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Authors

Grimes, Barbara
Ku, Elaine
Zhang, Lucy
et al.

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Brief Communication

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Risk of Death among Dialysis Patients Treated at Hospital-Affiliated versus Free-Standing Facilities in the United States

Lucy Y. Zhang[1], *Sandra Amaral*[2], *Charles E. McCulloch*[3], *Barbara Grimes*[3], *and Elaine Ku*[3,4]

Key Points

- Receipt of dialysis at hospital-affiliated facilities was associated with a higher risk of mortality compared with treatment at free-standing dialysis facilities.
- The differential mortality risk in free-standing versus hospital-affiliated facilities was more pronounced in non-Hispanic Black and Asian patients compared with other racial/ethnic groups.

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Introduction

End-stage kidney disease is associated with high risk of mortality, particularly for those receiving in-center hemodialysis.[1] It has long been established that mortality rates differ across dialysis facilities based on factors such as facility size,[2] chain affiliation,[3] and, most notably, profit status.[4–6] However, few studies have described whether there are differences in mortality risk in adults treated at dialysis facilities that are free-standing versus affiliated with a hospital.

In a study published almost 4 decades ago, Plough *et al.* found that hospital-affiliated dialysis facilities in Michigan treated a higher proportion of patients with greater severity of illness when compared with free-standing facilities.[7] At that time, only 33% of dialysis facilities were free-standing in the United States Today, over 70% of dialysis facilities are free-standing.[1]

Treatment at hospital-affiliated dialysis facilities may be associated with improved outcomes over free-standing facilities because of the better access of patients to inpatient care if needed and potential improvements in continuity of care between the inpatient and outpatient teams. However, these facilities may also accept patients whom free-standing facilities may be reluctant to treat because of current Centers for Medicare and Medicaid Services (CMS) reimbursement and quality metrics. Thus, we aimed to examine the association between dialysis facility type (free-standing versus hospital-affiliated) and mortality. In addition, given the extensive research suggesting that the relationship between facility characteristics and survival varies by race and ethnicity,[2,8] we sought to determine whether the association between type of dialysis facility and mortality was modified by race and ethnicity of patients.

Methods

Study Population

All patients older than 18 years who started outpatient in-center hemodialysis according to the United States Renal Data System between January 1, 2015, and December 31, 2019, were eligible for inclusion. Detailed inclusion and exclusion criteria are presented in Figure 1, and additional methods are available in the Supplemental Methods.

Study Variables

The primary exposure was type of outpatient dialysis facility (hospital-affiliated versus free-standing) based on variables from the United States Renal Data System (USRDS) Facility file, which incorporates data from the CMS dialysis facility surveys that are collected on an annual basis such as profit status and type of facility. If patients started dialysis as an inpatient, the first outpatient hemodialysis facility was used to categorize the primary exposure. The primary outcome was all-cause mortality, which was determined using the Patients' file.

Clinical and demographic characteristics of patients were obtained from the USRDS Patients and Medical Evidence Report (which includes data from the CMS-2728 form completed for all patients who developed ESKD). Given their independent

[1]School of Medicine, University of California San Francisco, San Francisco, California
[2]Department of Pediatrics, Children's Hospital of Philadelphia, Philadelphia, Pennsylvania
[3]Department of Epidemiology and Biostatistics, University of California San Francisco, San Francisco, California
[4]Department of Medicine and Pediatrics, University of California San Francisco, San Francisco, California

Correspondence: Ms. Lucy Y. Zhang, School of Medicine, University of California San Francisco, 500 Parnassus Avenue MBUE-414, San Francisco, CA 94131. Email: lucy.zhang@ucsf.edu

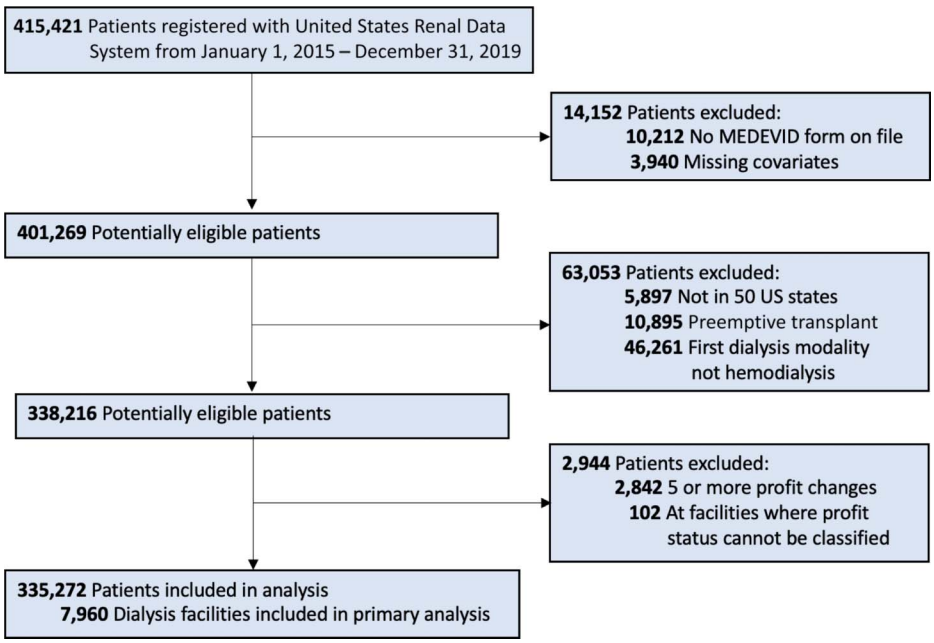

Figure 1. Cohort diagram for study. MEDEVID, Medical Evidence.

associations with mortality, we adjusted for the following factors which are potential markers of severity of illness or confounders: age at the start of dialysis, race (non-Hispanic White, non-Hispanic Black, Hispanic, Asian, Other), sex, US census region (Northeast, Midwest, South, West), primary cause of ESKD, ESKD network, insurance status, rural/urban status, distance to dialysis facility, calendar year of dialysis initiation, time-updated dialysis modality, the presence of other comorbidities (coronary artery disease, peripheral vascular disease, heart failure, diabetes, malignancy, stroke, inability to ambulate, and chronic obstructive pulmonary disease), and profit status of the dialysis facility.

Statistical Analysis

Descriptive analyses were performed comparing patients treated at hospital-affiliated versus free-standing facilities using the initial facility for each person.

In subsequent analyses, the primary predictor (receipt of treatment at a hospital-affiliated versus free-standing facility) was treated as a time-varying covariate based on where the patient was receiving treatment and any changes reported by the facility to CMS. These data were ascertained from RXHIST (treatment history file) and Facility files which are part of the standard analytic files from the USRDS. Modality and facility profit status were also incorporated as time-varying covariates. Cox proportional hazards models were used in both unadjusted and adjusted analyses accounting for covariates as described above. Time in all models began at date of dialysis initiation, and follow-up was censored at transplantation, loss to follow-up, and recovery of kidney function. In secondary analyses, we tested for interaction between the primary predictor and race/ethnicity.

This study was deemed to be not human subject research by the University of California, San Francisco Institutional Review Board.

Results

Study Population

A total of 335,272 patients who met our inclusion criteria were included for analysis (Figure 1). Characteristics of patients are summarized in Table 1. More patients who had glomerulonephritis as the primary cause of ESKD were treated at hospital-affiliated facilities (10.0%) versus free-standing facilities (7.4%). In addition, patients treated at hospital-affiliated facilities had higher rates of coronary artery disease (14.3% versus 9.9%), peripheral vascular disease (10.6% versus 8.6%), congestive heart failure (28.0% versus 25.8%), and malignancy (6.5% versus 4.8%, Table 1).

Association between Type of Dialysis Facility and Mortality Risk

A total of 83,055 patients (24.8%) died during mean 1.86±1.39 (SD) years of follow-up. The mortality rate at hospital-affiliated facilities was 28% versus 24.6% at free-standing dialysis facilities. Compared with patients treated at free-standing dialysis facilities, patients treated at hospital-affiliated facilities had a higher risk of death in both unadjusted (hazard ratio [HR], 1.10 [95% confidence interval (CI), 1.06 to 1.14]) and adjusted analyses (HR, 1.15

Table 1. Baseline patient characteristics by initial dialysis facility type

Baseline Characteristics	Total	Free-Standing	Hospital-Based	*P* Value
Facilities	7960	7477 (93.9)	483 (6.1)	
Patients	335,272	319,407 (95.3)	15,865 (4.7)	
Facility-level characteristics at start of dialysis				
For-profit	6884 (86.5)	6859 (91.7)	25 (5.2)	
Not for profit	1075 (13.5)	618 (8.3)	457 (94.6)	
Patient-level characteristics at start of dialysis				
Median age (IQR) in yr	58 (49–64)	58 (49–64)	58 (49–64)	0.26
Profit status				
For-profit	296,851 (88.5)	296,430 (92.8)	421 (2.7)	<0.001
Not for profit	38,421 (11.5)	22,977 (7.2)	15,444 (97.3)	
Sex				
Male	198,656 (59.3)	188,686 (59.1)	9970 (62.8)	<0.001
Female	136,616 (40.7)	130,721 (40.9)	5895 (37.2)	
Race				
Asian	12,560 (3.7)	12,049 (3.8)	511 (3.2)	<0.001
Non-Hispanic Black	102,332 (30.5)	97,743 (30.6)	4589 (28.9)	
Hispanic	59,346 (17.7)	56,831 (17.8)	2515 (15.9)	
Other	9068 (2.7)	8258 (2.6)	810 (5.1)	
Non-Hispanic White	151,966 (45.3)	144,526 (45.2)	7440 (46.9)	
Insurance				
Public	187,872 (56.0)	180,339 (56.5)	7533 (47.5)	<0.001
Private	122,201 (36.4)	115,268 (36.1)	6933 (43.7)	
None	25,199 (7.5)	23,800 (7.5)	1399 (8.8)	
Primary cause of ESKD				
Diabetes	173,020 (51.6)	165,006 (51.7)	8014 (50.5)	<0.001
Hypertension	89,284 (26.6)	86,200 (27.0)	3084 (19.4)	
Glomerulonephritis	25,199 (7.5)	23,616 (7.4)	1583 (10.0)	
Cystic kidney disease	7852 (2.3)	7357 (2.3)	495 (3.1)	
Other urologic disease	4302 (1.3)	4004 (1.3)	298 (1.9)	
Other cause	35,615 (10.6)	33,224 (10.4)	2391 (15.1)	
Comorbidities at start of dialysis				
Coronary artery disease	33,908 (10.1)	31,642 (9.9)	2266 (14.3)	<0.001
Peripheral vascular disease	29,013 (8.7)	27,339 (8.6)	1674 (10.6)	<0.001
Congestive heart failure	86,913 (25.9)	82,476 (25.8)	4437 (28.0)	<0.001
Diabetes	222,236 (66.3%)	212,114 (66.4%)	10,122 (63.8%)	<0.001
Malignancy	16,518 (4.9)	15,491 (4.8)	1027 (6.5)	<0.001
Stroke	27,691 (8.3)	26,373 (8.3)	1318 (8.3)	<0.001
Nonambulatory	54,472 (16.2)	52,063 (16.3)	2409 (15.2)	<0.001
Chronic obstructive pulmonary disease	26,680 (8.0)	25,367 (7.9)	1313 (8.3)	<0.001
Rural/urban				
Metropolitan	280,413 (83.6)	268,199 (84.0)	12,214 (77.0)	<0.001
Micropolitan	31,316 (9.3)	29,692 (9.3)	1624 (10.2)	
Rural	23,543 (7.0)	21,516 (6.7)	2028 (12.8)	
Region				
West	71,572 (21.3)	69,342 (21.7)	2230 (14.1)	<0.001
Midwest	63,430 (18.9)	59,109 (18.5)	4321 (27.2)	
South	149,133 (44.5)	144,783 (45.3)	4350 (27.4)	
Northeast	51,137 (15.3)	46,173 (14.5)	4964 (31.3)	
Distance to dialysis facility				
<15 miles	278,384 (83.0)	267,017 (83.6)	11,367 (71.6)	<0.001
15–30 miles	30,457 (9.1)	28,355 (8.9)	2102 (13.2)	
30–60 miles	10,794 (3.2)	9556 (3.0)	1238 (7.8)	
60–90 miles	2841 (0.8)	2479 (0.8)	362 (2.3)	
>90 miles	12,796 (3.8)	12,000 (3.8)	796 (5.0)	

IQR, interquartile range.

[95% CI, 1.10 to 1.20], Table 2). More details on covariates in the fully adjusted analysis can be found in Supplemental Table 1.

Effect Modification by Race

An interaction was noted between dialysis facility type and race and ethnicity ($P = 0.004$). The effect size for the

Table 2. Risk of death comparing hospital-affiliated versus free-standing facilities (reference group) in the overall cohort and by racial/ethnic group

Model	HR (95% CI)
Unadjusted	1.10 (1.06 to 1.14)
Adjusted	1.15 (1.10 to 1.20)
Adjusted analysis stratified by race[a]	
Asian	1.31 (1.00 to 1.71)
Non-Hispanic Black	1.18 (1.09 to 1.29)
Hispanic	1.11 (0.96 to 1.28)
Other	0.96 (0.76 to 1.21)
Non-Hispanic White	1.07 (1.01 to 1.14)

All adjusted models include the following covariates: age at the start of dialysis, race (Asian, non-Hispanic Black, Hispanic, Other, non-Hispanic White), sex, US census region (Northeast, Midwest, South, West), primary cause of ESKD, ESKD network, insurance status, rural/urban status, distance to dialysis facility, calendar year of dialysis initiation, time-updated dialysis modality, the presence of other comorbidities (coronary artery disease, peripheral vascular disease, heart failure, diabetes, malignancy, stroke, inability to ambulate, and chronic obstructive pulmonary disease), and time-updated profit status. HR, hazard ratio; CI, confidence interval.
[a]Indicates statistically significant interaction by race.

association between dialysis facility type and mortality was most pronounced among non-Hispanic Black patients (HR, 1.18 [95% CI, 1.09 to 1.29]) and Asian patients (HR, 1.31 [95% CI, 1.00 to 1.71]), attenuated in non-Hispanic White patients (HR, 1.07 [95% CI, 1.01 to 1.14]) and not statistically significant in other racial and ethnic groups (Table 2).

Discussion

In a contemporary cohort of US patients treated with dialysis, receipt of dialysis at hospital-affiliated facilities was associated with a higher risk of mortality compared with treatment at free-standing dialysis facilities, even when accounting for the profit status of facilities. The effect size that we observed was more pronounced in non-Hispanic Black and Asian patients compared with other racial/ethnic groups.

Our findings build on the previous literature relating the characteristics of dialysis facilities and their association with patient outcomes. To our knowledge, there have been no contemporary studies that have examined whether hospital-affiliated dialysis facilities versus free-standing dialysis facilities differ in their associated survival outcomes.[7]

We hypothesize that the main reason for our findings is that patients receiving treatment at hospital-affiliated facilities had greater severity of illness compared with patients at free-standing facilities. Our data show that there are differential prevalence of comorbidities between the two groups of patients and the proportion of patients who may have been immunosuppressed (such as those with glomerulonephritis as the cause of their ESKD). Although we adjusted for the presence or absence of these comorbidities, we do not have data on their severity, which could be contributory to our observations.

In addition, given that the CMS ESKD Quality Incentive Program uses facility performance to adjust their payments,[9] free-standing dialysis facilities may be disincentivized to treat patients who are more severely ill.

Finally, staffing ratios are known to vary by profit status and hospital affiliation of facilities, with nonprofit and hospital-based facilities having a higher ratio of registered nurse to patient ratio.[10] The need for higher staffing levels could indicate a higher level of complexity in the patient population of hospital-affiliated facilities.

The association between type of dialysis facility and mortality was most disparate among non-Hispanic Black and Asian patients. The reason for this finding is unclear. However, recent research suggests that facilities with higher proportions of Black patients have worse survival outcomes, regardless of race.[8] Fewer studies have examined survival outcomes among Asian patients. Further studies to understand whether neighborhood or community-level factors and structural racism contribute to the differential rates of survival in hospital-affiliated and free-standing facilities are needed.

Our findings have several implications. First, the CMS releases a quality of patient care star rating annually that incorporates mortality for each dialysis facility.[11] Patients are able to consider this rating when choosing a dialysis facility. Higher mortality in hospital-affiliated dialysis facilities could negatively affect this star rating, thus disincentivizing patients from choosing hospital-affiliated facilities even if these facilities offer similar or higher-quality care than free-standing facilities. Second, if free-standing dialysis facilities are indeed incentivized to treat patients who are less sick, such considerations should be accounted for in future risk adjustment policies.

Importantly, our study has limitations including the lack of time-updated data on patient comorbidities in the USRDS after the start of dialysis, and given its observational nature, residual confounding may be present.

Future research should evaluate whether hospital-affiliated facilities would benefit from additional resources or support to ensure better outcomes for their patient population, particularly if the population served by hospital-affiliated facilities require more intensive care than those treated at free-standing facilities.

Disclosures

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Author Contributions

Conceptualization: Elaine Ku, Lucy Zhang.
Data curation: Barbara Grimes, Elaine Ku.
Formal analysis: Barbara Grimes.
Funding acquisition: Elaine Ku.
Investigation: Elaine Ku, Lucy Zhang.
Methodology: Elaine Ku, Charles E. McCulloch.
Supervision: Elaine Ku.
Writing – original draft: Lucy Zhang.
Writing – review & editing: Sandra Amaral, Elaine Ku, Charles E. McCulloch, Lucy Zhang.

Supplemental Material

This article contains the following supplemental material online at http://links.lww.com/KN9/A375.

Supplemental Methods. Cohort selection.

Supplemental Table 1. Model of the association between hospital affiliation of dialysis facility and mortality.

References

1. United States Renal Data System. *2020 USRDS Annual Data Report: Epidemiology of Kidney Disease in the United States.* National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases; 2020.
2. Yan G, Norris KC, Xin W, Ma JZ, Yu AJ, Green T. Facility size, race and ethnicity, and mortality for in-center hemodialysis. *J Am Soc Nephrol.* 2013;24(12):2062–2070. doi:10.1681/ASN.2013010033
3. Zhang Y, Cotter DJ, Thamer M. The effect of dialysis chains on mortality among patients receiving hemodialysis. *Health Serv Res.* 2011;46(3):747–767. doi:10.1111/j.1475-6773.2010.01219.x
4. Deveraux PJ, Schunemann HJ, Ravindran N, et al. Comparison of mortality between private for-profit and private not-for-profit hemodialysis centers: a systematic review and meta-analysis. *JAMA.* 2002;288(19):2449–2457. doi:10.1001/jama.288.19.2449
5. Dickman S, Mirza R, Kandi M, Incze MA, Dodbiba L, Yameen R. Mortality at for-profit versus not-for-profit hemodialysis centers: a systematic review and meta-analysis. *Int J Health Serv.* 2020;51(3):371–378. doi:10.1177/0020731420980682
6. Garg PP, Frick KD, Diener-West M, Powe NR. Effect of the ownership of dialysis facilities on patients' survival and referral for transplantation. *N Engl J Med.* 1999;341(22):1653–1660. doi:10.1056/nejm199911253412205
7. Plough AL, Salem SR, Shwartz M, Weller JM, Ferguson CW. Case mix in end-stage renal disease. Differences between patients in hospital-based and free-standing treatment facilities. *N Engl J Med.* 1984;310(22):1432–1436. doi:10.1056/nejm198405313102205
8. Norris KC, Williams SF, Rhee CM, Nicholas SB, Kovesdy CP, Kalantar-Zadeh K. Hemodialysis disparities in African Americans: the deeply integrated concept of race in the social fabric of our society. *Semin Dial.* 2017;30(3):213–223. doi:10.1111/sdi.12589
9. Centers for Medicare and Medicaid Services. *ESRD Quality Incentive Program [Internet].* CMS.gov. https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/ESRDQIP. Accessed October 15, 2022.
10. Yoder LA, Xin W, Norris KC, Yan G. Patient care staffing levels and facility characteristics in US hemodialysis facilities. *Am J Kidney Dis.* 2013;62(6):1130–1140. doi:10.1053/j.ajkd.2013.05.007
11. Centers for Medicare and Medicaid Services. *Quality of Patient Care Readings. [Internet].* Accessed October 15, 2022.https://data.cms.gov/provider-data/topics/dialysis-facilities/dialysis-facilities-quality-of-patient-care-rating

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