

## Predictors of Cancer in Chronic Hemodialysis Patients: Results from the international Monitoring Dialysis Outcomes (MONDO) Initiative

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### Background

Epidemiologic data have demonstrated elevated cancer risk in hemodialysis (HD) patients. The aim of the present study was to evaluate the demographic, clinical and biochemical determinants of cancer development in HD patients.

### Methods

The MONitoring Dialysis Outcomes (MONDO) consortium consists of HD databases from Renal Research Institute (RRI) clinics in the US, Fresenius Medical Care (FMC) clinics in Europe, Asia Pacific (AP), Latin America (LA), KfH clinics in Germany, Imperial College, London, UK, Hadassah Medical Center, Jerusalem, Israel, and University of Maastricht, The Netherlands. We extracted data for only those patients who survived at least 12 months after the start of HD. Ninety-four HD patients with pre-existing cancer were excluded from the analysis. We used available variables to construct regression models to predict cancer development during 2 year follow-up. Candidate predictors included demographic characteristics (age, sex), comorbidities (diabetes, hypertension, cardiovascular disease (CVD), coronary artery disease (CAD), smoking), body mass index (BMI), dialysis parameters (eKtV, urea reduction ratio (URR), vascular access type, erythropoietin dosage, intra-dialytic weight gain (IDWG), normalized protein catabolic ratio (nPCR), blood pressure (BP)) and laboratory tests (albumin, hemoglobin (Hgb), sodium, potassium, calcium, phosphorus, ferritin, serum creatinine (sCR), white blood cell count, platelets, and total cholesterol). Continuous variables were converted into categorical based on optimal clinical cut off points used in the literature in a preprocessing step. Categorical variables were pre-screened using Chi-square test ( $P < 0.1$ ). Stepwise forward method was used for variable selection in the multiple logistic regression.

**Table 1:** Multivariate regression analysis with Cancer as an outcome

	Coefficient	Odds ratio	95% CI for OR	
			Lower	Upper
Age, years				
≥ 75	1.398	4.048	1.874	8.741
45-75	1.328	3.773	1.689	8.426
< 45 (ref)				
BMI, kg/m <sup>2</sup>				
≥ 30	.470	1.600	1.050	2.438
< 30 (ref)				
Ferritin, µg/L				
≥ 800	.903	2.467	1.704	3.574
< 500 (ref)				
Albumin, g/dl				
≤ 3.0	.806	2.240	1.238	4.050
≥ 4.0 (ref)				
Hemoglobin, g/dl				
< 9.0	1.779	5.926	3.072	11.431
9-10	1.035	2.816	1.553	5.107
10-11	.728	2.070	1.258	3.407
11-12	.223	1.250	.766	2.041
≥12.0 (ref)				
eKtV				
< 1.2	.826	2.284	1.170	4.460
1.2-1.7	.858	2.359	1.299	4.287
> 1.7 (ref)				
Access Category				
Catheter	.602	1.825	1.273	2.617
AV Fistula (ref)				
CAD yes	-1.079	.340	.125	.923
no (ref)				
Diabetes yes	-.716	.489	.328	.727
no (ref)				
IDWG, kg	-.273	.761	.618	.938

### Results

22,024 HD patients were studied (Eastern Europe: 4,830, Western Europe: 367, Northern Europe: 1,937, Southern Europe: 7,189, Western Asia: 2,115, Northern America: 5,586). The mean (SD) age was 63.2(15.0) years, 58.7% were males. The overall incidence of cancer was 0.84% (185 cases), and 0.3% (57 cases) of HD patients had cancer-related death. The incidence of cancer was highest in Eastern Europe (1.6%, 78 cases) and lowest in Western (0.3%, 1 case) and Northern Europe (0.3%, 5 cases). Men older than 75 years had a trend towards higher cancer incidence as compared to older female (1.2% vs 0.7%;  $P = 0.07$ ). The multivariable logistic regression model to predict two-year risk of cancer retained the following variables: age, BMI, ferritin, albumin, Hgb, eKtV, vascular access, CAD, diabetes, and IDWG (**Table 1**).

### Conclusion

Our study identifies clinical risk factors to predict cancer in HD patients. This risk assessment model could help clinicians to stratify patients for cancer screening, surveillance, prevention and early therapeutic intervention. Further studies are needed to evaluate our model validity and its generalizability.

