MATERIALS

A. *Database description*

The dataset of diagnosis for kidney dysfunction is purely real set data. The dataset used in this work is collected from the Hospital which contain Age, Sex, Height, Weight, Hemoglobin, Serum creatinine, Sodium(Na^+), Potassium(K^+), BMI, BUN, Urea , estimated Glomerular Filtration Rate (eGFR),Skin image of fore hand for 50subjects were analyzed in diagnostic .

B. *Kidney function*

The major role of the kidney is used to regulate the blood ph. by proper filtration .The step involve in the filtration process is given below,

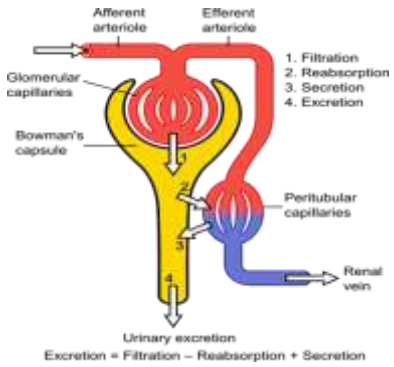


Fig –Ultra Filtration process of the kidney

1. Filtration:

Filtration, which takes place at the renal corpuscle, is the process by which cells and large proteins are filtered from the blood to make an ultra-filtrate that eventually becomes urine.

2. Reabsorption:

The kidney generates 180 litters of filtrate a day, while reabsorbing a large percentage, allowing for the generation of only approximately 2 litters of urine. Reabsorption is the transport of molecules from this ultra-filtrate and into the blood.

3. Secretion:

Secretion is the reverse process, in which molecules are transported in the opposite direction, from the blood into the urine.

4. Excretion:

The kidneys excrete a variety of waste products produced by metabolism into the urine. These include the nitrogenous wastes urea, from protein catabolism, and uric acid, from nucleic acid metabolism.

This requires several independent nephron characteristics to operate: a tight hairpin configuration of the tubules, water and ion permeability in the descending limb of the loop, water impermeability in the ascending loop, and active ion transport out of most of the ascending limb.

In addition, passive countercurrent exchange by the vessels carrying the blood supply to the nephron is essential for enabling this function.

C. ***MDRD and ECKD Equations***

The MDRD, ECKD equations are used to prescribe the CKD stages. By using this equations we can able to analysis the kidney filtration function i.e., GFR rate

Stage	GFR	Description
1	>105	normal or elevated GFR
	90-104	
2	75-89	mild GFR reduction
	60-74	
3	45-59	Mid moderate GFR reduction
	30-44	Moderate GFR reduction
4	15-29	severe GFR reduction
5	<15	renal failure

- The most important bio marker for the kidney function is creatinine. The normal range of the creatinine in the blood is 0.7 - 1.3 mg/dl for men and 0.6 -1.1 mg/dl for women .
- BUN (BLOOD UREA NITROGEN) is used to detrmine the amount of urea and nitrogen present in the blood. The normal range of the BUN is 7-20mg/dl in adults and 5-18 mg/dl in children.

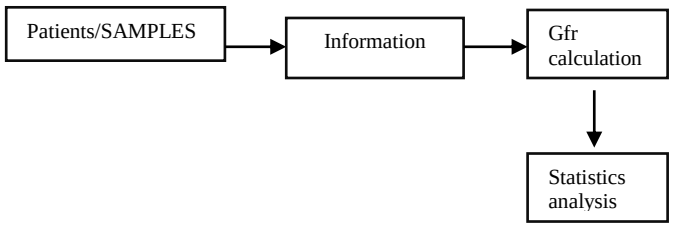
The MDRD formula, which is recognized as a more accurate and most accepted method by Nephrologists for the estimation of GFR from Creatinine level in the blood serum, is adopted for the renal diagnosis. The MDRD Equations used for calculating the GFR rate is listed below,

- MDRD formula: $175 \times S_{cr}^{-1.154} \times age^{-0.203}$ for men
- MDRD formula: $175 \times S_{cr}^{-1.154} \times age^{-0.203}$ x0.742 (if female) x 1.212 (if black)

The ECKD Equations used for calculating the GFR rate is listed below,

- $Eckd=141 \times \min(S_{cr}/k,1)^{\alpha} \times \max(S_{cr}/k,1)^{-1.209} \times 0.993^{age} \times 1.018$(female) x 1.159(black)
- K=0.7 female
- K=0.9 male
- α=-0.329 female
- α=-0.411 male

III. METHODOLOGY



Block diagram: Statistics analysis of CKD data's

A. Source of the data:

• The study comprised of patients with CKD/ESRD, both inpatients and out patients in the hospital.

Method of data collection:

a. No. of sample.

b. Type of study consists of different age groups.

c. Duration of the treatment for the patient.

d. Method used to estimate and analysis the result.

B. Analysis of the data

For analysis Mat lab is used to estimate different age set patient record and plot the relation between Gfr vs Scr using MDRD,Gfr vs Scr using ECKD,BUN vs Gfr using MDRD, BUN vs Gfr using ECKD ,Gfr vs BMI using MDRD ,Gfr vs BMI using ECKD ,BUN vs Urea .

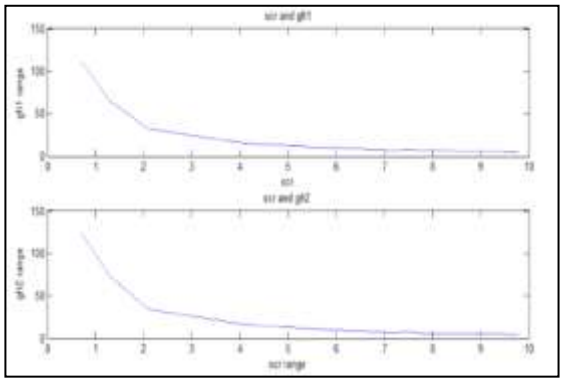


Fig- Gfr vs Scr using MDRD and ECKD

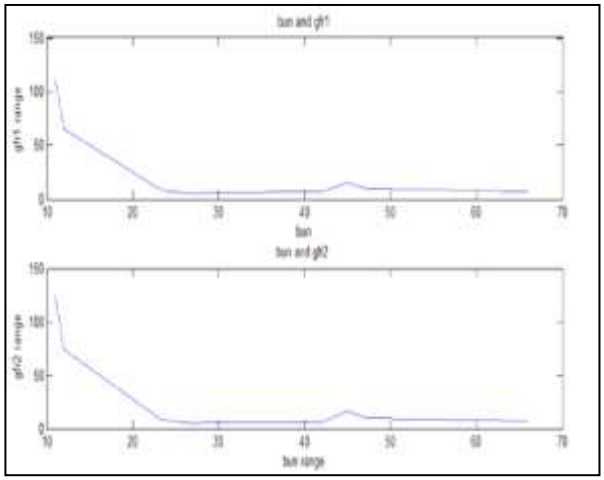


Fig- BUN vs Gfr using MDRD and ECKD

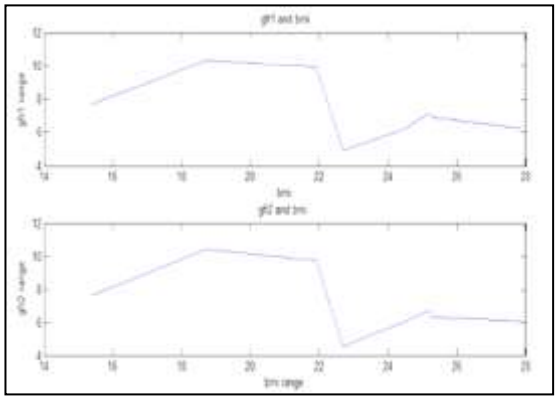


Fig- Gfr vs BMI using MDRD and ECKD

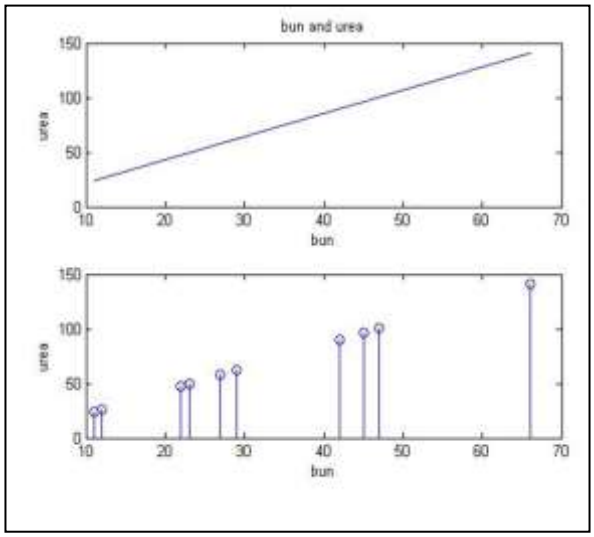


Fig- BUN vs Urea

IV. CONCLUSION AND FUTURE WORK

The Statistics analysis is done to determine the GFR rate obtained by MDRD and ECKD equation and find the relation between BUN and Urea .

In future work the diagnosis of kidney dysfunction is done by constructing the Artificial Neural network and modify the formula based on skin texture which was more ideal, dependable and trustworthy to the doctors for getting clinical clues and ideas regarding the therapy and medications according to the severity of suffered patients and progression of CKD.

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