Table 1 Summary of the original articles reporting on SARS-CoV-2 antibody testing (searched up to May 15, 2020) (Case-reports and review articles have not been included).

PubMed articles										
Author, Year	**Design of the study**	**N**	**Population**	**Nationality of the population**	**Antibody used**	**Methodology**	**Main findings and/or conclusions**	**Sensitivity**	**Specificity**	**PPV**	**NPV**
Li Z et al., 2020	Retrospective	525	397 RNA positive Patients, 128 controls	China	Commercial Assay	Jiangsu Medomics Medical Technologies lateral flow immunoassay	The test time was from day 8 to day 33 after infection symptoms appeared. The IgM-IgG combined assay has better utility and sensitivity compared with a single IgM or IgG test. Results demonstrate that the IgG-IgM combined antibody test kit can be used as a point-of-care test	88.66%	90.63%	NA	NA
Xiao D et al., 2020	Prospective	34	SARS-CoV-2 confrmed patients	China	Commercial assay	Chemiluminescence assay by Shenzhen Yahuilong Biotechnology	After 2 weeks from the onset of symptom, all but two subjects were positive to the test. From the 5th to the 7th weeks IgM became negative, while all had high levels of IgG	94.1%	NA	NA	NA
Zhao J et al., 2020	Prospective	535 samples from 173 subjects	173 RNA positive patients	China	Commercial assay	Beijing Wantai Biological Pharmacy Enterprise ELISA assay	The seroconversion rate for Ab, IgM and IgG was 93.1% , 82.7% and 64.7%, respectively. The cumulative seroconversion curve showed that the rate for Ab and IgM reached 100% around 1 month of illness day.	100% (>15days)	NA	NA	NA
Du Z et al., 2020	Retrospective	60	convalescent patients (6-7 weeks from the onset)	China	Commercial assay	ELISA	All patients tested positive for the IgG against the virus, while 13 patients tested negative for IgM	78% IgM 100% IgG	NA	NA	NA
Cassaniti I et al., 2020	Prospective	110	30 RNA positive patients, 50 patients with respiratory symptoms, 30 controls	Italy	Commercial assay	Rapid Viva Diag IgM /IgG immunoassay	The rapid test is not recommended for triage of patients with suspected COVID-19 in emergency room	18.4%	91.7%	87.5%	26.2%
Guo L et al., 2020	Prospective	208 samples from 140 subjects	82 confirmed and 58 probable cases	China	In House assay	ELISA for IgA, IgM , IgG	IgA, IgM and IgG were detected in 92.7%, 85.4% and 77.9% of samples from a median time of 5 days from the onset of symptoms	75.6% (IgM in confirmed cases) 93.1% (IgM in probable cases)	NA	NA	NA
Jin Y et al., 2020	Retrospective	76	43 RNA positive patients, 33 probable cases	China	Commercial assay	Chemiluminescence Shenzhen YHLO Biotech	Viral serological testing is an effective means of diagnosis for SARS-CoV-2 infection. The positive rate and titer variance of IgG are higher than those of IgM	48.1 % IgM 88.9% IgG	100% IgM 90.9% IgG	NA	NA

Pan Y et al., 2020	Retrospective	105	105 patients	China	In House	Immunocromatography	The positive rates of Ig in the early stage are relatively low, and gradually increase during the disease progression. The IgM positive rate rising from 11.1% of early stage to 74.2% of late stage, respectively. The IgG positive rate in the confirmed patients is 3.6% in early, and 96.8% in late stage, respectively.	68.6%	NA	NA	NA
Padoan A et al., 2020	Retrospective	87 sample from 37 subjects	37 patients	Italy	Commercial assay	MAGLUM 2000 Plus 2019-nCov IgM and IgG assays by Snibe	After the 11th day, all patients were found to be positive for IgG (100%), while the higher positivity of IgM (88%) was achieved only after the 13th day. Imprecision and repeatability of the test were acceptable	88% IgM 100% IgG	NA	NA	NA
Zhong L et al., 2020	Cross-sectional	347	47 RNA positive patients, 300 controls	China	Commercial assay	Elisa and Chemiluminescence detection assay	Both the ELISA and chemiluminescence methods to detect IgG and IgM antibodies by the recombinant N and S proteins of SARS-CoV-2 were consistent	97.9% IgM 95.7% IgG	99.7% IgM 85.7% IgG	NA	NA
Infantino M et al., 2020	Cross-sectional	125	61 RNA positive patients and 64 controls	Italy	Commercial assay	Chemiluminescence (iFlash CLIA)	The ROC auc was 0.918 and 0.980 for anti-SARS CoV-2 antibodies IgM and IgG, respectively	73.3% (IgM) 76.7% (IgG)	92.2% 100%	81.5% NA	88.1% 90.1%
Xiang F et al., 2020	Retrospective	216 samples from 109 subjects	85 confirmed and 24 suspected cases	China	Commercial assays	Zhu Hai LivZon Diagnostics ELISA	The seropositive rate of IgM increased gradually and notably. IgG was increased sharply on the 12th day after onset. Diagnostic performance calculated from samples obtained after 13 days from the onset	77.3 % IgM 83.3% IgG	100% 95%	100% 94.8%	80% 83.8%
Lee YL, et al., 2020	Retrospective	33 samples from 14 subjects, 28 samples from 28 controls	14 RNA positive patients and 28 controls	China	Commercial Assay	Alltest Rapid Test	Antibody response varied with different clinical manifestations and disease severity. Patients with symptoms and development of anti-SARSCoV-2 IgM antibodies had a shorter duration of positive rRT-PCR result and no worsening clinical conditions compared to those without the presence of anti-SARS-CoV-2 IgM antibodies.	78.6%	100%	NA	NA
Long QX et al., 2020	Cross sectional	285 patients	285 RNA positive patients	China	Commercial assay	Chemiluminescence Bioscience assay	The positive rate of IgG reached 100% at around 17-19 days after symptoms onset, while IgM seroconversion rate reached its peak of 94.1% at around 20-22 days after symptoms onset	94.% (IgM) 100% (IgG)	NA	NA	NA
Perera R et al., 2020	Retrospective	51 samples from 24 patients	24 RNA positive patients	China	In House assay	ELISA	IgG and IgM were reliably positive after 29 days from illness onset with no detectable cross-reactivity in age-stratified controls.	74%	100%	NA	NA
Qu J et al., 2020	Retrospective	347 samples from 41	41 RNA positive patients and 38 controls	China	Commercial assay	Chemilumenescence, YHLO biotech	The majority of the patients developed robust antibody responses between 17 and 23 days after illness onset	87.8 % (IgM) 97.6% (IgG)	NA	Na	NA

		patients and 38 samples from controls									
Shen B et al., 2020	Prospective	150 patients	150 suspected cases, of whom 97 were RNA positive	China	Commercial assay	Rapid immunocromatography test by Shanghai Outdo Biotech	The colloidal gold immunochromatography assay for SARS-Cov-2 specific IgM/IgG anti-body shows the potential for a useful rapid diagnosis test for COVID-19.	71%	96%	97%	64%
Zhao R et al., 2020	Retrospective	481	69 affected subjects and 412 controls	China	In House assay	ELISA assay	The overall accuracy of the ELISA test was 97.3%	97.5%	97.5%%	NA	NA
Cai X et al., 2020	Retrospective	276 samples from 276 subjects, 20o samples from 200 controls	276 RNA positive patients, and 200 healthy controls	China	In House assay	Chemiluminescence	Combining immunoassay with real-time RT-PCR might enhance the diagnostic accuracy of COVID-19.	57.2% (IgM) 71.4% (IgG)	NA	NA	NA
Dohla M et al., 2020	Prospective	Samples from 49 symptom atic patients	22 RNA positive and 27 RNA negative patients	Germany	Commercial assay	Rapid Test	The rapid test was substantially inferior to the RT-qPCR testing and should therefore neither be used for individual risk assessment nor for decisions on public health measures	36.4%	88.9%	72.7%	63.1%
Hoffman T et al., 2020	Cross-sectional	Samples from 153 subjects	29 RNA positive patients and 124 controls	Sweden	Commercial assay	Rapid COVID test by Zhejiang Orient Gene Biotech Co Ltd,	the test is suitable for assessing previous virus exposure, although negative results may be unreliable during the first weeks after infection	69% (IgM) 93% (IgG)	100% (IgM) 99.2% (IgG)	100% (IgM) 96.4% (IgG)	93.2% (IgM) 98.4% (IgG)
Hou H et al., 2020	Retrospective	338 subjects	338 RNA positive patients	China	Commercial Assay	Elisa test by YHLO	Quantitative detection of IgM and IgG antibodies against SARS-CoV-2 quantitatively has potential significance for evaluating the severity and prognosis of COVID-19.	82.7% (IgM) 88% (IgG)	NA	NA	NA
Imai K et al., 2020	Retrospective	139 samples from 112 patients and 48 controls	112 RNA positive patients and 48 controls	Japan	Commercial assay	One Step IgM/IgG Rapid Test by Artton	Immuno assay had low sensitivity during the early phase of infection, and thus immuno assay alone is not recommended for initial diagnostic testing for COVID-19	40%	NA	NA	NA
Lippi G et al., 2020	Prospective	48 patients	48 RNA positive patients	Italy	Commercial assays	Chemiluminescence MAGLUMI by Snibe and ELISA by Euroimmun	Results of MAGLUMI are well aligned with those of Euroimmun tets	10% (< 5days) 100% (>10 days)	NA	NA	NA

Pan Y et al., 2020b	Retrospective	86 samples from 67 cases	67 RNa positive patients	China	Commercial assay	Rapid Lateral flow assay Zhuhai Livzon Diagnositic	Serology may be considered a supplementary approach in clinical diagnosis	11% (<7 days) 92% (7-14 days) 96%(>14 days)	NA	Na	Na
Spicuzza et al., 2020	Cross Sectional	41 subjects	27 RNA positive patients, 7 symptomatic RNA negative patients and 7 controls	Italy	Commercial assay	Rapid lateral flow assay by Beijing Diagreat Biotechnologies	Antibody test is quite reliable and useful, since it has the advantage to be a pointof- care test that gives a response within minutes	83%	93%	NA	NA
Sun B et al., 2020	Cross sectional	130 samples from 38 patients, 16 samples from 16 controls	38 RNA positive patients and 16 controls	China	In House assay	ELISA	IgM and IgG increased gradually after symptom onset and can be used for detection of SARS-CoV-2 infection. Analysis of the dynamics of S-IgG may help to predict prognosis.	75% (after 1 week) 94.7% (after 2 weeks) 100% (after 3 weeks)	NA	NA	NA
To K et al., 2020	Cross sectional	16 patients	16 RNA positive patients	China	In House assay	ELISA	**Serological assay can complement RT-qPCR for diagnosis**	88% (IgM) 94% (IgG)	Na	NA	NA
Xie J et al., 2020	Prospective	56 patients	56 symptomatic patients	China	Commercial assay	Chemiluminescence by YHLO Biological technology	A combination of nucleic acid and IGs testing is a more accurate approach for diagnosing COVID-19	93.7% (IgM) 100 % (IgG)	NA	NA	NA
Yonh G et al., 2020	Retrospective	76 samples from 38 patients	38 symprtomatic patients	China	Comemrcial assay	Rapid assay GICA kit	Antibody detection could be used as an effective indicator os the virus in the absence of viral RNA	50 % (IgM) 92.1% (IgG)	NA	NA	NA
Bryan A et al., 2020	Cross sectional	6001 subjects	1020 controls and 125 patients. 4856 subjects from the general population	USA	Commercial assay	Chemiluminescence by Abbott SARS-CoV-2 IgG test	This study demonstrates excellent analytical performance of the Abbott SARS-CoV2 test as well as the limited circulation of the virus in western United States	53.1% (day 7) 82.4% (day 10) 96.9% (day 14) 100% (day 17)	99.9%	NA	NA
Demey B et al., 2020	Prosepctive	21 subjects	21 RNA positive patients	France	Commercial assays	Four rapid lateral flow assays	The immunochromatographic tests for the detection of the virus may have their role for the diagnosis of COVID-19	9-24% (day5) 67-82% (day 10) 100% (day 15)	99.8%	NA	NA
Jaaskeilanen A et al., 2020	Retrospective	77 subjects	40 RNA positive patients and 37 controls	Finland	Commercial Assay	ELISA by Euroimmun	The median time after onset of symptoms was 12 days (13 patients range: 5–20 days) for detection of IgGs, and 11 days (24 patients range: 5– 20 days) for detection of IgAs	na	91.9% (IgG) 73% (IgA)	Na	Na
Montesinos J et al., 2020	Retrospective	400 subjects	272 controls and 128 RNA positive epatients	Belgium	Commercial Assays	Chemiluminescence by MAGLUMI, ELISA by Euroimmun, and rapid assay	The sensitivity of the tests increased with time from the onset of symptoms	64.3% (MAGLUMI) 84.4% (Euroimmun) 70% (rapid assay)	99% 100%	NA	NA
Tang MS et al., 2020	Retrospective	201 subjects	48 patients and 153 controls	USA	Commercial Assays	Chemiluminescence by Abbott and ELISA by Euroimmun	Both the two assays have poor sensitivity during the first days of the disease. Abott tests generally	Abbott 0% (<3days) 30% (3-7 days)	99.4% (Abbott)	NA	NA

							performed better than the Euroimmun test	47.8% (8-13 days) 93.8% (>14 days) Euroimmun 0% (<3days) 25% (3-7 days) 56.5% (8-13 days) 85.4% (>14 days)			
MedRxiv articles											
Author, Year	**Design of the study**	**N**	**Population**	**Nationality of the population**	**Antibody used**	**Methodology**	**Main findings and/or conclusions**	**Sensitivity**	**Specificity**	**PPV**	**NPV**
Wang X et al., 2020	Prospective study with longitudinal follow-up	117 samples in 70 subjects	Inpatients and convalescent patients	China	In House	Modified cytopathogenic assay	The seropositivity rate reached up to 100.0% within 20 days since onset. Patients with a worse clinical classification had a higher antibody titer	100%	NA	NA	NA
Garcia PF et al., 2020	Prospective	163	55 RNA positive patients, 63 RNA negative patients, 45 controls	Spain	Commercial Assay	AllTestCOV 19 IgG IgM immunoassay	Sensitivity of the test was 73.9 % after 2 weeks from the onset of the symptoms	73.9%	100	NA	NA
Lassauniere R et al., 2020	Cross sectional	111	30 SARS-CoV-2 patients, 10 healthy controls, 71 patients with non SARS-CoV-2	Denmark	Commercial assays	3 ELISA tests and 6 POC lateral flow tests	The diagnostic performance of the commercial assays analyzed may vary by some degree	65-90% (ELISA) 83-93% (POCs)	96-100 % (ELISA) 80-100% (POCs)	82-100% (ELISA) 100% (POCs)	89-98% (ELISA) 80-91% (POCs)
Yangchun F, 2020	Cross sectional	294	186 RNA positive patients, 98 RNA negative patients	China	Commercial assay	ELISA	Antibody testing has a very good diagnostic performance in identifying positive subjects	96.1% (IgG)	92.4% (IgG)	96.09% (IgG)	90.1% (IgG)
Liu R et al., 2020	Retrospective	133	Samples from patients	China	Commercial Assay	YHLO IGs detection kit	In symptomatic patients, the IgM was superior to RT-PCR in detecting affected subjects. The positive ratio for IgM was 79.55% in moderate cases, 82.69% 156 in severe cases and 72.97% in critical cases. IgG antibody test was 93.18% in moderate cases, 100.00% in severe cases and 97.30% in critical cases	78.95% (IgM) 93.18% (IgG	NA	NA	NA
Liu Y et al., 2020	Retrospective	179	Patients RNA positive (n:90) and RNA negative (:89)	China	Commercial assay	Rapid immunoassay	The accuracy of the antibody testing increased over time (from 40% in the first week from the onset of symptoms to 93.9% two weeks later)	85.6%	91%	95.1%	82.7%
Yong G et al., 2020	Retrospective	38	Patients	China	Commercial assay	Rapid Assay. GICA IgG IgM detection kit	The accuracy of the test 8 days after the onset of symptoms	50%	92.1%	NA	NA
Lin D et al., 2020	Retrospective	149	79 RNA positive patients	China	Commercial assay	Darui Biotech ELISA kit	The sensitivity of the test increased with time from the onset of the disease	82.2%	97.5%	NA	NA
Lou B et al., 2020	Cross sectional	380	80 RNA positive patients. 300 healthy controls	China	Commercial assay	ELISA and lateral-flow assay	The overall seroconversion rate was 98.8% at a median time of 9 days from the onset of disease	98.8 %	94.3%	NA	NA

Liu L et al., 2020	Cross sectional	238	238 patients, 153 of them RNA positive. 120 controls	China	Commercial assay	Lizhu ELISA assay	Antibody detection should be used as a major viral diagnostic test for patients with symptoms for more than 10 days. The combination of ELISA and RT-PCR assays will greatly improve the detection efficacy, even in theearly stage of infection.	81.5%	NA	NA	NA
Bendavid E et al., 2020	Cross sectional	3300	3300 subjects from the general population	USA	Commercial	Premier Biotech Lateral flow immunoassay	The population prevalence of COVID-19 in Santa Clara- CA ranged from 2.49% to 4.16%, 50 to 85-fold more than reported cases	80.3%	99.5%	NA	NA
Paradiso AV et al., 2020	Prospective	191	191 symptomatic patients	Italy	Commercial	Rapid Viva Diag IgM /IgG immunoassay	The performance of the test at the onset of symptoms was low. The sensitivity was 66.7% 15 days later	30%	89%	NA	NA
Jia X et al., 2020	Retrospective	59	59 suspected patients. 24 of them were RNA positive	China	Commercial assay	Diagreat Immunofluorescence assay	The IgM and IgG may provide a quick, simple and accurate aided detection method for suspected COVID-19 patients	87.5%	NA	NA	NA
Zhang J et al., 2020	Retrospective	736	228 suspected cases, 3 were positive. 508 controls	China	Commercial assay	Chemiluminescence by Shenzhen Yahuilong Biotechnology	Detection of specific antibodies in patients with fever can be a good complement to nucleic acid diagnosis to early diagnosis of suspected cases	100%	97%	75%	100%
Xiang J et al., 2020	Retrospective	189	154 patients, 35 controls	China	Commercial assays	Zhu Hai Liv Zon Diagnostics ELISA and gold-immunochromatographic assays	There is no difference between the sensitivity of between ELISA and GICA assay they both are simple and fast and the results can be used for clinical reference	87.3% (ELISA) 82.4% (GICA)	100% (ELISA) 100% (GICA)	NA	NA
Hu Q et al., 2020	Prospective	993 samples from 221 subjects	221 hospitalized patients	China	Commercial assay	Chemiluminescence by BioScience	IgG and IgM antibodies examined every 3 days revealed increasing antibody levels which peaked on day 19-21. SARS-CoV-2 IgG and IgM antibodies testing should be combined with RT-PCR as an early diagnosis method	73.6% IgM 97.8% IgG (day 13-18 after the onset)	NA	NA	NA
Ma H et al., 2020	Cross sectional	216 samples from 87 subjects	87 RNA positive patients	China	In House assay	Chemiluminescence	Measuring SARS-CoV-2 specific antibodies IgA, IgM, and IgG in serum provides 81 a better serological testing with improved sensitivity and specificity	98.6% IgA 96.8% IgM 96.8% IgG	98.1% IgA 92.3%IgM 99.8%IgG	NA	NA
Qian C et al., 2020	Prospective, multicentric	2061 subjects from 10 hospitals	972 non-covid patients, 586 controls, 503 RNA positive patients	China	Commercial assay	Chemiluminescence by Shenzhen YHLO Biotech	The assay showed a coefficient of variation of less than 5%. SARS-CoV-2 IgM and IgG showed clinical specificity > 97%. 86.54% respectively for suspected cases.	85.8% IgM 96.6% IgG	99% IgM 99%IgG	NA	NA
National COVID testing Scientific Advisory Board, 2020	Cross-sectional	182	40 RNA positive patients, 142 controls	UK	Commercial assays	Elisa and 9 commercial lateral flow immunoassays (LFIA)	The performance of current LFIA devices is inadequate for most individual patient applications. ELISA can be calibrated to be specific for detecting and quantifying SARSCoV-2 IgM and IgG and is highly	85% (ELISA) 55-70% (LFIA versus RT-PCR	100% (ELISA) 65-85% (LFIA versus ELISA)	NA	NA

							sensitive for IgG from 10 days following symptoms onset				
Burbelo PD et al., 2020	Cross-sectional	100	68 patients, 32 controls	USA	In House assay	Luciferase 44 immunoprecipitation assay systems (LIPS) to the nucleocapsid (NP) and spike proteins (SP)	Antibody to the nucleocapsid protein of SARS-CoV-2 is more sensitive than 56 spike protein antibody for detecting early infection.	100% (Ab antin NP) 91% (Ab antiSP)	100% (Ab antiNP) 100% Ab anti SP	NA	NA
Adams ER et al., 2020	Retrospective	841 samples	270 positive samples, 564 negative samples	UK	Commercial assay	ELISA by Mologic	The ELISA assay tested had good diagnostic performance	88%	97%	NA	NA
Meyer B et al., 2020	Retrospective	357 subjects	176 controls, 181 RNA positive patients	Switzerland	Commercial assay	ELISA by Euroimmun	The assay displays an optima diagnostic accuracy using IgG, with no obvious gain from IgA serology	82%	100%	100%	46%
Norman M et al., 2020	Retrospective	81 subjects	81 subjects	USA	In House assay	Single Molecular array Assay (SIMOA)	The Simoa serological platform provides a powerful analytical tool	86%	100%	NA	NA
Tuaillon E et al., 2020	Prospective	58	38 RNA positive patients and 20 controls	France	Commercial Assay	Elisa tests by Euroimmun and IdVet and 5 rapid lateral flow tests	The second week of COVID-19 seems to be the best period for assessing the sensitivity of commercial serological assays	86.7 % (ELISA) 80-93.3% (Rapid tests))	80-85% (ELISA) 65-100% (rapid tests)	NA	NA
Wajnberg A et al., 2020	Prospective	1343 subkect	1343 symptomatic subjects, of whom 624 were RNA positive	USA	Commercial assay	Chemiluminescence by Roche	The vast majority of confirmed COVID19 patients seroconvert, potentially providing immunity to reinfection.	82%	Na	NA	NA
Wan Y et al., 2020	Retrospective	180	50 RNA positive patients and 130 controls	China	Commercial Assay	Four Chemiluminescence assay systems	Systems for CoVID-2019 IgM/IgG antibody test may perform differently	26-92%	78-99%	NA	Na
Xiao T et al., 2020	Retrospective	56 subjects	56 RNa positive patients (33 symptomatic and 23 asymptomatic)	China	Commercial assay	Chemiluminescence Microparticle Immuno Assay	Asymptomatic carriers were found to have a lower initial viral load, undetectable IgM and moderate levels of IgG.	90.9% 95.5% 90.9% 63.2%	NA	NA	NA
Zhou Q et al., 2020	Retrospective	419 subjects	19 RNA positive patients and 400 controls	China	Commercial Assay	Chemiluminescence	viral serological testing is an effective means for SARS-CoV-2 infection detection	91.6%	NA	NA	NA

Ozturk T et al., 2020	Cross sectional	148 subjects	32 RNA positive patients, 116 controls	USA	Commercial assay	ELISA by GenScript	The complex relationship between antibody levels, disease severity, and time since symptom onset, caution is needed in using serologic assay to inform public policies	88.9%	92.3%	NA	NA
Rosado J et al., 2020	Retrospective	594	259 RNA positive patients, 335 controls	France	In House assay	Multiplex serological assay Using a serological signature of IgG to four antigens	Serological signatures based on antibody responses to multiple antigens can provide more accurate and robust serological classification of individuals with previous SARS-CoV-2 infection	96.1%	99.1%	NA	NA

NA: not available