

## Global Dialysis Perspective: Israel

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KIDNEY360 1: 119–122, 2020. doi: <https://doi.org/10.34067/KID.0000052019>

### Introduction

Preliminary efforts for urgent dialysis as a life-saving measure for AKI were reported in three patients by Dr. Kurt Steinitz in Haifa, Israel as early as in 1948. He built a crude dialysis machine based on the publications of Kolff and Alwell. Three patients were treated and only one survived (1). Established dialysis programs for AKI and ESKD with trained staff began in 1958 and 1965, respectively, at the Hadassah University Hospital in Jerusalem under the direction of Prof. Ulman who had trained in the US. After the successful Hadassah experience, hemodialysis (HD) treatment soon spread to other main hospitals in the country. The first kidney transplantation in Israel was performed in Beilinson (today Rabin) medical center in 1964, by Prof. Morris Levy from a mother to her son, only 10 years after the first successful kidney transplantation in the world between twin brothers in Boston.

### Materials and Methods

Data were collected from the Israeli RRT Registry (2), annual Israeli RRT Registry reports to the European Renal Association-European Dialysis Transplantation Association (ERA-EDTA) (3) and US Renal Data System (4), Israeli Ministry of Health (MOH) official publications (5), and personal communications with Israeli opinion leaders in the field of nephrology. Data for patients on dialysis for >90 days were collected using questionnaires delivered to heads of all nephrology and dialysis units in the country that included age, sex, type of dialysis, community versus hospital location, vascular access, primary renal disease, kidney transplantation, and mortality. Whereas every effort was carried out to verify the data presented here, this report is not an official document of the Israeli authorities, and instead reflects the knowledge and opinions of its authors.

### Epidemiology

The incidence rate of dialysis in Israel is 179 per million population (pmp), whereas in 2015 it was 191 pmp, compared to the European average incidence rate of 121 pmp reported by the ERA-EDTA (3). Median age of prevalent dialysis patients is 68, and 60% of incident RRT patients are men. Of note, the percentage of incident RRT patients with diabetes mellitus (DM) in Israel is one of the highest in the world, *e.g.* 50% (95

pmp (4) in 2015) and the rate of prevalent Israeli dialysis patients with DM is the highest in the ERA-EDTA registry (355 pmp) (2).

Another characteristic of RRT in Israel is the high number of incident patients aged >75, *i.e.* 1219 pmp, second only to the US (1360 pmp) and Taiwan (4) (Table 2).

The prevalence of 75–84-year-old patients on dialysis rose 4.8-fold between 1990 and 2015, and currently this is the most frequent age group on dialysis in Israel, comprising 4871 pmp, the highest rate in the ERA-EDTA registry. The prevalence of all types of RRT is 1199 pmp (62% dialysis, 38% transplants) compared to 823 pmp reported as average by the ERA-EDTA and 2096 in the USA (3,4). The prevalence of dialysis in Israel was 742 pmp in 2018 (768 pmp in 2015) (Table 2) (3) compared to dialysis prevalence of 1582 in the USA. The number of patients with ESKD on the waiting list for kidney transplantation in Israel is 90 pmp (293 pmp in the US) and the transplantation rate in Israel in 2018 was 43 (45 pmp in 2015) (2), compared to 32 pmp European average reported by the ERA-EDTA (2) and 62 pmp in the US (3). Five percent of incident RRT patients are preemptive transplantations.

### Survival

In the last 5 years, the average annual increase in the number of prevalent dialysis patients was 1.95% (2), accounted for by slightly improved survival. During 20 years of dialysis practice the survival of dialysis patients improved significantly in Israel [from 2010 to 2014 versus 1990 to 1994, hazard ratio (HR) 0.58] (2). The annual mortality rate in Israeli dialysis patients is currently 18.5% (1) compared to the average EDTA-reported mortality rate of 17.2% (3). For dialysis patients on the waiting list for transplantation the annual mortality rate is 5.7% (5). Despite this low mortality rate relative to other dialysis patients, most of the patients on the waiting list will die while waiting for transplantation because slightly more (46 pmp in 2018) ESKD patients are joining the waiting list every year than are transplanted (43 pmp in 2018).

For female dialysis patients survival rates are better (HR 1.07 for males), similar to the US Renal Data System report (4). In this context, the gender paradox involves a higher rate of CKD in females, a lower rate of females on RRT, and a better outcome for females on

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RRT. Similar to in the US, minority survival in Israel is better (6). The Arab minority has better survival on dialysis than the Jewish majority (HR 1.12 for the Jewish population) (2). Patients on dialysis with DM have a worse prognosis (HR 1.3 versus patients with GN) (2).

### HD Practice

Although HD sessions are typically thrice-weekly, 4-hours in length, in some patients sessions are shorter because of small body weight or because of noncompliance. Pump speed is typically 300–350 ml/min. One-half (50.3%) of HD is provided by nonprofit hospitals (31 centers) and one-half (49.7%) by for-profit community-based private dialysis networks (45 U). The median patient/nephrologist ratio is 28.8 in hospitals and 36.5 in private units, whereas the median patient/nephrology-certified nurse ratio is 5.4 and 13.9, respectively (7) (the mandatory patient/all nurses ratio during a HD session is 4:1 where at least one nephrology-certified nurse must attend each separate room). In 1990, the market share of community HD units was only 4.6% but grew 10.5-fold by 2019. Hemodiafiltration has currently only a 5% market share but community dialysis units are currently upgrading the reverse osmosis water systems to ultrapure levels to allow sterile dialysis water grades for hemodiafiltration. Home dialysis is practically unavailable at the moment, but as regulatory standards have been completed, delivery of home HD in Israel is scheduled to begin in 2020 in the Haifa area.

### The Israeli Healthcare System and Dialysis Economics

Since 1995, Israel has had a National Health Insurance (NHI) providing a benefits package to all citizens and permanent residents of Israel, updated each year. The benefits package includes a broad list of services such as inpatient and ambulatory care, emergency and preventive care, diagnostic exams, and drugs. Compared to other Organization for Economic Co-Operation and Development (OECD) countries, Israel has had low health spending in the last decade (OECD report, 2014) (8). Nevertheless, health outcomes have improved (OECD report, 2012) (8) placing Israel, according to the Bloomberg health efficiency index report, in 10th place worldwide (Spain and Italy are in the first and second places, and the US is in 35th place) (9).

The NHI is financed predominantly from public sources collected *via* payroll and general tax revenues. Payment and provision of care are the responsibility of four competing nonprofit health plans (HPs), required by the NHI Law to provide services, and to ensure reasonable accessibility and availability. For this purpose, HPs are funded by the MOH mainly through prospective payments according to a risk-adjusted capitation formula that considers the insured's age, sex, and place of residence (periphery/center of the country). Small copayments are required for outpatient visits, pharmaceuticals, visits to specialists, and certain diagnostic exams (10,11). The four HPs manage the utilization and costs of healthcare services, taking into account three key organizational objectives: cost containment, quality improvement, and equity promotion. For each HD or PD patient, the government pays the HPs 65,000 USD annually, from which the HPs cover the all medical costs, and containment is one

of the HPs' main organizational objectives (10,11). Consequently, HPs control costs by reviewing the utilization of dialysis care and opting for discounted bulk purchasing from dialysis providers, other care providers, and pharmaceutical manufacturers. Hospitals in turn may maintain sufficiently large HD units to benefit from referral of HD patients to other hospital-based medical services rather than from direct revenues for HD sessions, because their personnel/patient ratio is higher than in the community dialysis networks. Because PD units require much fewer personnel, and there is hardly any cost for anticoagulation or fibrinolytic drugs, PD is more profitable for the providers. In Israel, PD providers are hospitals only and not private units. To avoid financial bias against patients with PD, HPs are equally reimbursed for PD or HD patients (formal monthly MOH tariffs are for PD 178 USD per day×31 days, and for HD 430 USD×13 sessions per month), whereas the monthly cost of peritoneal fluid bags is estimated as 1570 USD per average patient. We do not have data for home HD because this practice is yet to be launched in Israel. Taken together, PD has the highest benefit/cost ratio.

### Dialysis Patient Rights

Under the "law of serious illnesses" every Israeli inhabitant with ESKD is eligible for both free RRT and free medications. Illegal immigrants that have been diagnosed with ESKD in Israel and started on dialysis are deported to their country of origin on condition that dialysis services are accessible. Thus, because lack of accessible dialysis in their countries of origin may result in death for illegal immigrants with ESKD from some African countries, these patients remain in Israel on HD and incur huge debts that are never paid. However, for legal inhabitants, dialysis treatments and medications are free, whereas 50% of transportation to dialysis units is reimbursed. For transplanted patients, anti-rejection medications are free for life.

### Staff

A general practitioner, but not necessarily a nephrologist, is required to constantly attend community-based dialysis units. The nephrologist is required to determine the treatment plan and goals, and check each patient at least monthly. In contrast, the nurses are the dominant sector in HD and PD. Whereas a nephrologist is the medical director making individual medical and general operational decisions, the actual day-to-day acting managers of dialysis units in Israel are the head nurses. Nurses, but not technicians, are authorized to cannulate the patients and are primarily responsible for the dialysis sessions by adhering to treatment protocols and doctor's orders, and reacting to patients' conditions. Technicians may prepare the machines and dialyzer sets, but have no access to patients. Dialysis nurses undergo a 1-year nephrology/dialysis course to obtain certification to work in dialysis units. Finally, each dialysis unit must employ a dietitian and a social worker with a mandatory visit every 1 or 3 months, respectively.

### Unique Features of Israeli Nephrology

In addition to the high rates of DM as primary renal disease and of elderly patients on HD, a unique feature of

**Table 1. Baseline characteristics of RRT in Israel**

Number of dialysis patients	N=6694
Percent of patients on home dialysis	742/pmp HHD: 0.03%
Are all dialysis sessions covered by insurance, or do some patients have out-of-pocket expenses?	PD: 7.1% (APD 30%, CAPD 70%) Covered by insurance
Are the dialysis units hospital-based or freestanding?	Both
Are the dialysis units for-profit or non-profit?	Hospitals: nonprofit Community: for-profit
What is the reimbursement per dialysis session in \$US?	HD: 430 per session PD: 178 per d Dialysis nurses only
Are all of the staff who deliver dialysis nurses or do you also use patient care technicians?	
What is the typical patient to RN ratio in the dialysis units?	4:1
What is the average length of a dialysis session?	240 min
How many times per month are patients seen by a nephrologist during dialysis sessions?	1
What is the proportion of prevalent HD patients in your country using an AVF, AVG, and CVC?	AVF: 60% AVG: 8% CVC: 32%
What is the proportion of incident (d 1) HD patients in your country using an AVF, AVG, and CVC?	AVF: 18% AVG: 2% CVC: 75%
What is the rate of kidney transplantations?	Temp. Catheter: 5% 43 pmp, 60% living, 40% deceased
HD, hemodialysis; HHD, home HD; PD, peritoneal dialysis; APD, automated PD; CAPD, chronic ambulatory PD; AVF, arteriovenous fistula; AVG, arteriovenous graft; CVC, central venous catheter.	

ESKD in Israel is the recent dramatic rise in altruistic kidney donations (12). Whereas the overall transplant rate in Israel is 43 pmp (compared to averages of 32 pmp European (3) and 62 pmp in the USA (4)), Israel is one of the few countries reporting a substantially higher living donor rate than cadaver transplantation (12) (60% living versus 40% deceased donors, compare with the US with 28% living versus 72% deceased donors). Furthermore, among the living donors, there is a disproportionately high percentage of altruistic donors (54% altruistic versus 46% living-related donors) (12). Since 2009, a dramatic increase of altruistic donations resulted in a uniquely high rate of 14 pmp in 2018 (compare with a cadaver kidney donation rate in Israel of 17 pmp and a living-related donation rate of 12 pmp). Whereas there is some dispute regarding harvesting from brain-dead versus cardiac arrest-deceased donors in the Jewish rabbinic authorities, living donation is encouraged in Israel (12).

**Table 2. Change from 1990 to 2015**

RRT Characteristics	1990	2015
RRT incidence	113 pmp	196 pmp
RRT incidence of men	144 pmp	258 pmp
RRT incidence of women	81 pmp	135 pmp
Incidence of patients >75-yr old	632 pmp	1219 pmp
Prevalence of patients >75-yr old	1015 pmp	4871 pmp
DM as primary renal disease	18%	44.5%
Ratio of incident 75–84 age group compared to incident 20–44-yr old	7-fold	27-fold
Prevalence of functioning kidney graft	81.5 pmp	420 pmp
Percentage of PD of all dialysis	34.2%	7.1%
DM, diabetes mellitus; PD, peritoneal dialysis.		

## Conclusions and Future Challenges

In our opinion, the decline in both the rates of PD and permanent vascular access on initiation of HD can be improved by better ambulatory nephrology practice. Unfortunately, only 52% of patients who begin dialysis in Israel are seen by a nephrologist within the 6 months before dialysis onset, thereby accounting for the low permanent vascular access on dialysis onset (1,7) (Table 1). In contrast, 80% of PD patients are under regular nephrology follow-up within the 6 months before dialysis onset. The lack of adequate patient preparation for RRT contrasts with the generally good preventive medicine in Israel. A relatively low number of nephrologists (16 pmp) may partially account for the lack of adequate patient preparation for RRT in Israel. Lack of personnel is especially evident when comparing the periphery to the center of Israel; higher rates of arterio-venous fistulas and lower rates of mortality in the center of Israel compared to the periphery may indicate socio-economic and resource allocation differences.

## Acknowledgments

Y. Haviv and E. Golan conceptualized the study and wrote the original draft. E. Golan reviewed and edited the manuscript.

## Disclosures

Y. Haviv reports personal and other fees from Fresenius Israel outside the submitted work. E. Golan has nothing to disclose.

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