COVID-19 among Adults Receiving Home versus In-Center Dialysis

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In-center hemodialysis (HD) patients face greater communicable disease risks, including drug-resistant bacterial colonization and viral hepatitis, compared with home dialysis patients, who limit these risks, avoiding three-times weekly travel to dialysis clinics for treatments (1,2). Minimizing the high coronavirus disease 2019 (COVID-19) morbidity in dialysis patients is essential (3). We explored severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) positive rates, COVID-19–related hospitalization, mortality, and intensive care unit (ICU) admission by dialysis modality in Ontario, Canada.

Data collection was in accordance with Ontario Health's legislative authority under the Ontario Personal Health Information Protection Act of 2004. We linked seven administrative health databases including the Ontario Renal Reporting System, which captures the modality and treatment changes of all adult (>18 years) home dialysis (peritoneal dialysis or home HD) or center-based HD patients across Ontario. Our observation period was between March 1, 2020 and November 20, 2020. For individuals, demographic data, neighborhood income quintile, location, residence in long-term care, comorbidity, hospitalization, ICU admission, deaths, and SARS-CoV-2 provincial RT-PCR testing and results information was obtained.

Assuming a 14-day SARS-CoV-2 incubation period, COVID-19 infection was ascribed to the dialysis modality after 14 consecutive days of a home or in-center modality. Patients were followed until death, kidney transplantation, or study end. Follow-up SARS-CoV-2 tests after initial positive results were excluded in ascertaining testing rates. Long-term care residents and regional programs with no COVID-19 infections during the study period were excluded. Event rates for the following were defined as: (1) SARS-CoV-2 tests; (2) positive SARS-CoV-2 tests; (3) initial COVID-19 hospitalization (hospitalization within 1 week of SARS-CoV-2 positivity and/or hospitalization with an international classification of diseases-10 diagnosis of COVID-19); (4) COVID-19 mortality or ICU admission (admission to an ICU with COVID-19 during the initial COVID-19 hospitalization or death within 30 days of COVID-19 admission or SARS-CoV-2 positivity); (5) non–COVID-19 mortality (deaths during the study period not occurring within 30 days of SARS-CoV-2 positivity or COVID-19 admission; and (6) all-cause mortality. Unadjusted and adjusted rate ratios (ARR) for these events were calculated by dialysis modality using a log-binomial model. Logistic regression was used to calculate the adjusted odds ratio (AOR) of hospitalization and ICU admission and/or 30-day mortality by dialysis modality among those with COVID-19 infection. All models were adjusted for factors as indicated in Table 1. Marginal generalized estimating equations and a working dependence correlation structure were used to account for patients contributing patient-times to both modalities. Analyses were performed using SAS Version 9.4 SAS Institute, Cary, NC).

We identified 3622 home dialysis (n=2853 peritoneal dialysis, n=769 home HD) and 9890 center-based HD patients (761,059 and 2,084,665 person-days, respectively). In-center patients were older (66.0±15 versus 63±15 years) and of longer dialysis vintage (median interquartile range, 2 [1–4] versus 2 [1–3] years), and a greater proportion had diabetes (53% versus 41%) compared with home dialysis patients. Fifty-three percent and 49% of home dialysis and in-center patients were in the greater Toronto area, respectively.

SARS-CoV-2 testing rates were lower in home versus in-center dialysis patients (ARR, 0.37; 95% confidence interval [95% CI], 0.35 to 0.38). Six positive SARS-COV-2 episodes occurring within 14 days of dialysis initiation/modality transition were excluded. Positive SARS-CoV-2 tests and COVID-19 hospitalization rates were lower in home compared with in-center dialysis patients. COVID-19–related ICU admission and mortality (ARR, 0.44; 95% CI, 0.18 to 1.09) was lower in home versus in-center patients but did not reach statistical significance (Table 1).

Among COVID-19–infected individuals, hospitalization occurred in 85% (29 of 34) and 86% (177 of 205) of home and in-center patients, respectively. Median length of hospitalization (interquartile range; days) was 13 (3–25) for in-center dialysis patients compared with 12 (11–27) for home dialysis patients. Mortality and/or ICU admission occurred in 18% (6 of 34) and 21% (45 of 205) of infected home and in-center patients, respectively. There were no differences in hospitalization (AOR, 1.3; 95% CI, 0.38 to 4.8) or death and/or ICU admission risks (AOR, 1.3; 95% CI, 0.37 to 4.8) in home compared with in-center COVID-19–infected

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Table 1. Adjusted rate ratios for SARS-CoV-2 and COVID-19 outcomes by dialysis modality

Outcome	Number with Outcome/ Person Days	Rate (per 100,000 person-days)	Unadjusted Rate Ratio (95% CI)	Adjusted Rate Ratio (95% CI)
SARS-CoV-2 tests				
In-center HD	20804/2,084,665	998	1.0 (Ref)	1.0 (Ref)
Home dialysis	2317/761,059	304	0.35 (0.34 to 0.38)	0.37 (0.35 to 0.38)
SARS-CoV-2 positive				
In-center HD	182/2,084,665	8.7	1.0 (Ref)	1.0 (Ref)
Home dialysis	34/761,059	4.5	0.59 (0.41 to 0.86)	0.57 (0.39 to 0.83)
COVID-19 Hospitalization				
In-center HD	177/2,084,665	8.5	1.0 (Ref)	1.0 (Ref)
Home dialysis	29/761,059	3.8	0.53 (0.38 to 0.75)	0.57 (0.40 to 0.81)
COVID-19 ICU admission 30-day mortality				
In-center HD	45/2,084,665	2.2	1.0 (Ref)	1.0 (Ref)
Home dialysis	6/761,059	0.8	0.37 (0.16 to 0.85)	0.44 (0.18 to 1.09)
Overall Mortality				
In-center HD	1030/2,084,665	49.4	1.0 (Ref)	1.0 (Ref)
Home dialysis	283/761,059	37.2	0.75 (0.66 to 0.86)	0.94 (0.82 to 1.08)
Non-COVID-19 mortality				
In-center HD	996/2,084,665	47.8	1.0 (Ref)	1.0 (Ref)
Home dialysis	278/761,059	36.5	0.76 (0.67 to 0.87)	0.96 (0.83 to 1.09)

Mortality reported over the study period. All models adjusted for age, gender, diabetes, length of time on dialysis, race, neighborhood income quintile, geographic location, and prior kidney transplantation. A total of 587 patients contributed to both modalities during the study period. Linked databases included: The Ontario Renal Reporting System, The Registered Persons Database, The Ontario Laboratory Information System COVID-19 database, The Ontario Renal Network COVID-19 data collection tool, The Canadian Institute for Health Information Discharge Abstract Database, The Ontario Health Insurance Plan (was used to determined residency in long-term care), and the Postal Code Conversion File (Statistics Canada; was linked *via* postal codes to determine neighborhood income quintiles and geographic location). 95% CI, 95% confidence interval; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2; COVID-19, coronavirus disease; HD-hemodialysis; ICU, intensive care unit.

patients. Non-COVID-19–related and overall mortality rates were similar in home versus center-based patients over the study period.

We found a lower burden of COVID-19 infection, hospitalization, mortality, and ICU admission in community-dwelling home dialysis versus in-center patients. Our findings may relate to greater case finding in the in-center population, more frequent health care encounters, and routine screening/outbreak surveillance, which was at the program's discretion. If increased testing among in-center HD patients was the only explanation for the higher rates of COVID-19, one would have expected a disproportionate excess of milder cases (*i.e.*, SARS-CoV-2 positivity not requiring hospital admission) among in-center compared with home dialysis patients. However, among in-center HD patients, we also observed higher rates of COVID-19 hospitalization, mortality, and ICU admission that may have been due to a higher infection rate rather than greater case-associated morbidity. Among COVID-19–infected individuals, we found no differences in the adjusted odds of hospitalization and ICU admission or 30-day mortality by home versus in-center treatment (albeit with limited power owing to low event rates).

Our study captured over 90% of SARS-CoV-2 provincial tests. A limitation of this study is residual confounding based on unmeasured differences between in-center and home dialysis patients. One cannot exclude case-mix differences in the in-center versus home patients that may have accounted for the differences in COVID-19–related adverse event risks. We also could not distinguish between asymptomatic and symptomatic outpatient cases. Asymptomatic cases may have not been identified in the absence of mass screening. As community transmission of SARS-CoV-2 increased, and as HD facilities intensified infection prevention and control measures, differences in COVID-19 infection rates by dialysis modality may be attenuated compared with our observed findings over the early pandemic period.

In the United States, rates of home dialysis continue to increase following the introduction of favorable reimbursement and policy reform (4,5). In addition to other purported benefits, a major shift to home-based dialysis care could render the ESKD population more resilient to the effects of COVID-19, reducing exposure episodes and total exposure time to SARS-CoV-2 while conferring lower future exposure risks to highly transmissible infections.

Disclosures

P.G. Blake is a contracted Medical Lead and Medical Director at Ontario Renal Network, Ontario Health, has received honoraria from Baxter Global for speaking engagements, and is on the Editorial Board of *American Journal of Nephrology*. J. Ip, Y. Tang, D. Thomas, and A. Yeung are salaried employees of Ontario Renal Network, Ontario Health. M. Oliver is a contracted Medical Lead at Ontario Renal Network, Ontario Health and is owner of Oliver Medical Management Inc., which licenses Dialysis Management Analysis and Reporting System software. He has received honoraria for speaking from Baxter Healthcare and participated on Advisory Boards for Janssen and Amgen. J. Perl reports grants from the Agency for Healthcare Research and Quality during the conduct

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