Longitudinal Assessment of Point-of-Care LumiraDx Antigen and Antibody Test Performance During Acute SARS-CoV-2 Infection and Recovery

Ronit R. Dalmat, Roshni Prabhu, Marie Bauer, Matthew H Ikuma, Elena Rechkina, Daphne Hamilton, Jason L. Cantera, Benjamin D. Grant, and Paul K. Drain

BACKGROUND

> Diagnostic testing for acute SARS-CoV-2 infection is critical to identify COVID-19 cases, reduce transmission, and inform public health measures.

> Rapid tests available at point-of-care can offer significant advantages over lab methods.

> The LumiraDx SARS-CoV-2 test platform performs two microfluidic fluorescence assays for the rapid detection of:
- > SARS-CoV-2 antigen (Ag) in nasal samples
- > SARS-CoV-2 antibodies (Ab) in blood samples

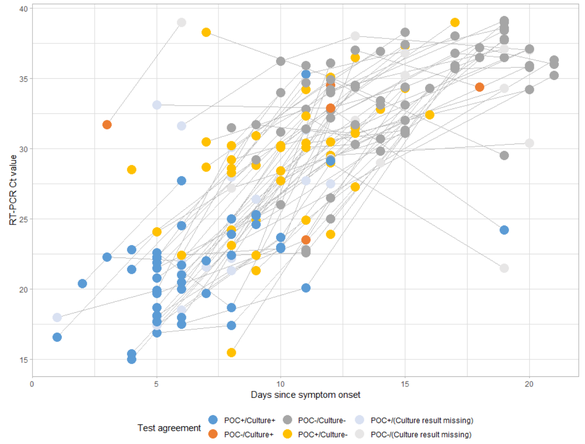
> We evaluated LumiraDx SARS-CoV-2 Ag and Ab tests in a longitudinal cohort to evaluate performance at different times of infection and recovery.

TABLE 1. CONCORDANCE BETWEEN RAPID ANTIGEN TEST AND COMPARATORS, BY DAYS SINCE SYMPTOM ONSET

Days since symptom onset	Positive Predictive Agreement		Negative Predictive Agreement		κ (95% CI)
	n/N	% (95% CI)	n/N	% (95% CI)	
(A) Rapid antigen versus laboratory antigen result					
Total	100/110	90.9 (84.9,95.9)	110/122	90.2 (84.1,95.1)	81.0 (72.6,88.7)
0-5	26/26	100.0 (100.0,100.0)	5/6	83.3 (50.0,100.0)	89.0 (52.9,100.0)
6-10	53/55	96.4 (90.6,100.0)	14/16	87.5 (70.6,100.0)	83.9 (65.4,96.4)
11-15	20/27	74.1 (56.2,91.3)	44/51	86.3 (76.7,96.0)	60.3 (40.8,78.2)
16-21	1/2	50.0 (0.0-100.0)	47/49	95.9 (89.6,100.0)	37.0 (-4.9,100.0)
(B) Rapid antibody versus laboratory antibody results					
Total	216/219	98.6 (96.9,100.0)	77/89	86.5 (78.8,93.3)	87.8 (81.0,93.5)
0-5	28/30	93.3 (82.6,100.0)	67/75	89.3 (81.6,95.7)	78.0 (61.8,100.0)
6-10	128/129	99.2 (97.5,100.0)	9/13	69.2 (43.8,92.3)	76.4 (51.0,93.3)
11-15	34/34	100.0 (100.0,100.0)	1/1	100.0 (100.0,100.0)	100.0 (100.0,100.0)
16-21	26/26	100.0 (100.0,100.0)	0/0	NC	NC
(C) Rapid antigen versus culture results					
Total	48/54	88.9 (79.6,96.2)	89/134	66.4 (58.1, 74.3)	45.5 (33.3,56.6)
0-5	21/22	95.5 (85.7,1.0)	3/5	60.0 (0, 100.0)	60.1 (0,100.0)
6-10	23/23	100.0 (100.0,100.0)	10/31	32.3 (16.1, 48.4)	28.9 (143.,48.1)
11-15	3/7	42.9 (0,83.3)	37/57	64.9 (51.7, 77.5)	3.90 (-14.5,0.24)
16-21	1/2	50.0 (0,100.0)	39/41	95.1 (87.5, 100.0)	36.5 (-5.9,100.0)
(D) Rapid antigen versus PCR results					
Total	109/116	93.6 (88.6,97.4)	69/121	57.0 (48.3, 65.7)	49.7 (39.8,59.6)
0-5	27/27	100.0 (100.0,100.0)	4/6	80.0 (33.3, 100.0)	87.1 (47.5,100.0)
6-10	52/54	96.3 (90.7,100.0)	9/17	52.9 (28.6, 77.8)	56.0 (31.6,78.4)
11-15	22/26	84.6 (69.7,99.0)	16/51	31.4 (19.1, 44.9)	12.4 (-2.4,27.4)
16-21	2/3	66.7 (0.0,100.0)	40/48	83.3 (71.4, 92.0)	23.9 (-6.2,56.9)

CI = Confidence Interval; κ = Cohen's Kappa coefficient

FIGURE 1. NASAL SAMPLES GROUPED BY PARTICIPANT (LINES) AND AGREEMENT OF RESULTS BETWEEN LUMIRADX ANTIGEN TEST RESULT AND CULTURE POSITIVITY (PROXY FOR INFECTIVITY).



X AXIS = DAY SINCE SYMPTOM ONSET AT TIME OF SAMPLE COLLECTION
Y AXIS =CT VALUE FROM PCR TESTING

METHODS

> Cohort of N=71 ambulatory adults recently diagnosed with acute SARS-CoV-2 infection
- > Nasal samples collected at clinic visits spanning 0-21 days since onset of symptoms (dsso)
- > Blood samples collected at clinic visits spanning 0-87 days since onset of symptoms (dsso)

> Antigen (Ag) testing:
- > LumiraDx Ag test
- > Lab MesoScale Diagnostics nucleocapsid (N) Ag test
- > RT-PCR (Hologic Panther Fusion)
- > Culture (growth in VeroE6AT cells)

> Antibody (Ab) testing:
- > LumiraDx Ab test
- > Roche Elecsys Anti-S SARS-CoV-2 total Ab test

> Measures of concordance between LumiraDx and comparators were calculated
- > Positive predictive agreement (PPA)
- > Negative predictive agreement (NPA)
- > Cohen's Kappa (κ)
- > Bootstrapped confidence intervals

RESULTS

> LumiraDx Ag concordance
- > Almost perfect agreement with lab N-Ag results (K>0.80) across all samples (Table 1A)
- > Moderate agreement with PCR results overall (K=0.60), though substantial (K>0.6) for 0-5 dsso and 6-10 dsso (Table 1D)
- > Moderate agreement with culture results overall (K=0.46): substantial (K=0.6) between 0-5 dsso and fair (K=0.29) between 6-10. (Table 1C)

> LumiraDx Ab concordance
- > Almost perfect agreement with lab Ab results across all samples (K=0.88) (Table 1B)
- > Substantial agreement (K>0.7) for samples collected 0-10 dsso and 11-28 dsso (Table 1B)

FIGURE 2. RAPID TEST RESULTS (ANTIGEN AND ANTIBODY) OVER TIME PER PARTICIPANT (N=71 PARTICIPANTS)

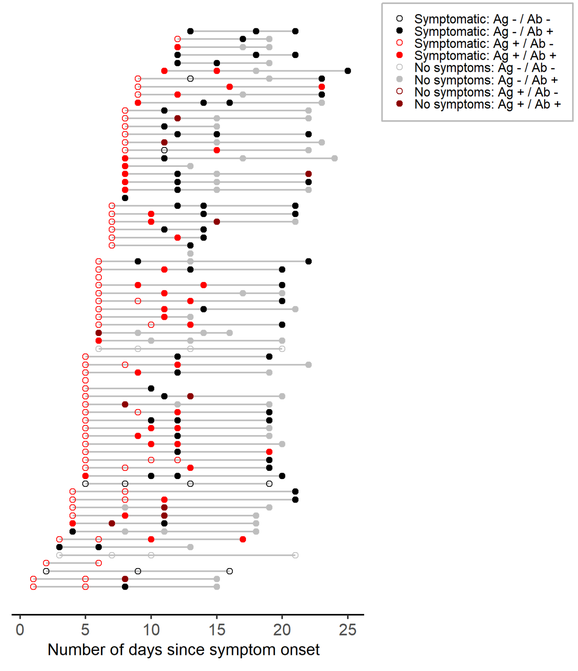
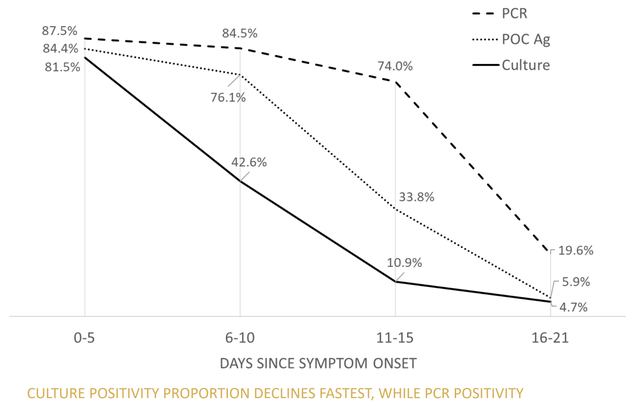


FIGURE 3. PROPORTION OF PCR, RAPID ANTIGEN, AND CULTURE TESTS THAT RESULTED POSITIVE, AT EACH TIME PERIOD OF COLLECTION (SINCE SYMPTOM ONSET)



CULTURE POSITIVITY PROPORTION DECLINES FASTEST, WHILE PCR POSITIVITY DECLINES SLOWEST.

DISCUSSION

> LumiraDx rapid tests perform well compared to more costly and time-consuming lab methods of Ag and Ab detection.

> Strengths of the study include high retention rates; repeated and consistent invasive sampling procedures; relatively young and healthy cohort more representative of general population.

> Limitations include exclusion of asymptomatic patients, who may be capable of transmitting infection; study design precluded ability to compare diagnostic results across variant sub-types.

> LumiraDx rapid tests may be helpful in identifying patients infectious between 0-5 dsso, given the substantial concordance of the rapid Ag test and culture positivity.

ACKNOWLEDGMENTS

> This study was funded by the Bill and Melinda Gates Foundation (#INV-017205).

DEPARTMENT OF GLOBAL HEALTH

UNIVERSITY *of* WASHINGTON