Assessment of a Laboratory-Based SARS-CoV-2 Antibody Test Among Hemodialysis Patients: A Quality Improvement Initiative

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Disclosures

- DEC, GM, and SMB are employees of DaVita Clinical Research
  - SMB's spouse is an employee of AstraZeneca
- KS, MP, MK, and JG are employees of DaVita Inc
- Other authors have nothing to disclose

Background

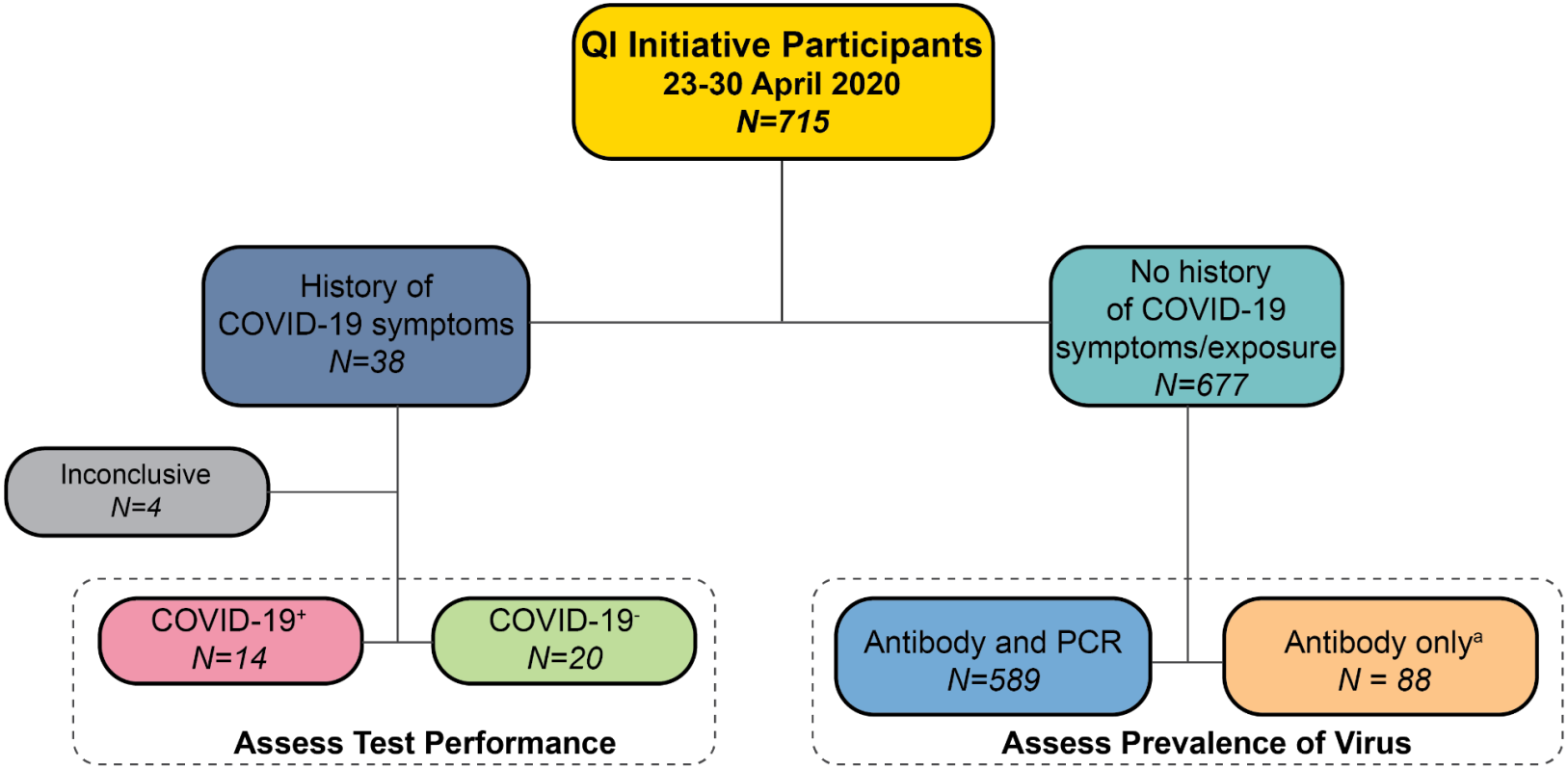
- The COVID-19 pandemic poses a particular threat to patients with end-stage kidney disease who are treated with in-center hemodialysis (ICHD).
- Identification and isolation of ICHD patients who are infected with the SARS-CoV-2 virus is an essential component of epidemic management in this population.
- The role of antibody testing in the identification of dialysis patients with current or previous SARS-CoV-2 infection is not known.
  - In particular, given the known biological latency between infection and antibody production, the role of antibody testing in cohorting decisions (and the functional sensitivity and specificity of the test in such circumstances) is not clear.

Approach

- Eligible patients were adults receiving in-center hemodialysis treatments at facilities operated by a large dialysis organization in the greater Miami, FL region (23-30 April 2020) who participated in a quality improvement (QI) initiative [1]
  - Patients with and without a history of symptoms consistent with COVID-19 were included.
  - Patients with such a history were further classified as either COVID-19+ or COVID-19- on the basis of the totality of clinical evidence, including PCR testing
- Samples for PCR and antibody testing were collected on the same day from participating patients.
  - PCR testing was performed with 2 primer and probe sets (Fulgent Genetics)
  - Tests for anti-SARS-CoV-2 antibodies (Diazyme Laboratories, Inc) were performed according to the manufacturer's protocol at an accredited clinical laboratory (DaVita Labs).
- Sensitivity and specificity of the antibody test were calculated among the group of COVID-19+ and COVID-19- patients; seroprevalence was assessed among patients with no history of COVID-19 symptoms and no high-risk contacts.

[1] All study data were derived from statistically de-identified electronic health records. Because this study was conducted using de-identified patient data, according to title 45, part 46 of the US Department of Health and Human Services' Code of Federal Regulations, it was deemed exempted from institutional review board or Ethics Committee approval (Quorum institutional review board, Seattle, WA, USA). We adhered to the Declaration of Helsinki and informed consent was not required.

Study Cohort

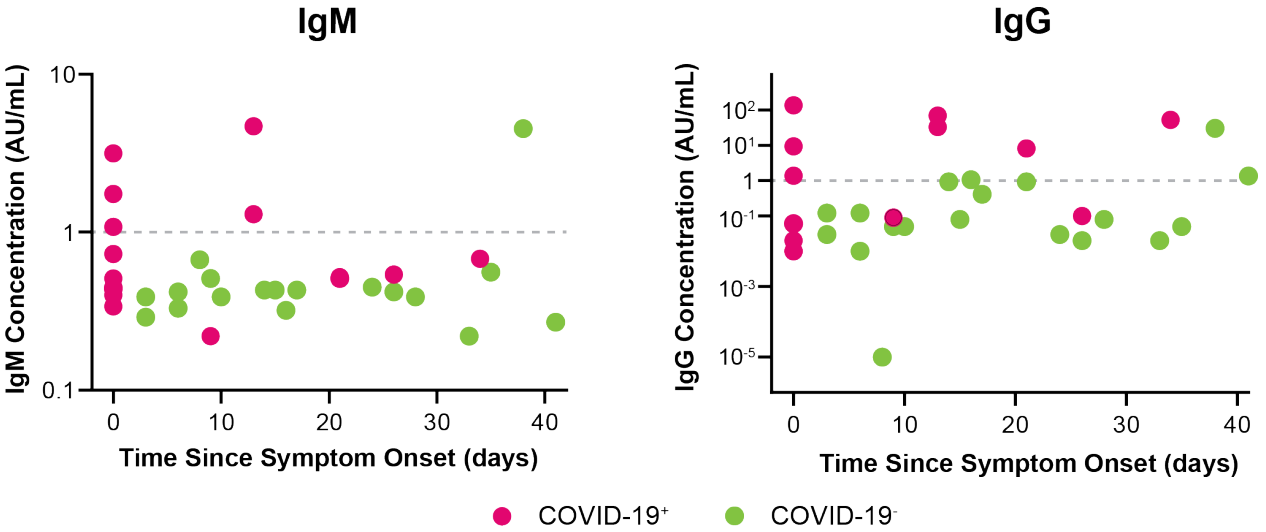


[a] PCR results missing, inconclusive, or unavailable due to inadequate sample

Characteristics of QI Participants

	QI Initiative Participants (N=715)	History of COVID-19 Symptoms (N=34)	No History of COVID-19 Symptoms/Exposure (N=677)
Age, years, mean ± SD	65.5 ± 14.5	63.1 ± 13.5	65.7 ± 14.5
Sex, female, n (%)	289 (40.4)	9 (26.5)	278 (41.1)
Race, n (%)			
White	29 (4.1)	2 (5.9)	27 (4.0)
Black	222 (31.1)	13 (38.2)	207 (30.6)
Hispanic	424 (59.3)	18 (52.9)	404 (59.7)
Other/unknown	40 (5.6)	1 (2.9)	39 (5.8)
Etiology of ESKD, n (%)			
Diabetes	237 (33.2)	11 (32.4)	225 (33.2)
Hypertension	252 (35.2)	14 (41.2)	237 (35.0)
Other	226 (31.6)	9 (26.5)	215 (31.8)
Dialysis vintage, months, median [p25, p75]	30 [13, 65]	34 [17, 59]	30 [13, 66]

IgG and IgM Concentration among QI Initiative Participants



Measured anti-SARS-CoV-2 IgM (left panel) and IgG (right panel) concentrations among COVID-19+ (magenta) patients and COVID-19- (green) patients are shown on the basis of elapsed time in days between symptom onset and serum sample collection. The manufacturer-specified cut-off between positive and negative test results was 1 AU/mL for each antibody (dashed grey lines).

Abbreviations: AU, arbitrary units; COVID-19, coronavirus disease 2019; IgG, immunoglobulin G; IgM, immunoglobulin M; QI, quality improvement

Sensitivity and specificity of antibody test among patients with known COVID-19 status

	COVID-19+ N=14			COVID-19- N=20		
	True Positive	False Negative	Sensitivity (%)	True Negative	False Positive	Specificity (%)
IgG[a]	7	6	53.9	17	3	85.0
IgM	5	9	35.7	19	1	95.0
Any antibody	8	6	57.1	17	3	85.0

COVID-19, coronavirus disease 2019; IgG, immunoglobulin G; IgM, immunoglobulin M.
[a] One COVID-19+ patient had missing IgG data.

- To assess the sensitivity and specificity of the antibody test, results were analyzed among the 14 COVID-19+ and 20 COVID-19- QI participants.
- When a positive test result was considered as the presence of *either* an IgM or an IgG value over the manufacturer-specified threshold of 1 AU/mL, the sensitivity of the test was 57.1%, with specificity of 85.0%.
- Considering IgM and IgG individually, sensitivities were 35.7% and 53.9%, respectively; specificities were 95% and 85%, respectively.

Prevalence of COVID-19 among patients with no history of COVID-19 symptoms or exposure

	PCR Negative	PCR Unavailable [a]	PCR Positive
Antibody Negative	555	83	1
Antibody Positive	33	5	0

COVID-19, coronavirus disease 2019; PCR, polymerase chain reaction.
[a] 8 inconclusive, 6 missing, 74 specimen insufficient for analysis

- Among 677 participants in the QI initiative who had no record of symptoms consistent with COVID-19 or known viral exposure, 588 had a negative PCR test for SARS-CoV-2, 88 had unavailable PCR data, and 1 had a positive PCR result.
- Based on measured IgG and IgM levels, 38 patients were antibody positive and 639 were antibody negative, corresponding to a seropositivity rate of 5.6% (95% CI 4.0-7.6%).

Conclusions and limitations

- Conclusions
  - The operational specificity of the antibody test (85.0%), combined with its ease of use, supports its use to supplement PCR testing to rule in disease among symptomatic patients of unknown COVID-19 status.
  - The low functional sensitivity of the test (57.1%) is specific to the use case explored here (ie testing patients within days or weeks of symptom onset) and not an intrinsic characteristic of the assay.
  - Prevalence of SARS-CoV-2 infection among QI participants was similar to that of the general population in the same geographic region during the same time period.
- Limitations
  - Small number of COVID-19+ and COVID-19- patients available for analysis
  - Longitudinal sampling to evaluate antibody concentrations over time was not possible
  - Date of symptom onset among symptomatic patients was taken from data collected for administrative purposes
  - Results pertain only to the specific antibody assay evaluated and cannot be generalized to other laboratory-based or point-of-care assays
  - The sensitivity and specificity of the antibody test observed here represent the functional characteristics of the assay when used among dialysis patients shortly after symptom onset and do not represent the analytic characteristics of the assay.