

An Initial Evaluation of Expanded Hemodialysis on Hospitalizations, Drug Utilization, Costs, and Patient Utility in Colombia

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BACKGROUND

An innovation called expanded hemodialysis with a middle cut-off dialyzer membrane allows for superior removal of potentially toxic medium-size molecules compared with traditional high flux (HF) hemodialysis (HD). Early clinical evidence suggests that **MCO** dialyzer membrane has the potential to improve patient outcomes and Quality of Life (QoL).

OBJECTIVE

The purpose of this retrospective, before and after study was to provide an initial health economic assessment of the impact of switching patients from HF HD to the **MCO** dialyzer membrane, on hospitalizations, hospital days, medication use, hospitalization and drug related costs, and patient utilities.

METHODS

Study Design

This retrospective study was undertaken in the Renal Therapy Services (RTS)-Colombia network to track and compare outcomes of a subset of patients over the age of 18 prior to, and after switching from HF-HD to the **MCO** dialyzer membrane. The patient's prescriptions (QD, QB, target Kt/V, duration, and dialysate) were not changed as part of this study. The study included clinical surveillance and periodic survey data related to quality of life between 2017 - 2019. The data for this analysis came from clinics in the RTS database in Colombia that had high-quality electronic medical record data with complete data for every patient. In addition, clinics included had switched all of their patients from HF-HD to **HDx** therapy, and had at least a year of data prior to, as well as after the switch to **HDx** therapy.

Eighty-one (81) patients qualified for inclusion in the study, and data in both the HF-HD phase and the **HDx** therapy phase of the study were collected.

Data Collection and Analysis

The annual count of hospitalizations, hospital length of stay, use of selected medications and QoL as measured by the **Kidney Quality of Life (KDQoL)-36** were collected during the 1 year prior to initiation of the **MCO** dialyzer membrane, while patients were receiving HF HD, and during the 1 year after initiation of the **MCO** dialyzer membrane. Detailed information on comorbidities was used to calculate severity using a **modified Charlson comorbidity index** validated in **End Stage Kidney Disease (ESKD)** patients.

Costs were estimated for hospitalization and medications. Hospital days were monetized based on a recent estimate of cost per day for dialysis-related hospitalizations conducted by RTS. Drug costs were estimated based on published prices, in Colombia. The hospital and drug-related cost estimates were then converted to US dollars based

on an average of the US Colombian exchange rate from March to September 2019 (3,338.27 pesos per US dollar). To examine patient utility associated with the treatment change, a published algorithm based on results from a population in Spain was used to convert the KDQoL results into **EQ-5D** utility scores. As a sensitivity analysis, a related method for generating utility scores based solely on the **Short Form (SF)-12** results of the **KDQoL-36** was also used; a patient utility score of 1 signifies perfect health.

A generalized linear multivariable model was conducted to assess the effect of the **MCO** dialyzer membrane on hospitalization days, which were controlled for some demographic and clinical confounding variables. In addition, annual cost estimates for a patient on HF-HD and **HDx** therapy were calculated along with percent changes over time. All analyses were performed using **Stata version 14**.

Study Limitations

- > With a before and after design, time trends in medication use and hospitalizations may confound the treatment effect. The main analysis controlled for statistically relevant patient characteristics, which helps alleviate the potential for bias related to time-varying factors, but bias may still be present.
- > The results are from three clinics from one network in Colombia. Practices may vary to other settings; generalizing results should be performed with care.
- > The cost results reflect Colombian rates for hospitalizations and medications that are unlikely to match those in other countries.
- > The EQ-5D utilities mapped from the KDQoL are based on a scoring algorithm developed in Spain and may not adequately reflect Colombian preferences.
- > This analysis has focused solely on estimating the impact of the **MCO** dialyzer membrane, in reducing the cost of hospitalizations and medications. The potential cost savings/cost-avoidances of this technology will depend on pricing dynamics and the contracting models for such treatments, over time.

RESULTS

Patient Characteristics

Baseline characteristics of the 81 patients enrolled in the study included:

- > Average age: 61.1 years
- > 64.2% male, 35.8% female
- > 98.8% from urban areas
- > Primary cause of Chronic Kidney Disease (CKD): 39.5% diabetes, 28.4% hypertension



- > Median dialysis vintage: 3.8 years
- > 25.9% with a **modified Charlson comorbidity index** of 3 or greater

Hospitalizations

- > Hospitalization rate per patient year: 0.77 with HF-HD and 0.71 in **HDx** therapy
- > Hospitalization days showed a sizable and statistically significant reduction of ~1.53 days; 5.94 hospital days per patient year on HF-HD to 4.41 on **HDx** therapy

Medication Utilization

- > While the proportion of patients on Erythropoietin Stimulating Agents (ESA), iron, insulin, and hypertension-related medications was roughly the same for patients on HF-HD and **HDx** therapy, doses per patient were significantly lower on **HDx** therapy (See Table 2)
- > Intravenous (IV) In-Center Medications - mean dosage per patient, per year
 - > ESA: significantly reduced by 13,194 IU; $p < 0.01$
 - > Iron: significantly reduced by 200 mg; $p < 0.01$
- > Other Medications
 - > Insulin: mean dosage per patient, per year significantly reduced by 1,949 IU; $p < 0.01$
 - > Hypertension medications: mean number of tablets, per patient year significantly reduced by 452 tablets; $p < 0.01$

Patient Utilities

- > The average utility of the patients was estimated, with patient utility remaining stable
- > Using a **KDQoL-36** based estimate, patient utility was 0.70 on HF-HD and 0.72 on **HDx** therapy
- > Using the SF-12 based estimate, patient utility was 0.83 during both the HF-HD and **HDx** therapy phases

Please see Table 2.

Outcome	HD HF mean (95% CI) N=81	HDx mean (95% CI) N=81
Yearly Hospitalization Rate	0.77 (0.60–0.98)	0.71 (0.55–0.92)
Yearly Hospitalization Days	5.94 (5.41–6.50)	4.41 (3.97–4.90) ^a
Proportion Using ESA	0.85 (0.77–0.93)	0.88 (0.80–0.94)
Dosage Per Patient Per Year of ESA (IU)	181 318 (151 647–210 988)	168 124 (138 452–197 794) ^a
Proportion of Patients using Iron	0.81 (0.70–0.90)	0.78 (0.69–0.87)
Dosage Per Patient Per Year of Iron (mg)	959 (760–1158)	759 (560–958) ^a
Proportion of Patients Using Insulin	0.35 (0.24–0.45)	0.35 (0.24–0.45)
Dosage Per Patient Per Year of Insulin (IU)	5383 (3274–7490)	3434 (1327–5543) ^a
Proportion using Hypertension Medications	0.78 (0.69–0.87)	0.74 (0.65–0.84)
No. Tablets Patient Per Year of Hypertension Medications	1183 (970–1394)	731 (518–943) ^a
KDQOL-36 based EQ-5O Utility Score	0.70 (0.65–0.75)	0.72 (0.67–0.77)
SF-12 based EQ-5O Utility Score	0.83 (0.80–0.86)	0.83 (0.80–0.86)

Table 2. Hospitalizations, Medication Utilization, and Patient Utilities with HD or HDx therapy. Table adapted from Ariza et al. Statistically significant difference found in corresponding univariate GLM analysis of outcome on **HDx** therapy. ^aAll had a P-value <0.01. HD HF: high flux hemodialysis; **HDx** therapy: expanded hemodialysis; ESA: erythropoietin stimulating agents; KDQOL: Kidney disease quality of life; EQ-5D: EuroQol-5 Dimension; GLM: Generalized linear Poisson.

Annual Costs

Estimates for annual average costs of hospitalization were nearly 24% lower with **HDx** therapy and sizably lower for many of the medication-related estimates of costs, per patient year.

- > Hospitalizations: average annual costs reduced by \$428 with **HDx** therapy; 23.9% decrease
- > IV in-center Medications – average annual costs:
 - > ESA costs reduced by \$28 (7.27%) with **HDx** therapy
 - > Iron costs reduced by \$0.90 (20.83%) with **HDx** therapy
- > Other Medications – average annual costs:
 - > Insulin: costs reduced by \$79 (32.64%) with **HDx** therapy
 - > Antihypertensives: costs decreased by \$57 (30.16%) with **HDx** therapy

Please see Table 3.

Annual Per Patient Cost Category	Average Annual Costs with HD HF	Average Annual Costs with HDx	Percent change HDx vs. HD HF
Hospitalizations	\$1,822	\$1,394	-23.9%
ESA	\$385	\$357	-7.27%
Iron	\$4.32	\$3.42	-20.83%
Insulin	\$242	\$163	-32.64%
Antihypertensives	\$189	\$132	-30.16%

Table 3. Annual Costs with HD HF and with HDx therapy. Adapted from Ariza et al. HD HF: high flux hemodialysis; **HDx**: expanded hemodialysis; ESA: erythropoietin stimulating agents.

DISCUSSION AND CONCLUSIONS

The **MCO** dialyzer membrane has shown promise as an important advancement in chronic dialysis-related care, with efficient removal of conventional/large middle molecules and the potential to improve patient outcomes while maintaining QoL. This analysis shows that **HDx** therapy statistically and significantly reduces hospitalization days and lowers doses of medications (including those used in-center), in a real-world setting over a period of two years. These reductions suggest a potential cost savings of \$593 USD per patient, per year with the **MCO** dialyzer membrane. In addition, the results on utility projections provided initial evidence that **HDx** therapy was associated with stable EQ-5D utility scores, over time.

A switch to HDx therapy was associated with a significant reduction in hospital days and medication usage (including ESA and iron), suggesting potential savings of \$593 per patient, per year (or ~\$4/treatment) with the MCO dialyzer.