Point of care antibody tests for covid-19: Field-based performance, South Africa

POINT OF CARE ANTIBODY TESTS FOR COVID-19: FIELD-BASED PERFORMANCE, SOUTH AFRICA

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BACKGROUND

SARS-CoV-2 antibody testing is an important auxillary test for identifying past infection, investigating for long COVID-19 or multisystem inflammatory syndrome of childhood. Epidemiological serology studies may also assist public health planning. Access to formal laboratory testing is not universal in many low-and middle-income (LMIC) countries and rapid lateral flow antibody tests are an attractive alternative. Performance of these tests has been inconsistent. A large-scale study was undertaken in South Africa, **during the beta and delta waves,** to assess the **field-based performance** of rapid point of care (POC) COVID-19 antibody tests, and **compare them with polymerase chain reaction (PCR) and serology.**

POC tests were selected following a rapid in-laboratory evaluation.

METHODS

- Symptomatic, ambulatory persons under investigation for COVID-19 (PUIs), aged 18 years and older at public health (non-research) facilities in three provinces, South Africa were enrolled at baseline.
- Nasopharyngeal swabs were taken and processed for SARS-CoV-2 PCR testing using either a GeneXpert (Cepheid, USA), Biofire (Biofire, USA) or Cobas (Roche, Switzerland) platform at National Health Laboratory Service laboratories as per routine national protocols.
- Participants testing PCR positive or rapid antibody positive, and 500 PCR negative participants were offered followed up 5-14 days later.
- At baseline and follow-up trained study staff performed three POC lateral flow (rapid) antibody tests on a fingerstick sample. Blood was collected for formal laboratory-based serology.
- Rapid antibody tests were compared with PCR and serology performed on 3 platforms – Euroimmun (Euroimmun, Lubeck) IgA, Euroimmun IgG anti-S antibodies and Abbott Architect IgG test.
- The sensitivity (S), specificity (Sp), positive (PPV) and negative predictive (NPV) values of tests for PUIs at baseline and follow-up were calculated.

Field-based performance of rapid antibody tests are sub-optimal compared with serology. Surveillance studies using rapid antibody tests testing may under-estimate SARS-CoV-2 infection

RESULTS

- 1696 participants presenting with symptoms of acute COVID-19 (PUIs) were enrolled (October 2020-2021):
- 426 (25%) tested PCR positive at baseline.
- Characteristics of the study population at baseline are described in CROI 2022 poster 00823.
- 507 participants were followed up at 5-14 days.
- Median days since symptom onset was 3 (IQR 2-6) at baseline and 12 (IQR 8-17) at follow-up.
- Test performance is summarised below

Table 1: Rapid antibody test performance at Baseline and Follow-up: Reference standard: PCR

Point of Care antibody tests	Sensitivity (95%CI)	Specificity (95%CI)	PPV (95%CI)	NPV (95%CI)
BIOSYNEX COVID-19 BSS: Baseline: IgM/IgG (n=1238)	25.1 (20.7 – 30.1)	83.6 (81.0 – 86.0)	37.3 (31.1 – 43.9)	74.2 (71.4 – 76.9)
BIOSYNEX COVID-19 BSS: Follow-up: IgM/IgG (n=504)	24.5 (13.3 – 38.9)	77.1 (73.0 – 80.9)	10.3 (5.5 – 17.4)	90.5 (87.1 – 93.2)
Genrui Biotech Novel Coronavirus (2019-nCoV) (Colloidal Gold) Baseline : IgG/IgM (n=939)	22.8 (17.6 – 28.8)	87.7 (85.0 – 90.0)	37.9 (29.8 – 46.4)	77.6 (74.5 – 80.4)
Genrui Biotech Novel Coronavirus (2019-nCoV) (Colloidal Gold) Follow-up: IgG/IgM (n=456)	20.0 (9.6 – 34.6)	87.8 (84.3 – 90.8)	15.3 (7.2 – 27.0)	90.9 (87.7 – 93.6)
Orient Gene Covid-19: Baseline IgM/IgG (n=1228)	21.1 (17.0 – 25.8)	84.7 (82.2 – 87.1)	35.6 (29.1 – 42.5)	72.9 (70.1 – 75.6)
Orient Gene Covid-19: Follow-up IgM/IgG (n=495)	25.0 (13.6 – 39.6)	77.4 (73.2 – 81.2)	10.6 (5.6 – 17.8)	90.6 (87.2 – 93.3)

Table 2: Rapid antibody test performance at Baseline and Follow-up: Reference standard: Serology

	Abbot				Euroimmun IgA				Euroimmun IgG			
Point of Care antibody tests	Sensitivity (95%CI)	Specificity (95%CI)	PPV (95%CI)	NPV (95%CI)	Sensitivity (95%CI)	Specificity (95%CI)	PPV (95%CI)	NPV (95%CI)	Sensitivity (95%CI)	Specificity (95%CI)	PPV (95%CI)	NPV (95%CI)
BIOSYNEX COVID-19 BSS: Baseline: IgM/IgG	43.8 (37.2-50.5)	91.5 (88.5-93.9)	71.7 (63.5-79.1)	76.7 (72.9- 80.2)	32.6 (27.8- 37.7)	93.1 (89.9-95.5)	83.2 (76.1-88.9)	56.7 (52.5- 60.8)	39.5 (33.8-45.4)	91.8 (88.8-94.1)	75.3 (67.6- 82)	70.5 (66.6- 74.1)
BIOSYNEX COVID-19 BSS: Follow-up: IgM/IgG	67.1 (55.4- 77.5)	87.7 (81.5-92.5)	72.9 (60.9-82.8)	84.5 (77.9- 89.7)	44.7 (37.3-52.3%)	88.8 (81.9-93.7)	85.1 (76.3-91.6)	52.9 (45.9- 59.8)	53.9 (45.7-61.9)	91 (85.6-94.9)	84.7 (76.0- 91.2)	68.2 (61.6- 74.2)
Genrui Biotech Novel Coronavirus (2019-nCoV) (Colloidal Gold) Baseline : IgG/IgM	30.8 (24.7-37.5)	92.8 (89.8- 95.1)	69.5 (59.2-78.5)	71.6 (67.5-75.4)	23.7 (19.3-28.6)	93.8 (90.5-96.2)	80.8 (71.7- 88.0)	52.8 (48.6-57.1)	30.2 (24.7-36.1)	93.8 (91-96)	76.2 (66.9- 84)	67.2 (63.2-71.1)
Genrui Biotech Novel Coronavirus (2019-nCoV) (Colloidal Gold): Follow-up: IgG/IgM	32.9 (22.3-44.9)	94.0 (88.8- 97.2)	72.7 (54.5- 86.7)	74.1 (67.2- 80.2)	25.3 (19- 32.4)	95.2 (89.8- 98.2)	88.0 (75.7-95.5)	47.8 (41.4- 54.2)	28.3 (21.3- 36.2)	94.4 (89.7-97.4)	82.7 (69.7- 91.8)	58.2 (52- 64.3)
Orient Gene Covid-19: Baseline IgM/IgG	42.4 (35.9- 49.2)	91.4 (88.4- 93.9)	71.4 (63-78.9)	75.9 (72-79.5)	32.6 (27.7-37.7)	93.8 (90.7-96.1)	84.6 (77.4-90.2)	57.1 (52.9- 61.3)	39.1 (33.2-45.1)	92.1 (89.1-94.4)	75.4 (67.4-82.2)	70.9 (66.9- 74.5)
Orient Gene Covid-19: Follow-up IgM/IgG	64.0 (52.1-74.8)	89.1 (83.1- 93.5%	73.8 (61.5-84)	83.7 (77.2- 89.0)	45.6 (38.1- 53.1)	91.2 (84.8-95.5)	88.2 (79.8-93.9)	53.8 (46.8- 60.6)	55.2 (47- 63.2)	92.9 (87.9-96.3)	87.6 (79.4- 93.4)	69.3 (62.9- 75.3)

Footnote: Biosynex Baseline: n=683 for Abbot, 711 for Euroimmun IgA and 736 for Euroimmun IgG; **Biosynex Follow-up:** n=231 for Abbot, 304 for Euroimmun IgA and 321 for Euroimmun IgG; **Genrui Baseline:** n=616 for Abbot, 644 for Euroimmun IgA and 669 for Euroimmun IgG; **Genrui Follow-up:** n=222 for Abbot, 299 for Euroimmun IgA and 313 for Euroimmun IgG; **Orient gene Baseline:** n=668 for Abbot, 691 for Euroimmun IgA and 715 for Euroimmun IgG; **Orient gene Follow-up:** n=231 for Abbot, 305 for Euroimmun IgA and 322 for Euroimmun IgG

CONCLUSIONS

- Compared with PCR, rapid POC SARS-CoV-2 antibody tests performed poorly. This is expected as antibody responses typically develop from Day 7.
- Using serology as a reference:
  - At baseline, rapid antibody test sensitivity ranged from 24-40%.
  - At follow-up, although sensitivity improved, they were still low, ranging from 25-55%.
- Rapid antibody tests may under-estimate SARS-CoV-2 infection. This is particularly important in seroprevalence studies.
- More analysis are underway to understand: (i) rapid POC test performance by SARS-CoV-2 variant and COVID-19 severity and (ii) whether field-circumstances (temperature, lighting, storage conditions) and participant characteristics explain the documented poor performance of rapid antibody tests compared with laboratory-based serology.

ADDITIONAL KEY INFORMATION

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Acknowledgements: SAMRC, NHLS, Natasha Titus, Khanya Mohlabi, Carl Lombard, Terusha Chetty, Nadia van Niekerk