Supplementary Online Content

This supplementary material has been provided by the authors to give readers additional information about their work.

eMethods. Comorbidities, Market Competition, Variance Decomposition Analysis, Dialysis Facility Location, and Median Income

Identifying Comorbidities:

We defined comorbid conditions using ICD-9 codes and procedure codes from ≥1 inpatient or ≥2 outpatient encounters separated by at least one day in the three-to-six months prior to (but not including) the index date (December 31, 2014). A modified Charlson score was obtained using the following algorithm:

1) 1 point was assigned to the following comorbidities: peripheral vascular disease, dementia, chronic lung disease, rheumatological disease, peptic ulcer disease, diabetes.
2) 2 points were assigned to the following conditions: myocardial infarction, congestive heart failure, cerebral vascular disease, liver disease, cancer, HIV, and hemiplegia.

Cerebrovascular disease included diagnoses of central nervous system bleed, central nervous system vascular disease, stroke, or transient ischemic attack. Peptic ulcer disease included patients with diagnosed peptic ulcer disease along with diagnosed gastrointestinal bleed. Myocardial infarction included patients diagnosed with an acute myocardial infarction, a history of a coronary bypass or percutaneous coronary intervention, and a history of unstable angina. Heart failure included patients with diagnosed heart failure along with valvular disease. Chronic lung disease included patients with diagnosed lung disease or pulmonary hypertension. We assumed a diagnosis of liver disease was moderate or severe. Because of difficulty ascertaining complications from diabetes using claims, we assigned 1 point for all diagnoses of diabetes.

In an effort to retain as much information as possible, we combined some elements of the modified Charlson comorbidity index with the original Charlson comorbidity index. Specifically, our calculation deviated from the modified Charlson morbidity index described by Hemmelgarn et al. in the following ways[1]:

1) Since we did not have reliable information on the type of cancer, we assigned 2 points to a diagnosis of cancer (which is what the original Charlson comorbidity index assigns for neoplasia), and did not include separate point scores for lymphoma or metastatic disease.
2) We assigned 2 points for hemiplegia, which is what is used in the original Charlson comorbidity index (the modified index did not include hemiplegia due to insufficient data).
3) The modified Charlson comorbidity index did not include HIV due to insufficient data. Because we had information about HIV, we included it in our comorbidity index. However, the original Charlson comorbidity index assigned "AIDS" a value of 6. Since that time, mortality associated with HIV has declined substantially in the general population and among patients with end-stage renal disease. In one cohort, the relative risk of death declined by 78% over more than two decades.[2] To account for this decline in relative risk of death, we assigned patients with a diagnosis of HIV 2 points.

Calculating Metric of Market Competition:

The equation used to calculate Herfindahl-Hirschman Index (HHI) is as follows:

$$HHI_{hospital\ service\ area} = \sum_{i=1}^{n} s_i^2$$

Where S_i represents the proportion of patients living in a Hospital Service Area (HSA) receiving dialysis at the ith firm in the HSA.

We adapted a model of market competition that is based off of HSAs but that also accounts for some patients' decisions to receive dialysis in different HSAs. Specifically, we used the following steps to calculate a measure of observed HHI for each dialysis facility based on where patients received dialysis on December 31, 2014:

1. Calculate a "first-stage" competition measure for each HSA where patients live (using the equation above), based on market shares of firms where patients living in each HSA choose to dialyze. In this stage all patients residing in a given HSA define the "market" for each firm-HSA pair. Firms do not have to be located in the same HSA where patients reside, and a given dialysis facility can be included in the calculation of HHI for multiple HSAs if patients from multiple HSAs dialyze at that facility. For the purposes of this step, facilities owned by the same dialysis chain were considered to be one firm, reflecting the likelihood that they do not directly compete against one another for patients due to shared ownership. The market share for a firm in an HSA is equal to the proportion of patients in that HSA who choose to dialyze at that firm. For example, in an HSA where half of the patients receiving dialysis went to one of four facilities owned by one firm and the other half of patients went to one of two facilities owned by a second firm, the market share would be considered to be split evenly across the two firms, with an HHI for that HSA of $0.5^2 + 0.5^2 = 0.5$.

2. Calculate a dialysis-facility-level measure of competition, using a weighted average of the "first-stage" HSA-level HHIs for patients who dialyze at each facility. This measure is calculated for each separate facility, regardless of which firm owns a facility. It assumes that facilities compete for patients within HSAs and can discriminate upon patients living in different HSAs when competing against rival firms.

In summary, this dialysis facility-specific index represents a weighted average of competition indices for patients that each facility treats. This index of market competition assumes that facilities can discriminate upon patients residing in different HSAs when determining how much competition they face. It also assumes that facilities owned by the same organization can modify their practices based on the amount of competition that they face locally. Because this index is based on where patients receive dialysis on one day of each year, it does not incorporate information about patients who switch dialysis units during a year.

Variance Decomposition Analysis:

In a variance decomposition analysis, we determined the amount of the total population variance explained by different categories of observable characteristics and Hospital Referral Region (HRR) random affects as determined by the R^2 from different regression models, where R^2 is represented by the following equation:

$$R^2 = \frac{1 - [\sum_{ij}(Y_{ij} - \hat{Y}_{ij}|X_{ij}; m)]}{\sum_{ij}(Y_{ij} - \bar{Y})^2]}$$

In our case, $\hat{Y}_{ij}|X_{ij}; m$ illustrated above is the estimated patient experience score for the ith facility in the jth hospital referral region according to the model 'm' that includes different combinations of patient, facility and geographic characteristics in addition to hospital HRR random effects.

This method of decomposing variance in the context of mixed regression models was described by Brookhart et al.[3] as well as others. It involves using a series of nested mixed regression models to estimate variance components. In order to ensure that all models would share the same overall variance, we only included mixed regression models with Hospital Referral Region (HRR) random effects.

To conduct the variance decomposition analysis, we first assessed a mixed linear regression model with ICH-CAHPS scores as the outcome, an intercept, and HRR random effects. This initial "intercept-only" model did not include any other covariates and is illustrated in **Equation 1** below.

Intercept only model: $\qquad ICH - CAHPS_{i,j} = \alpha_{00} + \pi_{0,j} + \varepsilon_{i,j}$ $\qquad$ *(1)*

where ICH-CAHPS$_{i,j}$ represents ICH-CAHPS scores in the ith facility and jth Hospital Referral Region (HRR); α_0 is the intercept; π_j is the random effect of the facility with mean 0 and variance Var$_{HRR.1}$ (the variance due to between HRR differences), and ε_{ij} is the residual with variance Var$_{Residual.1}$.

The intercept only model yielded estimates of the variance associated with the HRR random effects and the variance associated with the residuals (**See table S1**). We used these estimates to identify the total variance in the population within the mixed regression framework using **Equation 2** below:

Relationship among variances: $\qquad Var_{total.1} = Var_{HRR.1} + Var_{residual.1}$ $\qquad$ *(2)*

The intercept-only model also enabled us to estimate the R^2 associated with geographic random effects prior to inclusion of observable fixed effects using **Equation 3** below:

Estimating R$_2$ for random effects: $\quad R^2_{HRR.1} = (Var_{HRR.1})/Var_{total.1}$ $\qquad$ *(3)*

We then ran a series of nested mixed effect models using ICH-CAHPS scores as the outcome of interest including observed characteristics as fixed effects and HRR random effects. **Equation 4** below illustrates the mixed effect model. Each model varied based on what fixed effects comprised X.

Mixed effect model: $$ICH - CAHPS_{i,j} = \alpha_{00} + \beta X_{i,j} + \pi_{0,j} + \varepsilon_{i,j} \qquad (4)$$

where X_{ij} represents observed characteristics in the *i*th facility and *j*th HRR.

In each nested model, we used the variances associated with the residual and HRR random effects, in addition to the total variance in the population ($Var_{total.1}$ from the intercept-only model described above) to calculate the R^2 associated with that nested model's various components. Specifically, the R^2 of the components included in each nested model 'λ' were calculated from the following **Equations 5, 6, and 7**:

Nested linear mixed models:

$$R^2_{total.\lambda} = (Var_{total.1} - Var_{Residual.\lambda})/Var_{total.1} \qquad (5)$$

$$R^2_{HRR.\lambda} = Var_{HRR.\lambda}/Var_{total.1} \qquad (6)$$

$$R^2_{fixed\ effects.\lambda} = (Var_{total.1} - Var_{Residual.\lambda} - Var_{HRR.\lambda})/Var_{total.1} \qquad (7)$$

$R^2_{fixed\ effects}$ refers to the amount of the total population variance explained by observed patient, dialysis facility, and geographic fixed effects included in each nested model 'λ'. These fixed effects varied with each model, depending on what set of characteristics we included in a given model. R^2_{HRR} describes the amount of total population variance explained by HRR random effects in each nested model. This value varied for each nested model, as it was obtained after accounting for the explanatory value of fixed effects.

The three nested regression models are described below. Each model controlled for HRR random effects.

- 1st model: Controlled for all observed patient, facility, and geographic characteristics. The other models include fixed effects that are nested within the fixed effects included in this model. Results from this first model that we used for variance decomposition (listed in **Table S1**) are the $R^{2\_total}_{A+B}$, $R^{2\_HRR}_{A+B}$, $R^{2\_FixedEffects}_{A+B}$.

- 2nd model: Controlled for observed patient characteristics (referred to as "A"). Results from this second model that we used for variance decomposition (listed in **Table S1**) are the $R^{2\_total}_{A}$, $R^{2\_HRR}_{A}$, $R^{2\_FixedEffects}_{A}$.

- 3rd model: Controlled for observed facility and geographic characteristics (referred to as "B"). Results from this third model that we used for variance decomposition (listed in **Table S1**) are the $R^{2\_total}_{B}$, $R^{2\_HRR}_{B}$, $R^{2\_FixedEffects}_{B}$.

eTable. Results of Nested Regression Models Used in Variance Decomposition Analysis

| Model Name	Equation for Model	Variance of HRR Random Effect	Variance of Residual	Total Variance	R^2 HRR	R^2 (Fixed Effects)	R^2 (Model)	Percent of total explained variance
Intercept-only	$ICH\text{-}CAHPS_{i,j} = \alpha+\pi_j + \varepsilon_i$	11.2	57.9	**69.2**	0.16	0.00	0.16	60.0%
Observed patient characteristics	$ICH\text{-}CAHPS_{i,j} = \alpha+ \beta_iA + \pi_j + \varepsilon_i$	6.9	53.8		0.10	0.12	0.22	81.9%
Observed facility and geographic characteristics	$ICH\text{-}CAHPS_{i,j} = \alpha+ \lambda_iB + \pi_j + \varepsilon_i$	9.3	52.2		0.13	0.11	0.25	90.7%
Primary model: observed patient, facility, and geographic characteristics	$ICH\text{-}CAHPS_{i,j} = \alpha+ \beta_iA + \lambda_iB + \pi_j + \varepsilon_i$	6.4	50.5		0.09	0.18	0.271	100.0%

Note: Subscripts 'i' and 'j' refer to facility 'i' and Hospital Referral Region (HRR) 'j'. The variance of the HRR effect is calculated after accounting for explanatory value of "fixed effects". In this case, "fixed effects" refers to observable patient characteristics ("X") or observable dialysis facility and geographic characteristics ("Y"). The amount of total explained variance accounted for by each R^2 is equal to the $R^2/0.27$. The last column illustrates the total variance explained for each nested model.

Calculations involving dialysis facility location:

We used the three sets of R^2 estimates ("A", "B", and "A+B") described above to calculate the size of each space in a Venn diagram (exemplified in **Figure S1**), which we then used to identify the amount of total variance explained by each component of our analysis. The following equations illustrate how results listed in **Table S1** (above) were used to estimate the size of each space in a Venn diagram exemplified in **Figure S1**, where **'A'** represents variance explained by observable patient characteristics, **'B'** represents variance explained by observable facility and geographic characteristics, and **'C'** represents variance explained by HRR random effects:

- **'C'** = $[R^2_{HRR.1}]$
- **'A U B U C'** = $[R^{2\_total}_{A+B}]$
- **'A U B'** = $[R^{2\_FixedEffects}_{A+B}]$
- **'A U C'** = $[R^{2\_total}_{A}]$
- **'A'** = $[R^{2FixedEffects}_{A}]$
- **'B U C'** = $[R^{2\_total}_{B}]$
- **'B'** = $[R^{2\_FixedEffects}_{B}]$
- **'A ∩ B' = A + B – (A U B)**
- **'A ∩ C' = A + C – (A U C)**
- **'B ∩ C' = B + C – (B U C)**
- **'A ∩ B ∩ C' = -1/2*[(A + B + C) – (A U B U C) – [(A ∩ B) – (A ∩ C) – (B ∩ C)]**
- Independent effect of "A" = **A – (A ∩ B) – (A ∩ C) + (A ∩ B ∩ C)**
- Independent effect of "B" = **B – (A ∩ B) – (B ∩ C) + (A ∩ B ∩ C)**
- Independent effect of "C" = **C – (A ∩ C) – (B ∩ C) + (A ∩ B ∩ C)**

eFigure 1. Example Diagram Illustrating Variance Components
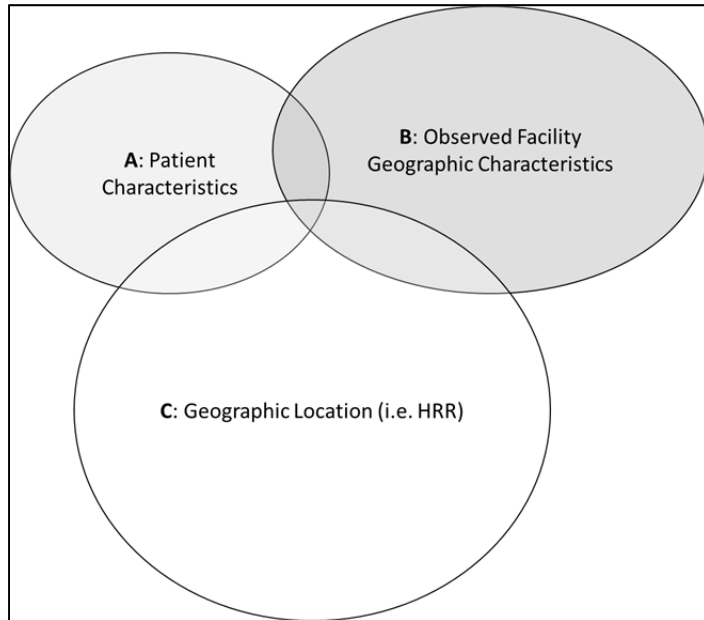
eFigure 2. Distribution of mean ICH-CAHPS Score and its 6 Components across Dialysis Facilities.
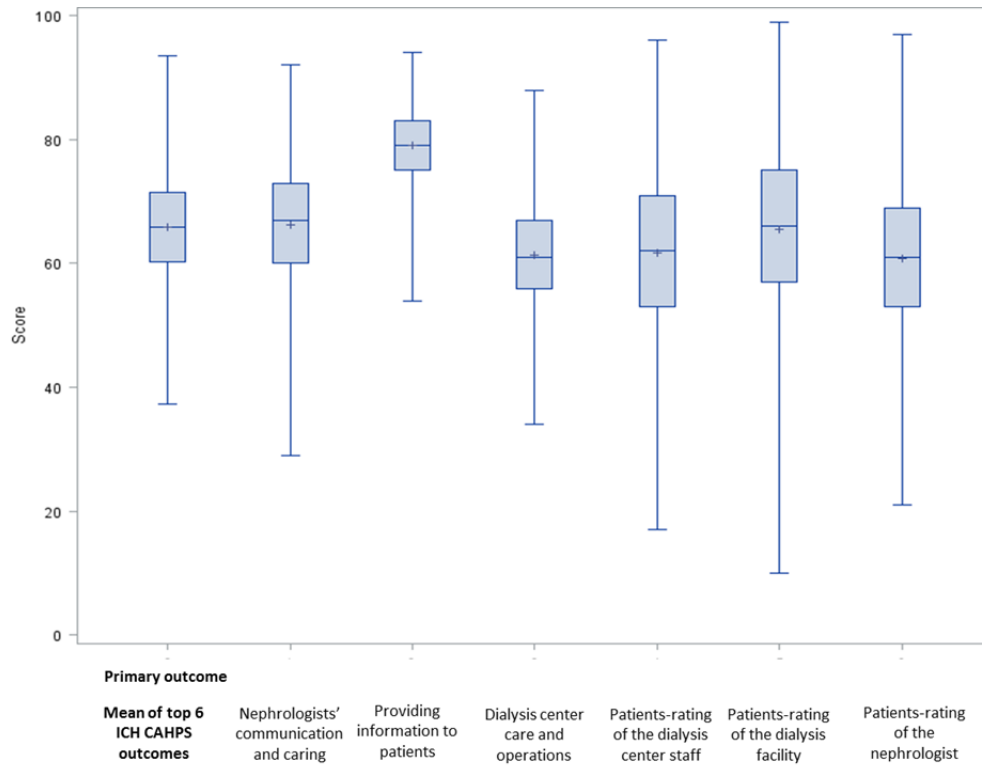
Footnote: Skewness/kurtosis – Mean top-box score: -0.09/0.04; Nephrologists' communication and caring: -0.35/0.43; Dialysis center care and operations: 0.12/-0.09; Providing information to patients: -0.37/0.13; Rating of nephrologists: -0.19/0.01; Rating of dialysis center staff: -0.16/-0.15; Rating of dialysis facility: -0.26/-0.01.

<u>Examining the association between median income and Mean ICH-CAHPS score</u>:

In our primary analysis, we found that facilities with a larger proportion of patients in the 3rd quartile of median income had slightly lower ICH-CAHPS scores. In particular, there was a reduction of 0.34 in ICH-CAHPS score (95% CI 0.18 to 0.50) for every 10% increase in the proportion of patients living in zip-codes in the 3rd quartile of median income. Due to known geographic biases associated with use of zip-code median income as a measure of socioeconomic status, we conducted a sensitivity analysis where we substituted quartile of median income with quartile of the percent of adults in a zip-code with at least a high-school education. This is also available from the U.S. Census, and is commonly used as a less biased proxy for socio-economic status. In this sensitivity analysis, we did not find a significant association between high-school education and ICH-CAHPS score. This suggests that the association between median income and ICH-CAHPS score may be due to factors other than patient socioeconomics.

We examined possible reasons why median income might be associated with ICH-CAHPS scores by examining each observed patient, facility, and geographic characteristics among patients in each quartile of median income. There were a number of trends that continued in the same direction with increasing quintile of income. For example, the proportion of patients who were White and who lived in metropolitan areas increased with each quartile of median income, while the proportion of patients who were dual-eligible for Medicaid and who were female declined with each increase in median income quartile. However, several characteristics had unique patterns that were more specific to the 3rd income quartile. For example, the third quartile of median income had more patients aged 50-64 than the 1st two and 4th quartiles of median income. And, the proportion of patients with more than two years on dialysis was constant across the first three income quartiles, but declined in the 4th quartile of income. The proportion of patients living in Micropolitan areas increased with higher income quartiles, before decreasing sharply among patients in the highest income quartile.

These non-monotonic trends across income quartiles suggest that certain patient and geographic characteristics may have complex associations with income. To the extent that our model did not sufficiently control for these associations, this could lead to erroneous observations in the association between median income and ICH-CAHPS score.

eTable 2. Characteristics of Facilities with ≥30 Patients Stratified by Missing ICH-CAHPS Score, and Facilities with < 30 Patients

	Facilities with ICH CAHPS score	Facilities without ICH CAHPS score	P Value	Facilities with fewer than 30 patients
	(n=2,933)	(n=1,254)		(n=784)
Patient characteristics				
Health-% (SD)				
co-morbidity score: ≤ 1	23.5 (9.5)	22.9 (11.6)	0.122	23.5 (18.0)
co-morbidity score: 2-3	23.6 (7.0)	22.7 (9.5)	0.005	22.8 (15.2)
co-morbidity score: 4-6	32.3 (7.7)	32.8 (10.5)	0.109	32.2 (16.4)
co-morbidity score: ≥ 7	20.7 (9.1)	21.6 (11.6)	0.015	21.4 (17.2)
on dialysis for <1 year	11.4 (6.3)	12.5 (8.9)	<.001	14.6 (14.7)
on dialysis for 1 year	14.0 (6.3)	14.2 (8.1)	0.465	15.9 (13.6)
on dialysis for 2 years	12.1 (5.4)	12.5 (7.6)	0.151	12.7 (11.5)
on dialysis for >=3 years	62.4 (11.2)	60.8 (14.2)	<.001	56.8 (19.7)
immobile	5.4 (4.2)	6.2 (6.1)	<.001	6.2 (9.8)
alcohol or drug use	6.3 (4.6)	6.6 (5.8)	0.116	5.6 (8.6)
Demographic, race and ethnicity-% (SD)				
female	44.1 (8.3)	44.7 (11.7)	0.132	44.7 (17.9)
< 50 years old	18.2 (7.7)	18.5 (10.4)	0.486	18.8 (19.8)
50-64 years old	34.2 (9.1)	33.5 (11.5)	0.067	30.2 (16.3)
65-74 years old	26.0 (7.3)	26.5 (10.9)	0.195	27.2 (16.4)
≥75 years old	21.6 (10.1)	21.6 (11.9)	0.976	23.8 (16.8)
White	55.9 (29.4)	60.3 (30.1)	<.001	75.1 (29.4)
Black	39.3 (30.2)	35.3 (30.4)	<.001	20.8 (28.4)
Asian	3.9 (9.6)	2.7 (7.0)	<.001	2.1 (7.7)
American Indian	0.8 (5.4)	1.6 (8.4)	0.001	2.0 (9.6)
Other race	0.2 (0.6)	0.1 (0.8)	0.564	0.0 (0.5)
Hispanic ethnicity	13.0 (20.6)	10.1 (17.7)	<.001	7.4 (17.1)
Socioeconomic-% (SD)				
eligible for Medicaid	46.6 (16.5)	46.6 (17.2)	0.976	42.7 (22.0)
In 1st quartile of household income	24.3 (26.6)	22.0 (26.8)	0.010	15.7 (25.2)
In 2nd quartile of household income	24.9 (22.3)	27.4 (25.3)	0.002	29.2 (30.0)
In 3rd quartile of household income	25.2 (21.6)	26.1 (24.5)	0.242	30.0 (29.5)
In 4th quartile of household income	25.6 (28.8)	24.5 (29.3)	0.251	25.1 (33.0)
Facility and geographic characteristics				
Facility Size-%			<.001	
<60 patients	17.5	80.2		
60-90 patients	36.8	17.0		
>90 patients	45.8	2.8		

			<.001	
Facility Location-%			<.001	
Metropolitan	83.9	72.1		52.9
Micropolitan	11.9	16.9		20.2
Small town	3.5	9.3		22.3
Rural	0.6	1.8		4.6
Full-time nurses per 100 patients- # (SD)	6.0 (2.4)	7.1 (3.9)	<.001	16.5 (72.9)
Full-time techs per 100 patients- # (SD)	1.5 (2.5)	1.7 (3.7)	0.088	3.2 (8.5)
Dialysis chairs per 100 patients- # (SD)	24.0 (7.5)	33.6 (12.2)	<.001	67.4 (83.7)
% with private insurance- # (SD)	4.4 (2.9)	4.6 (3.6)	0.162	4.7 (5.8)
Free-Standing facility-%	96.1	94.1	0.004	84.9
Large Dialysis Organization-%	68.6	68.1	0.768	59.9
For-profit facility-%	88.6	87.2	0.172	77.6
Evening shift available-%	24.5	10.5	<.001	4.7
Facility market-%			<.001	
More competitive market	5.8	3.0		2.5
Moderately competitive market	53.2	53.1		41.1
Less competitive market	41.0	43.9		56.4

Note: The comparison of facilities with missing vs. non-missing ICH-CAHPS scores only includes facilities with ≥30 patients. Notably, it excludes 6 facilities reporting <30 patients in the annual facility survey that were also given an ICH-CAHPS score.

eTable 3. Regression of Missing ICH-CAHPS Score

	OR	95% CI	P Value
Patient characteristics			
Health-10% change in patients			
co-morbidity score (≤1 is reference)†			0.012 (Joint P Value)
2-3	0.96	[0.84,1.10]	0.524
4-6	1.02	[0.91,1.15]	0.715
≥ 7	1.16	[1.04,1.31]	0.010
on dialysis (≥3 years is reference)			0.232 (Joint P Value)
<1 year	0.99	[0.87,1.12]	0.857
1 year	0.88	[0.78,0.99]	0.039
2 years	0.99	[0.86,1.13]	0.842
immobile	1.30	[1.08,1.56]	0.006
alcohol or drug use	1.25	[1.04,1.51]	0.016
Demographic, race and ethnicity-10% change in patients			
female	1.03	[0.94,1.13]	0.541
age (<50 is reference)			0.06 (Joint P Value)
50-64 years old	0.86	[0.75,0.99]	0.033
65-74 years old	0.86	[0.74,0.99]	0.034
≥75 years old	0.83	[0.72,0.95]	0.009
race (White is reference)			0.282 (Joint P Value)
Black	1.03	[0.98,1.08]	0.291
Asian	1.06	[0.91,1.22]	0.453
American Indian	1.13	[0.97,1.32]	0.106
Other race	2.17	[0.60,7.86]	0.239
Hispanic ethnicity	1.05	[0.98,1.13]	0.155
Socioeconomic-10% change in patients			
eligible for Medicaid	1.11	[1.02,1.20]	0.015
household income (4th quartile is reference)‡			0.256 (Joint P Value)
1st quartile	0.97	[0.92,1.02]	0.253
2nd quartile	1.01	[0.96,1.06]	0.721
3rd quartile	0.97	[0.92,1.02]	0.191
Facility and geographic characteristics			
Facility size (>90 is reference)			
30-60 patients	67.08	[44.66,100.75]	<.001
60-90 patients	6.92	[4.72,10.16]	<.001
Facility Location (Metropolitan is reference)			
Micropolitan	0.82	[0.61,1.09]	0.165
Small town	1.05	[0.71,1.55]	0.810
Rural	0.86	[0.39,1.88]	0.708
Full-time nurses per 100 patients	1.05	[1.01,1.09]	0.007
Full-time technicians per 100 patients	1.01	[0.98,1.04]	0.365
Dialysis chairs per 100 patients	1.03	[1.02,1.04]	<.001
% with private insurance-10% change in patients	1.78	[1.32,2.38]	<.001
Free-Standing facility	0.30	[0.17,0.53]	<.001
Large Dialysis Organization	1.08	[0.87,1.35]	0.478
For-profit facility	1.22	[0.85,1.74]	0.281
Evening dialysis shift available	0.72	[0.55,0.94]	0.018
Facility market (More competitive market is reference)*			
Moderately competitive market	0.79	[0.44,1.42]	0.431
Less competitive market	0.73	[0.40,1.33]	0.302

eTable 4. Regression Results of Composite Score Components of ICH-CAHPS Survey

	Nephrologist Communication & Caring		Dialysis Center Care & Operations		Providing Information to Patients	
	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Patient characteristics						
Health-10% change in patients						
co-morbidity score (≤1 is reference)						
2-3	-0.59	[-1.16,-0.01]	-0.46	[-0.93,0.01]	-0.46	[-0.81,-0.11]
4-6	-0.17	[-0.67,0.33]	-0.3	[-0.71,0.12]	-0.13	[-0.43,0.18]
≥7	-0.21	[-0.69,0.26]	-0.09	[-0.47,0.30]	-0.25	[-0.54,0.03]
on dialysis (≥3 years is reference)						
<1 year	-0.28	[-0.84,0.29]	-0.2	[-0.66,0.27]	-0.31	[-0.65,0.04]
1 year	-0.34	[-0.87,0.18]	-0.25	[-0.68,0.19]	-0.24	[-0.56,0.09]
2 years	-0.61	[-1.21,-0.00]	-0.33	[-0.83,0.17]	-0.35	[-0.72,0.02]
immobile	-0.08	[-0.87,0.71]	0.46	[-0.19,1.12]	0.17	[-0.32,0.65]
alcohol or drug use	-0.1	[-0.90,0.69]	0.21	[-0.44,0.86]	0.46	[-0.02,0.94]
Demographic, race and ethnicity-10% change in patients						
female	0.33	[-0.07,0.73]	0.03	[-0.30,0.36]	0.15	[-0.09,0.39]
age (<50 is reference)						
50-64 years old	-0.33	[-0.92,0.26]	0.11	[-0.38,0.59]	-0.41	[-0.77,-0.05]
65-74 years old	-0.26	[-0.88,0.37]	0.12	[-0.39,0.63]	-0.09	[-0.47,0.29]
≥75 years old	-0.42	[-1.02,0.18]	0.19	[-0.30,0.69]	-0.36	[-0.72,0.01]
race (White is reference)						
Black	-0.18	[-0.39,0.03]	-0.89	[-1.05,-0.72]	-0.75	[-0.87,-0.62]
Asian	0.17	[-0.36,0.69]	-0.31	[-0.71,0.08]	-0.4	[-0.68,-0.11]
American Indian	-0.79	[-1.53,-0.06]	-1.1	[-1.68,-0.52]	-0.45	[-0.88,-0.03]
Other race	5.33	[0.24,10.42]	2.39	[-1.82,6.59]	-0.19	[-3.32,2.94]
Hispanic ethnicity	-0.07	[-0.37,0.23]	-0.26	[-0.49,-0.03]	-0.46	[-0.62,-0.29]
Socioeconomic-10% change in patients						
eligible for Medicaid	-0.07	[-0.41,0.27]	0.18	[-0.09,0.46]	0.04	[-0.16,0.24]
household income (4th quartile is reference)						
1st quartile	-0.16	[-0.39,0.06]	-0.03	[-0.21,0.15]	0.1	[-0.03,0.23]
2nd quartile	-0.19	[-0.38,0.01]	-0.01	[-0.16,0.15]	0.1	[-0.02,0.22]
3rd quartile	-0.36	[-0.55,-0.16]	-0.26	[-0.42,-0.10]	0	[-0.11,0.12]
Facility and geographic characteristics						
Facility Size (>90 is reference)						
<60 patients	2.53	[1.42,3.65]	2.94	[2.02,3.86]	1.36	[0.68,2.05]
60-90 patients	1.07	[0.30,1.84]	1.27	[0.64,1.91]	0.61	[0.14,1.09]
Facility Location (Metropolitan is reference)						
Micropolitan	-0.41	[-1.60,0.78]	-0.74	[-1.71,0.23]	0.3	[-0.42,1.02]
Small town	1.58	[-0.34,3.49]	1.77	[0.20,3.34]	1.36	[0.19,2.52]
Rural	-2.57	[-6.58,1.44]	2.7	[-0.60,6.00]	1.8	[-0.65,4.26]
Full-time nurses per 100 patients	-0.01	[-0.17,0.14]	0.26	[0.13,0.38]	0.03	[-0.06,0.12]
Full-time technicians per 100 patien	0.06	[-0.07,0.18]	-0.02	[-0.12,0.08]	0	[-0.08,0.08]
Dialysis chairs per 100 patients	-0.05	[-0.09,-0.00]	0	[-0.04,0.04]	-0.01	[-0.04,0.01]
Private insurance-10% change in pat	0.79	[-0.42,2.01]	0.57	[-0.43,1.56]	1.2	[0.46,1.93]
Free-standing facility	-1.65	[-3.80,0.50]	-2.39	[-4.14,-0.64]	-0.04	[-1.34,1.25]
Large Dialysis Organization	-1.21	[-2.01,-0.42]	-1.59	[-2.24,-0.95]	-0.25	[-0.72,0.23]
For-profit facility	-2.43	[-3.73,-1.14]	-2.52	[-3.57,-1.47]	-1.54	[-2.31,-0.76]
Evening dialysis shift available	-0.06	[-0.87,0.75]	-0.36	[-1.02,0.31]	-0.4	[-0.90,0.09]
Facility market (More competitive market is reference)						
Moderately competitive market	-0.42	[-2.54,1.69]	1.47	[-0.15,3.09]	2.96	[1.79,4.13]
Less competitive market	-1.28	[-3.49,0.93]	0.88	[-0.82,2.57]	3.08	[1.85,4.31]

eTable 5. Regression Results From Global Experience Rating ICH-CAHPS Components

	Rating of Nephrologist		Rating of Dialysis Center Staff		Rating of Dialysis Facility	
	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Patient characteristics						
Health-10% change in patients						
co-morbidity score (≤1 is reference)						
2-3	-0.32	[-1.05,0.41]	-0.87	[-1.60,-0.14]	-0.59	[-1.34,0.17]
4-6	-0.15	[-0.79,0.50]	-0.58	[-1.22,0.06]	-0.59	[-1.25,0.07]
≥ 7	0.26	[-0.35,0.87]	-0.05	[-0.64,0.55]	0.16	[-0.46,0.77]
on dialysis (≥3 years is reference)						
<1 year	-0.29	[-1.01,0.43]	-0.39	[-1.11,0.33]	-0.14	[-0.88,0.61]
1 year	-0.69	[-1.37,-0.02]	-0.58	[-1.26,0.09]	-0.7	[-1.39,-0.01]
2 years	-0.43	[-1.20,0.34]	-0.6	[-1.38,0.17]	-0.39	[-1.19,0.40]
immobile	0.28	[-0.73,1.30]	0.97	[-0.05,1.99]	0.89	[-0.15,1.94]
alcohol or drug use	-0.48	[-1.50,0.54]	0.19	[-0.82,1.19]	0.09	[-0.94,1.13]
Demographic, race and ethnicity-10% change in patients						
female	0.45	[-0.06,0.96]	0.29	[-0.22,0.81]	0.34	[-0.19,0.86]
age (<50 is reference)						
50-64 years old	-0.22	[-0.98,0.53]	0.14	[-0.62,0.89]	0.1	[-0.68,0.88]
65-74 years old	-0.14	[-0.94,0.65]	0.04	[-0.75,0.84]	0.28	[-0.54,1.10]
≥75 years old	-0.25	[-1.02,0.52]	0.28	[-0.48,1.04]	0.29	[-0.49,1.07]
race (White is reference)						
Black	-0.64	[-0.91,-0.37]	-1.79	[-2.04,-1.53]	-1.56	[-1.82,-1.30]
Asian	0.09	[-0.58,0.77]	-0.76	[-1.36,-0.16]	-0.42	[-1.04,0.19]
American Indian	-1.08	[-2.02,-0.13]	-1.59	[-2.48,-0.71]	-0.91	[-1.82,0.00]
Other race	4.18	[-2.33,10.70]	0.05	[-6.50,6.59]	0.29	[-6.43,7.01]
Hispanic ethnicity	-0.05	[-0.44,0.34]	-0.43	[-0.78,-0.08]	-0.21	[-0.58,0.15]
Socioeconomic-10% change in patients						
eligible for Medicaid	-0.18	[-0.62,0.25]	0.39	[-0.03,0.81]	0.16	[-0.27,0.59]
Household income (4th quartile is reference)						
1st quartile	0	[-0.29,0.28]	-0.24	[-0.51,0.03]	-0.24	[-0.52,0.04]
2nd quartile	-0.02	[-0.28,0.23]	-0.11	[-0.35,0.14]	-0.12	[-0.37,0.13]
3rd quartile	-0.41	[-0.66,-0.16]	-0.49	[-0.74,-0.25]	-0.49	[-0.74,-0.24]
Facility and geographic characteristics						
Facility Size (>90 is reference)						
<60 patients	2.95	[1.52,4.37]	4.54	[3.10,5.97]	3.81	[2.35,5.28]
60-90 patients	1.02	[0.04,2.01]	1.28	[0.29,2.27]	1.36	[0.34,2.38]
Facility Location (Metropolitan is reference)						
Micropolitan	-1.22	[-2.75,0.30]	-0.76	[-2.26,0.75]	-1.08	[-2.62,0.47]
Small town	0.37	[-2.08,2.82]	3.2	[0.76,5.64]	2.87	[0.37,5.37]
Rural	-4.72	[-9.85,0.41]	-1.27	[-6.40,3.87]	-0.26	[-5.53,5.01]
Full-time nurses per 100 patients	-0.02	[-0.22,0.17]	0.32	[0.13,0.52]	0.34	[0.14,0.54]
Full-time technicians per 100 patient	0.04	[-0.12,0.20]	0.01	[-0.15,0.17]	-0.02	[-0.18,0.15]
Dialysis chairs per 100 patients	-0.06	[-0.11,0.00]	-0.02	[-0.08,0.03]	0.01	[-0.04,0.07]
Private insurance-10% change in pati	1.77	[0.22,3.32]	0.68	[-0.86,2.23]	1.92	[0.33,3.51]
Free-standing facility	-2.59	[-5.35,0.17]	-3.82	[-6.53,-1.11]	-3.64	[-6.42,-0.86]
Large Dialysis Organization	-1.85	[-2.87,-0.84]	-1.83	[-2.83,-0.84]	-2.66	[-3.68,-1.63]
For-profit facility	-2.86	[-4.52,-1.20]	-2.7	[-4.33,-1.08]	-3.46	[-5.13,-1.79]
Evening dialysis shift available	-0.23	[-1.26,0.81]	-0.76	[-1.79,0.27]	-1.11	[-2.16,-0.05]
Facility market (More competitive market is reference)						
Moderately competitive market	0.12	[-2.61,2.85]	2.92	[0.47,5.36]	2.57	[0.05,5.09]
Less competitive market	-0.62	[-3.47,2.23]	2.66	[0.10,5.22]	2.64	[0.01,5.28]

eTable 6. Mean ICH-CAHPS Scores Among Facilities Stratified by Values of Each Continuous Characteristic

		Facilities Stratified by Each Characteristic		
	distribution of characteristics among facilities	Mean ICH-CAHPS score among facilities in the bottom half of facilities for characteristic	Mean ICH-CAHPS score among facilities in the upper half of facilities for characteristic	P Value
	25th, 50th, 75th percentile	mean (SD)	mean (SD)	
Outcome				
Mean ICH CAHPS score	60.3, 65.8, 71.5	59.2 (5.1)	72.4 (4.8)	<.001
Patient characteristics				
Health				
co-morbidity score: ≤ 1†	17.1, 23.5, 29.6	66.4 (8.4)	65.2 (8.1)	<.001
co-morbidity score: 2-3†	18.8, 23.3, 27.9	66.5 (8.1)	65.1 (8.4)	<.001
co-morbidity score: 4-6†	27.3, 32.0, 37.2	65.2 (8.2)	66.3 (8.3)	<.001
co-morbidity score: ≥ 7†	14.3, 19.4, 26.0	65.2 (8.2)	66.4 (8.2)	<.001
on dialysis for <1 year	7.1, 10.6, 15.0	65.3 (8.2)	66.3 (8.3)	<.001
on dialysis for 1 year	9.5, 13.3, 17.6	65.4 (8.3)	66.2 (8.2)	0.010
on dialysis for 2 years	8.4, 11.8, 15.3	65.5 (8.2)	66.1 (8.3)	0.050
on dialysis for >=3 years	55.5, 63.2, 70.0	66.6 (8.3)	65.0 (8.1)	<.001
immobile	2.3, 4.8, 7.5	65.4 (8.2)	66.2 (8.3)	0.013
alcohol or drug use	2.9, 5.6, 8.9	66.2 (8.0)	65.4 (8.4)	0.013
Demographic, race and ethnicity				
female	38.6, 44.2, 50.0	65.9 (8.2)	65.6 (8.3)	0.378
< 50 years old	13.0, 17.7, 23.0	66.7 (8.0)	64.9 (8.4)	<.001
50-64 years old	28.0, 34.1, 40.0	66.7 (8.3)	64.9 (8.1)	<.001
65-74 years old	21.1, 25.7, 30.6	65.3 (8.3)	66.3 (8.2)	<.001
≥75 years old	14.3, 20.5, 27.8	64.7 (8.2)	66.8 (8.1)	<.001
White	31.0, 58.5, 82.1	63.5 (8.1)	68.1 (7.7)	<.001
Black	11.1, 34.5, 64.9	68.1 (7.7)	63.4 (8.1)	<.001
Asian	0.0, 0.0, 3.4	65.7 (8.4)	65.9 (8.1)	0.450
American Indian	0.0, 0.0, 0.0	65.6 (8.2)	67.3 (8.3)	<.001
Other race	0.0, 0.0, 0.0	65.7 (8.3)	66.5 (8.2)	0.188
Hispanic ethnicity	0.0, 4.2, 15.0	65.4 (8.8)	66.2 (7.6)	0.014
Socioeconomic				
eligible for Medicaid	34.5, 46.2, 57.1	66.7 (8.2)	64.9 (8.2)	<.001
In 1st quartile of household income‡	2.3, 13.3, 40.9	67.0 (8.1)	64.6 (8.2)	<.001
In 2nd quartile of household income‡	6.6, 19.2, 37.9	66.0 (8.2)	65.6 (8.3)	0.233
In 3rd quartile of household income‡	7.2, 20.0, 38.1	65.6 (8.3)	66.0 (8.2)	0.234
In 4th quartile of household income‡	3.4, 13.6, 39.5	65.1 (8.5)	66.5 (8.0)	<.001
Facility and geographic characteristics				
Full-time nurses per 100 patients	4.5, 5.7, 7.1			<.001
Full-time technicians per 100 patients	0.0, 0.0, 2.3	65.6 (8.5)	66.8 (8.1)	0.154
Dialysis chairs per 100 patients	18.8, 22.9, 27.9	65.3 (7.9)	66.0 (8.0)	0.002
% with private insurance	2.2, 4.0, 6.1	65.4 (8.4)	66.3 (8.5)	0.011

Note: The 3rd and 4th columns include different sets of facilities for each characteristics being examined.

eTable 7. Full ICH-CAHPS Survey Questionnaire	
Your Kidney Doctors	
1	Where do you get your dialysis treatment?	At home/At the dialysis center/I do not currently receive dialysis
2	How long have you been getting dialysis at [SAMPLE FACILITY NAME]	
3	In the last 3 months, how often did your kidney doctors listen carefully to you?	Never/Sometimes/Usually/Always
4	In the last 3 months, how often did your kidney doctors explain things in a way that was easy for you to understand?	Never/Sometimes/Usually/Always
5	In the last 3 months, how often did your kidney doctors show respect for what you had to say?	Never/Sometimes/Usually/Always
6	In the last 3 months, how often did your kidney doctors spend enough time with you?	Never/Sometimes/Usually/Always
7	In the last 3 months, how often did you feel your kidney doctors really cared about you as a person?	Never/Sometimes/Usually/Always
8	Using any number from 0 to 10, where 0 is the worst kidney doctors possible and 10 is the best kidney doctors possible, what number would you use to rate the kidney doctors you have now?	0-10
9	Do your kidney doctors seem informed and up-to-date about the health care you receive from other doctors?	Yes/No
The Dialysis Center Staff	
10	In the last 3 months, how often did the dialysis center staff listen carefully to you?	Never/Sometimes/Usually/Always
11	In the last 3 months, how often did the dialysis center staff explain things in a way that was easy for you to understand?	Never/Sometimes/Usually/Always
12	In the last 3 months, how often did the dialysis center staff show respect for what you had to say?	Never/Sometimes/Usually/Always
13	In the last 3 months, how often did the dialysis center staff spend enough time with you?	Never/Sometimes/Usually/Always
14	In the last 3 months, how often did you feel the dialysis center staff really cared about you as a person?	Never/Sometimes/Usually/Always
15	In the last 3 months, how often did the dialysis center staff make you as comfortable as possible during dialysis?	Never/Sometimes/Usually/Always
16	In the last 3 months, did dialysis center staff keep information about you and your health as private as possible from other patients?	Yes/No
17	In the last 3 months, did you feel comfortable asking the dialysis center staff everything you wanted about dialysis care?	Yes/No

18	In the last 3 months, has anyone on the dialysis center staff asked you about how your kidney disease affects other parts of your life?	Yes/No
19	The dialysis center staff can connect you to the dialysis machine through a graft, fistula, or catheter. Do you know how to take care of your graft, fistula, or catheter?	Yes/No
20	In the last 3 months, which one did they use most often to connect you to the dialysis machine?	Graft/Fistula/Catheter/I don't know
21	In the last 3 months, how often did dialysis center staff insert your needles with as little pain as possible?	Never/Sometimes/Usually/Always
22	In the last 3 months, how often did dialysis center staff check you as closely as you wanted while you were on the dialysis machine?	Never/Sometimes/Usually/Always
23	In the last 3 months, did any problems occur during your dialysis?	Yes/No
24	In the last 3 months, how often was the dialysis center staff able to manage problems during your dialysis?	Never/Sometimes/Usually/Always
25	In the last 3 months, how often did dialysis center staff behave in a professional manner?	Never/Sometimes/Usually/Always
26	In the last 3 months, did dialysis center staff talk to you about what you should eat and drink?	Yes/No
27	In the last 3 months, how often did dialysis center staff explain blood test results in a way that was easy to understand?	Never/Sometimes/Usually/Always
28	As a patient you have certain rights. For example, you have the right to be treated with respect and the right to privacy. Did this dialysis center ever give you any written information about your rights as a patient?	Yes/No
29	Did dialysis center staff at this center ever review your rights as a patient with you?	Yes/No
30	Has dialysis center staff ever told you what to do if you experience a health problem at home?	Yes/No
31	Has any dialysis center staff ever told you how to get off the machine if there is an emergency at the center?	Yes/No
32	Using any number from 0 to 10, where 0 is the worst dialysis center staff possible and 10 is the best dialysis center staff possible, what number would you use to rate your dialysis center staff?	0-10
The Dialysis Center		
33	In the last 3 months, when you arrived on time, how often did you get put on the dialysis machine within 15 minutes of your appointment or shift time?	Never/Sometimes/Usually/Always
34	In the last 3 months, how often was the dialysis center as clean as it could be?	Never/Sometimes/Usually/Always

3 5	Using any number from 0 to 10, where 0 is the worst dialysis center possible and 10 is the best dialysis center possible, what number would you use to rate this dialysis center?	0-10
3 6	You can treat kidney disease with dialysis at a center, a kidney transplant, or with dialysis at home. In the last 12 months, did your kidney doctors or dialysis center staff talk to you as much as you wanted about which treatment is right for you?	Yes/No
3 7	Are you eligible for a kidney transplant?	Yes/No/I don't know
3 8	In the last 12 months, has a doctor or dialysis center staff explained to you why you are not eligible for a kidney transplant?	Yes/No
3 9	Peritoneal dialysis is dialysis given through the belly and is usually done at home. In the last 12 months, did either your kidney doctors or dialysis center staff talk to you about peritoneal dialysis?	Yes/No
4 0	In the last 12 months, were you as involved as much as you wanted in choosing the treatment for kidney disease that is right for you?	Yes/No
4 1	In the last 12 months, were you ever unhappy with the care you received at the dialysis center or from your kidney doctors?	Yes/No
4 2	In the last 12 months, did you ever talk to someone on the dialysis center staff about this?	Yes/No
4 3	In the last 12 months, how often were you satisfied with the way they handled these problems?	Never/Sometimes/Usually/Always
4 4	Medicare and your State have special agencies that check the quality of care at this dialysis center. In the last 12 months, did you make a complaint to any of these agencies?	Yes/No

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