**Supplementary Materials**

**Table S1.** Characteristics of the control samples used for the assessment of specificity of each kit (n = 70).

|  |  |  |
| --- | --- | --- |
| **Category** | **Virus** | **No. of samples\*** |
| Antibodies against other coronaviruses | MERS CoV | 20 |
| SARS-CoV |
| Other human coronaviruses (HCoV-229E, NL63, OC43, HKU1) |
| Antibodies against non-CoV respiratory viruses | RSV | 15 |
| H1N1 Influenza |
| Antibodies against various non-respiratory viruses (n = 59) | HSV-1 (IgG)  HSV-2 (IgG)  HHV-6 (IgG)  HHV-8 (IgG)  EBV (IgG/IgM)  HBV (HBcAb)  HCV  HEV (IgG/IgM)  HGV (IgG)  Dengue (IgG)  Chikungunya (IgG)  B19 (IgG/IgM)  WNV (IgG/IgM) | 33 |
| Antibodies against nuclear antigens (ANAs) |  | 2 |

**\* A sample can test positive for more than one virus**

Abbreviations: MERS, middle east respiratory syndrome coronavirus; SARS-CoV, severe acute respiratory syndrome coronavirus; RSV, respiratory syncytial virus; HSV-1, herpes simplex virus 1; HSV-2 herpes simplex virus 2; HHV-6, human herpes virus-6; HHV-8, human herpes virus-8; EBV, Epstein-Barr virus; HBV, hepatitis B virus; HCV, hepatitis C virus; HEV, hepatitis E virus; HGV, hepatitis G virus; B19, parvovirus B19; WNV, West Nile virus; SARS-CoV-2, severe acute respiratory syndrome virus-2

**Table S2.** Specifications of the evaluated CE-marked IgG ELISA kits, and comparison of the sensitivity and specificity reported by the company vs. obtained results.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **ELISA Kit** | **Manufacturer** | **Antigen coating wells** | **LOT No.** | **Reported sensitivity** | **Estimated sensitivity** | **Reported specificity** | **Estimated specificity** |
| EDI™ Novel Coronavirus COVID-19 IgG ELISA Kit | Epitope Diagnostics, Inc. | Recombinant full length Nucleocapsid protein | P745C | 100% (vs. RT-PCR) | 78.6% (≤ 7 days)  90.0% (8–14 days)  84.8% (> 14 days) | 100% | 97.1% |
| AnshLabs SARS-CoV2 IgG ELISA | AnshLabs | Purified SARS-CoV-2 recombinant antigen (epitope in Nucleocapsid (N) and Spike (S) region) | 041520 | 95% (vs. commercial CLIA)  83.6% (vs. RT-PCR results) | 57.1% (≤ 7 days)  72.5% (8–14 days)  66.7% (> 14 days) | 98.3% (vs. commercial CLIA)  91.3% (vs. RT-PCR results) | 75.7% |
| Dia.Pro COVID-19 IgG | Dia.Pro  Diagnostic Bioprobes | Recombinant Nucleocapsid and Spike antigens | 0420/6FB | ≥ 98% (vs. RT-PCR) | 57.1% (≤ 7 days)  75.0% (8–14 days)  60.6% (> 14 days) | ≥ 98% | 97.1% |
| NovaLisa® SARS–CoV-2 IgG ELISA | NovaTec Immundiagnostica GmbH | Recombinant Nucleocapsid antigen | COVG-001 | 8–40%  (0–11 days)  100%  (≥ 12 days)  (vs. RT-PCR) | 67.9% (≤ 7 days)  82.5% (8–14 days)  87.9% (> 14 days) | 99.3% | 85.7% |
| Lionex COVID-19 ELISA - Human IgG | Lionex Diagnostics & Therapeutics | Specific recombinant S1 antigen | I00026 | > 84% (vs. RT-PCR) | 64.3% (≤ 7 days)  87.5% (8–14 days)  87.9% (> 14 days) | 99.35% | 98.6% |

**Table S3**. IgG test results for the control group and COVID-19 patient cohort with the different evaluated ELISA assays.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sample** | **Sample specifications** | **EDI** | **AnshLabs** | **Dia.Pro** | **NovaTec** | **Lionex** |
| 1 | HGV+ | 0 | 0 | 0 | 0 | 0 |
| 2 | HCV+ | 0 | 0 | 0 | 0 | 0 |
| 3 | HBcAb+, HGV+ | 0 | 0 | 0 | 0 | 0 |
| 4 | HBcAb+, HGV+ | 0 | 1 | 0 | 0 | 0 |
| 5 | HBcAb+, HCV+ | 1 | 1 | 0 | 1 | 0 |
| 6 | HBcAb+, HCV+ | 0 | 1 | 0 | 1 | 0 |
| 7 | HBcAb+, HBsAg+ | 0 | 0 | 0 | 0 | 0 |
| 8 | HBcAb+, HBsAg+ | 0 | 0 | 0 | 0 | 0 |
| 9 | HEV IgG+ | 0 | 1 | 0 | 0 | 0 |
| 10 | HEV IgM+ | 0 | 0 | 0 | 0 | 0 |
| 11 | HEV IgG/M+ | 0 | 1 | 0 | 0 | 0 |
| 12 | HEV+, HSV1 IgG+ | 0 | 0 | 0 | 0 | 1 |
| 13 | HEV+, EBV+, HSV1+ | 0 | 0 | 0 | 0 | 0 |
| 14 | HEV+, EBV+, DENV+, HSV1+ | 0 | 0 | 0 | 0 | 0 |
| 15 | HEV+, EBV+, DENV+, HSV1+ | 0 | 0 | 0 | 0 | 0 |
| 16 | HEV+, EBV+, DENV+, HSV1+, HHV6+ | 0 | 1 | 0 | 0 | 0 |
| 17 | HEV+, EBV+, DENV+, HSV1+, HHV6+ | 0 | 0 | 0 | 0 | 0 |
| 18 | HEV+, EBV+, DENV+, HSV1+, HHV6+ | 0 | 0 | 0 | 0 | 0 |
| 19 | HEV+, EBV+, DENV+, HSV1+, HHV6+ | 0 | 0 | 0 | 0 | 0 |
| 20 | HEV+, DENV+, HSV1+, HHV6+ | 0 | 1 | 0 | 1 | 0 |
| 21 | HEV+, EBV+, HHV6+, | 0 | 0 | 0 | 0 | 0 |
| 22 | HEV+, EBV+, HSV1+, HHV8+ | 0 | 0 | 0 | 0 | 0 |
| 23 | HEV+, EBV+, HHV8+ | 0 | 0 | 0 | 0 | 0 |
| 24 | HEV+, EBV+, CHIK+, HHV6+ | 0 | 0 | 0 | 0 | 0 |
| 25 | HEV+, CHIKV+ | 0 | 0 | 0 | 0 | 0 |
| 26 | EBV IgG/M+ | 0 | 0 | 0 | 0 | 0 |
| 27 | EBV-, HEV+, HSV1+ | 0 | 0 | 0 | 0 | 0 |
| 28 | EBV-, HEV+, DENV+, HHV6+, HSV1+ | 0 | 0 | 0 | 0 | 0 |
| 29 | B19 IgG+, HSV1+ | 0 | 0 | 0 | 0 | 0 |
| 30 | B19 IgM+, HEV+ | 0 | 0 | 0 | 0 | 0 |
| 31 | WNV IgM+/IgG+ | 0 | 0 | 0 | 0 | 0 |
| 32 | WNV IgM+/IgG+ | 0 | 0 | 0 | 0 | 0 |
| 33 | WNV IgM+/IgG+ | 0 | 0 | 0 | 0 | 0 |
| 34 | ANA+ | 0 | 0 | 0 | 0 | 0 |
| 35 | ANA+ | 0 | 1 | 0 | 0 | 0 |
| 36 | MERS IgM+, SARS-CoV IG+ | 0 | 0 | 0 | 0 | 0 |
| 37 | MERS IgG+ (confirmed by ppNT) | 0 | 0 | 0 | 0 | 0 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 38 | MERS IgG+ | 0 | 0 | 0 | 0 | 0 |
| 39 | MERS IgG+ | 1 | 1 | 1 | 1 | 0 |
| 40 | MERS IgG+ | 0 | 0 | 0 | 0 | 0 |
| 41 | MERS IgG+ | 0 | 0 | 0 | 0 | 0 |
| 42 | MERS IgG+ | 0 | 0 | 0 | 0 | 0 |
| 43 | MERS IgG+ | 0 | 0 | 0 | 0 | 0 |
| 44 | MERS IgG+ | 0 | 0 | 0 | 0 | 0 |
| 45 | MERS IgG+ | 0 | 0 | 0 | 0 | 0 |
| 46 | MERS IgG+ | 0 | 0 | 0 | 0 | 0 |
| 47 | MERS IgG-, other hCoVs IgG+ | 0 | 0 | 0 | 0 | 0 |
| 48 | MERS IgG-, other hCoVs IgG+ | 0 | 0 | 0 | 0 | 0 |
| 49 | MERS IgG-, other hCoVs IgG+ | 0 | 0 | 0 | 0 | 0 |
| 50 | MERS IgG-, other hCoVs IgG+ | 0 | 0 | 0 | 0 | 0 |
| 51 | MERS IgG-, other hCoVs IgG+ | 0 | 1 | 0 | 1 | 0 |
| 52 | MERS IgG-, other hCoVs IgG+ | 0 | 0 | 0 | 0 | 0 |
| 53 | MERS IgG-, other hCoVs IgG+ | 0 | 0 | 0 | 0 | 0 |
| 54 | MERS IgG-, other hCoVs IgG+ | 0 | 1 | 0 | 1 | 0 |
| 55 | MERS IgG-, other hCoVs IgG+ | 0 | 0 | 0 | 0 | 0 |
| 56 | Influenza +ve | 0 | 0 | 0 | 0 | 0 |
| 57 | Influenza +ve | 0 | 0 | 0 | 0 | 0 |
| 58 | Influenza +ve | 0 | 0 | 0 | 0 | 0 |
| 59 | Influenza +ve | 0 | 1 | 0 | 1 | 0 |
| 60 | Influenza +ve | 0 | 0 | 0 | 0 | 0 |
| 61 | Influenza +ve | 0 | 0 | 0 | 0 | 0 |
| 62 | Influenza +ve | 0 | 1 | 0 | 1 | 0 |
| 63 | Influenza +ve | 0 | 1 | 0 | 0 | 0 |
| 64 | Influenza +ve | 0 | 1 | 1 | 1 | 0 |
| 65 | Influenza +ve | 0 | 1 | 0 | 0 | 0 |
| 66 | RSV +ve | 0 | 0 | 0 | 0 | 0 |
| 67 | RSV +ve | 0 | 0 | 0 | 0 | 0 |
| 68 | RSV +ve | 0 | 0 | 0 | 0 | 0 |
| 69 | RSV +ve | 0 | 0 | 0 | 0 | 0 |
| 70 | RSV +ve | 0 | 1 | 0 | 1 | 0 |
| **Group 1 (tested within ≤ 7 days of symptom onset)** | | | | | | |
| **Sample no.** | **Sample source** | **EDI** | **Ansh Labs** | **Dia.Pro** | **NovaTec** | **Lionex** |
| 1 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 2 | Hospitalized, Non-ICU | 0 | 0 | 0 | 0 | 0 |
| 3 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 4 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 5 | Hospitalized, Non-ICU | 0 | 0 | 0 | 0 | 1 |
| 6 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 7 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 8 | Hospitalized, Non-ICU | 0 | 1 | 0 | 1 | 0 |
| 9 | Hospitalized, Non-ICU | 0 | 1 | 0 | 0 | 1 |
| 10 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 11 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 12 | Hospitalized, Non-ICU | 0 | 0 | 0 | 0 | 0 |
| 13 | Hospitalized, Non-ICU | 0 | 0 | 0 | 0 | 0 |
| 14 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 15 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 16 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 17 | Hospitalized, Non-ICU | 0 | 1 | 0 | 1 | 0 |
| 18 | ICU | 0 | 1 | 0 | 0 | 1 |
| 19 | ICU | 0 | 0 | 0 | 0 | 1 |
| 20 | ICU | 0 | 1 | 0 | 0 | 1 |
| 21 | ICU | 1 | 1 | 1 | 1 | 1 |
| 22 | ICU | 1 | 1 | 1 | 1 | 1 |
| 23 | ICU | 1 | 1 | 1 | 1 | 1 |
| 24 | ICU | 1 | 1 | 1 | 1 | 0 |
| 25 | ICU | 1 | 1 | 1 | 1 | 1 |
| 26 | ICU | 1 | 1 | 1 | 1 | 0 |
| 27 | ICU | 0 | 1 | 0 | 0 | 0 |
| 28 | ICU | 0 | 0 | 0 | 0 | 0 |
| **Group 2 (tested within 8–14 days of symptom onset)** | | | | | | |
| **Sample no.** | **Sample source** | **EDI** | **Ansh Labs** | **Dia.Pro** | **NovaTec** | **Lionex** |
| 1 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 2 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 3 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 4 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 5 | Hospitalized, Non-ICU | 0 | 0 | 0 | 0 | 0 |
| 6 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 7 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 8 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 9 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 10 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 11 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 12 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 13 | Hospitalized, Non-ICU | 1 | 1 | 0 | 1 | 1 |
| 14 | Hospitalized, Non-ICU | 0 | 0 | 0 | 0 | 0 |
| 15 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 16 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 17 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 0 |
| 18 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 19 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 20 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 21 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 22 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 23 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 24 | ICU | 0 | 0 | 0 | 0 | 0 |
| 25 | ICU | 1 | 1 | 1 | 1 | 1 |
| 26 | ICU | 1 | 1 | 1 | 1 | 1 |
| 27 | ICU | 0 | 1 | 0 | 1 | 0 |
| 28 | ICU | 0 | 1 | 0 | 1 | 1 |
| 29 | ICU | 0 | 1 | 0 | 1 | 1 |
| 30 | ICU | 1 | 1 | 1 | 1 | 1 |
| 31 | ICU | 1 | 1 | 1 | 1 | 1 |
| 32 | ICU | 0 | 1 | 0 | 1 | 1 |
| 33 | ICU | 1 | 1 | 1 | 1 | 1 |
| 34 | ICU | 1 | 1 | 1 | 1 | 1 |
| 35 | ICU | 0 | 0 | 0 | 0 | 0 |
| 36 | ICU | 1 | 1 | 1 | 1 | 1 |
| 37 | ICU | 0 | 1 | 0 | 0 | 1 |
| 38 | ICU | 1 | 1 | 1 | 1 | 1 |
| 39 | ICU | 1 | 1 | 1 | 1 | 1 |
| 40 | ICU | 0 | 1 | 0 | 1 | 0 |
| **Group 3 (tested after > 14 days of symptom onset)** | | | | | | |
| **Sample no.** | **Sample source** | **EDI** | **Ansh Labs** | **Dia.Pro** | **NovaTec** | **Lionex** |
| 1 | Recovered patient | 1 | 1 | 1 | 1 | 1 |
| 2 | Recovered patient | 1 | 1 | 1 | 1 | 1 |
| 3 | Recovered patient | 1 | 1 | 1 | 1 | 1 |
| 4 | Recovered patient | 0 | 1 | 0 | 0 | 0 |
| 5 | Recovered patient | 0 | 1 | 0 | 1 | 1 |
| 6 | Recovered patient | 1 | 1 | 1 | 1 | 1 |
| 7 | Recovered patient | 0 | 1 | 0 | 1 | 1 |
| 8 | Recovered patient | 0 | 1 | 0 | 1 | 1 |
| 9 | Recovered patient | 1 | 1 | 1 | 1 | 1 |
| 10 | Recovered patient | 0 | 0 | 1 | 1 | 1 |
| 11 | Recovered patient | 0 | 0 | 0 | 0 | 1 |
| 12 | Recovered patient | 1 | 1 | 1 | 1 | 1 |
| 13 | Recovered patient | 0 | 1 | 0 | 1 | 1 |
| 14 | Recovered patient | 1 | 1 | 1 | 1 | 1 |
| 15 | Recovered patient | 0 | 0 | 0 | 0 | 1 |
| 16 | Recovered patient | 1 | 1 | 1 | 1 | 1 |
| 17 | Recovered patient | 1 | 1 | 1 | 1 | 1 |
| 18 | Recovered patient | 0 | 1 | 0 | 1 | 1 |
| 19 | Recovered patient | 0 | 1 | 0 | 1 | 1 |
| 20 | Recovered patient | 1 | 1 | 1 | 1 | 1 |
| 21 | Recovered patient | 1 | 1 | 1 | 1 | 1 |
| 22 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 23 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 24 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 25 | Hospitalized, Non-ICU | 1 | 1 | 1 | 1 | 1 |
| 26 | Hospitalized, Non-ICU (mild symptoms) | 0 | 0 | 0 | 1 | 0 |
| 27 | ICU | 1 | 1 | 1 | 1 | 1 |
| 28 | ICU | 1 | 1 | 1 | 1 | 1 |
| 29 | ICU | 1 | 1 | 1 | 1 | 1 |
| 30 | ICU | 1 | 1 | 1 | 1 | 1 |
| 31 | ICU | 0 | 1 | 1 | 1 | 0 |
| 32 | ICU | 1 | 1 | 1 | 1 | 1 |
| 33 | ICU | 0 | 0 | 0 | 0 | 0 |

\*All borderline results were considered positive in the analysis; 0 = negative result, 1 = positive result.

**Table S4.** Cross-tabulation of ELISA assays vs. standard test.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **Standard test** | | **Row marginal** |
|  |  | **+** | **–** |
| **ELISA assay** | **+** | A | B | R1 |
| **–** | C | D | R2 |
| **Column**  **marginal** | | C1 | C2 | N |

**Overall percent agreement**

* The proportion of all specimens where the ELISA assay and the standard test agree

**Sensitivity**

* The proportion of the assay to detect a positive outcome among those who are truly positive by the standard test

**Specificity**

* The proportion of the assay to detect a negative outcome among those who are truly negative by the standard test

**Positive predictive value**

* The proportion of those who are truly positive by the standard test among those who tested positive with the assay

**Negative predictive value**

* The proportion of those who are truly negative by the standard test among those who tested negative with the assay

**Cohen’s Kappa statistic**

* The metric that estimates the level of agreement (beyond chance) between two diagnostic tests
* Pr(a) is the (a) is the actual percent agreement
* Pr(e) is the expected/chance percent agreement