A COST EFFECTIVENESS ANALYSIS OF PERITONEAL DIALYSIS VERSUS IN-CENTER HEMODIALYSIS IN ITALY

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Abstract

Background and Aims: An analysis of the recent scientific literature shows that peritoneal dialysis (PD) is cost effective compared to thrice weekly conventional in-center hemodialysis (ICHD). However, such cost effectiveness has never been conducted from Italian payer perspective. The aim of this study was to estimate the benefits and costs associated with different hypothetical scenarios of dialysis ratio of PD/ICHD vs. the current situation of 10% PD vs. 90% conventional ICHD in Italy.

Methods: We constructed an Excel-based Markov model to estimate the costs and quality adjusted life years (QALYs) associated with different modality distributions from the Italian payer's perspective. We modeled an incident dialysis patient population over a time horizon of 5 and 10 years. The current Italy dialysis modality distribution (scenario 0) of 10% PD and 90% conventional ICHD, was compared to 3 hypothetical scenarios: Scenario 1: 30% PD; Scenario 2: 20% PD; Scenario 3: 5% PD. In all scenarios, the percentage of ICHD changed accordingly to 70%, 80%, and 95% respectively. Model parameters and data inputs were obtained from published articles, the Lombardy Registry of Dialysis and Transplantation (RLDT), and the ERA-EDTA registry. All future costs and benefits were discounted to their present value at an annual rate of 3.0%.

Results: The number of incident dialysis patients was estimated to be 11,809 in Italy in 2010. Scenarios 1 (30% PD) and 2 (20% PD) demonstrate lower costs and higher QALYs compared to Scenario 0 (10% PD), whereas opposite findings were seen for Scenario 3 (5% PD) compared to Scenario 0. Increasing PD to 20% saves between €3,942-4,795 per patient and results in an increase of 0.013-0.014 QALYs per patient over 5 to 10 years. Increasing PD to 30% saves between €7,884-9,591 per patient and results in an increase of 0.025-0.027 QALYs per patient over 5 to 10 years. Reducing the PD use to 5% results in an increase of costs between €1,971-2,397 per patient and a decrease in QALY between 0.006-0.007 per patient.

Conclusions: Our study indicates that increasing the use of PD from 10% to 20 or 30% among incident Italian ESRD patients might generate healthcare savings while improving health benefits. However, decreasing the use of PD from 10% to 5% might increase healthcare costs and unfavorably impact health outcomes These results are consistent with the published literature in other countries.

Background

• Patients with end-stage renal disease (ESRD) need renal replacement therapy (RRT) – renal transplantation or dialysis, to save and sustain life. The two main types of dialysis are peritoneal dialysis (PD) and hemodialysis (HD).

• PD can be performed manually (CAPD, continuous ambulatory peritoneal dialysis) or with a cycler (APD, automated peritoneal dialysis). HD is usually performed in a hospital or clinic (ICHD), but it can also be performed at home (HHD).

• Due to the aging population, extended life expectancy, and the global epidemic of diabetes mellitus, the number of patients with ESRD is rising rapidly across the globe.[1,2] It is estimated that more than 2,6 million people globally were affected by ESRD at the end of 2010.[3] That number included about 53,940 individuals in Italy who required dialysis in 2010.[4]

• Evidence suggests that PD is as effective as HD clinically. However, economically, PD has been demonstrated to be a cost saving therapy compared to HD in most developed countries and some developing countries.[5]

Objective

To investigate the cost effectiveness of 3 hypothetical scenarios of PD/HD modality distribution vs. the current situation of 10% PD with 90% HD from the Italian payer's perspective.

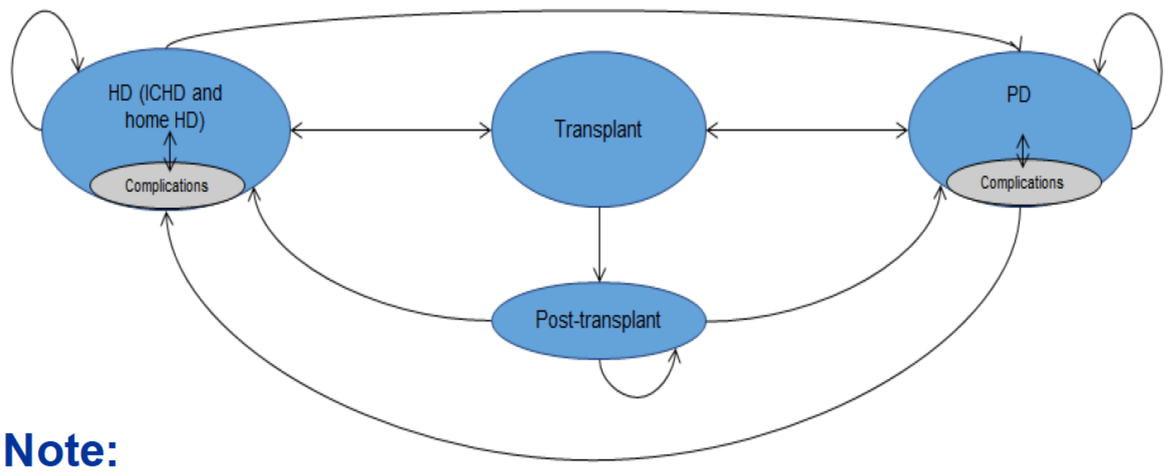
Methods

- An Excel-based Markov model was developed using Microsoft Excel 2010 to estimate the cost-effectiveness of various dialysis modality distributions over 5 and 10 years.
- The Markov model considered all possible movements that may be made by patients between different modalities (Figure 1). Patients could switch dialysis modalities at any point; switching rates were sourced from the literature.
- Survival was based on survival curves published in the ERA-EDTA Annual Data Report in 2009.[6] Extrapolation of survival over 5 years was conducted using best fit survival curves for HD and PD patients.

Methods (cont'd)

- The current dialysis modality distribution among incident ESRD patients of 10% PD and 90% HD was compared to 3 hypothetical scenarios:
  - Scenario 1: 30% PD with 70% HD.
  - Scenario 2: 20% PD with 80% HD.
  - Scenario 3: 5% PD with 95% HD.
- Model input data in terms of prevalent and incident dialysis population, survival, hospitalization, transition probabilities, were based on 2010 Italy Renal Registry Report and published literature. (Table 1)
- From the Italian payers' perspective, the cost data associated with ESRD treatment include dialysis access establishment and maintenance, dialysis services, patient monitoring, hospitalization, erythropoiesis-stimulating agents (ESAs), transportation to and from clinics, and kidney transplantation were sourced from Italian Lombardy Registry of Dialysis and Transplantation (RLDT) report. We are still elaborating the data of 2 other Regions: Emila Romagna and Sicily. (Table 2)
- All costs and outcomes were discounted at an annual rate of 3.0%.

Figure 1: Model flow diagram



Note:

- One-way arrows indicate that patients can move in one direction; two-way arrows indicate that patients can move in either direction. Each dialysis modality is a separate health state in the model, as follows: haemodialysis (HD) conventional = hospital or satellite; PD = continuous ambulatory peritoneal dialysis (CAPD) or automated peritoneal dialysis (APD); transplant (transient health state); post-transplant. Patients can die from any of the model's health states. The absorbing death state is not shown in this diagram.

Table 1: Model parameters

Parameter	Value (range)
Conventional HD hospitalisation probability	7.05% (5.29% - 8.81%)[7]
PD hospitalisation probability	6.69% (5.02%-8.36%)[8]
Proportion moving from HD -> PD	0.03%[9]
Proportion moving from PD -> HD	0.97%[9]
Conventional HD utility	0.56 (0.49 - 0.62)[10]
PD utility	0.58 (0.50-0.67)[10]
Transplant/post-transplant utility	0.81 (0.72 – 0.90)[10]
Transplant rate – all modalities	0.0022[11]
Graft failure probability – all modalities	0.0034[12]
Survival for transplant recipients	
Deceased donor (5-year)	92%[12]
Living donor (5-year)	95%[12]

Table 2: Cost elements

Cost elements	Value
HD vascular access (weighted)	€ 3,925[13]
PD vascular access	€ 4,022[113]
HD cost /Session (Hospital)	€ 195[13]
HD cost /Session (Satellite)	€154[13]
PD cost/day (CAPD)	€ 57 [13]
PD cost/day (APD)	€ 67[13]
Conventional HD ESA cost	
Dose (units / week)	7,020[13]
ESA cost per 1,000 units	€ 4.51[13]
PD ESA cost	
Dose (units/week)♦	3,807[13]
ESA cost per 1,000 units	€ 4.51[13]
Cost per HD hospitalisation	€ 4,801[14]
Cost per PD hospitalization	€ 4,379[14]
Clinical monitoring/visit	€ 71[13]
Transport cost per visit	€ 15[13]
Transplant cost (1st year)	€ 52,543[15-17]
Post-transplant (annual)	€ 14,235[15-17]

Results

- Tables 3 & 4 illustrate the cost and QALY results for the current scenarios and 3 hypothetical scenarios. For the reference scenario, the total costs and QALYs per patient over 5 and 10 year period were €154,810 and 1.950 and €215,231 and 2.898, respectively.
- Assuming an increase in PD from 10% to 20% of all dialysis use among incident dialysis patients (Scenario 1), the cost difference versus reference scenario is a per patient saving of €3,942 over 5 years and €4,795 over 10 years. The difference in QALYs is an increase of 0.013 over 5 years and 0.014 over 10 years per patient. Scenario 2 is dominant (lower costs and better benefits).
- Assuming the use of PD increase from 10% to 30% among incident dialysis patients (Scenario 2), the cost difference versus the current scenario is a saving of €7,884 over 5 years and €9,591 over 10 years per patient. The difference in QALYs is a increase of 0.025 over 5 years and 0.027 over 10 years per patient. Scenario 1 is dominant (lower costs and better benefits).
- On the other hand, if the use of PD decreases to 5%, the total costs per patient would increase €1,971 and €2,397 over 5 and 10 years respectively, while the QALYs would decrease 0.006 and 0.007 over 5 and 10 years respectively. Scenario 3 is dominated (higher costs, but less benefits).

Table 3: 5-year results (per patient, current present value, discount 3%)

	Reference scenario	Scenario 1 (PD 30%)	Scenario 2 (PD 20%)	Scenario 3 (PD 5%)
Total costs (€)	154,810	150,869	146,927	156,781
QALYs	1.950	1.962	1.975	1.943
ICER		Dominant*	Dominant*	Dominated**

Table 4: 10-year results (per patient, current present value, discount 3%)

	Reference scenario	Scenario 1 (PD 30%)	Scenario 2 (PD 20%)	Scenario 3 9PD 5%)
Total costs (€)	215,231	210,435	205,639	217,628
QALYs	2.898	2.912	2.926	2.892
ICER		Dominant*	Dominant*	Dominated**

Note: ICER, incremental cost effectiveness ratio; QALY, quality-adjusted life years; reference scenario, 10% PD and 90% HD; scenario 1, 20% PD and 80% HD; scenario 2, 30% PD and 70% HD; scenario 3, 5% PD and 95% HD. * less cost and better outcomes; ** most costly, worse outcomes.

Discussion

- Under the current dialysis tariff, increasing the proportion of patients requiring dialysis on PD could help the Italian payer reduce dialysis associated costs and improve patient outcomes.
- Our research findings are consistent with the findings reported in the literature that PD is cost effective compared to conventional HD from payers' perspective.[14,15]
- Our analysis has several limitations. First, the model was constructed from the Italian payer perspective and included only healthcare related costs. Second, although the best-available published evidence was used for the model inputs, some of the model inputs were derived from other countries where the dialysis practice might be different from those in Italy. Third, the current model conclusions only applies to adult patients who are clinically appropriate for both dialysis modalities.
- However, our results provide valuable information for decision makers in Italy under the current economic environment. Substituting conventional HD (3 times/week, 3-5 hours/time) with the more cost-effective PD could help the system save money while not compromising patient outcomes.

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