



## High rates of cancer screening among dialysis patients seen in primary care a cohort study

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### ABSTRACT

Routine preventive cancer screening is not recommended for patients with end-stage renal disease (ESRD)<sup>1</sup> due to their limited life expectancy. The current extent of cancer screening in this population is unknown. Primary care (PC) reminder systems or performance incentives may encourage indiscriminate cancer screening. We compared rates of cancer screening in patients with ESRD, with and without PC visits. This is a retrospective cohort study using United States Renal Data System (USRDS) billing data and electronic medical record data. Patients aged  $\geq 18$  years starting dialysis from 2001 to 2008, Midwest regional dialysis network were categorized with or without a PC visit (defined as an office visit in family practice, internal medicine, pediatrics, geriatrics or preventive medicine during the first two years of dialysis). Cancer screening was based on Current Procedural Terminology codes in USRDS. We identified 2512 incident dialysis patients (60% men, median age 65y). Cancer screening rates were more frequent among those seen in PC: 38% vs 19% ( $P = 0.0002$ ), for breast; 18% vs 10% ( $P = 0.047$ ) for cervical; 13% versus 8% ( $P = 0.024$ ) for prostate; and 18% vs 9% ( $P = 0.0002$ ) for colon cancer. Multivariable analyses found that those with PC were more likely to be screened after adjusting for age, sex, and comorbidities.

In our practice, cancer screening rates among chronic dialysis patients are lower than those previously reported for our general population (64% for breast cancer). However, a sizeable proportion of our ESRD population does receive cancer screening, especially those still seen in primary care.

### 1. Introduction

Cancer screening rates are some of the most commonly used performance measures in health care, both for pay-for-performance models and for public reporting (2014; Song et al., 2014). As a result, primary care clinicians and practices have incorporated cancer screening as a key component of care with the goal of achieving the highest rates

possible. Routine cancer screening may provide little benefit to individuals with limited life expectancy (Royce et al., 2014; Walter and Covinsky, 2001). Patients with end-stage renal disease (ESRD) on hemodialysis (HD) form a high-risk group with average survival of < 10 years for patients over 40 years old (2006). Therefore, unless they are transplant candidates, preventive cancer screening is not recommended for dialysis patients (Holley, 2007, 2013). Recently, the American

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<sup>1</sup> Notable abbreviations: primary care (PC), End Stage Renal Disease (ESRD), United States Renal Data System (USRDS).

Society of Nephrology (ASN) highlighted the importance of this topic as one of the five *Choosing Wisely* recommendations (Williams et al., 2012). In addition to potential patient harms, cancer screening has been shown unproductive for ESRD patients, with only 5 days of net gain in life expectancy (Chertow et al., 1996). Two recent papers (Royce et al., 2014; Tran et al., 2014) have highlighted the high rates of cancer screening in patients with limited life expectancy (Royce et al., 2014) and the risks associated with such screening (Tran et al., 2014). However, little is known about ESRD patients' utilization of preventive services and the appropriateness thereof. It is also not known whether the increased emphasis on preventive services performance measurement over the past decade has impacted screening rates.

Dialysis patients have a high comorbidity and treatment burden. Due to frequent interactions with health care providers, they may be more affected by systems that promote screening and preventive services. Such interventions may be more often implemented by primary care practices than by nephrology (or other specialty) care practices that manage patients with ESRD. The objective of this study was to examine the patterns of routine cancer screening in chronic dialysis patients to assess whether rates of services differ between patients with versus without a primary care visit during the first two years of dialysis.

## 2. Methods

### 2.1. Cohort data sources and exposure

The institution reported on in this study includes eight community-based outpatient HD facilities and a Midwestern tertiary care center, covering 8 dialysis units and a population of 395,000 as previously described (Hickson et al., 2015; Schoonover et al., 2013; Thorsteinsdottir et al., 2017). Adult (age > 18 y) patients initiating dialysis within this network between January 1, 2001 and December 31, 2010, as determined by an institutional administrative database, were linked with the United States Renal Data System (USRDS) data to create a local cohort of USRDS patients as previously described (Thorsteinsdottir et al., 2017; Thorsteinsdottir and US Renal Data). Patients were matched using name, social security number, date of birth, and date of death. ESRD patients under age 65 become eligible for Medicare coverage after 3 months of in-center HD. To ensure we had the most complete records possible we excluded patients with < 90 days of follow-up and patients for whom Medicare was not the primary payer. For any ESRD patient covered by a group health insurance plan, Medicare is the secondary payer for up to 33 months of ESRD services. Patients who had less than \$675 per month in outpatient dialysis claims were considered to have Medicare as a secondary payer as recommended in the USRDS researcher's guide (United States Renal Data System, 2013b). The cohort was truncated at 2008 to allow for 2 years of follow-up for every patient. The local Institutional Review Board and USRDS approved this study. The group was divided into those that had been seen by primary care clinicians and those who had not. Primary care office visits were defined as any claims in the USRDS database for visits with Family Practice, Internal Medicine, Pediatrics, Geriatrics and Preventive Medicine, and/or visits allocated to the following provider types: General Practice, Family Practice, Internal Medicine, Pediatric Medicine, Geriatric Medicine and Preventive Medicine.

### 2.2. Hypothesis

Our primary hypothesis was that seeing primary care clinicians, would result in increased use of preventive services.

### 2.3. Outcomes and follow up

As the primary outcome, rate of screenings for each cancer type was calculated during the first 2 years of dialysis to allow for capture of more services than are recommended on an annual basis. Preventive

**Table 1**  
Codes used to identify screening tests.  
(Thorsteinsdottir and US Renal Data)

Screening	Healthcare Common Procedure Coding System (HCPCS) codes used
Breast	Mammography: G0204, G0206, G0202, 76090, 76091, 76092, 77051, 77052, 77055, 77056, 77057
Cervical	Screening Pap Tests: G0123, G0143, G0144, G0145, G0147, G0148, P3000, Q0060, Q0061, Q0063 Physician Interpretation of Screening Pap Tests: G0124, G0141, P3001 Laboratory Specimen of Screening Pap Tests: Q0091
Colon	Colorectal cancer screening: G0104, G0105, G0106, G0107, G0120, G0121, G0122, G0328, 099PT, 3017F, 82270, 82271, 82272, 82273, 82274
Prostate	Screening PSA test: G0103 Digital Rectal Exam: G0102 S0605 45990

breast, cervical, colon, and prostate cancer screening services were identified by USRDS claims data using Medicare codes (Table 1). Breast cancer screening was defined by any mammography claims; cervical cancer screening by any pap-smear claims; colon cancer screening was defined by any claims for fecal occult blood, flexible sigmoidoscopy, CT colonography or colonoscopy; and prostate cancer screening by prostate-specific antigen (PSA) testing and digital rectal exam claims. Because colon or cervical cancer screenings are typically repeated > 2 years apart, a separate analysis over the first 5 years of dialysis as opposed to 2 was conducted.

### 2.4. Covariates

Baseline demographics and cause of ESRD, and comorbidities were collected from the USRDS Standard Analytic Files including Centers for Medicare & Medicaid Services CMS-2728 form (ESRD Medical Evidence Report Medicare Entitlement and/or Patient Registration), and institutional electronic medical records. Comorbid conditions were identified and scored according to the Charlson Comorbidity Index using the first 90 days of claims data, the CMS-2728 form, and supplemented by an automated electronic search strategy to extract Charlson comorbidities from the electronic medical records (Singh et al., 2012). Primary cause of ESRD was divided into diabetic and non-diabetic renal disease, as ESRD patients with diabetes have a poorer survival (2014). Candidates for transplant were determined from the CMS-2728 form and from an institutional transplant database.

Patients qualified for screenings were defined as per U.S. Preventive Services Task Force (USPSTF) as: breast cancer screening for women ages 40–75 years (U.S. Preventive Services Task Force, 2002a; US Preventive Services Task Force, 2009), cervical cancer screening for women age 18–65 years (U.S. Preventive Services Task Force, 2003), PSA screening for men ages 50–75 years (U.S. Preventive Services Task Force, 2002c, 2008b), and colon cancer screening for men and women ages 50–75 years (U.S. Preventive Services Task Force, 2002b, 2008a). We used the 2008–2009 recommendations to inform the upper limit of the recommended screening age of 75 years for breast and colon cancer, as the dialogue about the questionable benefit of cancer screening in the elderly started well before the recommendations formally changed in 2008–2009 (Briss et al., 2004; Walter and Covinsky, 2001). The value of prostate cancer screening in general was questioned in 2002 and 2008, especially in men over age 75 years (U.S. Preventive Services Task Force, 2002c, 2008b). The 2003 recommendation for cervical cancer screening already recommended against screening women over age 65 years (U.S. Preventive Services Task Force, 2003). The reminder systems built into our system's primary care practices from 2003 onwards also used 75 as an upper age limit for screening reminders for breast, colon, and prostate cancer and 65 for cervical cancer.

## 2.5. Statistical analyses

Follow-up for preventive cancer screening began at initiation of HD and continued until kidney transplantation, death as determined by USRDS data, or completion of 2 years of HD. A secondary analysis extended follow-up until 5 years of HD. Baseline characteristics and covariates were summarized by cancer screening type using descriptive statistics. The Charlson score was dichotomized to  $< 6$  or  $\geq 6$ , which is associated with higher mortality (Fried et al., 2001; Rattanasompattikul et al., 2012; van Manen et al., 2002). The Charlson score was also analyzed continuously using smoothing splines to allow for non-linear effects (Fig. 2). Cox proportional hazards regression was used to determine the impact of primary care on risk of each type of cancer screening with adjustment for race, sex (for colon cancer screening only), age, Charlson score, primary care use, meeting USPSTF age cutoff, and diabetes as the primary cause of ESRD. We attempted to do a sensitivity analysis based on prior cancer diagnosis in the CMS form 2728, but this was limited by missing data and absence of billing claims predating dialysis initiation. Transplant candidacy also was not included in the primary analysis due to missing data on the CMS 2728 form. Cross-checking with our network's transplant database did not solve this problem. However, secondary analyses were performed in the subset of patients with available transplant candidacy data and also among patients meeting USPSTF sex and age cutoffs for each type of cancer screening. Due to changes in the USPSTF recommendations during the time period of interest, calendar time trends in screening rates were examined, but minimal changes in screening rates were observed by calendar year (data not shown). Screening event rates were estimated with adjustment for competing risks of death and transplant using methods by Gray (1988). Analyses were performed using SAS version 9.3 (SAS Institute, Cary, NC, USA) and R 3.1.1 (R Foundation for Statistical Computing, Vienna, Austria).

## 3. Results

The cohort included 2512 patients (Fig. 1), 60% males, 90% white, with a median age at HD start of 65 years (Interquartile range [IQR]: 53, 74) and a median Charlson score of 5 (IQR: 2, 7). Overall in the first 2 years following dialysis initiation, 16% (SE = 0.7) were screened for colon cancer, 36% (SE = 1.5) of women were screened for breast cancer and 17% (SE = 1.2) for cervical cancer, and 13% (SE = 0.9) of men were screened for prostate cancer (Table 2). After 4 years 21% (SE = 0.8) had been screened for colon cancer, 44% (SE = 1.6) for breast, 23% (SE = 1.3) for cervical, and 18% (SE = 1.0) for prostate cancer.

### 3.1. Screening rates by comorbidities

Patients with a Charlson score  $\geq 6$  were more likely to have breast, colon, and prostate cancer screening but less likely to have cervical cancer screening (Tables 3 and 4, Fig. 2). Additionally, when the Charlson score was analyzed as a continuous variable, the likelihood of screening increased with a higher number of comorbidities. Patients who had a Charlson score  $\geq 6$  were also more likely to see primary care providers (ChiSq  $P < 0.001$ ) Patients meeting USPSTF age cutoff received higher rates of breast, prostate, and cervical cancer screenings compared to those who did not (Table 2). Those with diabetes as the ESRD cause had no difference in cancer screening rates compared to patients without diabetes, and did not influence results. The relationship between age, Charlson score, and incidence of cancer screening was further examined (Table 3 and Fig. 2). The cumulative incidence for receiving cancer screening by 2 years after initiating HD for those meeting USPSTF age cutoff did not differ by Charlson score and age group for breast and prostate cancer screening, but cervical screening rates increased with increasing Charlson scores in women age 18–49 years (Fig. 2). The Charlson score remained a significant

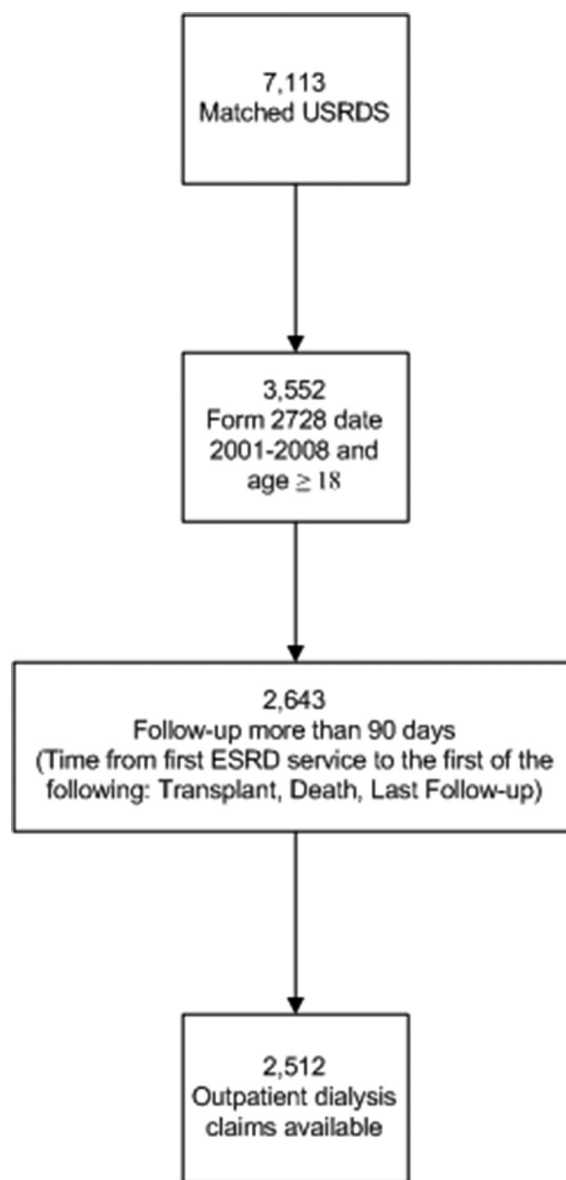


Fig. 1. Derivation of cohort.

Individual patient identifiers were sent to the United States Renal Data System for cohort matching, the cohort was further restricted to meet inclusion criteria for our study.

predictor for increased colon cancer screening. Adjusted screening rates show that women meeting USPSTF cutoff for breast cancer screening who had a Charlson score  $\geq 6$  still had high screening rates (49.7% for those aged 50–65 years and 48.0% for those aged 66–74 years). The highest screening rate of 51.5% occurred in women aged 66–74 years with a Charlson score  $< 6$ .

### 3.2. Screening rates by provider type

Patients cared for by primary care providers had higher cancer screening rates for breast (Hazard Ratio [HR] 1.83, Confidence Interval [CI]: 1.15, 2.92;  $P = 0.001$ ) and colon cancer (HR 1.58, CI: 1.08, 2.32;  $P = 0.019$ ) (Table 4). A trend toward higher screening rates was also noted for cervical (HR 1.85, CI: 0.97, 3.52;  $P = 0.06$ ) or prostate cancer (HR 1.52, CI 0.92, 2.51;  $P = 0.11$ ) screening, but these did not reach statistical significance in either univariable or multivariable models. Similarly, absolute rates of cancer screening were higher among patients cared for by primary care providers than those who were not (Fig. 3). Cumulative incidence rates of screening were higher among

**Table 2**  
Patient characteristics by screening test received within two years of dialysis initiation 2001–2010 in a Midwest dialysis network. (Thorsteinsdottir and US Renal Data)

	Breast		Cervix		Colon		Prostate	
	N	Screened	N	Screened	N	Screened	N	Screened
Overall	1010	361 (35.7%)	1010	171 (16.9%)	2512	413 (16.4%)	1502	188 (12.5%)
Race								
Non-White	117	32 (27.4%)	117	21 (17.9%)	257	22 (8.6%)	140	16 (11.4%)
White	893	329 (36.8%)	893	150 (16.8%)	2255	391 (17.3%)	1362	172 (12.6%)
Sex								
Female	1010	361 (35.7%)	1010	171 (16.9%)	1010	172 (17.0%)	1502	188 (12.5%)
Male					1502	241 (16.0%)		
Age (years)								
18–49	202	40 (19.8%)	202	44 (21.8%)	481	33 (6.9%)	279	17 (6.1%)
50–65	336	133 (39.6%)	336	79 (23.5%)	780	102 (13.1%)	444	63 (14.2%)
66–75	281	136 (48.4%)	281	44 (15.7%)	693	136 (19.6%)	412	71 (17.2%)
> 75	191	52 (27.2%)	191	4 (2.1%)	558	142 (25.4%)	367	37 (10.1%)
Charlson score								
0–5	631	209 (33.1%)	631	111 (17.6%)	1517	200 (13.2%)	886	104 (11.7%)
≥ 6	379	152 (40.1%)	379	60 (15.8%)	995	213 (21.4%)	616	84 (13.6%)
Primary cause of ESRD								
Diabetes	394	143 (36.3%)	394	73 (18.5%)	899	153 (17.0%)	505	
Other/Unknown	616	218 (35.4%)	616	98 (15.9%)	1613	260 (16.1%)	997	122 (12.2%)
Meeting USPSTF age cutoff for screening								
Yes	716	297 (41.5%)	538	124 (23.0%)	1473	238 (16.2%)	856	134 (15.7%)
No	294	64 (21.8%)	472	47 (10.0%)	1039	175 (16.8%)	279	54 (8.4%)
Primary care								
Yes	909	342 (37.6%)	909	161 (17.7%)	2194	384 (17.5%)	1285	171 (13.3%)
No	101	19 (18.8%)	101	10 (9.9%)	318	29 (9.1%)	217	17 (7.8%)

Abbreviations: ESRD, end-stage renal disease; USPSTF, United States Preventive Services Task Force.

**Table 3**  
Adjusted cumulative incidence for cancer screening at 2 years after dialysis initiation, 2001–2010 in a Midwest dialysis network, among patients eligible for screening.<sup>a</sup> (Thorsteinsdottir and US Renal Data)

Age (years)	Charlson score	Breast eligible	Cervix eligible	Colon eligible	Prostate eligible
18– < 50	< 6	20.6	19.6	–	–
18– < 50	≥ 6	53.9	21.3	–	–
50– < 65	< 6	37.2	22.1	9.7	12.4
50– < 65	≥ 6	49.7	23.8	22.4	16.4
65– < 75	< 6	51.5	–	16.3	22.4
65– < 75	≥ 6	48.0	–	21.0	15.2

Note: There were too few non-primary care patients to get reliable estimates for primary care vs. non primary care.

<sup>a</sup> Adjusted for race, sex (where applicable), and diabetes as primary cause of ESRD.

those cared for by primary care providers compared to others for all screening types (Fig. 3; Table 4). Among those meeting the USPSTF cutoff for screening, the associations between primary care and cancer screening were similar to the overall findings (breast: HR 2.26, 95% CI 1.29, 3.96; cervix: HR 2.04, 95% CI 0.99, 4.20; colon: HR 1.40, 95% CI 0.84, 2.35; prostate: HR 1.57, 95% CI 0.86, 2.87).

### 3.3. Other factors associated with screening rates

As shown in Table 4, other factors such as race, age, and Charlson score were also associated with cancer screening. Transplant candidacy information was available in 75% of patients. Transplant candidacy was appropriately associated with higher screening rates for breast (HR 1.49, 95% CI 1.16, 1.92) and cervix (HR 1.69, 95% CI 1.18, 2.43) in our multivariable models. Associations between transplant candidacy and screening did not reach statistical significance for colon (HR 1.22, 95% CI 0.93, 1.60) or prostate (HR 1.16, 95% CI 0.83, 1.64). However, a sensitivity analysis with additional adjustment for transplant candidacy

had little impact on the association between primary care and cancer screening (breast: HR 1.70, 95% CI 1.06, 2.74; cervix: HR 2.00, 95% CI 1.04, 3.85; colon: HR 1.41, 95% CI 0.90, 2.21; prostate: HR 2.00, 95% CI 1.10, 3.65).

We attempted to do a sensitivity analysis based on prior cancer diagnosis in the CMS form 2728, but this was limited by missing data and absence of billing claims predating dialysis initiation.

## 4. Discussion

Our data show that despite their poor prognoses, HD patients are routinely screened for cancer, even though most will benefit very little from these screenings (Chertow et al., 1996; Holley, 2007). Seeing a primary care clinician was associated with significantly increased screening rates for breast and colon cancer and a non-significant increase in cervix and prostate cancer screening. In the first 2 years after HD initiation, half of our female cohort aged 50–65 with a Charlson score of ≥ 6 was screened for breast cancer, and almost a quarter received cervical cancer screening. In a previous study, we had shown that patients who were seen in primary care were older, with more comorbidity, and less likely to be on the transplant list compared to those not seen in primary care; in light of this, the screening rates should have been lower for the primary care group (Thorsteinsdottir et al., 2017) if they were guided by patient's prognosis (Thorsteinsdottir et al., 2017). For those within the guideline-recommended screening age, neither age nor a higher Charlson score was consistently associated with lower screening rates. Ironically, higher Charlson scores tended to be associated with higher rather than lower screening rates, suggesting that increased exposure to healthcare providers may lead to more screening irrespective of prognosis. Transplant candidacy was associated with higher screening rates for breast and cervical screening, but did not reach statistical significance for colon and prostate. Likewise a sensitivity analysis adjusting for transplant candidacy did not meaningfully change the estimates. This indiscriminate screening suggests

**Table 4**  
Univariable and Multivariable Cox models by screening test received within two years of dialysis initiation 2001–2010 in a Midwest dialysis network.  
(Thorsteinsdottir and US Renal Data)

Characteristic	Breast		Cervix		Colon		Prostate	
	Hazard ratio (95% CI)	P value	Hazard ratio (95% CI)	P value	Hazard ratio (95% CI)	P value	Hazard ratio (95% CI)	P value
White race	1.62 (1.12, 2.32)	0.010	1.02 (0.65, 1.61)	0.94	2.28 (1.48, 3.50)	0.0002	1.24 (0.74, 2.06)	0.42
Male	NA		NA		0.94 (0.77, 1.14)	0.54	NA	
Age (years)								
18–49	0.50 (0.35, 0.71)	< 0.0001	1.00 (0.69, 1.44)	0.99	0.52 (0.35, 0.77)	0.001	0.41 (0.24, 0.69)	0.0009
50–65	Reference		Reference		Reference		Reference	
66–75	1.47 (1.16, 1.87)	0.002	0.68 (0.47, 0.99)	0.042	1.68 (1.30, 2.17)	< 0.0001	1.37 (0.97, 1.92)	0.07
> 75	0.74 (0.53, 1.02)	0.06	0.09 (0.03, 0.24)	< 0.0001	2.32 (1.80, 3.00)	< 0.0001	0.75 (0.50, 1.12)	0.16
Charlson score ≥ 6	1.50 (1.22, 1.85)	0.0002	1.00 (0.73, 1.36)	0.98	1.87 (1.54, 2.27)	< 0.0001	1.34 (1.01, 1.79)	0.04
Primary cause of ESRD is diabetes	1.05 (0.85, 1.30)	0.63	1.16 (0.86, 1.57)	0.33	1.03 (0.84, 1.25)	0.810	1.01 (0.75, 1.36)	0.95
Meeting USPSTF screening cutoff	2.03 (1.55, 2.66)	< 0.0001	2.13 (1.53, 2.95)	< 0.0001	0.93 (0.76, 1.13)	0.45	1.98 (1.44, 2.71)	< 0.0001
Primary care	1.98 (1.25, 3.15)	0.004	1.59 (0.84, 3.01)	0.16	1.83 (1.25, 2.67)	0.002	1.58 (0.96, 2.60)	0.07
Multivariable regression								
White race	1.45 (1.00, 2.09)	0.048	1.31 (0.82, 2.08)	0.26	2.08 (1.35, 3.21)	0.0009	1.12 (0.67, 1.88)	0.66
Male	NA		NA		0.92 (0.75, 1.12)	0.40	NA	
Charlson score ≥ 6	1.45 (1.16, 1.81)	0.001	1.35 (0.95, 1.92)	0.10	1.79 (1.46, 2.20)	< 0.0001	1.26 (0.93, 1.70)	0.14
Primary cause of ESRD is diabetes	0.90 (0.72, 1.12)	0.34	1.00 (0.73, 1.38)	0.98	0.89 (0.72, 1.09)	0.26	0.86 (0.63, 1.18)	0.36
Meeting USPSTF age cutoff for screening	2.08 (1.59, 2.73)	< 0.0001	2.76 (1.91, 3.97)	< 0.0001	0.87 (0.71, 1.05)	0.15	1.97 (1.43, 2.71)	< 0.0001
Primary care	1.83 (1.15, 2.92)	0.011	1.85 (0.97, 3.52)	0.06	1.58 (1.08, 2.32)	0.019	1.52 (0.92, 2.51)	0.11

Abbreviations: ESRD, end-stage renal disease; USPSTF, United States Preventive Services Task Force age- and gender-based cutoff for screening.  
Note: USPSTF (United States Preventive Services Task Force) age cutoff for screening of prostate cancer and colon cancer is age 50–75, which coincides exactly with our defined age groups, so separating hazard ratio estimates for meeting USPSTF age cutoff for screening is not possible in these multivariable models.

either misaligned incentives for screening or lack of acknowledgement and acceptance of the poor prognosis and lack of benefit in this population group (Wachterman et al., 2013). Indeed dialysis patients tend to overestimate their long term prognosis.

Our screening rates were similar to those reported in the 2001 and 2002 USRDS data reports for breast and cervical cancer screening (U. S. Renal Data System, 2001, 2002). Current trends are unknown given that the USRDS has not reported more recent cancer screening rates. Our observed rates are also similar to those previously reported in the first year after HD initiation (Winkelmayer et al., 2002). The screening rates in the present study are lower than those reported in the 2009 National Health Interview Survey (NHIS) (Smith et al., 2009) as well as those previously reported for breast cancer screening in our general regional population (Chaudhry et al., 2007), suggesting that the providers at our institution do to some extent integrate the HD patient's prognosis into the decision to screen.

Several factors may play a role in the observed rates. The longitudinal nature of the patient and provider relationship spans many years often with slow clinical decline. Our center has a long tradition of offering patients thorough annual exams with an emphasis on preventive services. The initiation of HD is a significant milestone in a patient's life, the prognostic impact of which may take time to fully be accepted by the patient and physician. It is also possible that patients seeing primary care providers reminded and measured on preventive screening rates, were more likely to get screened, despite being older and sicker than those not seen in primary care. At the time of the study, primary care providers at our center were accountable to meet state-determined metrics, which included cancer screening based on USPSTF recommendations for the general population. Starting in 2003 the providers and their empaneled patients were also exposed to electronic reminder systems (Chaudhry et al., 2007; Rajeev Chaudhry et al., 2012a, 2012b). These interventions were shown to affect screening rates, but were not designed to be sensitive to the patient's clinical status or prognosis beyond age (Chaudhry et al., 2007; R. Chaudhry et al., 2012a, b). This could have influenced our findings of higher screening rates among patients seeing primary care providers. The initial efforts were focused on mammograms, which may have indiscriminately influenced the breast cancer screening rates during the

period of study and possibly explain the difference in screening rates for breast cancer vs. other cancer screening. In our study, colon cancer screening rates were not higher for those meeting USPSTF cutoff. Colonoscopy is likely the test most sensitive to confounding by other test indications as opposed to screening.

Patients tend to overestimate benefit and underestimate the harm associated with screening, tests, and treatments (Hoffmann and Del Mar, 2015). They also overestimate their own survival rates (Wachterman et al., 2013). This optimism bias and preference for preventive care may have played a role. Physicians are also likely to overestimate their patients' survival (Christakis and Lamont, 2000). Whether misaligned performance metrics, patient preference, or lack of appreciation for the patients' poor prognosis influenced these high screening rates is uncertain. Breast cancer screenings were more commonly done than other screening tests. After decades of health awareness campaigns to emphasize the importance of breast cancer screening, women may be reluctant to opt out of breast cancer screening even as evidence accumulates on its unfavorable risk/benefit.

It is important to monitor the effect if any of the Choosing Wisely campaign in the rates of cancer screening in this population. While the nephrology specific guidelines specifically addressing the lack of efficacy of cancer screening for dialysis patients, the general internal medicine choosing wisely campaign also includes a recommendation against cancer screening in populations with limited life expectancy. While this campaign has been quite visible among clinicians, it's patient facing presence has been less effective and shrouded in patients fear of masked rationing in the current health care environment. Given patients overestimation of their current prognosis and nephrologists hesitancy to discuss prognosis with their patients, it may prove hard to change practice (Wachterman et al., 2013). Electronic reminder systems will need to reflect these recommendations in their preventive services prompts, especially those facing patients.

This study has several limitations. The biggest limitation is potential for confounding by indication for the cancer screening tests. Thus, some of the tests may have been done for diagnostic purposes as opposed to screening purposes, calling for caution in the interpretation of findings. We attempted to do a sensitivity analysis based on prior cancer diagnosis in the CMS form 2728, but this was limited by missing data and

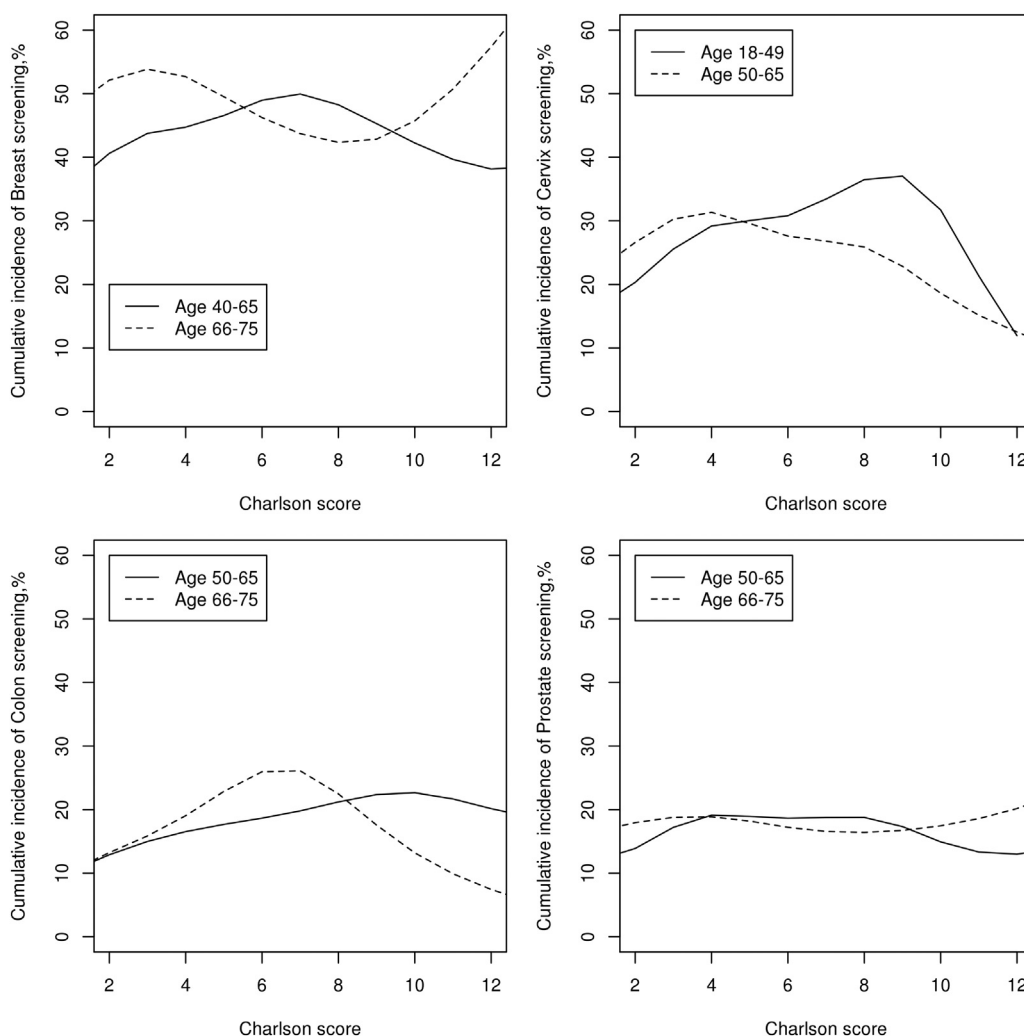


Fig. 2. Cumulative incidence for receiving cancer screening by 2 years after initiating dialysis, 2001–2010 in a Midwest dialysis network, for those meeting USPSTF age cutoff according to Charlson score and age group by screening test adjusted for sex (colon only), race, primary care and diabetes as primary cause of ESRD.

absence of billing claims predating dialysis initiation. Doing so would have allowed exclusion of patients with prior cancer diagnoses or hysterectomy. Secondly, this is a single network experience, and ascertainment bias may have occurred due to the restriction of our cohort to those initiating dialysis within our network. Limiting the cohort to patients with Medicare as primary payer also causes younger patients to be disproportionately excluded from the cohort limiting generalizability for those age groups. In addition, our primary care providers had a unique decision support system as described above. Thus, the observed findings may not be representative of other geographical locations with different patient and clinician mix. While previous studies have shown our local population to mirror that of the US (St Sauver et al., 2012), the race distribution of our dialysis patients is very different from the overall USRD population, i.e., 5.5% black vs. 28.0% black in the overall population (United States Renal Data System, 2014). By using Medicare data, we overcome some of these limitations inherent to a single-center experience, as USRD captures all services for these patients irrespective of location allowing for accurate reflection of the total services used. Additionally, our study has the limitations of observational retrospective cohort studies in that the observations represent associations and not causality between predictors and outcomes. Finally there are inherent weaknesses related to working with USRD Medicare claims data. Only 50% and 80% of respectively incident and prevalent HD populations have Medicare insurance (Foley and Collins, 2013). Utilization patterns may differ for those patients

who have private insurance or Medicare Advantage that are not captured in this paper (Foley and Collins, 2013). The Medical Evidence Report (form CMS-2728) is not always complete (Foley and Collins, 2013). By excluding the first ninety days after HD initiation as recommended by the USRD researchers guide (United States Renal Data System, 2013a), we gain a stable HD population, but potentially miss some information about the period of transition to HD as well as the younger privately insured population that may continue to be covered through their private insurance.

### 5. Conclusion

Dialysis patients seen in primary care were more likely to get breast and colon cancer screening despite being on average older with more comorbid illness and less likely to be listed for kidney transplant than those patients who had no primary care contact. Screening rates overall were lower than that for the general US population, yet half of women over age 65 received breast cancer screening within two years of dialysis initiation. Further research is needed to better understand the drivers of cancer screening in the ESRD population and other high-risk groups and whether indiscriminate performance metrics or quality reporting play a role. It is also important to monitor the effect if any of the Choosing Wisely campaign. This will allow us to develop effective strategies to educate providers and patients as to the balance of risks and benefits of cancer screening and promote evidence-based shared

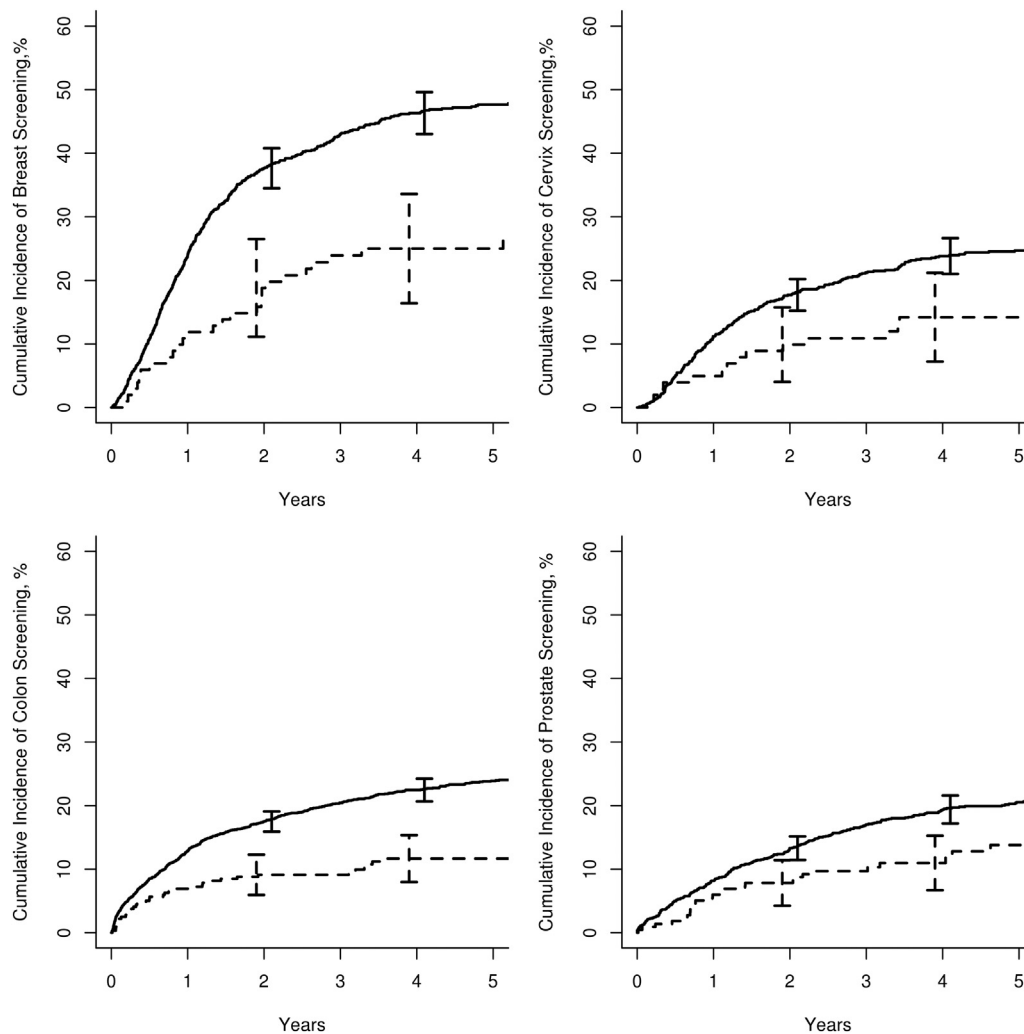


Fig. 3. Cumulative incidence for receiving screening test after initiating dialysis, 2001–2010, in a Midwest dialysis network, Primary Care (solid line) vs No Primary Care (dashed line), by screening test.

decision making and high-value care.

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**Disclosures**

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*This data was presented in poster format at the ASN kidney week 2014. The corresponding and senior authors had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.*

**Competing interest statement**

The authors have no competing interests to report.

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