## Supplemental Material

# Dialysis Facility Profit Status and Early Steps in Kidney Transplantation in the Southeastern United States

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**Supplemental Table 1.** Sensitivity analysis of the characteristics of patients with incident ESRD initiating dialysis between January 1, 2012 and August 31, 2016 in Georgia, North Carolina, and South Carolina followed through March 1, 2018; study population compared to preemptively referred patients

**Supplemental Table 2.** Characteristics and bivariable cause-specific hazard ratios of patients with incident ESRD kidney failure who initiated dialysis between January 1, 2012 and August 31, 2016 in Georgia, North Carolina, and South Carolina who were referred for transplant, and who initiated evaluation at a transplant center, and who was waitlisted during follow-up (to August 31, 2017 for referral, to March 1, 2018 for evaluation and waitlisting)

**Supplemental Table 3**. Sensitivity analysis results of the crude and adjusted cause-specific hazard ratios between dialysis facility profit status and referral, evaluation, and waitlisting for kidney transplantation during follow-up among incident ESRD patients who initiated dialysis in dialysis facilities in Georgia, North Carolina, and South Carolina

**Supplemental Table 4.** Sensitivity analysis results of adjusted cause-specific hazard ratios between dialysis facility profit status and referral for kidney transplantation during follow-up among incident kidney failure patients who initiated dialysis in dialysis facilities in Georgia, North Carolina, and South Carolina, *examining the interaction effect between age and profit status*

**Supplemental Table 1.** Sensitivity analysis of the characteristics of patients with incident kidney failure initiating dialysis between January 1, 2012 and August 31, 2016 in Georgia, North Carolina, and South Carolina followed through March 1, 2018; study population compared to preemptively referred patients

| Population Characteristics | Overall study population | Preemptively Referred Patients | p-value |
|---|---|---|---|
| **Facilities, n (%)** | 686 (100) | 539 (100) | - |
| **Total patients, n (%)** | 33,651 (100) | 2251 (100) | - |
| ***Patient Demographics*** | | | |
| **Age in years**, mean (SD); | 60 (13.2) | 54 (13.4) | <.001 |
| **Age category,** n (%) | | | <.001 |
| 18-29 | 914 (3) | 118 (5) | |
| 30-39 | 2,012 (6) | 233 (10) | |
| 40-49 | 4,324 (13) | 405 (18) | |
| 50-59 | 7,545 (22) | 586 (26) | |
| 60-69 | 10,120 (30) | 653 (29) | |
| ≥70 | 8,736 (26) | 256 (11) | |
| **Sex,** n (%) | | | 0.36 |
| Male | 18,498 (55.0) | 1,215 (54.0) | |
| Female | 15,153 (45.0) | 1,036 (46.0) | |
| **Race/ethnicity**, n (%) | | | 0.23 |
| White, non-Hispanic | 13,451 (40) | 858 (38) | |
| Black, non-Hispanic | 18,853 (56) | 1,292 (57) | |
| White, Hispanic | 713 (2) | 57 (3) | |
| Other race/ethnicity | 634 (2) | 44 (2) | |
| ***Patient Clinical Characteristics*** | | | |
| **Attributed cause of kidney failure**, n (%)[a] | | | <.001 |
| Diabetes | 15,348 (47) | 1,054 (48) | |
| Hypertension | 12,216 (37) | 689 (31) | |
| Glomerulonephritis | 2,225 (7) | 274 (12) | |
| Other | 3,216 (10) | 199 (9) | |
| **Comorbidities**, n (%)[b] | | | |
| BMI ≥ 35 kg/m$^2$ | 8,519 (26) | 598 (27) | 0.22 |
| Congestive heart failure | 9,406 (28) | 333 (15) | <.001 |
| Atherosclerotic heart disease | 3,347 (10) | 138 (6) | <.001 |
| Other cardiac disease | 5,894 (18) | 253 (11) | <.001 |

| | | | |
|---|---|---|---|
| Cerebrovascular disease (stroke) | 3,156 (10) | 118 (5) | <.001 |
| Peripheral vascular disease | 3,007 (9) | 146 (7) | <.001 |
| Hypertension | 30,076 (89) | 2,054 (91) | 0.005 |
| Diabetes | 20,320 (60) | 1,310 (58) | 0.04 |
| Chronic Obstructive Pulmonary Disease | 3,097 (9) | 99 (4) | <.001 |
| Tobacco use | 3,120 (9) | 138 (6) | <.001 |
| Cancer | 2,081 (6) | 77 (3) | <.001 |
| **Pre-kidney failure nephrology care,** n (%)[c] | | | |
| Received | 21,090 (71) | 1,938 (92) | <.001 |
| Did not receive | 8,527 (29) | 161 (8) | |
| **Patient informed of transplant as a treatment option,** n (%)[d] | | | |
| Informed of transplant options | 32,495 (97) | 2,238 (100) | <.001 |
| Not informed of transplant options due to medical reasons | 1,045 (3) | 7 (0.3) | |
| ***Patient Socioeconomic Characteristics*** | | | |
| **Primary health insurance provider**, n (%) | | | |
| Medicare | 13,774 (41) | 717 (32) | <.001 |
| Medicaid | 8,334 (25) | 471 (21) | |
| Employer group | 5,899 (18) | 781 (35) | |
| Other coverage | 2,141 (6) | 175 (8) | |
| No coverage | 3,503 (10) | 107 (5) | |
| **Dialysis initiation pre-KAS (before 12/4/2014) or Post-KAS (after/on 12/4/2014)** | | | |
| Dialysis initiation pre-KAS | 20,758 (62) | 1,266 (56) | <.001 |
| Dialysis initiation post-KAS | 12,893 (38) | 985 (44) | |
| **Patient neighborhood (zip code) factors** | | | |
| Number of patients living in a zip code where ≥20% of residents live below the poverty line, n (%) | 10,583 (31) | 589 (26) | <.001 |
| % African American population in patient zip code, mean (SD)[e] | 35 (23.7) | 34 (23.0) | 0.02 |
| % High school graduates in patient zip code, mean (SD)[f] | 83 (7.2) | 84 (7.3) | <.001 |
| ***Patient Dialysis Facility Characteristics*** | | | |

| | | | |
|---|---|---|---|
| **Number of patients per facility,** mean (SD)[g] | 91 (48.0) | 95 (54.2) | <.001 |
| **Number of patients per facility by category,** n (%)[g] | | | 0.11 |
| Very Small (0-25) | 568 (2) | 36 (2) | |
| Small (26-54) | 7,119 (21) | 436 (19) | |
| Medium (55-78) | 8,276 (25) | 540 (24) | |
| Large (>79) | 17,688 (53) | 1,239 (55) | |
| **Number of social workers per facility,** mean (SD) | 1 (0.7) | 1 (0.9) | 0.27 |
| **Ratio of patients to social workers per facility,** mean (SD)[h] | 104 (40.3) | 107 (40.8) | <.001 |

Abbreviations: BMI: Body Mass Index; CI: Confidence Interval; SD: Standard Deviation

[a] Attributable cause information missing for 646 patients (2%) in the study population and 35 patients (2%) among those preemptively referred.

[b] Patient BMI information missing for 243 patients (0.7%) in the study population and 8 patients (0.4%) among those preemptively referred; patients were removed if they were missing all comorbidities.

[c] Information on patients who received nephrology before kidney failure diagnosis missing for 4,034 patients (12%) in the study population and 152 patients (7%) among those preemptively referred.

[d] Information on patients who were not informed of transplant as a treatment option due to medical reasons is missing for 111 patients (0.3%) in the study population and 6 patients (0.3%) among those preemptively referred.

[e] Average percentage of African Americans in zip code of patient neighborhood was missing for 455 patients (1%) in the study population and 20 patients (0.9%) among those preemptively referred.

[f] Average percentage of high school graduates in zip code of patient neighborhood was missing for 461 patients (1%) in the study population and 20 patients (0.9%) among those preemptively referred.

[g] Determined by averaging the number of patients for each facility across all study years when the facility was in operation. Data from National Coordinating Center.

[h] Number of patients for every 1 social worker. For the study population, this was calculated only for patients (n=31,120) that had at least 1 social worker at their facility and not for patients with 0 social workers at their facility or missing information (n=2531). For those who were preemptively referred, this was calculated for 2069 patients (92%).

**Supplemental Table 2.** Characteristics and bivariable cause-specific hazard ratios of patients with incident kidney failure who initiated dialysis between January 1, 2012 and August 31, 2016 in Georgia, North Carolina, and South Carolina who were referred for transplant, who initiated evaluation at a transplant center, and who was waitlisted during follow-up (to August 31, 2017 for referral, to March 1, 2018 for evaluation and waitlistng).

| Characteristics | Overall population | Referred for evaluation at a transplant center (n, % of total) | | Initiated evaluation at a transplant center following referral (n, % of those referred) | | Waitlisted at a transplant center after evaluation (n, % of those evaluated) | |
|---|---|---|---|---|---|---|---|
| **Patients, n (%)** | **33,651 (100)** | **14,729 (44)** | | **7,815 (53)** | | **2880 (37)** | |
| | **n** | **n** | **HR[b]** | **n** | **HR[b]** | **n** | **HR** |
| | **(% of total)** | **(row %)** | **(95% CI)** | **(row %)** | **(95% CI)** | **(row %)** | **(95% CI)** |
| ***Dialysis Facility Profit Status*** | | | | | | | |
| **Patients treated in non-profit facilities** | 5,059 (15) | 2,386 (47) | [Ref] | 1,307 (55) | [Ref] | 454 (35) | [Ref] |
| **Patients treated in for-profit facilities** | 28,592 (85) | 12,343 (43) | 0.87 (0.78, 0.97) | 6,508 (53) | 0.95 (0.85, 1.06) | 2,426 (37) | 1.11 (0.96, 1.28) |
| ***Patient Demographics*** | | | | | | | |
| **Age category** | | | | | | | |
| 18-29 | 914 (3) | 675 (74) | 2.27 (2.08, 2.48) | 439 (65) | 1.45 (1.30, 1.62) | 244 (56) | 2.08 (1.76, 2.47) |
| 30-39 | 2,012 (6) | 1,464 (73) | 2.19 (2.05, 2.34) | 888 (61) | 1.29 (1.18, 1.41) | 387 (44) | 1.49 (1.30, 1,71) |
| 40-49 | 4,324 (13) | 2,863 (66) | 1.87 (1.78, 1.97) | 1,611 (56) | 1.15 (1.07, 1.23) | 692 (43) | 1.45 (1.28, 1.63) |
| 50-59 | 7,545 (22) | 3,968 (53) | 1.35 (1.28, 1.41) | 2,150 (54) | 1.11 (1.04, 1.18) | 766 (36) | 1.15 (1.03, 1.29) |
| 60-69 | 10,120 (30) | 4,152 (41) | [Ref] | 2,108 (51) | [Ref] | 672 (32) | [Ref] |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ≥70 | 8,736 (26) | 1,607 (18) | 0.40 (0.37, 0.42) | 619 (39) | 0.69 (0.62, 0.76) | 119 (19) | 0.59 (0.47, 0.74) |
| **Sex** | | | | | | | |
| Male | 18,498 (55) | 8,631 (47) | [Ref] | 4,648 (54) | [Ref] | 1758 (38) | [Ref] |
| Female | 15,153 (45) | 6,098 (40) | 0.83 (0.80, 0.86) | 3,167 (52) | 0.93 (0.89, 0.98) | 1122 (35) | 0.92 (0.85, 1.00) |
| **Race/ethnicity** | | | | | | | |
| White, non-Hispanic | 13,451 (40) | 4,675 (35) | [Ref] | 2,436 (52) | [Ref] | 857 (35) | [Ref] |
| Black, non-Hispanic | 18,853 (56) | 9,337 (50) | 1.46 (1.39, 1.53) | 4,924 (53) | 0.97 (0.91, 1.03) | 1798 (37) | 1.00 (0.92, 1.10) |
| White, Hispanic | 713 (2) | 391 (55) | 1.57 (1.38, 1.79) | 253 (65) | 1.38 (1.18, 1.63) | 125 (49) | 1.39 (1.12, 1.72) |
| Other race/ethnicity | 634 (2) | 326 (51) | 1.56 (1.34, 1.81) | 202 (62) | 1.32 (1.08, 1.61) | 100 (50) | 1.48 (1.19, 1.83) |
| ***Patient Clinical Characteristics*** | | | | | | | |
| **Attributed cause of kidney failure**[a] | | | | | | | |
| Diabetes | 15,348 (47) | 6,512 (42) | [Ref] | 3,313 (51) | [Ref] | 1008 (30) | [Ref] |
| Hypertension | 12,216 (37) | 5,563 (46) | 1.07 (1.03, 1.12) | 2,940 (53) | 1.06 (1.00, 1.12) | 1142 (39) | 1.33 (1.22, 1.45) |
| Glomerulonephritis | 2,225 (7) | 1,284 (58) | 1.51 (1.42, 1.62) | 785 (61) | 1.32 (1.21, 1.43) | 409 (52) | 2.00 (1.78, 2.25) |
| Other | 3,216 (10) | 1,123 (35) | 0.83 (0.77, 0.88) | 629 (56) | 1.21 (1.10, 1.32 | 248 (39) | 1.35 (1.16, 1.57) |
| **Comorbidities**[b] | | | | | | | |
| BMI ≥ 35 kg/m$^2$ | 8,519 (26) | 3,894 (46) | 1.05 (1.01, 1.10) | 1,912 (49) | 0.85 (0.80, 0.90) | 565 (30) | 0.69 (0.63, 0.76) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Congestive heart failure | 9,406 (28) | 3,290 (35) | 0.72 (0.68, 0.75) | 1,539 (47) | 0.81 (0.76, 0.87) | 386 (25) | 0.58 (0.52, 0.65) |
| Atherosclerotic heart disease | 3,347 (10) | 1,035 (31) | 0.63 (0.59, 0.68) | 467 (45) | 0.79 (0.72, 0.86) | 123 (26) | 0.65 (0.55,0.77) |
| Other cardiac disease | 5,894 (18) | 1,882 (32) | 0.66 (0.63, 0.71) | 886 (47) | 0.82 (0.76, 0.89) | 268 (30) | 0.76 (0.66,0.87) |
| Cerebrovascular disease (stroke) | 3,156 (9) | 986 (31) | 0.65 (0.60, 0.70) | 444 (45) | 0.77 (0.69, 0.86) | 115 (26) | 0.66 (0.54, 0.80) |
| Peripheral vascular disease | 3,007 (9) | 903 (30) | 0.64 (0.59, 0.69) | 378 (42) | 0.68 (0.62, 0.75) | 96 (25) | 0.64 (0.50, 0.80) |
| Hypertension | 30,076 (89) | 13,345 (44) | 1.13 (1.05, 1.21) | 7,082 (53) | 0.97 (0.89, 1.06) | 2599 (37) | 0.98 (0.84, 1.13) |
| Diabetes | 20,320 (60) | 8,511 (42) | 0.87 (0.84, 0.90) | 4,373 (51) | 0.90 (0.86, 0.95) | 1388 (32) | 0.68 (0.63, 0.74) |
| Chronic Obstructive Pulmonary Disease | 3,097 (9) | 787 (25) | 0.53 (0.49, 0.57) | 300 (38) | 0.66 (0.59, 0.75) | 35 (12) | 0.25 (0.17, 0.36) |
| Tobacco use | 3,120 (9) | 1,309 (42) | 0.95 (0.89, 1.02) | 604 (46) | 0.79 (0.71, 0.86) | 119 (20) | 0.43 (0.35, 0.52) |
| Cancer | 2,081 (6.) | 505 (24) | 0.53 (0.48, 0.58) | 253 (50) | 0.96 (0.84, 1.09) | 73 (29) | 0.75 (0.59, 0.96) |
| **Pre-kidney failure nephrology care**[c] | | | | | | | |
| Received | 21,090 (71) | 9,272 (44) | [Ref] | 4,932 (53) | [Ref] | 1,786 (36) | [Ref] |
| Did not receive | 8,527 (29) | 3,770 (44) | 1.03 (0.98,1.08) | 2,018 (54) | 1.02 (0.96, 1.08) | 797 (39) | 1.11 (1.02, 1.21) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Patient informed of transplant as a treatment option**[d] | | | | | | | |
| Informed | 29,552 (88) | 13,329 (45.1) | [Ref] | 7,130 (54) | [Ref] | 2,851 (37) | [Ref] |
| Not informed | 4,068 (12) | 1,380 (34) | 0.68 (0.62, 0.76) | 671 (49) | 0.84 (0.75,0.95) | 14 (21) | 0.49 (0.29, 0.85) |
| ***Patient Socioeconomic Characteristics*** | | | | | | | |
| **Primary health insurance provider** | | | | | | | |
| Medicare | 13,774 (41) | 4,549 (33) | 0.48 (0.45, 0.50) | 2,188 (48) | 0.67 (0.62, 0.72) | 608 (28) | 0.47 (0.42,0.52) |
| Medicaid | 8,334 (25) | 3,466 (42) | 0.61 (0.57, 0.64) | 1,668 (48) | 0.68 (0.64, 0.73) | 461 (28) | 0.46 (0.41, 0.52) |
| Employer group | 5,899 (18) | 3,429 (58) | [Ref] | 2,119 (62) | [Ref] | 1071 (51) | [Ref] |
| Other coverage | 2,141 (6) | 1,064 (50) | 0.77 (0.71, 0.83) | 566 (53) | 0.82 (0.74, 0.92) | 220 (39) | 0.72 (0.62, 0.84) |
| No coverage | 3,503 (10) | 2,221 (63) | 0.98 (0.93, 1.04) | 1,274 (57) | 0.87 (0.80, 0.94) | 520 (41) | 0.71 (0.63, 0.80) |
| **Dialysis Initiation Pre-KAS (before 12/4/2014) or Post-Kas (after/on 12/4/2014)** | | | | | | | |
| **Dialysis Initiation in Pre-KAS Era** | 20,758 (62) | 9,402 (45) | [Ref] | 2,897 (31) | [Ref] | 2,038 (41) | [Ref] |
| **Dialysis Initiation in Post-KAS Era** | 12,893 (38) | 5327 (41) | 1.09 (1.04, 1.14) | 2897 (54) | 1.16 (1.09, 1.23) | 842 (29) | 0.75 (0.69, 0.82) |
| ***Patient Dialysis Facility Characteristics*** | | | | | | | |
| **Number of patients per facility by category**[e] | | | | | | | |
| Very Small (11-25) | 568 (2) | 249 (44) | 1.12 (0.92, 1.37) | 139 (56) | 1.17 (0.95, 1.44) | 54 (39) | 1.28 (0.88, 1.84) |
| Small (26-54) | 7,119 (21) | 3,130 (44) | 1.08 (0.99, 1.19) | 1,724 (55) | 1.10 (0.99, 1.23) | 646 (37) | 1.06 (0.94, 1.19) |
| Medium (55-78) | 8,276 (25) | 3,776 (46) | 1.12 (1.03, 1.22) | 1,996 (53) | 1.05 (0.94, 1.17) | 736 (37) | 1.01 (0.90, 1.15) |
| Large (>79) | 17,688 (53) | 7,574 (43) | [Ref] | 3,956 (52) | [Ref] | 1444 (37) | [Ref] |

Abbreviations: BMI: Body Mass Index; CI: Confidence Interval; HR: Hazard Ratio; SD: Standard Deviation

[a]Attributable cause missing for 247 patients (2% ) who were referred for transplant and 148 patients (2%) of patients who initiated evaluation.

[b]Patient BMI missing for 74 patients (0.5%) who were referred for transplant, 34 patients (0.4%) who initiated evaluation, and 12 patients (0.4%) who were waitlisted..

[c]Information on nephrology care before dialysis initiation missing for 1,687 patients (12%) who were referred for transplant, 865 patients (11%) who initiated evaluation, and 297 patients (10%) who were waitlisted

[d]Information on patients who were not informed of transplant as a treatment option due to medical reasons was missing for 43 patients (0.3%) who were referred for transplant,29 patients (0.4%) who initiated evaluation, and 15 patients (0.5%) who were waitlisted

[e]Number of patients per facility was determined by averaging the number of patients for each facility across all study years when the facility was in operation. Data from National Coordinating Center.

**Supplemental Table 3**. Sensitivity analysis results of the crude and adjusted cause-specific hazard ratios between dialysis facility profit status and referral[a], evaluation[b] and waitlisting[c] for kidney transplantation during follow-up among incident kidney failure patients who initiated dialysis in dialysis facilities in Georgia, North Carolina, and South Carolina, *including preemptively referred patients* (n=2,251).

| | Unadjusted Model | Adjusted Model[d] |
|---|---|---|
| | HR (95% CI) | HR (95% CI) |
| **Referral for transplant** (among all incident patients) | | |
| Non-profit facility | [Ref] | [Ref] |
| For-profit facility | 0.91 (0.82, 1.01) | 0.87 (0.79, 0.97) |
| **Evaluation for transplant** | | |
| | Unadjusted Model | Adjusted Model[e] |
| | HR (95% CI) | HR (95% CI) |
| Non-profit facility | [Ref] | [Ref] |
| For-profit facility | 0.91 (0.81, 1.02) | 0.88 (0.79, 0.98) |
| **Waitlisted for transplant** (among those evaluated) | | |
| | Unadjusted Model | Adjusted Model[f] |
| | HR (95% CI) | HR (95% CI) |
| Non-profit facility | [Ref] | [Ref] |
| For-profit facility | 1.10 (0.96, 1.27) | 1.03 (0.91, 1.17) |

[a]Patients who initiated dialysis between 1/1/12-8/31/16, followed through 8/31/17 for referral
[b]Referred patients who initiated dialysis between 1/1/2012-8/31/16, and were followed for evaluation outcome through 3/1/18.
[c]Referred and evaluated patients who initiated dialysis between 1/1/12-8/31/16, and were referred and evaluated, were followed for waitlisting outcome through 3/1/18.
[d]Referral model was adjusted for the following variables: age, gender, race/ethnicity, primary cause of kidney failure, the presence of certain comorbidities (congestive heart failure, atherosclerotic heart disease, other cardiac disease, cerebrovascular disease, peripheral vascular disease, hypertension, diabetes, chronic obstructive pulmonary disease, and cancer), insurance status, facility size, pre-/post-KAS era and not informed of transplant options due to medical reasons.
[e]Evaluation model was adjusted for the same variables as the referral model with the exception of a differing list of comorbidities (BMI≥35kg/m$^2$, congestive heart failure, atherosclerotic heart disease, other cardiac disease, cerebrovascular disease, peripheral vascular disease, diabetes, chronic obstructive pulmonary disease, smoking, and cancer), and removal of facility size.
[f]Waitlisting model was adjusted for the same variables as the evaluation model with the addition of pre-kidney failure nephrology care.

**Supplemental Table 4.** Sensitivity analysis results of adjusted cause-specific hazard ratios between dialysis facility profit status and referral for kidney transplantation during follow-up among incident kidney failure patients who initiated dialysis in dialysis facilities in Georgia, North Carolina, and South Carolina, *examining the interaction effect between age and profit status*

| Age, in years | Overall N (%) | Initiating dialysis at for-profit facility N (%) | Initiating dialysis at non-profit facility N (%) | For profit facility (vs. non-profit facility) (95% CI) |
|---|---|---|---|---|
| 18-64 | 19709 (59) | 16709 (58) | 3000 (59) | 0.88 (0.80, 0.98) |
| ≥65 | 13942 (41) | 11883 (42) | 2059 (41) | 0.72 (0.63, 0.81) |