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ESTIMATING AVERAGE LIFESPAN AND EXPECTED COSTS FOR CHRONIC KIDNEY FAILURE (CKF) IN TURKEY

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ABSTRACT
The numbers of Chronic Kidney Failure (CKF) cases have increased dramatically in last years in Turkey. For that reason, the causes of CKFs and costs related to treatment of CKF are being assessed to compare the types of treatments and to plan the necessary budget. Through this study, the aim is to view the success factors of CKF treatment and quantify the results by Decision Tools. Hypertension and Diabetics are main causes of CKF. In a past study carried out by (Aslan&Ozen, 2013) in Turkey, it was found that first three stages of CKF are generally ignored and attention is given to the last two stages of CKF kidneys not being able to perform their functions. In the first case study, the average cost for treatment for each patient and probabilities are drawn to estimate future costs. In the second case study, average lifespan, average parameters of important body signs and cost estimations under different conditions were presented based on the data of Turkish Society Nephrology (TNS). The most beneficial treatment method is Transplantation (TX), but it is not possible to find a donor for each patient. The expected lifespan is higher for Haemodialysis (HD) patients but, Dialysis(PD) provides more flexibility than HD. The expected cost of a patient for his/her living years with HD is 160,933.04 TL/Life and the expected cost of a PD patient during the life span is 142, 730.67 TL/life.

1. INTRODUCTION

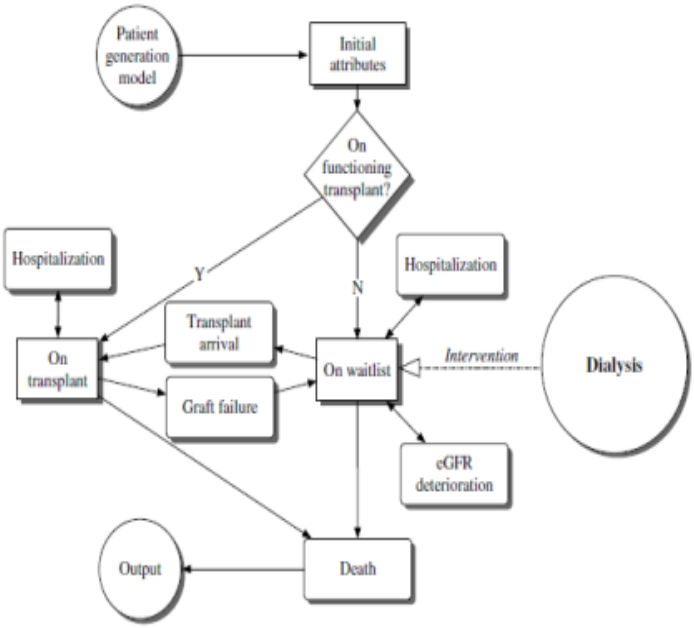
The increased numbers of CKFs add high costs in the budget of Health Ministry in Turkey. These costs can be decreased by managing the types of treatments and providing more transplantation(TX). There are five stages of kidney failure and each stage has different severity. First three stages are not so severe and people can live a normal life. But, last two stages are serious and needed to be treated regularly to make the blood clean from urine. The progression of Chronic Kidney Failure (CKF) can be slowed down and further stages can be prevented. Patients who are in stage 1-3 of CKF can be treated by taking suitable precautions aganist End Stage Renal Disease(ESRD). For that purpose, costs related to each treatment type and causes are estimated by using past data to draw probabilities. To estimate costs and probabilities, Decision Analysis tools like Genie Software are used. The most common causes of CKF are analyzed in the models to bring attention to the importance of screening and the detection of causes to prevent progress of CKF. From observation and interviews with patients, it was understood that patients head to hospital when they are stage 4-5 of CKD.

Reduced kidney function can cause collection of waste in body and wastes have to be removed from body by dialysis. Each patient needs to visit hospital two-three times of four

hours period each week to filter the blood. In many countries, these kinds of patients lead to high cost.

Thus, these costs can be decreased and the expected quality of life of patients can be increased by some methods and researches. Kidney transplantation is the best way to overcome that situation but it is not possible to find a suitable transplant all time and it requires high costs. Some patients need to wait more than five years in some countries for transplants. Late treatments and not visiting hospital properly lead to collection of uraemia in body resulting in death. Efficiency to treat patients better and equity to allocate resources are main criteria in dialysis treatment in order to manage optimal dialysis strategies and to estimate results. Customization to patient-specific conditions is the main strategy of treatment since standard treatment procedures may not be beneficial for all patients. Transplantation, progression of disease, and death with some probability rates are events that can occur from one stage to another stage and used for modelling by Markov chains. QALY method is a suitable measurement tool to make the model named as the Stochastic Shortest-Path Problem based on reward matrix. Schematic model of simulation shown in Figure 1 can be used for numerical purposes. The model decreases risk of death at the early stage of dialysis and different doses can save some costs. (Lee et. al., 2008)

Figure 1: A schematic representation of the simulation model. (Lee et. al., 2008)



Preventing disease progression, improving patient outcomes, and reducing costs are the main aims of screening CKD. Populations prone to CKD, like those having diabetes,

hypertension, and others with a history of medical illness related to weight, height, and blood pressure are the main focus of screening through blood and urine tests.

Screening data and detecting individuals with undiagnosed or early stages of disease can be used for policy development. Early symptomatic stage can be detected and progression can be slowed down or prevented in CKD. By screening, public can be informed by governments to decrease the burdens. Degrees of risk-factors are expected to be determined before screening(Obrador et. all., 2011) Expected survival rate can be found for a chronic illness. For example, the spread of an illness can be modelled by using markov chains to define the risks and costs with states of having severe illness, being well, coma, or deaths.(Bruce &Peter,2002) Stochastic networks and queuing networks are used over years as cost-effective methods in healthcare decision making. Quality-Adjusted Life Year (QALYs) is named as individual outcomes or effects. (Hazen &Huang , 2011)

2. THEORETICAL BACKGROUND

Autosomal Dominant Polycystic Kidney Disease (ADPKD) is the slow development of fluid-filled cysts in kidney by enlarging it and effect 1 in 500 and 1 in 1000 people resulting in end ESRD requiring transplant or dialysis(Takiar& Caplan, 2011). TX is mainly done from first and second type's relatives due to high matching probabilities. There are the risks of rejecting the kidney, infection, depression etc. Side effects after transplantation are other important parts of consideration (Yatkın,2007)Dialysis provides just 10% of kidney functions and transplantation can just provide 50% of it. The kidneys of 40% of patients may be rejected by patients in the first year. The lifespan for cadaveric kidney is 8 years and 11 years for living related kidneys (Stein& Wild,2002). It was found that 14% on kidney replant list have had a kidney transplantation before in the University of Pennsylvania in Philadelphia (Stam, 2010). Over years, the survival rate of deceased donor grafts increased from 40% in 1975 to %90 in 2005 for one year. Moreover, it increased from about 35% to about 40% from 1987 to 1995 for ten years. Half-lives of deceased donor transplants increased from 7.9 years in 1988 to 13.8 years in 1995(Ormandy, 2009). Each year, around 5,500 people have experience kidney failure and there are 41,000 people taking treatment. Around half of them are treated with TX, 40% of them are treated with HD and 10% of them are treated with PD in England (NHS., 2013). In UK, the mean living years of CKF is 5.1 years. The mean living years for TX, HD and PD are 10.2, 2.8 and 2.0 years respectively (Ormandy, 2009).

It is stated that there are 7,307,315 people in 1-5 stages of CKF and 2,369,059 patients are in 3-5 stages in Turkey(Süleymanlar et. all., 2011). In 2012, 2,901 kidney transplantations were carried out and 2,377 of them were done on living beings and 524 were carried out on dead bodies. 1,155 people died while waiting for a kidney transplant in that year. 31 kidneys were rejected by receiver. It has been deduced that kidney transplantation have decreased when compared with previous years (SP, 2013). The expected living years are high for first two years. The highest living years come from TX living kidneys. After 10 years, there is 72.5% chance of living with TXs from a live kidney donation. However, there is just 11.1% chance of living with dialysis(Gürkan,2013). The life quality is better for PD for first 1-2 years and there are fewer problems than HD patients having TX after PD (Seyrek, 2013). When HD and PD are compared, more bacteraemia is

seen in HD and more peritonitis is seen in PD. Moreover, higher cather infection is seen in PD and there is a higher risk of pneumonia infection for HD patients. Cellulites are close for both treatments.

With PD, there is more chance of immediate graft function whereas delayed graft function is high with HD. It was found that immediate graft function is 68.5% for PD from 92 patients and 46.5% for HD from 587 patients. Delayed graft function is 22.5% for PD and 39.5% for HD. Besides, never function is 9% for PD and 14% for HD. There is a less graft loss in PD. An integrated treatment method can be applied to patients. In 1-2 years, more PD patients can live than HD patients (Fontán et. All., 1996; Utaş, 2013). For the first year, there is 96.1% and for the third year, there is 83.2% of living chance in PD. Moreover, there is 67.6% of living five years and 33.6% of living ten years from 12 years analysis for PD. As the years increase, the chance of living decreases(Utaş, 2013). The increase of 0.5% of GFR increase the living chance by 9 % (CANUSA, 2013; Seyrek, 2013). This result can be used in Turkish hospitals as a parameter of success. A ranking based on increase of GFR can be drawn for hospitals that patients can make better decisions for their treatments.

ESRD identified and monitored timely for therapy has increased 4 times since 2000. It was found that 98.2% of people are not aware of their CKF. The costs of TX in the first year, and in second year are 23,393 $ and 10,028 $ per year in Turkey. In 2004, 830,000,000 $ was spent on CKF and it was 1,218,650,000 $ for 2006. 5% of health budget is spent on CKFs in Turkey. The cost of HD, PD and TX are 52,000 $, 45.000 $ and 18,000 $ respectively per year in USA. 28.3 billion $ was spent on CKF in USA in 2010(Süleymanlar, 2012). It was found that 25,353.99 TL (17,779 $) is paid for each PD patient per year and 33,287.29 TL (23,342 $) is paid for each HD patient per year. PD is 7,933.3 TL cheaper than PD per year in Turkey. In developed countries, 22% of patients are treated with PD and this rate is low in Turkey. It was found that if 22% patients in Turkey are treated by PD, then one more from 400 patients can be treated with the same budget. Less medication is used in PD and thus it is cheaper than HD (Utaş, 2013). When there are between 50-79 patients per centre, the cost per séance is 181.6 TL and when the number patients increase, the cost decreases (Tatar, 2012). It is found that HD session was about 169.86 TL for each time. About 2/3 haemodialysis patients have been cured in private hospitals. These costs are mainly supported by government insurance(DİADER, 2013).

3B-5 chronic kidney disease patients from 721 multidisciplinary care group and 661 non-multidisciplinary care group patients between 18-80 years from 2007 were followed in National Taiwan University Hospital. Kidney transplant, acute kidney injury, received renal replacement therapy, child pugh class B-C liver cirrhosis, and terminal malignancies were excluded in that study. In that study, all critical body signs, tests and calculating costs were been carried out regullarly. Age, sex, diabetes mellitus, cardiovascular disease, systolic blood pressure, eGFR(estimated Glomerular Filtration Rate), albumin, calcium and phosphate product, and log urine protein creatinine ratio are used to evaluate the results of program. Multidisciplinary care consisting doctors, nurses, and dietitians for patient education, diet consultation, behavior adjustment and continous monitoring system with eGFR < 45 mL/min per 1.73 m2 was found to be more benefical than nonmultidisciplinary care by decreasing the risk renal replacement therapy with 33.6%, having less chance emergent dialysis and being cost effective. With multidisciplinary care,

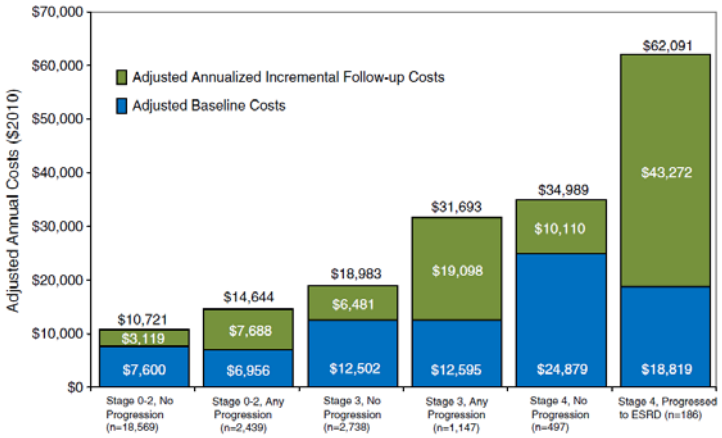
less ESRDs patients and deaths are seen. Multidisciplinary care group has a significantly slower annual eGFR decline rate and some favorable annual hemoglobin and urine protein-creatinine ratio. There are no differences for albumin level and blood pressures during 2.42 years control period.

Moreover, hospitalization days are shorter for multidisciplinary care group with less emergent start of dialysis and there are significantly more emergency department visits for nonmultidisciplinary care group. Also, multidisciplinary care group has significantly lower annual cost per patient year (US $2372 vs $3794, P < 0.001) due to quick progression of ESRDs for nonmultidisciplinary care group. In this study, it was found that since 2007, the numbers of ESRDs have decreased in Taiwan and the multidisciplinary care program is the most effective for stage 4 CKD patients(Chen et all., 2015).

CKD-related comorbidities such as obesity, diabetes, and hypertension cause to increase the number of CKFs in USA and Australia with 1 from 9 people. Severe CKD or dialysis group ((eGFR)< 30; n = 330), moderate CKD group (eGFR: 30–60; n = 2648) and referent CKD status group (eGFR: ≥ 60; n= 10,020) with percutaneous coronary(PCI) intervention at 12 months following PCI in patients are compared to find the burden of each group. It is found that severe CKF has significantly higher cost than reference CKD status. Mean total costs per patient are 4,442 $AUD for reference group, 4, 851 $AUD for moderate CKD and 6, 958 $AUD for severe CKD/dialysis(Thathya, 2013) Patients with CKD have more risk of having cardiovascular disease (CVD). HMG-CoA reductase inhibitors are used to avoid risk of Myocardial Infarction (MI) and stroke in patients with CVD for. CKD stages 3a (eGFR 45 to), 3b (eGFR: 30 to 44), 4 (eGFR: 15 to 29), and 5 (eGFR <15) with moderate CVD were followed for three monts to estimate the costs. Rates of muscle-related toxicity(rhabdomyolysis) from statins increased with CKF. Stains therapy increse the life expectancy by 50 days, increases total lifetime costs for all patient groups and decrease at least one MI over a lifetime (before to ESRD) from 39.8% to 34.7% For 65-year-old men, cost $18,000 per QALY for 65-year-old men and for 65-year-old women cost $33,400 per QALY are gained with statins at $4 per month. 40 mg of pravastatin with $47 per month results statin therapy cost between $51,700 and $87,700 per QALY gained for 50- 85 years old men with high or moderate hypertension by stocastic models as shown inFigure 4 in Appendix(Erickson, 2014)

25,576 members at Kaiser Permanente around the Portland, Oregon, and Atlanta-Georgia, metropolitan areas of USA were put through 2 diabetes and at least one serum creatinine measurement in 2005. In USA, both CKD and diabetes account for $18 billion treatment costs for patients above 65 years of age. From stage 0–2 to stage 3 or higher, the progression is followed for 90 days. $8206, $12,529, and $23,229 per patient per year for CKD stage 0–2, 3, and 4, respectively cost occured in 2005. Incremental annual adjusted follow-up costs are cost of excess of baseline costs during during follow-up as shown in Figure ….Costs can be decreased by preventing progression of diabetic kidney disease. MI among patients with diabetes and CKD risk has almost two times higher risk than the risk of patients with just diabetes. Better efficent treatments and improving treatment adherence can decrease the costs as shown in Table 2 in Appendix(Vupputuri et all., 2014)

Fig. 2. Adjusted baseline medical costs and incremental, annual, adjusted medical costs during follow-up, by Baseline Stage of CKD and progression status(Vupputuri et all., 2014)



Intensive glycemic control of previously uncontrolled diabetic patients saved 0.075 QALYs for Austrialian patients. Cardiovascular events, deaths, and the need for ESRD are prevented by that control. About six patients deaths and one noncardiovascular death per 1000 patients were prevented. Moreover, less than six patients requiring ESKD were found per 1000 patients. Intensive control of previously inadequately controlled hypertension results in 0.136 QALYs with $A 352 cost. The use of an ACE inhibitor by all diabetic patients brings in a gain of 0.124 QALYs. Screening for diabetes between the ages of 50 and 69 years causes to an incremental lifetime cost of $A1345 and gain of 0.098 QALYs. Screening for hypertension plus intensive blood pressure results in 0.116 incremental QALYs as shown in Table 3. In Appendix (Kirsten et all., 2010). Hyperphosphatemia the excess of serum phosphorus between 2.7 and 4.6 mg/dl in predialysis patients and between 3.5 and 5.5 mg/dl in dialysis patients in the blood increases morbidity and mortality in CKD patients on dialysis. Lanthanum carbonate (LC) a noncalcium-based phosphate binding agent licensed for hyperphosphatemic dialysis patients and calcium-based phosphate binders . CBs(calcium-based binder) are used as a cost effective method for CKD treatment with markov chains. The total clinical benefit of second-line LC at £6900 per QALY gained in the dialysis population after first-line use of CBs was used for gaining 44.1 QALYs in the predialysis population of 1000 predialysis patient cohort with 21 dialysis-free years and cost savings of £339 per patient and 55.8 QALYs in the dialysis population. The gains were 44.1 QALYs in the predialysis population and 55.8 QALYs in the dialysis population of the 1000 incident dialysis patients cohort in United Kingdomas shown in Figure 5. In Appendix (Vegter et all., 2011). Hyperglycemia and chronic complications can develop in patients not incorporating diet modifications. 4.6 million (21%) of diabetes patients in US in 2011 did not include modified diet as a part of their therapy. Patients who did not include diet modification incurred more costs (M = $11,230) than those who included diet modifications (M = $10,638) in their total healthcare expenditure.

By initiating exenatide QW, exenatide, or LIRA with different healthcare costs from 1,610 exenatide QW, 2,690 exenatide, and 6,499 LIRA patients, exenatide has the lowest cost among these metdos via multivariable-adjusted models in USA in 2012. Uncontrolled type 2 diabetes mellitus(T2DM) patients with stage 1, 2, 3A, 3B, and 4 of CKD had total costs of 1.18, 1.17, 1.44, 1.54, and 1.80 times more costs than without CKD patients in US from 23,492 T2DM patients(Chuang et all., 2014)Average cost in the management of anemia among chronic kidney disease patients on hemodialysis per patient per 7 months was 1989.45 $ for EPO, iron and vitamin supplements from 62 patients in Indian(Mateti et all., 2014) 0.09 QALYs after two years, 0.16 after three years, 0.36 after five years and up to 0.93 incremental QALYs after the first 10 years were received in the Lazio Region –Italy with the costs of a low-protein diet(€ 1,440 per patient per year for CKD with satge 4 and 5 of annual cost of dialysis per patient approximately € 34,072(Mennini et all., 2014) Anemia educational program affecting energy, daily activities, and general well-being and clinical pharmacy education (CPE) on infection management among patients with chronic kidney disease (CKD) stages 4 and 5 in Haji Adam Malik Hospital, Indonesia was carried out. Skin, dialysis water, treatment systems, and dialyzer reuse are cause of infection which is the second leading cause of death of patients with CKD, especially those in stages 4 and 5 with inflammatory state later causing the development of atherosclerosis and increased risk of cardiovascular disease. Urinary tract infection, pneumonia, and sepsis of ESRD are three most frequent infectious complications. “too little or too much of the drug provided to the patients”, “comprising drug–drug, drug–food”and “drug–laboratory interactions” can make the effects of CKF worser. Control group (n= 80) and experimental group(n=63) were compared by comparing collected data in 2010 with glomerular filtrationrate of less than 15 ml/min/1.74m2 surface area as shown in Table 4. in Appendix. Incremental cost-Effectiveness Ratios(ICERs) were used for cost effectiveness analysis. ICERs= (CostwithCPE – cost with out CPE)/(Outcome with CPE – Out come without CPE(Nasution et all., 2013).

3. COST AND LIVING YEARS ESTIMATION

Based on data shown above and TSN registry, two case studies are carried out. In the first case study, the average cost of each patient is estimated for two years. In second case study, the average living years, some average critical body signals, and costs are presented for each patient for his/her living years and all patients by using decision analyzing tools. Genie decision software is used in decision making in that study.

3.1 Case 1: Decision Analysis of CKF based on general data

Below, the reasons of CKF and their effects are seen. Types of treatments data are taken from Turkish Nephrology Community(TNC) and they are equally distributed to each cause.

Table 1: Probabilities of reasons for CKF

The reasons o...	DiabetesM...	Ischemiche...	Congestive...	Chroniclun...	Peripherav...	Malignancy	cerebrovas...	Chroniclver...	Others
HD	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859	0.859
PD	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093
TX	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048

Table 2: Sensitive Analysis for HD

The reasons o...	DiabetesM...	Ischemiche...	Congestive...	Chroniclun...	Peripherav...	Malignancy	cerebrovas...	Chronicliver...	Others
HD	0.859	0.7	0.859	0.859	0.859	0.9	0.859	1	0.859
PD	0.093	0.2	0.093	0.093	0.093	0.05	0.093	0	0.093
TX	0.048	0.1	0.048	0.048	0.048	0.05	0.048	0	0.048

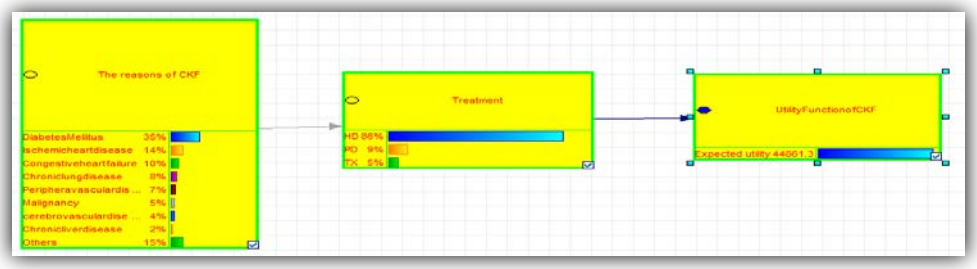
When, HD treatment is set and some probabilities are changed as shown above. "What if we judge them to be HD?" we will set the evidence in node Expert Forecast to HD, updating the model, and observing that the probability of Diabetes Mellitus is now 0.35542672 as shown below. To find whether there is a relationship between the roots and treatment type, then more realistic probabilities can be calculated.

Table 3: Changes in probabilities

DiabetesMellitus	0.35542672
Ischemicheartdisease	0.11985004
Congestiveheartfailure	0.10519814
Chroniclungdisease	0.078643269
Peripheravasculardis...	0.069451199
Malignancy	0.048154036
cerebrovasculardisea...	0.044939011
Chronicliverdisease	0.026157748
Others	0.15217983

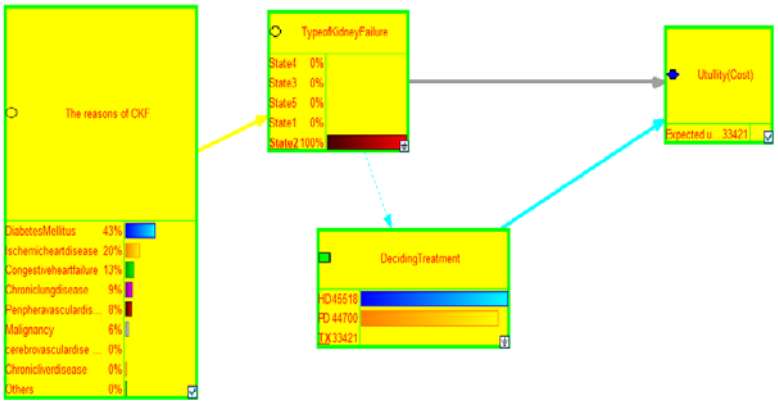
It was found that the cost of haemodialysis is 22.759 $ per year for each patient.The costs of PD, TX first year, and TX second year are 22,350 $, 23,393 $ and 10,028 $ per year in Turkey(Süleymanlar, 2012). Based on type of treatment, expected cost of a dialysis per two years can be found. Kidney transplant costs are presented for two years. Hence, the model showed below is used to estimate cost per two years for comparison. The expected cost was found to be 44.846.3 $ per two years for each patient. This result is high due to mainly preferring HD (86%) in Turkey.

Figure 3: Expected Utility of CKF



If it is known that all kidneys are at stage 2 as shown below, the probabilities of reasons are changed. The scenario analysis provides beneficial results to develop strategies and sensitivity. 33,421 $ is the expected cost of all treatments per two years for each patient in that case.

Figure 4: Staging states for HD



3.2. Case Study 2: 2011 Registry by Turkish Society of Nephrology

TSN has collected data for CKD about HD, PD and TX from 840 out of 1,009 units. 83.3% of units have answered the request (TSN,2012). The expected cost, expected living years and expected values of patients are tried to be drawn based on these data with some decision tools. The results of trend analysis from Aslan & Ozen(2013) are also used to calculate overall cost estimations. Furthermore, some studies results having done in that field are used in the models and estimations.

The costs of TX first year, and TX second year are 23,393 $ and 10,028 $ per year in Turkey (Aslan & Ozen, 2013). It was found that 25,353.99 TL (17,779 Dollar) is paid for each PD patient per year and 33,287.29 TL (23,342 Dollar) is paid for each HD patient per year(Utaş, 2013).

3.2.1 HD Analysis

Almost half of patients (47.1%) of HD have diabeties between 45-64 ages. This means that all diabetics could be potential CKD patients. For all patients with this illness, the CKF tests are required. 37.3% of patients have Type 1 DM and Type 2 DM. At 28.1, hypertension is the second most common disease in Turkey with 28%. 1,139 patients have not answered to that section and 12.8% of HD causes are not known. Around 13.5% patients have a kind of nephrology illness. Cardiovascular system failures are the most frequent cause of deaths for HD patients at 54.4%. It is known that HD and PD create higher blood pressure over time since fluids do not move in body in a suitable manner. Malignancy is the second biggest cause of deaths with 11% in 2011. Cerebrovascular accidents are the third largest cause of death. Cardiovascular events leading to deaths with heart failure as 40.3% and ischemic heart disease at 35.8%. Hypervolemia pulmonary oedema at 35.1 % is the greatest contributor to HD. Persistent nausea; vomiting and anorexia are the second greatest reasons behind severe HD at 18.1%. The urgent patients show different indicators as a cause of HD from regular HD patients. Hypertension is just 12.7% of urgent patients.

The average of serum creatinine is about 6.825 mg/dL by considering median values and max value as 10.0 mg/dL for HD patients. In the same manner, the average value for serum urea is 149.875 mg/dL. Moreover, haemoglobin average is 9.95 g/L. These averages can be compared with acceptable ranges to see their levels. They are mainly high due to malfunction of kidneys and other disorders. 86% patients have more than 0.65 urea reduction rate at the end of 2011. Decreasing the urea rate increases the life years of patients. Another important success factor of CKF can be the amount of urea reduction per patient in each hospital or dialysis centre by calculating the risk of death.

A normal results for serum creatinine are between 0.7 to 1.3 mg/dL for men and 0.6 to 1.1 mg/dL for women. From 7 to 20 mg/dL (2.5 to 7.1 mmol/L) are considered normal for urea(Mayo, 2013).

Table 4: Distribution of chronic HD patients according to dialysis duration, as of the end of 2011.(TSN,2012)

Years	N(Number of Patients)	%
0-5 years	21055	59
6-10 years	9640	27
11-15 years	3538	9.9
16-20 years	1121	3.1
>20 years	337	0.9
Total	35691	100.0

Expected living years is 5.691 years by considering 20 years as the highest life span of living with median values in the range. This value is very small when compared with TX living years and healthy years living average. Increasing that average can be a parameter of success for policy makers with AQLY. The minimum expected living years is 3.385 years with minimum values in the range as shown above. The average number of HD frequency scans are 2.981 times per week from Table 2. This average can be used to calculate the amount of expenses of all patients. 109,492 scans are taken by 36,730 HD patients per week.

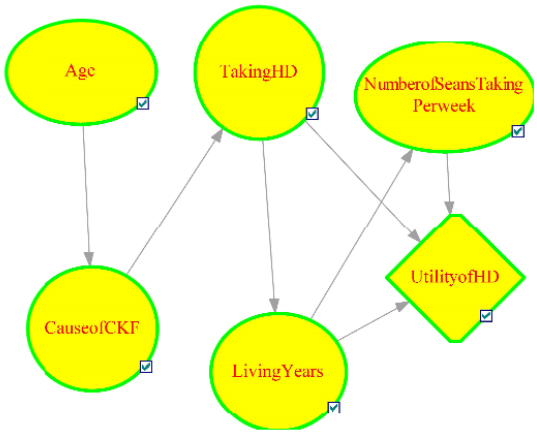
Table 5: Distribution of chronic HD patients according to HD frequency, as of the end of 2011(TSN,2012)

Seans	N(Number of Patients)	%
Once wekly	320	0.9
Twice weekly	2616	7.1
3 times weekly	33526	91.3
Times weekly or nocturnal HD	268	0.7
Total	35691	100.0

Central venous catheterization causes some complications. Artery function is the most common of early complication. Localized exit site infection is the latest complications. Late complications are higher than early complications. Hypertension (<140/90 mmHg) without medicine is 56.8% and Hypertension (<140/90 mmHg) with medicine is 24.7% from 34,733 patients data.

Hypertension is very dangerous for the functions of life like causing brain blooding. Blood pressure's serious complications should be checked regularly to prevent early deaths. 59.0% patients of HD use parenteral iron therapy and 40.2% of them does not use iron therapy. The cost of iron per patient per year is 186 $ for PD and 820 $ for HD. 9,393 patients representing 86.7% according to Hepatitis serology in chronic HD are HbsAg(-) and Anti-HCV(-). Hepatitis can be transmitted by other patients. It is strictly suggested that these kinds of patients are expected to be dialyzed at different rooms and they should not contact with other devices and patients. Secondary hyperparathyroidism excess production of parathyroid hormone and harmful for bone drug use is 50.7% from 34,563 patients and IV vitamin D usage is 33.1 % from that results. The rest of patients do not use any vitamin for that group.

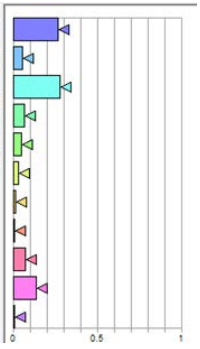
Figure 5: HD Costing and estimating living years ranges



To see the load of HD on the country, a model with 163.5 TL per séance is developed. The cost based on the living years and numbers of séance is calculated from utility function as shown above. The probabilistic nature of CKFs forces to use some decisions tools and simulations for understanding the steps. Based on the model above, scenario analysis can be carried out by setting probabilities.

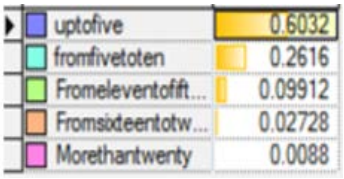
Table 6: Probabilities for Causes of HD patients

Age	Bir	iki	uc	dort	Bes
TypeDMbir	0.268	0.268	0.268	0.268	0.26
TypeDMiki	0.056	0.056	0.056	0.056	0.05
Heypertension	0.279	0.279	0.279	0.279	0.27
Glomerurlon...	0.07	0.07	0.07	0.07	0.0
PKD	0.048	0.048	0.048	0.048	0.04
Pyleonefrit	0.03	0.03	0.03	0.03	0.0
Amiloidoz	0.017	0.017	0.017	0.017	0.01
RVD	0.011	0.011	0.011	0.011	0.01
Other	0.071	0.071	0.071	0.071	0.07
Unknown	0.139	0.139	0.139	0.139	0.13
Missingdata	0.011	0.011	0.011	0.011	0.01



Causes of CKF for HD are shown above. For each age group, the same probabilities are used due to not having accurate data for different age group. Diabetic and hypertension are two most serious cause of CKF as stated before. Probabilities of number of séance per week are drawn from data above. Mainly, three séance are taken per week.

Table 7: Living years for HD patients



Living years are very important success factor for policy makers. Most people live up to 5 years with 0.6032 probabilities as shown above. This makes HD undesirable since it cleans the blood around 5-10%. Increasing living years is expected to be the main target of Health Ministery in Turkey. Current policy focuses just on treating people instead of quality of life, screening and increasing living years. The expected cost of a patient for his/her living years with HD is 160,933.04 TL/life. If just two séance are taken per week, the cost is 123,753.54 TL/life and with three séance, it is 185,630.31 T/lifeL. Moreover, if just one séance is taken, it is just 61,876.771 TL for the whole life of a patient.

Table 8: Modelling results of cost and living years for whole life of patients at each year

Living Years	Cost Scenario(In TL) for just a patient	Cost Scenario for 2014 and afterward years(In TL)-All patients	Cost Scenario for 2022 and afterward years(In TL))-All patients
0-5	114,227.64	7,009,579,129	9,988,750,207
6-10	228,455.28	14,019,158,260	19,977,500,410
11-15	342,682.92	21,028,737,390	29,966,170,170
16-20	456,910.56	28,038,316,510	39,955,000,830
>20	571,138.2	35,047,895,640	49,955,173,800

The cost of incurred on one patient during the CKF with expected 0-5 living years is currently 114,227.64 TL/life and the cost for all patients is estimated to be 9,988,750,207 TL in 2022 and afterward years life years. If the patients live 20 years, the costs will be 49,955,173,800 for all HD patients for the living years in 2022 and afterward years. The question how this costs can be decreased and the how the living years can be increased. The expected living years are very low currently. Patients are expected to live longer time when compared with developed countries standards. However, this will bring extra costs on government budget and if patients cannot get treatment, they may live shorter with less cost. The humanitarian way of treatment plays great role in the treatment of dialysis that increasing expected living years and quality are expected to the main of focus of policy makers. Minimizing cost at the same time with increasing living years will bring extra advantages as shown in literature part by screening, giving some medicines, diet, education etc.

3.2.2. PD Analysis

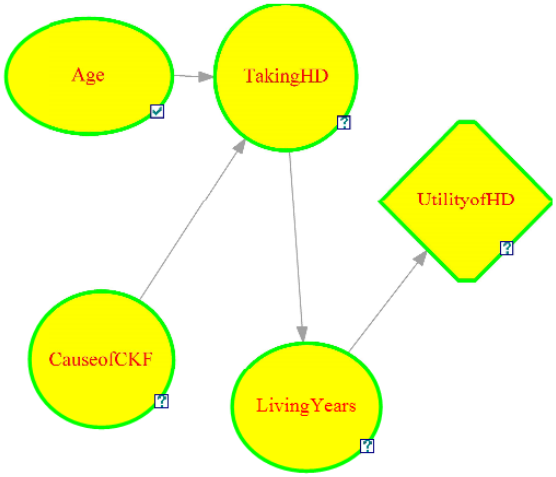
PD, hypertension is the biggest cause of CKF aside from HD. Diabeties is also high for this patient group but not as much as of HD. Type 2 DM is the second highest cause of CKF of PD patients. Moreover, glormerulonephritis with 10.1% is also a crucial cause of CKF in that group. Cardiovascular problems are the main cause of deaths with 51% in that group. Infection is 12.4% cause of deaths and this is a very high percent since infection can be prevented with suitable treatments and medicines as shown in literature section. 17.8 % of causes of deaths are not stated in that group needing more accurate data. By considering middle point of ranges, the expected living years for PD patients is 4.2075 years. That means patients of PD live shorter than HD patients of 5.691 years. Average 1.48 years more, patients can live by taking HD. PD patients can live 6.575 maximum expected years and they can live minimum expected 1.84 years and this value is expected 3.385 years.

Table 9: Distribution of chronic PD patients according to dialysis duration, as of the end of 2011(TSN,2012)

Years	N(Number of Patients)	%
0-5 years	2507	73.5
6-10 years	744	21.8
11-15 years	150	4.4
16-20 years	11	0.3
>20 years	0	0.0
Total	3412	100.0

By considering minimum values, the expected serum albumin level is 2.566 g/dL for PD patients. With max values and considering 5 g/dL as the upper value, the expected serum albumin level is 4.043 g/dL in that case. Patients are mainly cantered around 3.5-4 g/dL. Distribution of chronic PD patients according to haemoglobin level (mean value of last 3 months), as of the end of 2011 is 11.19 (9.00-13.60) gr/dL. There are more hypoalbuminemia in PD patients than HD patients (PD: 29.4%, HD: 12%), which can be prevented by iron theraphy. Hyperlipidemia is an important complication in PD with 11.9%. Moreover, obesity with 6.5% can be decreased as a success factor of PD treatment with psychological problems and suitable diet. These two factors can be controlled and checked by healthcare staff. Age, living years, causes of CKF for PD and taking or not PD are depicted in the model below. Utility is drawn based on yearly cost of PD for a patient. The model is simplified due to not having costing about other stages. 6.6% of patients have PD in this model.

Figure 6: Modelling PD with living years



The expected cost of a PD patient during the life span is 142, 730.67 TL with 25 highest living years and middle point of ranges. This cost is 160,933.04 TL for a HD patient for the whole life living years with PD. The minimum total expected cost of PD is 1,171,388.3 TL by considering minimum values in all ranges. The table below is prepared by setting evidence to each living year range as accepting each case happens with 100%. Numbers of PD patients are taken from trend analysis of (Aslan & Ozen, 2013) for estimation. As the number of years increases, the expected costs increase at the same time. These scenario analyses can help decision makers about what they want to do in future about PD. However, the quality dimension of treatment should not be ignored. If evidence is set to PD, 106,676.91 TL cost occurs per patient during expected living years and 145,278.36 TL cost occurs for not having PD.

Table 10: Cost Analyzing for PD for whole life of patients at each year

Living Years	Cost Scenario(In TL) for just a patient	Cost Scenario for 2014 and afterward years (In TL)-All patients	Cost Scenario for 2022 and afterward years (In TL))-All patients
0-5	63,384.975	45,5547,815.3	644,625,195.8
6-10	202831.92	1,457,753,009	2,062,800,626
11-15	329,601.87	2,368,848,640	3,352,051,018
16-20	456,371.82	3,279,944,270	4,641,301,409
>20	633,849.75	4,555,478,153	6,446,251,958

3.2.3. TX Analysis

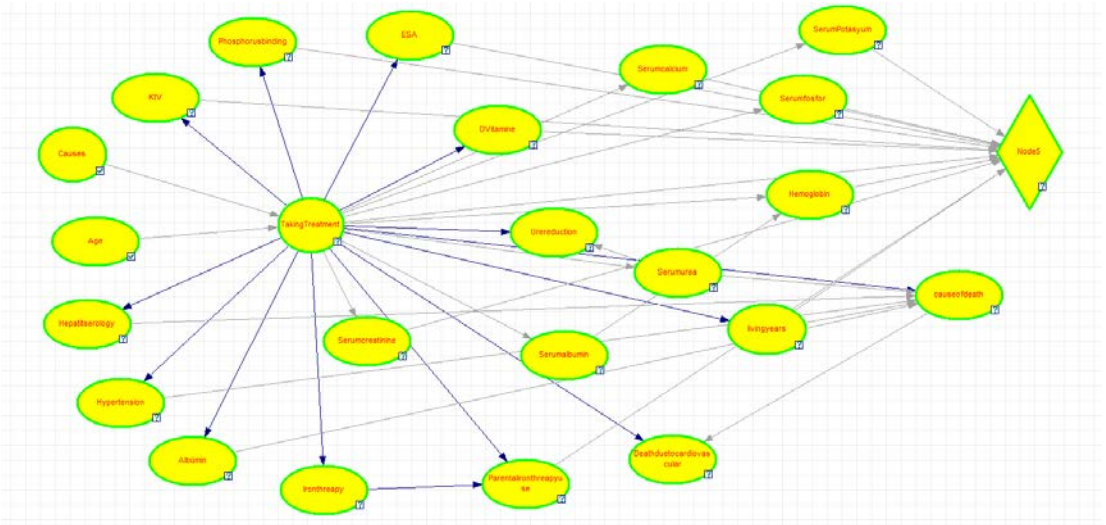
It was found that 22, 759 $ for HD, 22,350 $ for Continuous Ambulatory Peritoneal Dialysis (CAPD), and 23393 $ and 10,028 $, respectively, for the first and second years of transplantation (TX) is spend in turkey(TSN,2013).

Age, ischemic heart disease, no primary renal disease, and HD treatment associate with greater daily costs in dialysis of patients (Mayo,2013). Drugs are the most expensive part of TXs with 10,348 $.Operation cost is just 1,150 $.In the second year, the cost of drugs is 5,084 $. These drugs increase the chances of accepting the kidney. However, they cause infections and cancer in long run(tsn,2013) TXs of living donors are given by relatives to the patient with 68%. Mother and sisters or brothers are two main providers with 42%.The biggest donor segment of kidneys is spouse from non relatives. Hypertension is the main cause of CKFs in TX patient group and an interesting result is that diabetes mellitus is the fourth aetiology different from HD and PD patients group. Glomerulonephritis is the second greatest cause of CKFs. 39% of data are not clearly categorized in that patient group. Not completely register CKFs are another weakness of this data. Some patients carry out their TX at abroad and these patients are also not included in this data. These data gives just general information about TX but not accurate information. Due to the money turning in organ trafficking, it is difficult to get most accurate data. Infection is the highest cause of deaths with 44.8% since some medicines are given and these medicines decrease the immunology system of patients. Pulmonary emboli with 17.2% is the third cause of deaths in TXs patients group. Cardiovascular distribution cause of deaths is low in that group of patients. Most of TXs patients come from HD with 69.9%. The PD patients are the second greatest group from 883 patients. Pre-emptive TX operated before is 14.2%. The graft loss in KTx patients, as of the end of 2011 is 20.3% from 1,082 sample. The greatest cause of graft loss is death with 61.5%.This shows the risk of TX clearly. Chronic rejection is 27.1%. TX provides high quality of life. However, patients are expected to be aware the risk of dying and rejection. If the cause of all graft loss is evidenced as death, the expected cost per two years is 41,616 $. Expected cost is 26,863.908 $ for a patient. If all TXs are accepted, the cost is 29,512.62 $ per two years for a patient. When the probabilities sated TNC are used, the expected cost is 30,710.855 $ for two years. When all kidneys are rejected, the cost is 41,616 $ per two years. Based just from arrow of accept or reject node as shown in Appendix in Figure 3., the cost is 30,634.47 $**.** The expected cost of all patients in 2014-15 is 107,557,448.6 $ and it is 174,739,016.9 $ for 2021-2022 years.

3.2.4. The Whole Model of All Treatments

The model shown below represents the whole model based on data of TNC. There are more complex relations than that figure compared with previous models. Each probabilistic node can be used to estimate the probabilities of others. Taking treatment is in this model not a decision node but a probabilistic node. Living years, death and taking treatments are centre nodes in that model to make estimation. Due to not having actual costing of all nodes, some of them are not connected to utility node (Node5). The model nodes are selected according data collected by TNC. More accurate data can be collected in future to get real data. Expected years of living are 8.005 years according to maximum years in the range, 5.2825 years according to middle point and 3.055 according to minimum point for CKF patiens with ESRD.

Figure 7: Whole model



When setting evidence as TX, the expected living years are 20.7225. TXs patients live three times more than HD and PD patients. The probability of living more than 20 years is 59% for TX as shown below. Expected cost according data and considering TX as 20,806 $ is 1, 707,610,400 $ for 2022 for all CKF patients.

Table 11: Years of living for treatments

TakingTreatment	HD	PD	TX
uptofive	0.59	0.735	0.01
fromfivetoten	0.27	0.218	0.031
Fromeleventofifteen	0.099	0.044	0.099
Fromsixteentotwenty	0.031	0.003	0.27
Morethantwenty	0.01	0	0.59

4. DISCUSSION OF RESULTS

The numbers of increasing CKFs are to be decreased in Turkey when the high expected costs are considered in the model above. Patients are mainly treated by private hospitals supporting by governments. Results show that the number of patients will be doubled in 2022 in Turkey , resulting in high costs. CKD progression in predialysis patients can be slowed down or prevented to decrease the number CKFs patients and costs. The living chance of predialysis patients is higher than dialysis patients. Diabetics and cardivasiculer patients are to be followed to prevent CKF. Some medicines as shown in literature section can prevent the progression of CKF and increase the living years. Some costly medicenes can be added the treatment of CKF patients.

The registration about 1-3 stages is not available in private and government hospitals. Screening can be carried out over risky patients to prevent ESRD patients by some medicines and precautions.

Private hospitals are not willing to take a leader role in screeing of patients in Turkey since governments do not give any monetary support. Government hospitals are mainly full of patients and sometimes there are not enough doctors to handle CKFs patients.

5. CONCLUSION AND FUTURE RESEARCH

TX is best way of treatment after comparing the three methods. However, it is not possible to find a donor kidney that easily. Hence, patients have to take PD and HD during CKF. The summary of case studies and literature is shown in Table 1 in Appendix for PD and HD. These results can be helpful to select the type of method for treatment. PD is cheaper but PD patients live for shorter duration than HD patients. Immediate graft function is higher for PD than HD. Moreover, satisfaction is higher with PD.

Expected years of living are 8.005 years according to maximum years in the range , 5.2825 years according to middle point better than UK average 5.1 years and 3.055 according to minimum point for all treatments in Turkey . When setting evidence as TX, the expected living years are 20.7225 in Turkey.

One weakness of this data, is that there aren't enough data points to make all connections in the main model. Also, TNC do not have all data about causes of CKF and TXs. Early hypertension can be a cause of some complications in later stages like cerebral haemorrhage - the biggest cause of deaths. Diabetics has a high impact on the kidneys and most of secondary complications are developed from it. Moreover, low budget is allocated on CKF in Turkey when compared with developed countries. Also, 1-3 stages of CKF are ignored. However, increasing aging population may redirect more health spend to CKF. Further studies about studies presented in literature section can be done in Turkey to see the effects of mentinioned medicines. Moreover, individual diet for patients can be found by giving different foods to patients.

REFERENCES

Aslan İ.& Özen Ü. "Decision Analysis and Markov Chains for Management of Chronic Kidney Failures in Turkey", *ISS & MLB*, p.610-626, Nagoya/Japan, 2013.

Lee C.P, Chertow G.M., and Zenios S.A. "Optimal Initiation and Management of Dialysis Therapy", Operations Research, 56(6), pp. 1428–1449, 2008.

Bruce C. A. and Peter S. P. "Estimation of the transition matrix of a discrete-time Markov chain", *Health Econ.,* 11.p.33–42 ; DOI:10.1002/hec.654.,2002.

Hazen G. B., &Huang M. "Markov Chain Population Models in Medical Decision Making. , Northwestern University"- under revision, 2011.

Obrador Gregorio T., Mitra Mahdavi-Mazdehand,Allan J. Collins "Establishing the Global Kidney Disease Prevention Network (KDPN): A Position Statement from the National Kidney Foundation" *Am J Kidney Dis*., 57(3), pp.361-370, 2011.

Takiar V.,. Caplan M.J. "Polycystic kidney disease: Pathogenesis and potential therapies", *Biochimica et Biophysica Acta*, 1812 , pp.337–1343,2011.

Yatkın I. "Renal Transplantasyon Hastalarında ve Vericilerde Transplantasyon Öncesi ve Sonrasında Depresyon, Anksiyete, Yaşam Kalitesi ve Sosyal Destek", Haydarpaşa Numune Eğitim ve Araştırma Hastanesi Psikiyatri Kliniği, Uzmanlık Tezi, Istanbul, 2009.

Stein A. and janet wild(2002) "Kidney Failure Explained" 2nd Edition, *Class Publishing*, London

Stam L. E. "100 Questions & Answers About Kidney Dialysis.", *Jones and Bartlett Publishers*, USA, 2010.

Ormandy P.(2008) "Chronic Kidney Disease:Patient Information Need, Preferences and Priorities" Degree of Doctor of Philosophy, School of Nursing,Institute of Health and Social Care Research, University of Salford, UK.

NHS.(2013), Dialysis, http://www.nhs.uk/Conditions/Dialysis/Pages/Introduction.aspx

Süleymanlar G,Utaş C,Arinsoy T,Ateş K,Altun B,Altiparmak MR,Ecder T,Yilmaz ME,Çamsari T,Başçi A,Odabas AR,Serdengeçti K.(2011)"A population-based survey of Chronic Renal Disease In Turkey- the CREDIT study." Nephrol Dial Transplant, 26(6), 1862-71. doi: 10.1093/ndt/gfq656, 2011.

SP(Sağlık Personeli)(2013), "Number of deats", Ankara: Sağlık Personeli, Retrieved from http://www.saglikpersoneli.com.tr/saglik/1765-hasta-bu-yuzden-oldu-h16390.html(03.05.2013)

Gürkan A.(2013) "Organ Nakli Koordinatörlüğü", http://alpgurkan.com.tr/organ-nakli-koordinatorlugu/(4.11.2013))

Seyrek N.(2013)" Diyaliz tedavisinde ilk seçenek: Periton diyalizi", Çukurova Üniversitesi Tıp Fakültesi, Nefroloji BD, Adana. http://www.tsn.org.tr/folders/file/kis_okulu_sunumlar/Neslihan_Seyrek.pdf(14.09.2013)

Fontán M. P., Carmona A R., Bouza P, Falcón T G., Adeva M, Valdés F. (1996) "Delayed Graft Function After Renal Transplantation in Patients Undergoing Peritoneal Dialysis and Hemodialysis." *Adv Perit Dial,* 12, pp.101.

Utaş C.(2013) "Diyaliz Uygulamalrinda Maliyet Analizi.", TSN. http://tndt.org/pdf/pdf_TNDT_719.pdf(13.09.2013)

CANUSA(1996)"Adequacy of dialysis and nutrition in continuous peritoneal dialysis: association with clinical outcomes", Canada-USA (CANUSA) Peritoneal Dialysis Study Group, J Am Soc Nephrol. , 7(2):198-207, 1996.

Süleymanlar G.(2012) "Kronik Böbrek Hastalığını Önleme ve Kontrol Programı", Akdeniz Üniversitesi Tıp Fakültesi , Nefroloji Bilim Dalı, Antalya.

Tatar M.(2012) Özel Hemodiyaliz Merkezleri Maliyet Analizi Çalışması. Hacettepe Üniversitesi, İktisadi ve İdari Bilimler Fakültesi, Ankara. Retrieved from www.diader.org.tr (2012).

DİADER(2013)"Özel Diyaliz Merkezleri Derneği, Türkiye'de Hemodiyaliz Hizmetlerinde Özel Diyaliz Merkezlerinin Rolü, Kalite maliyet ilişkisi, Diyaliz maliyet ve geri ödemeleri, Kamu maliyetinin düşürülmesi." DIADER, Turkey, Retrieved from www.diader.org.tr/dosya/DiyalizRaporEkim2009.pdf(23.02.2013)

Chen Ping Min, Tai Shuan Lai, Ping Yu Chen, Chun Fu Lai, Shao Yu Yang, VinCent Wu, Chih Kang Chiang, Tze Wah Kao, Jenq Wen Huang, Wen Chih Chiang, Shuei Liong Lin, Kuan Yu Hung, Yung Ming Chen, Tzong Shinn Chu, Ming Shiou Wu, Kwan Dun Wu, Tun Jun Tsai(2015) "Multidisciplinary Care Program for Advanced Chronic Kidney Disease: Reduces Renal Replacement and Medical Costs", *The American Journal of Medicine*, 128, 68-76.

Thathya V. Ariyaratne , Zanfina Ademi , Stephen J. Duffy , Nick Andrianopoulos , Baki Billah , Angela L. Brennan , Gishel New, Alexander Black , Andrew E. Ajani , David J. Clark , Bryan P. Yan , Cheng-Hon Yap , Christopher M. Reid(2013) "Cardiovascular readmissions and excess costs following percutaneous coronary intervention in patients with chronic kidney disease: Data from a large multi-centre Australian registry",*International Journal of Cardiology*,168, 2783–2790

Erickson Kevin F., Sohan Japa, Douglas K. Owens, Glenn M. Chertow, Alan M. Garber, Jeremy D. Goldhaber-Fiebert(2013) "Cost-Effectiveness of Statins for Primary Cardiovascular Prevention in Chronic Kidney Disease", *Journal of the American College of Cardiology,* Vol. 61, No. 12.

Vupputuri Suma, Teresa M. Kimes , Michael O. Calloway, Jennifer B. Christian, David Bruhn , Alan A. Martin, Gregory A. Nichols(2014) "The economic burden of progressive chronic kidney disease among patients with type 2 diabetes" Journal of Diabetes and Its Complications, 28.pp-10–16.

Kirsten Howard, Sarah WhiteGlenn Salkeld, Stephen McDonald, Jonathan C. Craig, MBBS, Steven Chadban, MBBS, Alan Cass(2010) "Cost-Effectiveness of Screening and Optimal Management for Diabetes, Hypertension, and Chronic Kidney Disease: A Modeled Analysis", *Value in Health*, Volume 13 , Number 2.

Vegter Stefan, PharmD, Keith Tolley, MPhil, Michael S. Keith, Maarten J. Postma(2011) "Cost-Effectiveness of Lanthanum Carbonate in the Treatment of Hyperphosphatemia in Chronic Kidney Disease Before and During Dialysis" *Value in Health* ,pp-852 – 858.

Chuang C.C,Lee E,Yang E,Tawah A,Ghosh S, Chen S.Y,(2014) "Health care resource utilization and costs associated with various stages of chronic kidney disease among type 2 diabetes mellitus patients", *Value in Health*,17, A1 - A295

Mennini F.S,Russo S, Marcellusi A, Quintaliani G, Fouque D,(2014) "Economic Effects Of Treatment Of Chronic Kidney Disease With Low- Protein Diet", *Value in Health*, 17, A1 - A2 95.

Nasution Azizah, Dra., .A.SyedSulaiman,BPharm,Pharm, A.A.Shafie(2013) "Cost-Effectiveness of Clinical Pharmacy Education on Infection Management among Patients with Chronic Kidney Disease in an Indonesian Hospital" *Value in Health,* Regional Issue 2,pp-43-47.

TSN (Turkish Society of Nephrology)(2012) "Registry of the nephrology, Dialysis and Transplantation in Turkey", *Registry 2011,* ISBN 978 - 605 - 62465 - 0 – 0, Istanbul, 2012.

Erek E, Sever MS, Akoglu E, Sariyar M, Bozfakioglu S, Apaydin S, Ataman R, Sarsmaz N, Altiparmak MR, Seyahi N, Serdengecti K.(2007) "Cost of renal replacement therapy in Turkey."*Nephrology (Carlton)* ,9(1), pp.33.

Salonen T, Reina T, Oksa H, Sintonen H, Pasternack A.(2003) "Cost analysis of renal replacement therapies in Finland." Am J Kidney Dis., 42(6), p.1228-38.

Mayo Clinic(2013) Blood Urea Nitrogen (BUN) Test, http://www.mayoclinic.com/health/blood-urea-nitrogen/MY00373/DSECTION=results(6.11.2013)

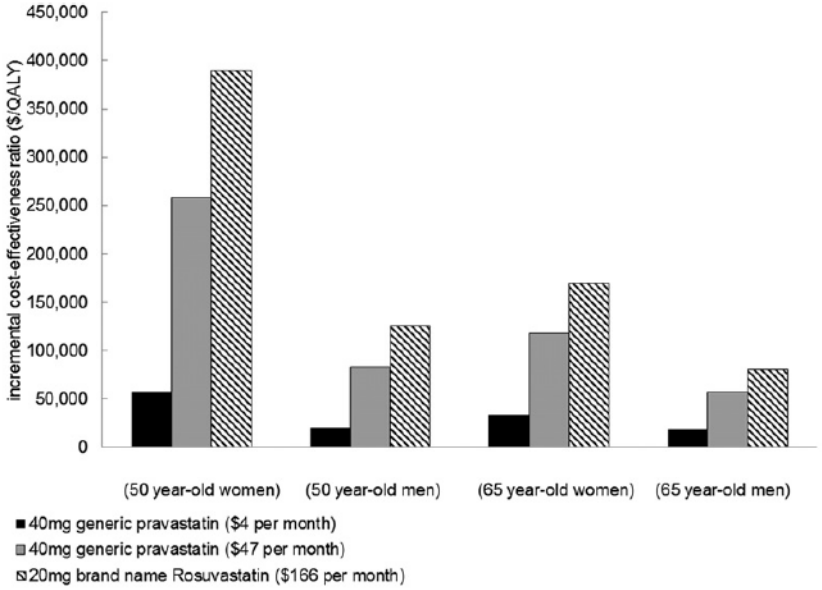
Mateti U.V,Nagappa A.N,Attur R.P. Bairy M,Nagaraju S.P,Balkrishnan R.(2014) "Management Of Anemia Among Chronic Kidney Disease Patients On Hemodialysis: A Study Of Cost Of Illness",*Value in Health,* 17, A1 - A295.

Appendix A

Table 1: Comparing HD and PD

HD	PD
• 33,287.29 TL cost each year • The expected cost of a patient for his/her living years with HD is 160,933.04 TL • If the patients live 20 years, the costs will be 49,955,173,800 TL for all HD patients for the living years in 2022 and afterward years. • Diabetics is the biggest cause of CKF • Cardiovascular events cause of deaths with heart failure as 40.3% • Bacteraemia is common complication. • Immediate graft function is 46.5% • Delayed graft function is 39.5% for HD and never any function is 14% for HD • About 85% of dialysis in Turkey • Just at hospital cared, there are HHDs too. • The satisfaction of HD is 56% (Juergensen et al., 2006). • The average of serum creatinine is about 6.825 mg/dL in Turkey • The average value for serum urea is 149.875 mg/dL in Turkey • Hemoglobin average is 9.95 g/L in Turkey • Expected living years are 5.691 years in Turkey and the minimum expected living years are 3.385 years • The average number of HD frequency is 2.981 times per week in Turkey • 86% patients have more than 0, 65 urea reduction rate at the end of 2011 in Turkey • Hypertension (<140/90 mmHg) without medicine is 56.8% and Hypertension (<140/90 mmHg) with medicine is 24.7% in Turkey. • 59.0% patients of HD use parenteral iron therapy and 40.2% of them do not use iron therapy. • The cost of iron per patient per year is 820 $ for HD. • Secondary hyperparathyroidism is 50.7%. • IV vitamin D usage is 33.1 %. • The cost of Vitamin D is 321 dollar for HD per year for each patient.	• 25,353.99 TL cost each year • The expected cost of a PD patient during the life span is 142, 730.67 TL • If the patients live 20 years, the costs will be 6,446,251,958 TL for all PD patients for the living years in 2022 and afterward years. • Hypertension is the biggest cause of CKF • Cardiovascular is the main cause of deaths with 51% in that group • Peritonitis, pneumonia, and cathere infection are complications • Immediate graft function is 68.5% for PD • Delayed graft function is 22.5% for PD and never any function is 9% for PD • About 10% of dialysis in Turkey • The satisfaction of PD is 85% (Juergensen et al., 2006). • No vessel is used in PD • Flexible, can be used at home • The expected serum albumin level is 2.566 g/dL • Distribution of chronic PD patients according to haemoglobin level as of the end of 2011 is 11.19 (9.00-13.60) gr/dL. • The expected living years for PD patients are 4.2075years and minimum is 1.84 years • The cost of iron per patient per year is 186 dollar for PD • The cost of Vitamin D is 92 $ for PD year for each patient

Figure 4: Price Sensitivity Analysis: Cost-Effectiveness at Different Statin Prices



Kaynak: Kevin F. Erickson, Sohan Japa, Douglas K. Owens, Glenn M. Chertow, Alan M. Garber, Jeremy D. Goldhaber-Fiebert(2013) "Cost-Effectiveness of Statins for Primary Cardiovascular Prevention in Chronic Kidney Disease*", Journal of the American College of Cardiology*, Vol. 61, No. 12, 2013.

Table 2: Annual follow-up costsa PPPY among patients who progressed to a higher stage of CKD, prior to and following progression, by Baseline stage of CKD.

	Years of Observation, Mean	Costs, Mean			
		Total	Inpatient	Outpatient	Pharmaceuticals
Stage 0–2 (n = 2439)					
Prior to Progression to CKD	2.12	$12,561	$5051	$4818	$2692
After Progression	2.52	$22,039	$12,124	$6760	$3155
Cost of Progression	–	$9478	$7073	$1942	$463
p value[b]	–	<0.001	<0.001	<0.001	0.011
Stage 3 (n = 1147)					
Prior to Any Progression	2.07	$24,026	$13,834	$6395	$3797
After Progression	2.14	$64,704	$43,947	$16,257	$4500
Cost of Progression	–	$40,678	$30,113	$9862	$703
p value[b]	–	<0.001	<0.001	<0.001	0.007
Stage 4 (n = 186)					
Prior to Any Progression	1.76	$29,573	$12,403	$12,470	$4700
After Progression	1.88	$162,238	$104,812	$51,250	$6176
Cost of Progression	–	$132,665	$92,409	$38,780	$1476
p value[b]	–	<0.001	<0.001	<0.001	0.315

CKD = chronic kidney disease; PPPY = per patient per year.
[a] Unadjusted models.
[b] Calculated using paired t-tests.

Kaynak: Suma Vupputuri , Teresa M. Kimes , Michael O. Calloway, Jennifer B. Christian, David Bruhn , Alan A. Martin, Gregory A. Nichols(2014) "The economic burden of progressive chronic kidney disease among patients with type 2 diabetes" *Journal of Diabetes and Its Complications,* 28.pp-10–16.

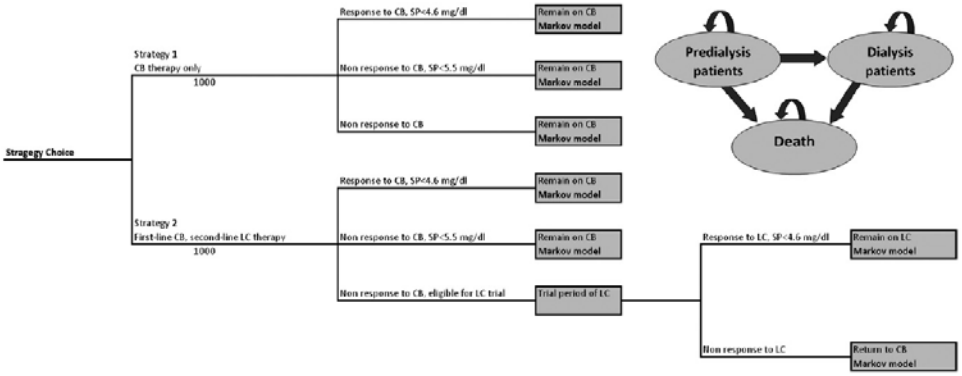
Table 3: Cost-effectiveness of population screening strategies with alternative starting ages and screening participation

Screening intervention	Cost ($A 2008) (intervention)	Cost ($A 2008) (comparator)	Incremental cost ($A 2008)	QALYs (intervention)	QALYs (comparator)	Incremental QALYs	ICER ($ per QALY gained)
Diabetes screening							
Starting age for screening							
30	$18,231	$16,487	$1,744	12.808	12.701	0.107	$16,299
40	$18,097	$16,487	$1,610	12.805	12.701	0.104	$15,481
50 (base-case)	$17,832	$16,487	$1,345	12.798	12.701	0.097	$13,866
60	$17,495	$16,487	$1,008	12.789	12.701	0.088	$11,455
Screening participation (%)							
25%	$17,419	$16,487	$932	12.794	12.701	0.093	$10,022
50%	$17,671	$16,487	$1,184	12.797	12.701	0.096	$12,333
75% (base-case)	$17,832	$16,487	$1,345	12.798	12.701	0.097	$13,866
100%	$17,931	$16,487	$1,444	12.8	12.701	0.099	$14,586
Hypertension screening							
Starting age for screening							
30	$14,302	$14,004	$298	12.955	12.831	0.124	$2,403
40	$14,183	$14,004	$179	12.946	12.831	0.115	$1,557
50 (base-case)	$14,061	$14,004	$57	12.947	12.831	0.116	$491
60	$13,677	$14,004	−$327	12.953	12.831	0.122	Dominant
Screening participation (%)							
25%	$13,570	$14,004	−$434	12.953	12.831	0.122	Dominant
50%	$13,803	$14,004	−$201	12.951	12.831	0.12	Dominant
75% (base-case)	$14,061	$14,004	$57	12.947	12.831	0.116	$491
100%	$14,194	$14,004	$190	12.953	12.831	0.122	$1,557
Proteinuria screening							
Starting age for screening							
30	$17,102	$16,821	$281	12.763	12.731	0.032	$8,781
40	$17,034	$16,821	$213	12.764	12.731	0.033	$6,455
50 (base-case)	$16,974	$16,821	$153	12.763	12.731	0.032	$4,781
60	$16,897	$16,821	$76	12.764	12.731	0.033	$2,303
Screening participation (%)							
25%	$16,815	$16,821	−$6	12.764	12.731	0.033	Dominant
50%	$16,856	$16,821	$35	12.763	12.731	0.032	$1,094
75% (base-case)	$16,974	$16,821	$153	12.763	12.731	0.032	$4,781
100%	$17,065	$16,821	$244	12.764	12.731	0.033	$7,394

ICER, incremental cost-effectiveness ratio; QALY, quality-adjusted life-year.

Kaynak: *Kirsten HowardSarah WhiteGlenn Salkeld, Stephen McDonald, Jonathan C. Craig, MBBS, Steven Chadban, MBBS, Alan Cass(2010) "Cost-Effectiveness of Screening and Optimal Management for Diabetes, Hypertension, and Chronic Kidney Disease: A Modeled Analysis", Value in Healt h, Volume 13 , Number 2.*

Figure 5: Decision analytical structure and Markov model (top right corner). CB, calcium-based binder; LC, lanthanum carbonate.



Kaynak: *Stefan Vegter, PharmD, Keith Tolley, MPhil, Michael S. Keith, Maarten J. Postma(2011) "Cost-Effectiveness of Lanthanum Carbonate in the Treatment of Hyperphosphatemia in Chronic Kidney Disease Before and During Dialysis" Value in Health ,pp-852 - 858)*

Table 4: Cost-effectiveness analysis in group with and without CPEs

Description	Without CPE		With CPE	
	Stage 4 (n = 14)	Stage 5 (n = 66)	Stage 4 (n = 8)	Stage 5 (n = 55)
Direct medical cost	Rp34,938,537.00	Rp276,918,614.00	Rp21,653,012.00	Rp243,850,649.80
Direct nonmedical cost (hotel)	Rp3,780,000.00	Rp22,235,000.00	Rp2,160,500.00	Rp13,095,003.00
Total	Rp38,718,537.00	Rp299,153,614.00	Rp23,813,512.00	Rp256,945,652.80
Cost to treat 100 patients	Rp276,560,978.57 (x_1)	Rp453,263,015.52 (x_2)	Rp297,668,900.00 (x_3)	Rp467,173,914.18 (x_4)
Outcome (hypothetical lives saved per 100 patients treated) (y)	78.57 (y_1)	57.58 (y_2)	88.89 (y_3)	65.45 (y_4)
CE ratio = x/y	Rp3,519,931.00/life saved	Rp7,871,882.87/life saved	Rp3,348,733.27/life saved	Rp7,137,874.93/life saved
	ICER			
CKD stage 4	(Cost x_3 – Cost x_1)/(Outcome y_3 – Outcome y_1) = 21,107,921.43/10.32 = 2,045,341.22			
CKD stage 5	(Cost x_4 – Cost x_2)/(Outcome y_4 – Outcome y_2) = 13,910,898.66 /7.87 = 1,767,585.60			

CKD, chronic kidney disease; CPE, clinical pharmacy education; ICER, incremental cost-effectiveness ratio.

Kaynak: Azizah Nasution,Dra., , S.A.SyedSulaiman,BPharm,Pharm, A.A.Shafie(2013) "Cost-Effectiveness of Clinical Pharmacy Education on Infection Management among Patients with Chronic Kidney Disease in an Indonesian Hospital" Value in Healt h Regional Issue 2,pp-43-47.