

# Epidemiology and cost of haemodialysis in Jordan

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## وبائيات وتكاليف الدِّيال الدموي (الغسيل الكلوي) في الأردن

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**الخلاصة:** أُجري، خلال شهري أيلول/سبتمبر وتشرين الأول/أكتوبر 2003، مسحٌ شمل جميع المرضى الذين يتلقون دِيالاً دمويًا (غسيلاً كلويًا) في الأردن (1711 مريضاً)، لتقييم وبائيات الفشل الكلوي والعبء الناجم عن عمليات غسل الكلى. وبلغ متوسط العمر لدى هؤلاء المرضى 48.9 عاماً، وكانت نسبة الذكور بينهم 56%. وكان 86.8% منهم عاطلين عن العمل و92% يعانون من الفقر. وبلغ متوسط المسافة للوصول إلى مركز الغسيل الكلوي 13.6 كيلومتر. وكانت نسبة انقلاب تفاعلية المصل بالنسبة إلى التهاب الكبد "بي" و"سي": 0.34% و2.6% على التوالي، في المرضى الذين كانوا سلبيين المصل قبل خضوعهم للغسيل الكلوي. وبلغ معدل انتشار الغسيل الكلوي 312 لكل مليون من السكان، بعد أن كان 111 لكل مليون في عام 2002. كما بلغ معدل الإماتة 20% بعد مرور سنة واحدة. ومثل السكري السبب الرئيسي وراء الاحتياج للغسيل الكلوي لدى 29.2% من الحالات، وقدر إجمالي تكلفة الغسيل الكلوي في عام 2003 بـ 29.7 مليون دولار أمريكي.

**ABSTRACT** To assess the epidemiology and burden of haemodialysis in Jordan, all patients on haemodialysis (1711 patients) were surveyed during September/October 2003. Mean age was 48.9 years, 56% were male, 86.8% were unemployed and 92% were poor. Mean distance to the haemodialysis service was 13.6 km. Annual hepatitis B and C seroconversion for patients negative before dialysis was 0.34% and 2.6% respectively. Prevalence of haemodialysis was 312 per million population; the incidence in 2002 was 111 per million population. Fatality rate at 1 year was 20%. Diabetes mellitus was the leading cause of haemodialysis, 29.2% of cases. Total estimated cost of haemodialysis in 2003 was US\$ 29.7 million.

## Épidémiologie et coût de l'hémodialyse en Jordanie

**RÉSUMÉ** Afin d'évaluer l'épidémiologie et le coût financier de l'hémodialyse en Jordanie, tous les patients hémodialisés, à savoir 1711 sujets, ont fait l'objet d'une enquête conduite au cours des mois de septembre et octobre 2003. L'âge moyen de la population enquêtée était de 48,9 ans, celle-ci étant composée à 56,0 % d'individus de sexe masculin, à 86,8 % de chômeurs et les économiquement faibles représentant 92,0 %. L'unité d'hémodialyse la plus proche se situait à une distance moyenne de 13,6 km. Les taux annuels de séroconversion pour les hépatites B et C de patients séronégatifs avant dialyse étaient respectivement de 0,34 % et de 2,6 %. La prévalence de l'hémodialyse se chiffrait à 312 cas par million d'habitants, son incidence en 2002 étant de 111 cas par million d'habitants. La mortalité à 1 an était de 20,0 %. Le diabète sucré était la principale indication de l'hémodialyse, soit 29,2 % des cas. Pour l'année 2003, le coût total estimé de l'hémodialyse atteignait USD 29,7 millions.

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## Introduction

End-stage renal disease (ESRD) is a growing problem worldwide and renal replacement therapy is increasingly exerting pressure on health systems [1]. The situation is particularly serious in developing countries where health resources are limited.

The adjusted incidence of renal replacement therapy in 9 European countries has increased from 79.4 per million population (pmp) in 1990–91 to 117.1 pmp in 1998–99, i.e. an average annual increase of 4.8% [1]. This increase occurred largely among older age groups. The incidence of ESRD due to diabetes, hypertension and renal vascular disease almost doubled over the same period. Similar trends were observed in Japan [2], Australia and New Zealand [3] and the United States of America (USA) [4].

The distribution of patients on haemodialysis in the world is strongly influenced by economic factors [5]. In Jordan, the number of patients on haemodialysis has doubled over the past 5 years presenting a real challenge for the scarce health resources.

The objective of the study was to report on the epidemiology of haemodialysis in Jordan and to provide current estimates of the associated costs.

## Methods

We conducted a survey in all haemodialysis units in Jordan (56 units) between 1 September and 31 October 2003. Each patient was personally interviewed in the haemodialysis unit by the attending nurse, using a structured questionnaire specifically designed for the purpose of this study. Additional data such as hepatitis B and C positivity were collected from the patient's medical record. The cause of ESRD was provided by the attending physician. We also collected relevant data on each haemodialysis

unit. This included: number of patients on haemodialysis in the unit at the time of the survey (July 2003), number of patients who died in the unit in 2002, and the number of patients who started haemodialysis in the unit in 2002 and their status in July 2003.

*Epi-Info*, version 6 software was used for data entry and analysis. The distribution of the patients by relevant sociodemographic and clinical characteristics was obtained. The prevalence of haemodialysis by certain variables was obtained using population estimates of Jordan from the Department of Statistics as the denominator for these rates. Incidence of haemodialysis in the year 2002 was obtained by dividing the total number of patients who started haemodialysis in all units in 2002 (irrespective of whether they were still living at the time of the survey) by the population of Jordan in 2002. The case fatality rate in the first year after initiating haemodialysis was obtained by dividing the number of deaths that occurred among all patients who started haemodialysis in 2002 followed through June 30, 2003 by the total starting haemodialysis. The cost of haemodialysis in Jordan for the year 2003 was calculated by adding the cost of the haemodialysis session (US\$ 105 in the private sector and US\$ 85 in the public sector), the cost of medications and investigations, the cost of admissions, and the cost of the arterial access (arterio-venous fistula in over 95% of patients).

## Results

A total of 1711 patients were on haemodialysis at the time of the survey in Jordan.

### Sociodemographic characteristics of the patients

Table 1 shows the sociodemographic characteristics of the patients on haemodialysis. The age of patients ranged from 5 years to

Table 1 Sociodemographic characteristics of patients on haemodialysis in Jordan, 2003

Characteristic	No. (n = 1711)	%
<b>Age<sup>a</sup> (years)</b>		
< 20	82	4.8
20–39	440	25.7
40–59	620	36.2
≥ 60	569	33.2
<b>Sex</b>		
Male	957	55.9
Female	754	44.1
<b>Education (years of schooling completed)</b>		
Illiterate	476	27.8
1–6	353	20.7
7–12	648	37.8
> 12	234	13.7
<b>Smoking status</b>		
Current smoker	294	17.2
Past smoker	209	12.2
Never smoked	1208	70.6
<b>Employment status</b>		
Employed	225	13.2
Retired	227	13.3
Unemployed	1259	73.5
<b>Family income/month (US\$)</b>		
< 140 (very poor)	609	35.6
140–420 (poor)	962	56.2
≥ 421 (comfortably off)	140	8.2

<sup>a</sup>Mean (standard deviation) = 48.9 (16.7) years.

88 years with a mean age (standard deviation) of 48.9 (16.7) years. About one-third of the patients were 60 years of age or more. Of the 1711 patients, 957 (55.9%) were male. About 28% of the patients were illiterate and 17% current smokers. Only 13.2% were employed and the vast majority was poor (92%) (family income < US\$ 420/month).

### Service-related characteristics

Although the average distance to the haemodialysis unit was 13.6 km, a good propor-

tion of patients (11.5%) had to travel 30 km or more. The major service provider was the private sector (43.4%) followed by the Ministry of Health (27.4%). The duration on haemodialysis ranged from 1 month to 27 years resulting in a skewed distribution (mean = 42.7 months, median = 28 months). Over 54% of patients were maintained on 3 haemodialysis sessions per week, 45% on 2 sessions per week, and only 9 patients on 1 session per week (Table 2). The proportion of patients on 3 sessions per week was much higher in the private sector (89%) than in

Table 2 Service-related characteristics of patients on haemodialysis in Jordan, 2003

Characteristic	No. (n = 1711)	%
<b>Distance to haemodialysis unit<sup>a</sup> (km)</b>		
< 10	832	48.6
10–19	494	28.9
20–29	189	11.0
30+	196	11.5
<b>Haemodialysis service provider</b>		
Ministry of Health	468	27.4
Royal Medical Services	385	22.5
University hospitals	115	6.7
Private sector	743	43.4
<b>Duration on haemodialysis<sup>b</sup> (years)</b>		
< 1	444	25.9
1–2	545	31.9
3–5	306	17.9
> 5	416	24.3
<b>No. of haemodialysis sessions/week</b>		
1	9	0.6
2	774	45.2
3	928	54.2

<sup>a</sup>Mean (standard deviation) = 13.6 (16.2) km.

<sup>b</sup>Mean (standard deviation) = 42.7 (44.8) months, median = 28 months.

the Ministry of Health (32.7%) or the Royal Medical Services (20%). These proportions were inversely correlated with the ratio of patients per haemodialysis machine in the different sectors: 3.1, 4.4 and 5.7 respectively.

### Sexual activity

Because of the considerable impact on the quality of life of patients on dialysis, we asked about patients' sexual activity. For cultural reasons, the frequency of sexual intercourse was assessed only in married males. Out of the 744 patients, 689 (93%) responded to the question. Table 3 demonstrates the frequency of intercourse by age. Overall about 48% were not sexually active at all. As expected, lack of sexual activity increased markedly with age from 6.4% in patients < 40 years to 36.4% in patients 40–59 years to reach 79.2% at age  $\geq$  60 years.

### Hepatitis B and C status

The hepatitis B and C status of the patients before dialysis was unknown in 12% and 24% of the patients respectively. Seroconversion rates were calculated only for patients with known hepatitis B and C status prior to haemodialysis.

The overall positivity rate for hepatitis B virus (HBV) among our patients was 4%

Table 3 Sexual activity of patients on haemodialysis in Jordan by age, 2003

Frequency of intercourse	Age (years)		
	< 40 %	40–59 %	$\geq$ 60 %
Twice/week or more	32.7	15.7	2.4
Once/week	47.3	24.7	5.1
Twice/month	13.6	21.3	12.9
Once/month or less	0	1.9	0.4
None	6.4	36.4	79.2

Table 4 Hepatitis B and C positivity of the 1711 patients on haemodialysis in Jordan, 2003

Hepatitis	Positive		Negative		Unknown	
	No.	%	No.	%	No.	%
B	68	4	1643	96	0	0
C	351	21	1341	78	19	1

(Table 4). Of the 68 positive patients, 17 (25%) seroconverted after starting haemodialysis. The percentage of HBV-negative patients who seroconverted after initiation of haemodialysis was 1.2%. Given an average duration of haemodialysis of 3.5 years, the annual seroconversion rate was 0.34%

With respect to hepatitis C virus (HCV), the overall positivity rate was 21%. About one-third (32.2%) of HCV-positive patients were negative before starting haemodialysis. The percentage of HCV-negative patients who became positive after initiation of haemodialysis was 9.2% yielding an annual seroconversion rate of 2.6%. The HCV status before starting haemodialysis was unknown for 24% of this population.

Table 5 Prevalence of haemodialysis in Jordan by age and sex, 2003

Variable	Population	Patients	Prevalence (per million population)
<i>Age group (years)</i>			
< 20	2 745 480	82	30
20–39	1 723 460	440	255
40–59	598 700	620	1036
$\geq$ 60	312 360	569	1822
<i>Sex</i>			
Male	2 866 200	957	334
Female	2 613 800	754	288
<i>Total</i>	5 480 000	1711	312

### Prevalence and incidence of haemodialysis

The overall prevalence of haemodialysis in Jordan was 312 pmp. Table 5 shows the prevalence by age and sex. The prevalence increased from 30 pmp below age 20 years to 1822 pmp among the elderly ( $\geq 60$  years). The prevalence was also higher among males (329 pmp) as compared to females (288 pmp).

The total number of patients who started haemodialysis in 2002 in all units, irrespective of whether they were still on haemodialysis at the time of the survey, was 578 accounting for an incidence of 111 pmp in 2002 (the total population of Jordan in 2002 was 5.2 million).

### Mortality

The total number of deaths among patients on haemodialysis in Jordan during the 1-year period preceding the survey was 292. Of the 578 who started haemodialysis in 2002, 116 had died by 1 July 2003 giving a case fatality of 20% during the first year. Kidney transplantation was carried out for only 5% of those patients.

Table 6 Cause of end-stage renal disease among patients on haemodialysis in Jordan, 2003

Cause	No. (n = 1711)	%
Diabetes mellitus	499	29.2
Hypertension	315	18.4
Glomerulonephritis	210	12.3
Obstructive uropathy	70	4.1
Reflux uropathy	70	4.1
Primary kidney disease	40	2.3
Other causes	141	8.2
Unknown	366	21.4

### Cause of ESRD leading to haemodialysis

Table 6 presents the causes of ESRD among patients on haemodialysis at the time of the survey. The commonest cause was diabetes mellitus (29.2%) followed by hypertension (18.4%) and glomerulonephritis (12.3%). The category of other causes in Table 6 included, for example, systemic lupus erythematosus, analgesic nephropathy, Alport syndrome, and familial Mediterranean fever. For over one-fifth of the patients, the cause was classified as unknown as the attending physician was unable to provide the cause which led to ESRD after full investigation, including renal biopsy. In fact, these cases may be considered as having primary kidney disease although they are categorized separately in Table 6.

For patients who started haemodialysis during 2002 and 2003, diabetes mellitus was the cause in 33.4% and 44.0% respectively.

### Cost of haemodialysis in Jordan

The estimated total annual cost of haemodialysis in Jordan was US\$ 29 715 553 (Table 7). Haemodialysis sessions accounted for about three-quarters of the total cost while medications and investigations accounted for an additional 20%. Erythropoietin was

Table 7 Estimated annual cost of haemodialysis in Jordan, 2003

Item	Cost (US\$)
Haemodialysis sessions	22 555 573
Medications and investigations	5 781 000
Admissions	1 205 550
Arterial access	173 430
Total	29 715 553

regularly supplied to 92% of patients on haemodialysis, calcium to 98%, vitamin D to 91% and iron to 88%. Erythropoietin was given twice weekly on average with the objective of raising the haemoglobin level to 10–12 g/dL.

## Discussion

Data on haemodialysis in Jordan are very scarce. The present study has shown an incidence of haemodialysis in Jordan of 111 pmp in 2002, a figure slightly lower than reported from Europe in 1998–1999 (117 pmp) [1] but much higher than the incidence in Baltic countries [6]. In the United States, the incidence of ESRD in the year 2000 was 291 pmp [7]. In Egypt the reported incidence of ESRD in the year 1992 was 200 pmp, of whom 80 pmp were accepted on the dialysis programme [8]. Variation in the incidence of haemodialysis largely reflects differentials in acceptance of patients onto the haemodialysis service, as well as the reference year for the reported incidence, since an increasing trend has been observed almost everywhere. The prevalence of haemodialysis in Jordan seems to be increasing at a high pace from 114 pmp in 1992 [9] to 181 pmp in 1998 [10] reaching 312 pmp in the year 2003 (average annual increase of 8.5%). Such an increase may largely reflect the increasing availability of haemodialysis in Jordan.

Consistent with data from other countries [1,4,7], diabetes mellitus was the commonest underlying cause for haemodialysis among our patients (29.2%) followed by hypertension (18.4%) and glomerulonephritis (12.3%). However, considering patients who started haemodialysis in 2003 alone, diabetes accounted for 44% of the cases. Several explanations can be offered, such as more elderly persons accepted on haemodialysis, shorter survival of diabetics on

haemodialysis, or an actual increase in the contribution of diabetes to ESRD. Diabetes mellitus is a highly prevalent disease in Jordan affecting 13.4% of Jordanians  $\geq 25$  years of age [11]. The mean age of patients on haemodialysis in Jordan has increased from 44.6 years in 1998 [10] to 48.9 years in 2003 and the percentage of patients aged  $\geq 60$  years has increased from 21% in 1998 [10] to 33% in 2003.

In agreement with data from other countries [1], more males (55.9%) than females were being maintained on haemodialysis and the prevalence of haemodialysis was 334 pmp in males compared to 288 pmp in females.

HBV positivity was relatively low (4%), and annual seroconversion occurred in 0.34% of our patients after starting haemodialysis. HCV positivity among our patients was 21% with an annual seroconversion of 2.6%. These figures are assuring even when compared with data from a number of European countries, Japan and the United States [12]. The DOPPS study showed the prevalence and seroconversion of HBV among haemodialysis patients in 5 European countries, Japan and the United States [12]. The overall prevalence and seroconversion was 3.3% and 0.78 per 100 patient-years respectively. Recent data on HBV in the general population are lacking in Jordan but the prevalence is generally low in selected groups such as healthy blood donors (1.8%–3.9%) [13] and multi-transfused patients for hereditary haemolytic anaemia (3.5%) [14]. With respect to HCV, the prevalence among haemodialysis patients in Jordan was much lower than in many countries in our region such as Saudi Arabia (72.3%) [15], Kuwait (40%) [16] and Pakistan (68%) [17], but higher than that in developed countries such as Germany (7%) [18]. In Jordan, the prevalence of HCV in the general population is not known, but it

is available for subgroups of the population such as healthy blood donors (0.65–2.1%) [13] and multi-transfused patients (40.5%) [14]. A previous study in 6 Ministry of Health haemodialysis units in Jordan reported an HCV prevalence of 34.6% [19]. In the present study, HCV prevalence in Ministry of Health haemodialysis units was very similar (33%) compared to 7.3% in the private sector. The most likely explanation for the observed lower rate in the private sector is a reluctance to accept HCV positive patients since neither the private nor the public sector have HCV infection control protocols which could account for such a discrepancy. In contrast, a standard HBV prevention protocol exists in all haemodialysis units in Jordan. It should be noted that strict infection control measures in haemodialysis units and isolation policy for HCV-positive patients have been shown to limit HCV transmission as it has done in reducing HBV transmission [12,20–22]. Patient-to-patient transmission of HCV also occurs in haemodialysis units highlighting the importance of the strict enforcement of standard infection prevention measures [23]. Nurse understaffing of haemodialysis units was shown to have a negative effect on HCV transmission [24] probably because of difficulty in ensuring adherence to infection control measures in such a situation.

Among the interesting issues in our study was the assessment of sexuality. Total sexual inactivity affected the great majority of patients  $\geq 60$  years of age and over one-third of those aged 40–59 years. Complete lack of sexual intercourse was a problem even at a younger age for over 6% of the patients. These findings may add to our understanding of the suffering of haemodialysis patients and their quality of life. Attending physicians should be aware of this problem and be ready to assist their patients in this

regard. Sexual dysfunction of patients on haemodialysis has been reported by other studies [25,26].

The fatality rate observed in our study (20%) is similar to rates in the United States where the 1-year fatality rate was approximately 22% in 2002 [27]. However, patients accepted for haemodialysis in Jordan tend to be younger than United States patients, and this may explain the favourable outcome in Jordan.

Expansion of haemodialysis services in Jordan has a high cost. Jordan is a developing country with an annual per capita income of approximately US\$ 1800. The overall expenditure on haemodialysis in 2003 was about US\$ 30 million, i.e. about 4% of the total health expenditure in Jordan. In Turkey, the annual cost of haemodialysis was US\$ 22 759 per patient, while the cost of transplantation was US\$ 23 393 and US\$ 10 028 per patient respectively for the first and second year [28]. In industrialized countries, the annual costs of haemodialysis are much higher, being highest in France (US\$ 78 947 per patient) [29] compared to Japan [30] and the United States [31] (US\$ 46 000 per patient).

Expenditure in Jordan is likely to increase rapidly in the near future as more and more of the elderly are accepted into the service. The government of Jordan bears almost all the costs of haemodialysis. Although the cost of haemodialysis in Jordan is relatively low (US\$ 17 385/patient/year), the burden is huge in a country with limited resources like Jordan, and the efficiency of the allocated resources for haemodialysis should be an issue for consideration.

The cost of kidney transplantation in Jordan is not accurately known but has been shown in other countries to be a less costly alternative [28,31]. Rough estimates of the cost of transplantation in Jordan, based on

personal communication, range from US\$ 20 000–22 000 in the first year, dropping to US\$ 10 000–12 000 in the second year, to reach US\$ 8000–10 000 later on. Unfortunately, kidney transplant is used by only a small minority (5%) of patients with ESRD in Jordan. The reasons behind this are not clear but restrictions on transplants from non-relative donors exist by law to prevent the sale of human organs and may contribute significantly to this underuse. While permitted in Jordan, cadaveric transplants are not widely available, probably because of a lack of efforts to raise the awareness of people of the importance of organ donation after death. Appropriate strategies to promote kidney transplantation are needed and may succeed in containing the escalating costs. However, in the long run, prevention of ESRD is particularly important and can be achieved by early detection and prompt treatment of the major diseases leading to ESRD, namely diabetes, hypertension and glomerulonephritis. Restriction of haemodialysis to patients who are likely to benefit from the intervention and excluding patients with advanced multi-organ disease have been suggested [28] as a way to contain cost, but may be unacceptable on ethical grounds.

In the present study, we did not collect data on peritoneal dialysis which is rarely used in Jordan. In fact, no programme for peritoneal dialysis exists in Jordan. There is no system to reimburse private physicians for caring for patients on peritoneal dialysis

and therefore they direct their patients to haemodialysis. Moreover, as peritoneal dialysis is usually carried out at home, it is more likely to be successful in educated patients.

In conclusion, our study has provided a profile of patients on haemodialysis in Jordan. Diabetes is the leading cause of haemodialysis and its role seems to be increasing. Haemodialysis is expanding rapidly and the burden is high given the limited resources in Jordan. HBV and HCV prevalence and seroconversion are relatively low suggesting that the current infection control measures are working and, therefore, should be intensified. Promotion of less expensive interventions such as kidney transplantation and prevention of the main causes leading to ESRD may be needed to curb the escalating costs. Research is needed on the quality of life of patients on haemodialysis and their families.

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