THE PROBLEM OF CHRONIC KIDNEY DISEASE IN EGYPT

By

ENAS MANSOUR HUSSEIN

Introduction and objective:-

A chronic disease is an important problem that should be raced by health planning especially in developing countries. Among these diseases, Chronic Kidney disease is of great importance in Egypt, because of the great spread of Bilharziasis which leads ultimately to renal failure.

Treatment of renel failure is subdivided into two stages:-

1- Dialysis : means treatment by artificial kidney through interment haemodialysis, which was not provided until the early months of 1964. Although the experience of the first dialysis center in Egypt has now expanded, the providing of dialysis treatment is still on a small scale. The number of subjects who would need dialysis is very large in comparison with the available resources of treatment. Hence, according to an estimation (1) made in 1976 and with the present standard of medical care, only 5% of the potentially fit candidates would be dialysed. It follows that a system should be put for the proper choice of the fitted subjects for reguler dialysis treatment (RDT). Dialysis may be divided into two Categories:-

   a) dialysis in hospital.

   b) home dialysis.

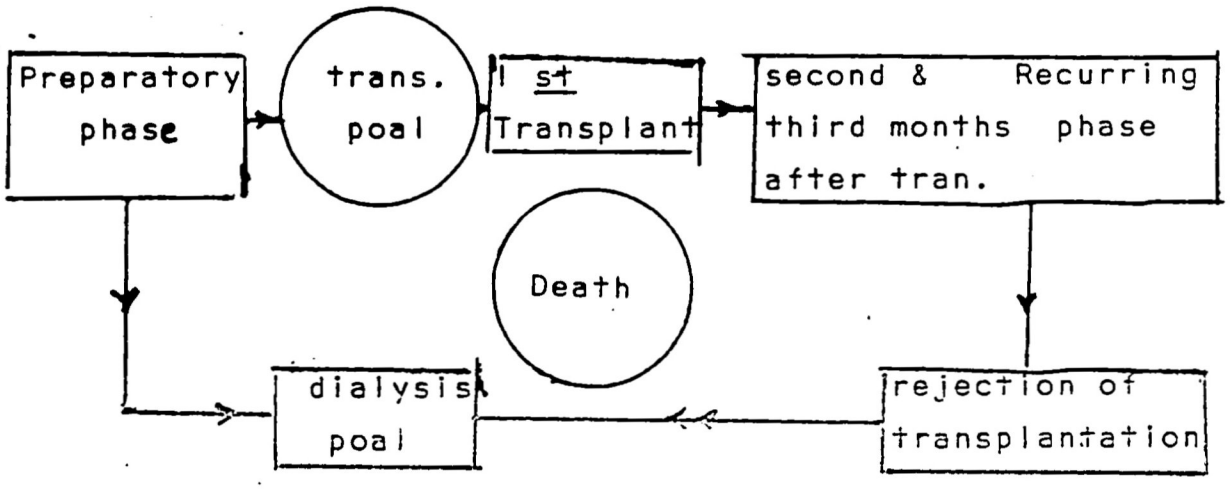
In Egypt, we can say that there is no home dialysis because of its difficulty in re-equiping home as well as retraining the patient and his spouse and neighbours.

2- Kidney transplantation: which is still under investigation. The rule of transplantation is to mop up cases from (RDT).The main problem of kidney transplantation is due to the scaresity of kidney doners. In addition, if there is a possibility of transplantation, its cost is very high. There is a possibility of more than one transplantation, but also in Egypt, there is no a possibility of second transplantation.

The objective of this paper is to estimate the number fo patients with renal failure during 1985 say. Then a stochastic process model is used to estimate their distribution among the different states of the disease in each month during that year. This leads to estimating the number of patients who would need dialysis as well as the number of transplant operators required in each month in 1985, i.e this leads to an estimation of the monthly natural demand of sources.

The problem:-

A patient with renal failure might go through eight stages of the desease, starting from his first haemodialysis. These stages and the relations among them are given in the following flow chart:-



Transplantation & Dialysis

Stage 1 :- represents the first six months on dialysis. During this period the patient is fully investigated with a view to futur transplantation, rehoused and his spouse or nearest relation is trained to help in home dialysis of anailable. This period is supposed to be a preparatory phase.

Stage 2 :- represents a variable number of nonths that a patient spends waiting for transplantation. The maximun duration of this stage is supposed to be six month. Patients could be an home dialysis during this stage. But as mentioned before, there is no home dialysis in Egypt, therefore the patient stays on a dialysis unit in a hospital.

Stage 3 :- Represents the first month after a transplant and is spent in a sterile side room.

Stage 4,5:- represent the second and third months respectiviely after transplantation. It is hoped that the patients will be at home at these stages.

Stage 6 :- is a recuring state that represent the subsequent months after a successful transplantation.

Stage 7 :- represents the first month of rejiction of a transplant. and is spent in a sterile side room. Rejiction means transformation into the dialysis poal.

Stage 8 :- represents patients on dialysis and not being considered for futur transplantation. Patients enter this state either from the end of the preparatory phase or from state 7. The patients from preparatory phase are those who refuse to consider transplantation at any time or those who are found unsuitable on medical ground. Patients from state 7 are those with rejected transplant.

Stage 9 :- Represent death and can be entered from any state of the system.

In order to find out the estimated number of patients in each stage in 1985, we will start by estimating the total number of patients with renal failure during 1985, then using a stochastic process model we will estimate their distribution among the different states.

* Estimation of the total number of patients during 1985:

In order to abtain this estimate we need a time series data about the yearly number of renal failure patients in Egypt: but since there is no good registration for the patients in Egyptian hospitals, we will take the mortalities from renal failure as a guide to estimate the number of patients (1).

Data about mortalities that we need here come under the heading "genetourinary mortalities". We will put some criteria to find out the number of mortalities, who would have benefited - as patients - from regular dialytic treatment and transplantation. These criteria take into consideration the following aspects:-

Aetiology:-

According to observable date from 1960, it has been found that (1) most of the subjects who would have benefited from RDT must had been included under the heading" other nephrites and nephresis".

Age:

We will take only the mortalities in age group 30-59 as the age distribution of mortalities from" other nephrites and nephresis" shows that: after an initial peak in thefirst 5 years of life mortalities decline for the age 5 to 29 years. It rises again in the age group 30-59 years. Hence, it is assumed the age of the subjects who would have satisfied the medical requirments for dialysis lies

mostly in the age group 30-59 years.

Geographical Distribution :

Finally, it is presumed that candidates for RDT are always Urban inhabitants, due to the availability of dialysis Egyptian centers, the means of transport and the nature of individual jobs. So we will take the mortalities from Urban Egypt only.

According to these aspects we use the number of mortalities from" other nephrites and nephresis" in age 30-59 from Urban Egypt, in place of the unavailable data about the number of patients who would have benefited from (RDT) and transplantation. The following table gives a time series of this data from 1962 to 1973:-

Table (1)
Urban mortalities in age 30-59 from other nephrites and nephrosis during 1962 to 1973

Years	Urban mortalities in age 30-59 from other nephrites and nephrosis
1962	753
63	813
64	894
65	858
66	887
67	901
69	923
70	944
71	890
72	987
73	1003

Source : The official yearly reports of " Central Agency For Mobilization And Statistics Cairo" Data included in these reports are presented according to " Medium International Classfication of Diseases".

According to the scatter diagram representing this time series, the regression model:

$Y = a\, e^{b x}$ is chosen to represent the relation between time, in years, (x) and the yearly number of "patients", (Y).

The least squares estimate of the linear model:-

$L n Y = L n A + B X$ Is given by:-

$(L n Y) = 6.6776 + .0191x$ where x=0 at 1962 with the following analysis of variance table:

Source of error	Sum of Squares	No.of degree of freedom	Mran of Squares
Regression	0.0 5138	1	.05138
Residual	0.0 0962	9	.00077
Total	0. 0583	10	

The observed F ratio $= \frac{.05138}{.00077} = 66.72$; while

the tabulated F value ($\alpha = 0.01$):

Is $F_{1,9} = 10.501$

Hence, the regression is significaint at $\alpha = 0.01$

The estimated number of " patients" in 1985

Y = 1265. 39 and the 99% confidence interval of this estimate is :-

1265. 39 $\pm$ 185. 89

As there are no seasonal effects, it is assumed here that the yearly number of patients is equaly divided among the 12 months, i.e.the estimated number of " patients" from other nephrites and nephrosis in age group 30-59 from Urban Egypt in 1985 range between 105 $\pm$ 15.5 (α= 0.01)

** <u>The monthly distribution of estimated patients among different states of the system</u>:-

To obtain this distribution a stochastic model is proposed. In this model there are 19 states each of which has a duration of one month (see the note following the transition matrix). The states are depected from the flow chart given earlier. The numerical values for the transition probabilities among the different states of this model should be obtained from a set of data about patients in Egyptian hospitals. But since the Egyptian experience in dialysis and transplantation is very limited , it has been difficult to obtain accurate information in order to assess these probabilities. Therfore, we have to incorport reliable data from similar but older experience. We will use the following transition matrix which is based on probabilities estimated from the experience of an English hospital (2). But as the English experience in dialysis and transplantation expended, there is a possibility of second and third

transplant, Therfore, we have neglected the second and third transplantation and its subsequent months from the previous flow chart and their numerical values from the transition probalities matrix.

Since the transition of the patient to any"future" state depends only on his "present" state and is completly independent of his "past" state, our stochastic model is in fact a Markov Chain.

The Transilation Matrix

	0	I,I	I,2	I,3	I,4	I,5	I,6	2,I	2,2	2,3	2,4	2,5	2,6	3	4	5	6	7	8
0	I.00																		
I,I	.00		1.00																
I,2	.0I			.99															
I,3	.06				.94														
I,4	.04					.96													
I,5	.02						.98												
I,6	.0I							.44											
2,I	.02								3605					.6195					
2,2	.02									5944				.3826					
2,3	.02										7025			.2775					
2,4	.02											7832		.2108					
2,5	.02												.8023	.1727					
2,6	.02												.8294	.1506					
3	.03														.85			.12	
4	.03															.82		.13	
5	.04																.82	.14	
6	.004																.98	.016	
7	.05																		.96
8	.05																		.95

Note : In this matrix, the states 0,3,4,5,6,7,8 correspond to the stages with the same numbers in the flow chart, statesl,l,l,2- ..,1,6 represent the diffent months within stage 1,i.e, the different months that represent the preparatory phase, States 2,1,...,2,6 represent the six months within stage 2 which represent the maximum duration of time waiting for transplanation.

It should be noted that using this Markov Chain Model implies the following two basic assumptions(2).

The firist: is that the probability of passing through more than one state in any one month is zero. Thus, the patient may transit to only one state in each month and to another state in the next month. In fact it is possible for a patient to have a transplant, reject his kidney, and die all in the space of a few days,. But this potential resource of error is supposed to be negligible. The importance of this assumption is that single transaction can occur only at monthly intervals, i.e, the system is abserved at a discrete set of time, hence, it is a Discrete Markov Chain.

The Second: is that all probabilities are constant with time and are independent of the previous progress of the patient through the unit.

Naw let :

P : represent the transision probabilities matrix.

$\underset{\sim}{x}_i$: represent the vector denoting the distribution of the patients on each state of the system at the end of month (i) and.

$\underline{x}_o$: represent the distribution of the patients at the beginning of the first month:-

then:

$$\underline{x}_j = P\,\underline{x}_{i-1} \qquad i = 1,2,\ldots$$

Applying this rule together with the proposed numerical transision matrix and our estimate of the monthly number of new " patients " who join the system at the beginning of each month (presumbly in state 1_1); we obtain the following results:-

Table (2)

The distribution of the estimated patients in I985 among the different states of the disease by end of each month .

States / End of month	0	1_1	1_2	1_3	1_4	1_5	1_6	2_1	2_2	2_3	2_4	2_5	2_6	3	4	5	6	7	8
I	0																		
2	I		I05	I04															
3	8		I05	I04	98														
4	20		I05	I04	98	93													
5	34		I05	I04	98	93	9I												
6	48		I05	I04	98	93	9I	86											5
7	64		I05	I04	98	93	9I	86	3I					54					9
8	82		I05	I04	98	93	9I	86	3I	I8				66	46			7	I3
9	I03		I05	I04	98	93	9I	86	3I	I8	I3			7I	57	37		I4	24
I0	I29		I05	I04	98	93	9I	86	3I	I8	I3	I0		74	60	47	30	2I	40
II	I65		I05	I04	98	93	9I	86	3I	I8	I3	I0	8	76	63	49	68	24	62
I2	I85		I05	I04	98	93	9I	86	3I	I8	I3	I0	I5	77	65	52	I06	25	86

Hence, at the end of 1985, about 185 patients will die, 77 patients will be ready for transplanation and about 86 patients will need dialysis.

References:-

(1) Dr. Amal Sami and Dr. Rashad Barsoum " Impact of population Growth On Health Care", Study of Chronic Kidney Disease".

Technical Paper, R/15, D.P.A. the American University at Cairo, December 74.

(2) S.C.Farrow, D.J. Fisher, D.B. Jahnson "Statistical Approach to Planning an Integrated Haemodialysis/ Transplantation Program". British medical journal 1971, Vol.2, 671-676.