

Supplementary Appendix

Supplement to: Bastos, ML et al. “Diagnostic accuracy of serological tests for COVID-19: a systematic review and meta-analysis.”

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Search strategy (Medline- Ovid)

1. ((exp coronavirus/ or exp coronavirus infections/ or (betacoronavirus* or beta coronavirus* or coronavirus* or corona virus*).mp.) and (exp china/ or (china or chinese or hubei or wuhan).af.)) or (coronavirus* or corona virus* or betacoronavirus* or beta coronavirus*).ti,kf.
 2. (severe acute respiratory syndrome coronavirus or "SARS CoV-2" or cov2 or "sars 2" or COVID or "coronavirus 2" or covid19 or nCov or ((new or Novel) adj3 coronavirus*) or ncp).ti,ab,kf. or ((exp pneumonia/ or pneumonia.ti,ab,kf.) and wuhan.af.)
 3. 1 or 2
 4. molecular diagnostic techniques/
 5. (assay* or detect* or diagnos* or immunoassay* or kit? or screen* or technique* or test*).ti,ab,kf.
 6. exp Nucleic Acid Amplification Techniques/
 7. (PCR or (Polymerase adj2 "Chain Reaction*") or nucleic acid*).ti,ab,kf.
 8. Serologic Tests/
 9. exp Antigens/ or exp Antibodies/
 10. (antigen* or antibod*).ti,ab,kf.
 11. exp Immunoglobulin Isotypes/
 12. (IGG or IGA or IGM or immunoglobulin*).ti,ab,kf.
 13. ((virus* or viral) adj2 (culture* or rna)).ti,ab,kf.
 14. (Virolog* adj2 assess*).ti,ab,kf.
 15. (Specimen* or sample* or swab*).ti,ab,kf.
 16. ((clinical or respir*) adj3 symptom*).ti,ab,kf.
 17. radiography, thoracic/ or exp Tomography, X-Ray Computed/ or (radiograph* or tomograph* or x ray* or xray* or chest ct or ct imag* or ct scan*).ti,ab,kf.
 18. (imaging adj (feature* or finding*)).ti,ab,kf.
 19. (rapid array* or microarray*).ti,ab,kf.
 20. di.fs.
 21. exp diagnosis/
 22. or/4-21
 23. 3 and 22
 24. 2020*.dt,ez,da.
 25. 23 and 24
- > No languages restrictions.

Table S1- Characteristics of included studies (N=40)

Study	Peer reviewed	City, Country	Study Population	Population to assess specificity*	Clinical setting	Study design
Cassaniti, Novazzi ¹⁵	Yes	Pavia, Italy	COVID-19 patients and controls	Triage population: Individuals suspected to have COVID-19 but RT-PCR negative Hospitalized: Samples collected during COVID-19 epidemic in individuals not suspected to have COVID-19	Inpatient, emergency	Cohort & case control
Gao, Li ¹⁶	Yes	Shijiazhuang, China	COVID-19 patients	No controls	Inpatient, not specified	Case-control
Guo, Ren ¹⁷	Yes	Wuhan, China	COVID-19 patients and controls	<u>Stratified:</u> -Confirmed with other virus infections - Samples collected prior to COVID-19 epidemic	Inpatient, not specified	Case-control
Liu, Liu ¹⁸	Yes	Wuhan, China	COVID-19 patients and controls	Samples collected during COVID-19 epidemic in individuals not suspected to have COVID-19	Inpatient, not specified	Case-control
Zhang, Du ¹⁹	Yes	Wuhan, China	COVID-19 patients	No controls	Inpatient, not specified	Case-control
Zhao, Yuan ²⁰	Yes	Shenzhen, China	COVID-19 patients and controls	Samples collected during COVID-19 epidemic in individuals not suspected to have COVID-19	Inpatient, not specified	Case-control
Xiao, Gao ²¹	Yes	Shanghai, China	COVID-19 patients	No controls	Inpatient, not specified	Case-control
To, Tsang ²²	Yes	Hong Kong, China	COVID-19 patients	No controls	Inpatient, not specified	Case-control
Li, Yi ²³	Yes	China	COVID-19 patients and controls	Individuals suspected to have COVID-19 but RT-PCR negative	N/R	Cohort
Cai, Chen ²⁴	No	Chongqing, China	COVID-19 patients and controls	Confirmed with other virus infections	Inpatient, not specified	Case-control
Gao, Yuan ²⁵	No	Fuyang, China	COVID-19 patients	No controls	Inpatient, not specified	Case-control
Jia, Zhang ²⁶	No	Shenzhen, China	COVID-19 patients and controls	Individuals suspected to have COVID-19 but RT-PCR negative	N/R	Cohort
Lin, Liu ²⁷	No	Shenzhen, China	COVID-19 patients and controls	Mixed controls: Samples collected during COVID-19 epidemic in individuals not suspected to have COVID-19 and tuberculosis patients	Inpatient, not specified	Case-control
Liu, Liu ²⁸	No	Beijing, China	COVID-19 patients and controls	Samples collected during COVID-19 epidemic in individuals not suspected to have COVID-19	Inpatient, not specified	Case-control
Liu, Liu ²⁹	No	Wuhan, China	COVID-19 patients and controls	Individuals suspected to have COVID-19 but RT-PCR negative	Inpatient, (ICU and non-ICU), Outpatient	Cohort
Lou, Li ³⁰	No	Hangzhou, China	COVID-19 patients and controls	Samples collected during COVID-19 epidemic in individuals not suspected to have COVID-19	Inpatient, not specified	Case-control
Pan, Li ³¹	No	Wuhan, China	COVID-19 patients	No controls	Inpatient, not specified	Cohort
Zhang, Gao ³²	No	Shenyang, Shijiazhuang China	COVID-19 patients and controls	Samples collected during COVID-19 epidemic in individuals not suspected to have COVID-19	N/R	Cohort
Zhao, Li ³³	No	Beijing and Wuhan, China	Controls	Samples collected prior to COVID-19 epidemic	Only controls samples	Case-control
Long, Deng ³⁴	No	Chongqing, China	COVID-19 patients	No controls	Inpatient (ICU and non-ICU)	Case-control
Chen, Zhang ³⁵	Yes	China	COVID-19 patients and controls	Individuals suspected to have COVID-19 but RT-PCR negative	N/R	Case-control
Infantino, Grossi ³⁶	Yes	Florence, Italy	COVID-19 patients and controls	Mixed of samples during and before epidemic. No stratified results	Inpatient, not specified	Case-control
Garcia, Perez Tanoira ³⁷	No	Spain	COVID-19 patients, suspected COVID-19 patients and controls	Samples collected during COVID-19 epidemic in individuals not suspected to have COVID-19	N/R	Case-control
Zhong, Chuan ³⁸	Yes	Chengdu, China	COVID-19 patients and controls	Samples collected during COVID-19 epidemic in individuals not suspected to have COVID-19	N/R	Case-control
Jin, Wang ³⁹	Yes	Hangzhou, China	COVID-19 patients and controls	Individuals suspected to have COVID-19 but RT-PCR negative	Inpatient, not specified	Case-control
Xie, Ding ⁴⁰	Yes	Wuhan, China	COVID-19 patients and controls	Individuals suspected to have COVID-19 but RT-PCR negative	Inpatient, not specified	Cohort
Xiang, Wang ⁴¹	Yes	Wuhan, China	COVID-19 patients and controls	Samples collected during COVID-19 epidemic in individuals not suspected to have COVID-19	Inpatient, not specified	Case-control

Freeman, Lester ⁴²	No	United States	COVID-19 patients and controls	Mixed of samples before epidemic and confirmed another virus infection	N/R	Case-control
Paradiso, De Summa ⁴³	No	Bari, Italy	Suspected COVID-19 patients	Individuals suspected to have COVID-19 but RT-PCR negative	Inpatient, non-ICU only (hospitalized or emergency room)	Cohort
Imai, Tabata ⁴⁴	No	Saitama, Japan	COVID-19 patients and controls	Samples collected prior to COVID-19 epidemic	Inpatient, not specified	Case-control
Yangchun ⁴⁵	No	Wuhan, China	COVID-19 patients and controls	Individuals suspected to have COVID-19 but RT-PCR negative	N/R	Not clear
Qian, Zhou ⁴⁶	No	Hubei and six other provinces from China	COVID-19 patients and controls	Donors during the epidemic period	Inpatient, not specified	Case-control
Ma, Zeng ⁴⁷	No	Hefei, China	COVID-19 patients and controls	<u>Stratified:</u> -Individuals suspected to have COVID-19 but RT-PCR negative -Samples collected prior to COVID-19 epidemic	Inpatient (ICU and non-ICU)	Case-control
Perera, Mok ⁴⁸	Yes	Hong Kong, China	COVID-19 patients and controls	Samples collected prior to COVID-19 epidemic	Inpatient (ICU and non-ICU)	Case-control
Adams, An ⁴⁹	No	United Kingdom	COVID-19 patients and controls	Samples collected prior to COVID-19 epidemic	Inpatient, not specified, outpatient	Case-control
Burbelo, Riedo ⁵⁰	No	United States	COVID-19 patients and controls	Samples collected prior to COVID-19 epidemic	N/R	Case-control
Lassauniere, Frische ⁵¹	No	Denmark	COVID-19 patients and controls	<u>Stratified:</u> - Samples collected during COVID-19 epidemic in individuals not suspected to have COVID-19 -Confirmed other virus infection	Inpatient, ICU	Case-control
Whitman, Hiatt ⁵²	No	San Francisco, USA	COVID-19 patients and controls	<u>Stratified:</u> -Samples collected prior to COVID-19 epidemic -Confirmed other virus infection	Inpatient (ICU and non-ICU), outpatient	Case-control
Hoffman, Nissen ⁵³	Yes	Uppsala, Sweden	COVID-19 patients and controls	Samples collected prior to COVID-19 epidemic	N/R	Case-control
Dohla, Boesecke ⁵⁴	Yes	German	COVID-19 patients and controls	Individuals suspected to have COVID-19 but RT-PCR negative	Outpatient	Case-control

Abbreviations: N/R: Not reported ICU: Intensive care unit

Notes:

*Samples before the epidemic: samples from patients with other condition diseases than not virus infection, or health donors. Sample during the epidemic: samples from patient not suspect of covid-19 or health donors. Includes studies where timing was unclear. Confirmed with other virus infection: samples from patients before or during epidemic period confirmed with virus infection,, as further stratification not possible. Suspect covid-19 patients, patients with clinical features of COVID-19 but RT-PCR negative

Table S2- Patient characteristics in included studies

Study	N patients included	Age years (mean/median)	Male: Female	Severity	Sample collection period
Cassaniti, Novazzi ¹⁵	50*	62 (range 33-97)	34:16	N/R	N/R
	60†	Cases: 74 (range 38-86) Controls: 39 (range 25-69)	36:24	Mild, Severe or critical	7 days (IQR 4-11) - after diagnosis
Gao, Li ¹⁶	22	40 (range 4-72)	8:14	Mild, Severe or critical	1-24 days- after onset of symptoms
Guo, Ren ¹⁷	317‡	N/R	N/R	Mild, Severe or critical	1-39 days- after onset of symptoms
Liu, Liu ¹⁸	314	N/R	N/R	N/R	15 days (range 0-55)- after onset of symptoms
Zhang, Du ¹⁹	16	N/R	N/R	N/R	N/R
Zhao, Yuan ²⁰	173	48 (IQR 35,61)	84:89	Mild, Severe or critical	7 days (IQR 5-10 days) - after onset of symptoms
Xiao, Gao ²¹	34	N/R	16:18	N/R	0-14 days- after onset of symptoms
To, Tsang ²²	16	N/R	N/R	Mild/severe	0-14 days- after onset of symptoms
Li, Yi ²³	525	N/R	N/R	N/R	N/R
Cai, Chen ²⁴	443‡	48 (IQR 37,56)	151:127	N/R	2-27 days- after onset of symptoms
Gao, Yuan ²⁵	38	40.5 (IQR 31,50)	21:17	N/R	N/R
Jia, Zhang ²⁶	57	N/R	N/R	N/R	1-34 days-after onset of symptoms
Lin, Liu ²⁷	159	N/R	N/R	N/R	0-14 days- after onset of symptoms
Liu, Liu ²⁸	358	55 (IQR 38,65)	138:200	N/R	0-20 days-after onset of symptoms
Liu, Liu ²⁹	179	Cases: 76 (SD 21) Controls: 56 (SD 21)	98:81	Mild, Severe or critical	0-16 days -after onset of symptoms
Lou, Li ³⁰	80	55 (IQR 45,64)	49:31	Mild, Severe or critical	8 (IQR 6,10)- days after onset of symptoms
Pan, Li ³¹	67	N/R	N/R	N/R	0-34 days-after onset of symptoms
Zhang, Gao ³²	163 samples not clear N of patients	N/R	N/R	N/R	N/R
Zhao, Li ³³	257 samples not clear N of patients	N/R	N/R	N/R	N/R
Long, Deng ³⁴	63	N/R	N/R	N/R	2-23- days after onset of symptoms
Chen, Zhang ³⁵	19 samples not clear N of patients	N/R	N/R	N/R	N/R
Infantino, Grossi ³⁶	125	Cases: 59 (SD 23) Controls: 49 (SD 17)	47:78	Mild, Severe or critical	12 days (range 8-17) days after onset of symptoms
Garcia, Perez Tanoira ³⁷	100	Cases: 62 (IQR 52,74) Controls: 55 (IQR 50,79)	55:45	N/R	11 days (range 7-23) days after onset of symptoms
Zhong, Chuan ³⁸	347	48 (range 18-82)	118:229	Mild, Severe or critical	N/R
Jin, Wang ³⁹	76	Cases: 47 (IQR 34,59) Controls: 31 (IQR 26,38)	39:37	N/R	16 days (IQR 9,20) days after onset of symptoms
Xie, Ding ⁴⁰	56	57 (IQR 49.3, 64.8)	24:32	Mild, Severe or critical	7-41 days after onset of symptoms

Xiang, Wang ⁴¹	145	Cases: 51 (range 32, 65) Controls: 34 (range 29,51)	56:89	Mild, Severe	13-29 days after onset of symptoms
Freeman, Lester ⁴²	694	N/R	N/R	N/R	N/R
Paradiso, De Summa ⁴³	191	59	115:75	N/R	Asymptomatic and symptomatic from 0-15 days onset of symptoms
Imai, Tabata ⁴⁴	112	67 (IQR 45,74)	64:48	N/R	5 (IQR 2,7) days after onset of symptomatic
Yangchun ⁴⁵	185	N/R	N/R	N/R	N/R
Qian, Zhou ⁴⁶	2061	N/R	N/R	N/R	N/R
Ma, Zeng ⁴⁷	699 samples not clear N of patients	N/R	N/R	Mild, Severe or critical	4-41 days after onset of symptoms
Perera, Mok ⁴⁸	263 samples not clear N of patients	N/R	N/R	Mild, Severe or critical	0-30 days after onset of symptoms
Adams, An ⁴⁹	90	N/R	N/R	Mild, Severe or critical	13 (range 8-19) after onset of symptoms. Convalescent plasma 48 (31-62) after onset of symptoms
Burbelo, Riedo ⁵⁰	67§	61 (range 19-95)	20:15	Mild, Severe or critical	2-50 days after onset of symptoms
Lassauniere, Frische ⁵¹	112	N/R	N/R	Severe	0-21 days after onset of symptoms
Whitman, Hiatt ⁵²	80	53 (SD 15)	55:25	Mild, Severe or critical	1-20 days after onset of symptoms
Hoffman, Nissen ⁵³	153	N/R	N//R	N/R	N/R
Dohla, Boesecke ⁵⁴	49	46 (IQR 28-72)	25:24	N/R	N/R

Notes: *Patients from emergency department, +Hospitalized patients, †Not clear how many controls, authors described number of samples for controls, and number of patients for cases. §Only information on 35 cases

Abbreviations: IQR: Interquartile range, N/R: Not reported, N: Number

Table S3 -Sero-diagnostic and reference test characteristics in included studies

Study	Index tests						Reference test			
	Method	Immunoglobulin	Antigens	Type Sample	Lab based or POC test	Commercial kit	Method	Sample type	PCR gene target	Commercial kit
Cassaniti, Novazzi ¹⁵	LFIA	IgG, IgM	S protein	Serum/whole blood	Unclear	Yes	RT-PCR	NPS, BAL	RdRp, E	Yes
Gao, Li ¹⁶	ELISA	IgG, IgM	S, N protein	Serum	Lab based	Yes	RT-PCR	Nasal and pharyngeal swab	ORFlab. N	Yes
	CLIA	IgG, IgM	S, N protein	Serum	Lab based	Yes				
	LFIA	IgG, IgM	S, N protein	Serum	Lab based	Yes				
Guo, Ren ¹⁷	ELISA	IgG, IgM, IGA	N protein	Blood	Lab based	No	RT-PCR/ Deep sequence	Throat swabs	Not reported	Not reported
Liu, Liu ¹⁸	ELISA	IgG, IgM	N, S protein	Serum	Lab based	Yes	RT-PCR	OPS, NPS	Not Reported	Not reported
Zhang, Du ¹⁹	ELISA	IgG, IgM	SARSr-CoV Rp3-N protein	Serum	Lab based	No	RT-PCR	OPS	S	Yes
Zhao, Yuan ²⁰	ELISA	IgG, IgM, Ab	S protein (IgM & Ab) N protein (IgG)	Blood	Lab based	Yes	RT-PCR	Respiratory samples	Not reported	Not reported
Xiao, Gao ²¹	CLIA	IgG, IgM	Not reported	Blood	Lab based	Yes	RT-PCR	N/R	Not reported	Not reported
To, Tsang ²²	EIA	IgG, IgM	S, N protein	Serum	Lab based	No	RT-PCR	Saliva	RdRp	No
Li, Yi ²³	LFIA	IgG, IgM	S protein	Serum/ plasma/ whole blood/ fingerpick	Unclear for most of the population	No	RT-PCR	Pharyngeal, sputum	Not reported	Not reported
Cai, Chen ²⁴	CLIA	IgG, IgM	S	Serum	Lab based	No	RT-PCR	Not reported	Not reported	Not reported
Gao, Yuan ²⁵	LFIA	IgG, IgM	Not reported	Serum	Lab based	Yes	RT-PCR	Throat swabs	ORF1ab, N	Yes
Jia, Zhang ²⁶	FIA	IgG, IgM	Not reported	N/R	Lab based	Yes	RT-PCR	OPS, NPS	Not reported	Not reported
Lin, Liu ²⁷	CLIA	IgG, IgM	N protein	Serum	Lab based	No	RT-PCR	Respiratory samples	ORF1ab, N	Yes
Liu, Liu ²⁸	ELISA	IgG, IgM	N protein	Serum	Lab based	Yes	RT-PCR	OPS, NPS	ORF1ab, N	Yes
Liu, Liu ²⁹	LFIA	IgG, IgM	Not reported	Serum	Lab based	Yes	RT-PCR	Nasal and pharyngeal swab	Not reported	Not reported
Lou, Li ³⁰	ELISA	IgG, IgM, Ab	S, N	Serum	Lab based	Yes	RT-PCR	Not reported	Not Reported	Not reported
	LFIA	IgG, IgM, Ab	S, N	Plasma	Unclear					
	CLIA	Ab, IGM	S, N	Serum	Lab based					
Pan, Li ³¹	LFIA	IgG, IgM	Not reported	Serum/ plasma	Unclear	Yes	RT-PCR	Throat swab	Not reported	Not reported
Zhang, Gao ³²	LFIA	IgG, IgM	S protein	Serum	Lab based	No	RT-PCR	Not reported	Not reported	Not reported

Zhao, Li ³³	ELISA	Ab	S protein	Serum	Lab based	No	Frozen samples before epidemic ⁴	Serum	N/A	N/A
Long, Deng ³⁴	CLIA	IgG, IgM	S, N protein	Serum	Lab based	Yes	RT-PCR	Nasal, pharyngeal swab	Not reported	Not reported
Chen, Zhang ³⁵	LFIA	IgG	S, N protein	Serum	Lab based	No	RT-PCR	Not reported	Not reported	Not reported
Infantino, Grossi ³⁶	CLIA	IgG, IgM	N, S protein	Serum	Lab based	Yes	RT-PCR	OPS, NPS	Not reported	Not reported
Garcia, Perez Tanoira ³⁷	LFIA	IgG, IgM	N	Serum	Lab based	Yes	RT-PCR	NPS	Not reported	Not reported
Zhong, Chuan ³⁸	ELISA	IgG, IgM	N, S protein	Serum	Lab based	No	RT-PCR	Not reported	Not reported	Not reported
	CLIA	IgG, IgM	N, S protein		Lab based	No				
Jin, Wang ³⁹	CLIA	IgG,	N, S protein	Serum	Lab based	Yes	RT-PCR	Oral swabs	Not reported	Not reported
Xie, Ding ⁴⁰	CLIA	IgG, IgM	E, N protein	Serum	Lab based	Yes	RT-PCR	Nasopharyngeal swab, Throat	ORF1ab, N	Yes
Xiang, Wang ⁴¹	ELISA	IgG, IgM	N protein	Serum	Lab based	Yes	RT-PCR	NPS, OPS	ORF1ab, N	Not reported
Freeman, Lester ⁴²	ELISA	IgG, IgM, pan-Ig	S protein	Serum	Lab based	No	RT-PCR	Not reported	Not reported	Not reported
Paradiso, De Summa ⁴³	LFIA	IgG, IgM	S protein	Venous blood	Lab based	Yes	RT-PCR	NPS, OPS	E, RdRP, N	Yes
Imai, Tabata ⁴⁴	LFIA	IgG, IgM	Not reported	Serum	Lab based	Yes	RT-PCR	NPS, OPS	Not reported	Not reported
Yangchun ⁴⁵	CLIA	IgG, IgM	Not reported	Not reported	Lab based	N/R	RT-PCR	Not reported	Not reported	Not reported
Qian, Zhou ⁴⁶	CLIA	IgG, IgM	N, S protein (fusion)	Serum	Lab based	No	RT-PCR	Not reported	Not reported	Not reported
Ma, Zeng ⁴⁷	CLIA	IgA, IgG, IgM	N, RbD S protein	Serum	Lab based	No	RT-PCR	Not reported	Not reported	Not reported
Perera, Mok ⁴⁸	ELISA	IgG, IgM	RbD S protein	Serum	Lab based	No	RT-PCR	Not reported	Not reported	Not reported
Adams, An ⁴⁹	ELISA	IgG, IgM	S protein	Plasma	Lab based	No	RT-PCR	NPS	Not reported	Not reported
	LIFA 1	IgG, IgM			Lab based	Yes				
	LIFA 2	IgG, IgM			Lab based	Yes				
	LIFA 3	IgG, IgM			Lab based	Yes				
	LIFA 4	IgG, IgM			Lab based	Yes				
	LIFA 5	IgG, IgM			Lab based	Yes				
	LIFA 6	IgG, IgM			Lab based	Yes				
	LIFA 7	IgG, IgM			Lab based	Yes				
	LIFA 8	IgG, IgM			Lab based	Yes				
LIFA 9	IgG, IgM		Lab based	Yes						

Burbelo, Riedo ⁵⁰	LPI	Not reported	N, S protein	Plasma/serum	Lab based	No	RT-PCR	Nasal, throat swabs	Not reported	Not reported
Lassauniere, Frische ⁵¹	ELISA	Ig	S protein	Serum	Lab based	Yes	RT-PCR	Respiratory samples	Not reported	Not reported
	ELISA	IgG, IgA	S protein		Lab based	Yes				
	LFIA	IgG, IgM	Not reported		Lab based	Yes				
	LFIA	IgG, IgM	Not reported		Lab based	Yes				
	LFIA	IgG, IgM	Not reported		Lab based	Yes				
	LFIA	IgG, IgM	Not reported		Lab based	Yes				
	LFIA	IgG, IgM	Not reported		Lab based	Yes				
	LFIA	IgG, IgM	Not reported		Lab based	Yes				
	LFIA	IgG, IgM	Not reported		Lab based	Yes				
	LFIA	IgG, IgM	Not reported		Lab based	Yes				
Whitman, Hiatt ⁵²	ELISA	IgG, IgM	S protein	Plasma/serum	Lab based	No	RT-PCR	NPS, OPS	Not reported	Not reported
	ELISA	IgG, IgM	N protein		Lab based	Yes				
	LFIA	IgG, IgM	Rbd, S		Lab based	Yes				
	LFIA	IgG, IgM	N, S		Lab based	Yes				
	LFIA	IgG, IgM	Not reported		Lab based	Yes				
	LFIA	IgG, IgM	Not reported		Lab based	Yes				
	LFIA	IgG, IgM	Unclear		Lab based	Yes				
	LFIA	IgG, IgM	N, S		Lab based	Yes				
	LFIA	IgG, IgM	Not reported		Lab based	Yes				
	LFIA	IgG, IgM	Not reported		Lab based	Yes				
	LFIA	IgG, IgM	Not reported		Lab based	Yes				
	LFIA	IgG, IgM	Not reported		Lab based	Yes				
Hoffman, Nissen ⁵³	LFIA	IgG, IgM	N, S protein	Blood/serum	Lab based	Yes	RT-PCR	Not reported	Not reported	Not Reported
Dohla, Boesecke ⁵⁴	LFIA	IgG, IgM	Not reported	Blood (fingertip/Serum)	POC mostly of population	Yes	RT-PCR	Throat swabs	E,S	Yes
Abbreviations: LFIA: lateral flow immunoassay, ELISA: enzyme-linked immunosorbent assay, CLIA: chemiluminescent immunoassay, FIA: fluorescent Immunoassay, EIA: enzyme Immunoassay, LPI: liquid phase immunoassay, Ig: immunoglobulin, S protein: surface protein, N protein: nucleocapsid protein, POC: point of care, RT-PCR: reverse transcription polymerase chain reaction, BAL: bronchoalveolar lavage, OPS: oropharyngeal swab, NPS: nasopharyngeal swab, N/A: not applicable										

Table S4- Commercial sero-diagnostic and reverse transcriptase PCR kits used in included studies

Study ID	Commercial sero-diagnostic	Commercial RT-PCR
Cassaniti, Novazzi ¹⁵	VivaDiagTM COVID-19 IgM/IgG Rapid Test (Viva check)	QIASymphony (QIAGEN, Qiagen, Hilden)
Gao, Li ¹⁶	Beier Bioengineering	2019-nCoV RNA Test Kit, Daan Gene
Liu, Liu ¹⁸	Lizhu Company & Hotgen	N/R
Zhao, Yuan ²⁰	Beijing Wantai Biological Pharmacy Enterprise	N/R
Xiao, Gao ²¹	Shenzhen YHLO Biotech	N/R
Gao, Yuan ²⁵	Innovita Biological Technology	Shanghai BioGerm Medical Biotechnology Company
Jia, Zhang ²⁶	Beijing Diagreat Biotechnologies	Daan, Sansure, BGI, Shanghai ZJ Biotech, GeneoDx, Biogerm
Lin, Liu ²⁷	N/A- in house kit	GeneoDX Company
Liu, Liu ²⁸	Lizhu	Daan Company
Lou, Li ³⁰	Beijing Wantai Biological Pharmacy Enterprise Company	N/R
Pan, Li ³¹	Zhuhai Livzon Diagnostisic	Biogerm
Long, Deng ³⁴	Bioscience Diagnostic	N/R
Infantino, Grossi ³⁶	Shenzhen YHLO Biotech	N/R
Garcia, Perez Tanoira ³⁷	AllTest COV-19 IgG / IgM kit (AllTest Biotech Company)	VIASURE SARS-CoV-2 Real Time PCR Detection Kit (Certest Biotech) & Allplex 2019-nCoV assay (Seegene)
Jin, Wang ³⁹	Shenzhen YHLO Biotech	N/R
Xie, Ding ⁴⁰	YHLO Biological Technology	N/R
Xiang, Wang ⁴¹	ELISA kits, Livzon	N/R
Paradiso, De Summa ⁴³	VivaDiagTM COVID-19 IgM/IgG Rapid Test (Viva check Company)	Allplex 2019-nCoV assay (Seegene)
Imai, Tabata ⁴⁴	One Step Novel Coronavirus (COVID-19) IgM/IgG Antibody Test (Artron)	N/R
Lassauniere, Frische ⁵¹	<u>ELISA</u> : Wantai SARS-CoV-2 Ab ELISA (Beijing Wantai Biological Pharmacy Enterprise) & Anti-SARS-CoV-2 IgG and IgA ELISAs (Euroimmun Medizinische Labordiagnostika, Lübeck) <u>LFIA</u> : -2019-nCoV IgG/IgM Rapid Test (Dynamiker Biotechnology) -OnSiteTM COVID-19 IgG/IgM Rapid Test (CTK Biotech); -Anti-SARS-CoV-2 Rapid Test (AutoBio Diagnostics) -One Step Novel Coronavirus (COVID-19) IgM/IgG Antibody Test (Artron) -2019-nCoV IgG/IgM Rapid Test Cassette (Acro Biotech) - AllTest COV-19 IgG / IgM kit (AllTest Biotech)	N/R
Whitman, Hiatt ⁵²	<u>ELISA</u> : Epitope Diagnostics, San Diego, CA, USA <u>LFIA</u> -BioMedomics Inc -Bioperfectus Technologies	N/R

	<ul style="list-style-type: none"> -Decombio Biotechnology -DeepBlue Medical Technology -Innovita Biological Technology -Premier Biotech -Sure Biotech -UCP Biosciences -VivaChek Biotech Co -Wondfo Biotech Co Ltd, 	
Hoffman, Nissen ⁵³	Zhejiang Orient Gene Biotech Company	N/R
Dohla, Boesecke ⁵⁴	N/R	Altona diagnostics
Abbreviations: NR: Not reported N/A: Not applicable		

Figure S1- QUADAS assessment for individual studies, by test method

	Risk of Bias				Applicability Concerns		
	Patient Selection	Index Test	Reference Standard	Flow and Timing	Patient Selection	Index Test	Reference Standard
Adams, An ELISA	●	●	?	●	●	●	●
Adams, An LFIA	●	●	?	●	●	●	●
Burbelo, Riedo LPI	●	●	?	●	●	●	●
Cai, Chen CLIA	●	?	?	●	●	●	●
Cassaniti, Novazzi Hospitalized LFIA	●	●	?	●	●	?	●
Cassaniti, Novazzi Triag LFIA	●	●	?	●	●	●	●
Chen, Zhang LFIA	●	●	?	?	●	●	●
Dohla, Boesecke LFIA	●	?	●	●	●	?	●
Freeman, Lester ELISA	●	●	?	?	●	●	●
Gao, Li CLIA	●	?	?	●	●	●	●
Gao, Li ELISA	●	?	?	●	●	●	●
Gao, Li LFIA	●	●	?	●	●	●	●
Gao, Yuan LFIA	●	●	?	●	●	●	●
Garcia, Perez Tanoiria LFIA	●	?	?	●	●	●	●
Guo, Ren ELISA	●	?	?	●	●	●	●
Hoffman, Nissen LFIA	●	●	?	●	●	?	●
Imai, Tabata LFIA	●	●	?	?	●	●	●
Infantino, Grossi CLIA	●	●	●	●	●	●	●
Jia, Zhang FIA	●	?	?	●	●	●	●
Jin, Wang CLIA	●	●	●	●	●	●	●
Lassauniere, Frische ELISA	●	?	?	?	●	●	●
Lassauniere, Frische LFIA	●	●	?	?	●	●	●
Li, Yi LFIA	●	●	?	●	●	?	●
Lin, Liu CLIA	●	?	?	●	●	●	●
Liu L, Liu W ELISA	●	?	?	?	●	●	?
Liu W, Liu L ELISA	●	●	?	●	●	?	●
Liu Y, Liu Y LFIA	●	●	?	●	●	●	●
Long, Deng CLIA	●	●	?	●	●	●	?
Lou, Li CLIA	●	?	?	●	●	●	●
Lou, Li ELISA	●	?	?	●	●	●	●
Lou, Li LFIA	●	●	?	●	●	●	●
Ma, Zeng CLIA	●	●	?	●	●	●	●
Pan, Li LFIA	●	●	?	●	●	?	●
Paradiso, De Summa LFIA	●	●	?	●	●	●	●
Perera, Mok ELISA	●	?	?	●	●	●	●
Qian, Zhou CLIA	●	●	?	●	●	●	●
To, Tsang EIA	●	●	?	●	●	●	●
Whitman, Hiatt ELISA	●	●	?	●	●	●	●
Whitman, Hiatt LFIA	●	●	?	●	●	●	●
Xiang, Wang ELISA	●	?	?	?	●	●	●
Xiao, Gao CLIA	●	?	?	●	●	●	●
Xie, Ding CLIA	?	●	?	?	●	●	●
Yangchun, CLIA	●	?	?	?	●	●	●
Zhang, Du ELISA	●	?	?	●	●	●	●
Zhang, Gao LFIA	●	?	?	?	●	●	●
Zhao, Li ELISA	●	?	?	?	●	●	?
Zhao, Yuan ELISA	●	?	?	●	●	●	●
Zhong, Chuan CLIA	●	●	?	?	●	●	●
Zhong, Chuan ELISA	●	●	?	?	●	●	●

● High ? Unclear ● Low

Abbreviations: ELISA: enzyme-linked immunosorbent assay, LFIA: lateral flow immunoassay, LPI: liquid phase immunoassay, FIA: fluorescent Immunoassay, EIA: enzyme Immunoassay, CLIA: chemiluminescent immunoassay.

Table S5- Sensitivity and specificity of other sero-diagnostic test methods: fluorescent Immunoassay, enzyme Immunoassay, & liquid phase immunoassay

Study	Method	IgM						IgG						Total Ig					
		Sensitivity			Specificity			Sensitivity			Specificity			Sensitivity			Specificity		
		TP	FN	Estimate	TN	FP	Estimate	TP	FN	Estimate	TN	FP	Estimate	TP	FN	Estimate	TN	FP	Estimate
Jia, Zhang ²⁶	FIA	19	5	72% (60%, 91%)	13	20	39% (25%, 56%)	17	7	71% (51%, 85%)	17	16	52% (35%,67%)	-	-	-	-	-	-
To, Tsang ²²	EIA anti-N	14	2	88% (60%, 98%)	-	-	-	15	1	-	-	-	-	-	-	-	-	-	-
	EIA anti-Rbd	15	1	94% (67%; 100%)	-	-	-	16	0	-	-	-	-	-	-	-	-	-	-
Burbelo, Riedo ⁵⁰	LPI anti-N	-	-	-	-	-	-	-	-	-	-	-	-	76	32	70% (60%, 79%)	32	0	100% (87%, 100%)
	LPI anti-S	-	-	-	-	-	-	-	-	-	-	-	-	60	40	60% (50%, 70%)	32	0	100% (87%, 100%)

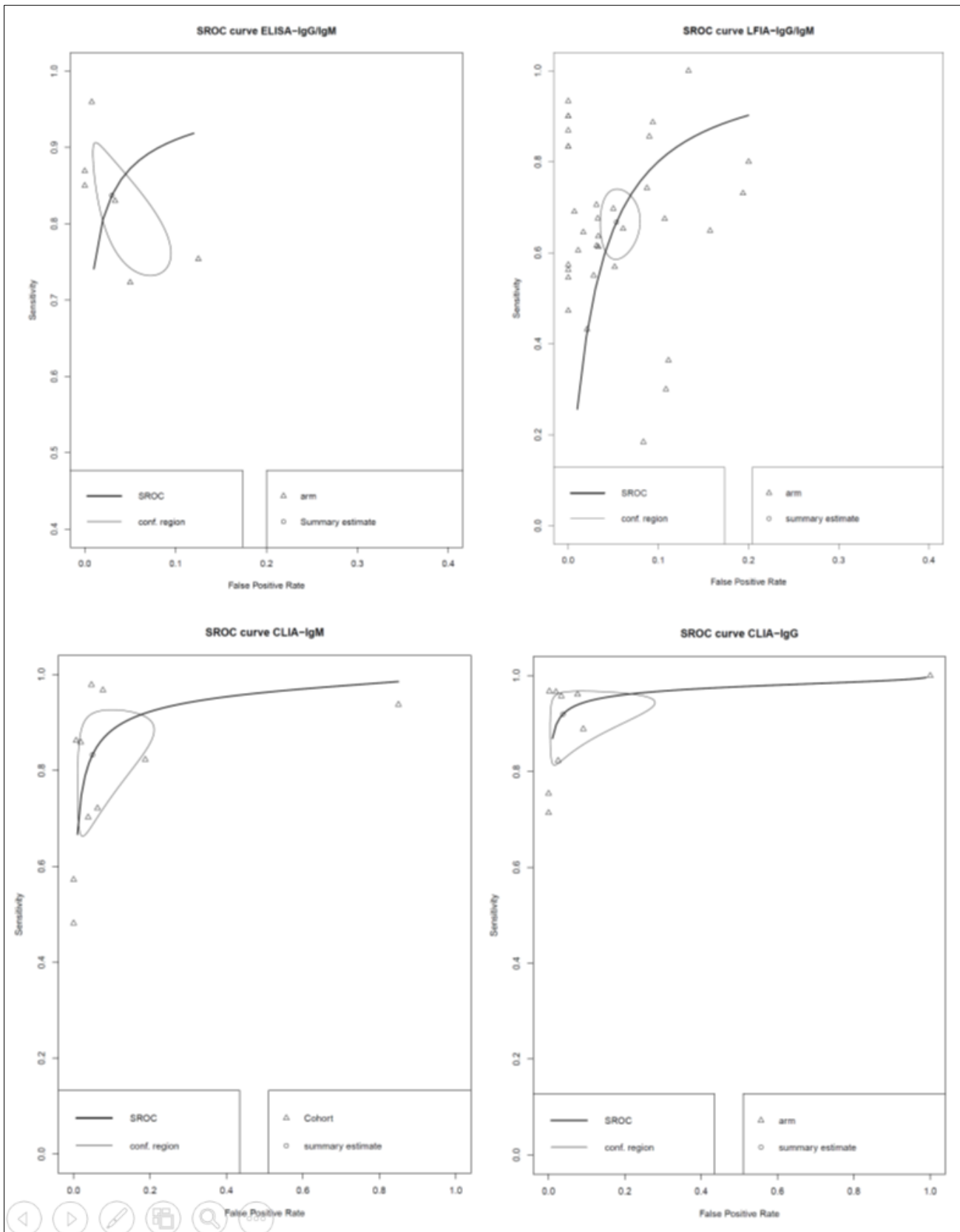
Abbreviations: Ig: immunoglobulin, TP: true positives, TN: true negatives, FP: false positives, FN: false negatives, FIA: fluorescent Immunoassay, EIA: enzyme Immunoassay, LPI: liquid phase immunoassay, N: nucleocapsid protein, Rbd: receptor binding domain, S: surface protein

Table S6- Sensitivity and specificity of sero-diagnostics that detect IgA or total Ig

Study	Method	IgA						Total Ig					
		Sensitivity			Specificity			Sensitivity			Specificity		
		TP	FN	Estimate	TN	FP	Estimate	TP	FN	Estimate	TN	FP	Estimate
Lassauniere, Frische ⁵¹	ELISA	28	2	93.3% (77.9% to 99.2%)	76	6	92.7% (84.8% to 97.3%)	-	-	-	-	-	-
Ma, Zeng ⁴⁷	CLIA	213	3	98.6% (96.0% to 99.7%)	474	9	98.1% (96.5% to 99.1%)	-	-	-	-	-	-
Zhao, Yuan ²⁰	ELISA	-	-	-	-	-	-	161	12	93.1% (88.2% to 96.4%)	211	2	99.1% (96.7% to 99.9%)
Lassauniere, Frische ⁵¹	ELISA	-	-	-	-	-	-	28	2	93.3% (77.9% to 99.2%)	82	0	100% (95.6% to 100%)
Lou, Li ³⁰	ELISA	-	-	-	-	-	-	80	2	97.6% (91.5% to 99.7%)	300	0	100% (98.8% to 100%)
	CLIA	-	-	-	-	-	-	77	2	97.5% (91.2% to 99.7%)	298	0	100% (98.8% to 100%)
	LFIA	-	-	-	-	-	-	78	2	97.5% (91.3% to 99.7%)	199	2	99.0% (96.5% to 99.9%)

Abbreviations: Ig: immunoglobulin, TP: true positives, TN: true negatives, FP: false positives, FN: false negatives, ELISA: enzyme-linked immunosorbent assay, CLIA: chemiluminescent immunoassay, LFIA: lateral flow immunoassay

Figure S2- Summary receiver operating characteristic curves

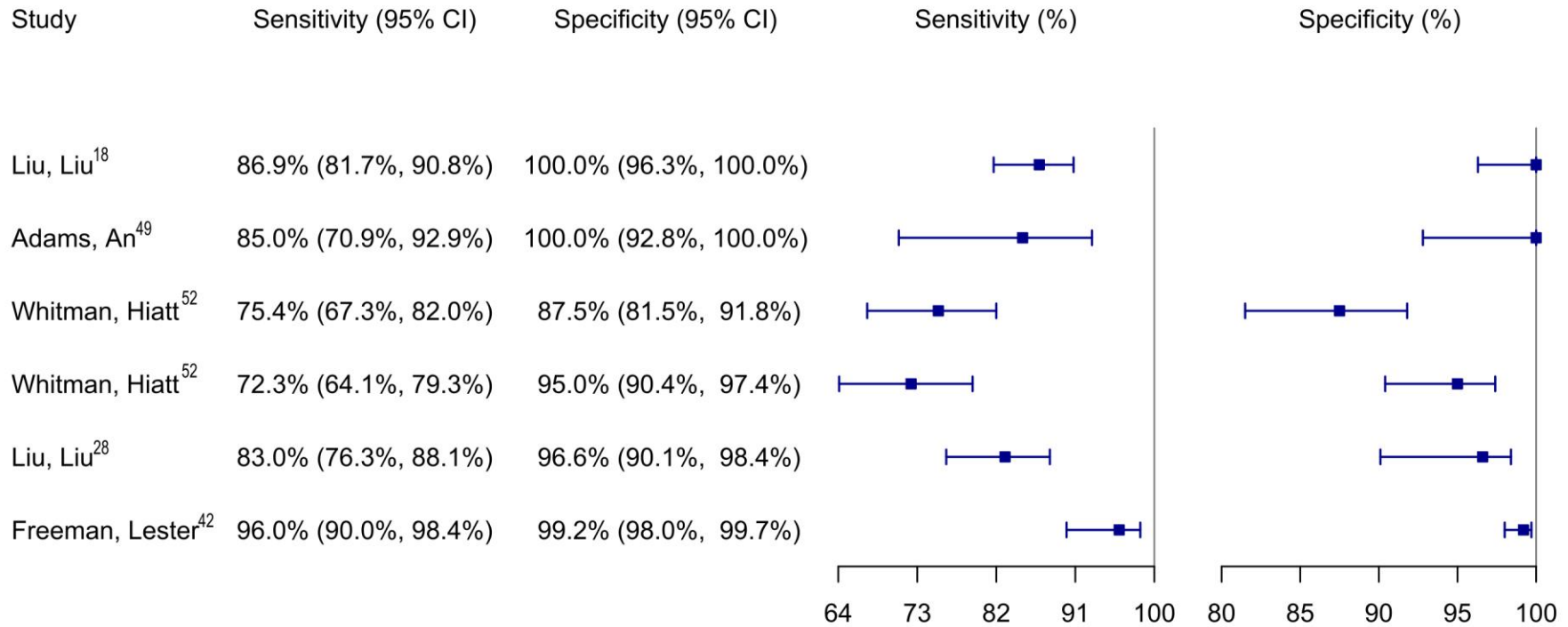


Notes: Summary ROC curves and prediction regions were estimated from bivariate random effects meta-analysis with a test-level random effect, using the mada package in R. A zero-cell correction of 0.5 was applied when necessary.

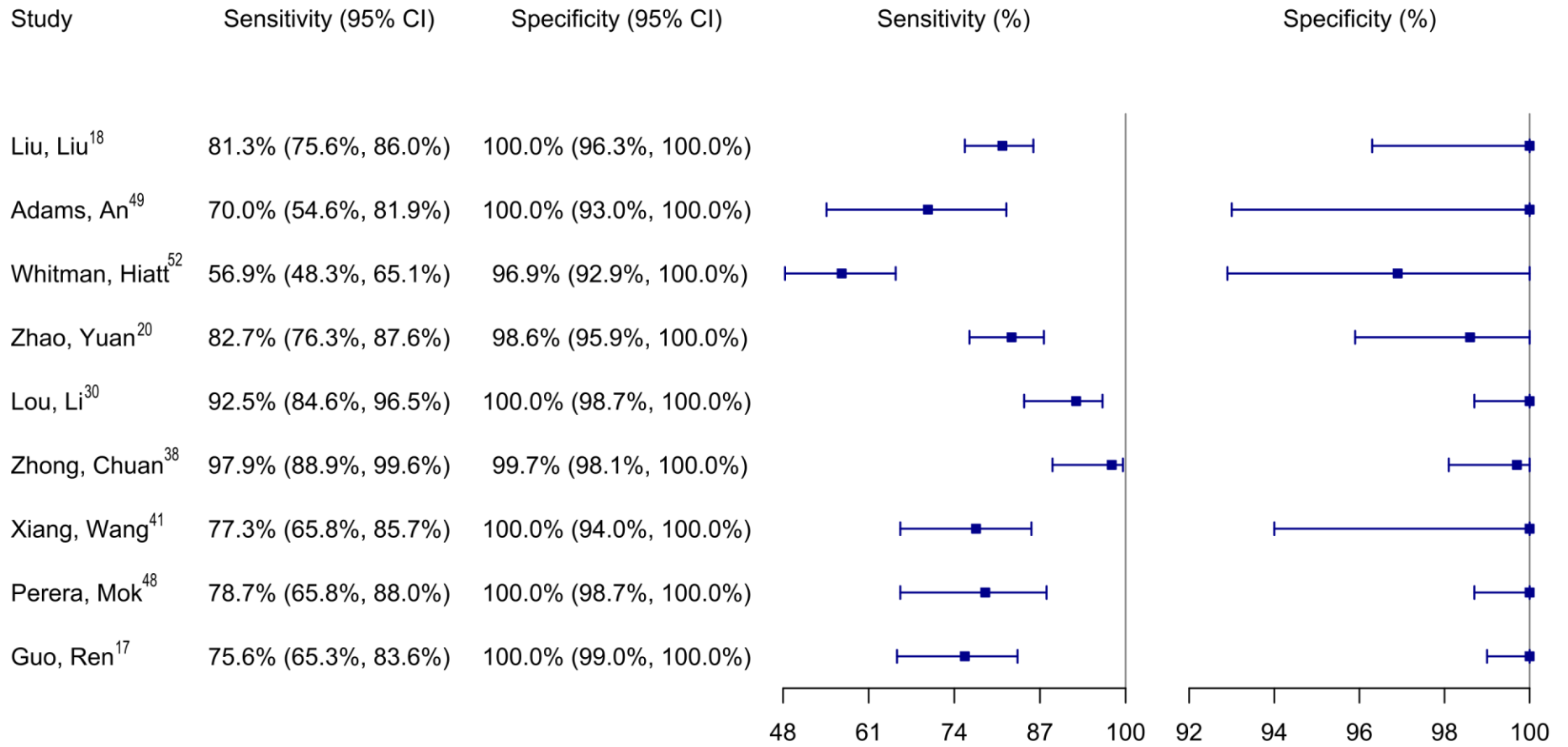
Abbreviations: SROC: summary receiver operating characteristic, ELISA: enzyme-linked immunosorbent assay, Ig: immunoglobulin, LFIA: lateral flow immunoassay, CLIA: chemiluminescent immunoassay.

Figure S3- Forest plots of sensitivity and specificity by sero-diagnostic test method and immunoglobulin detected

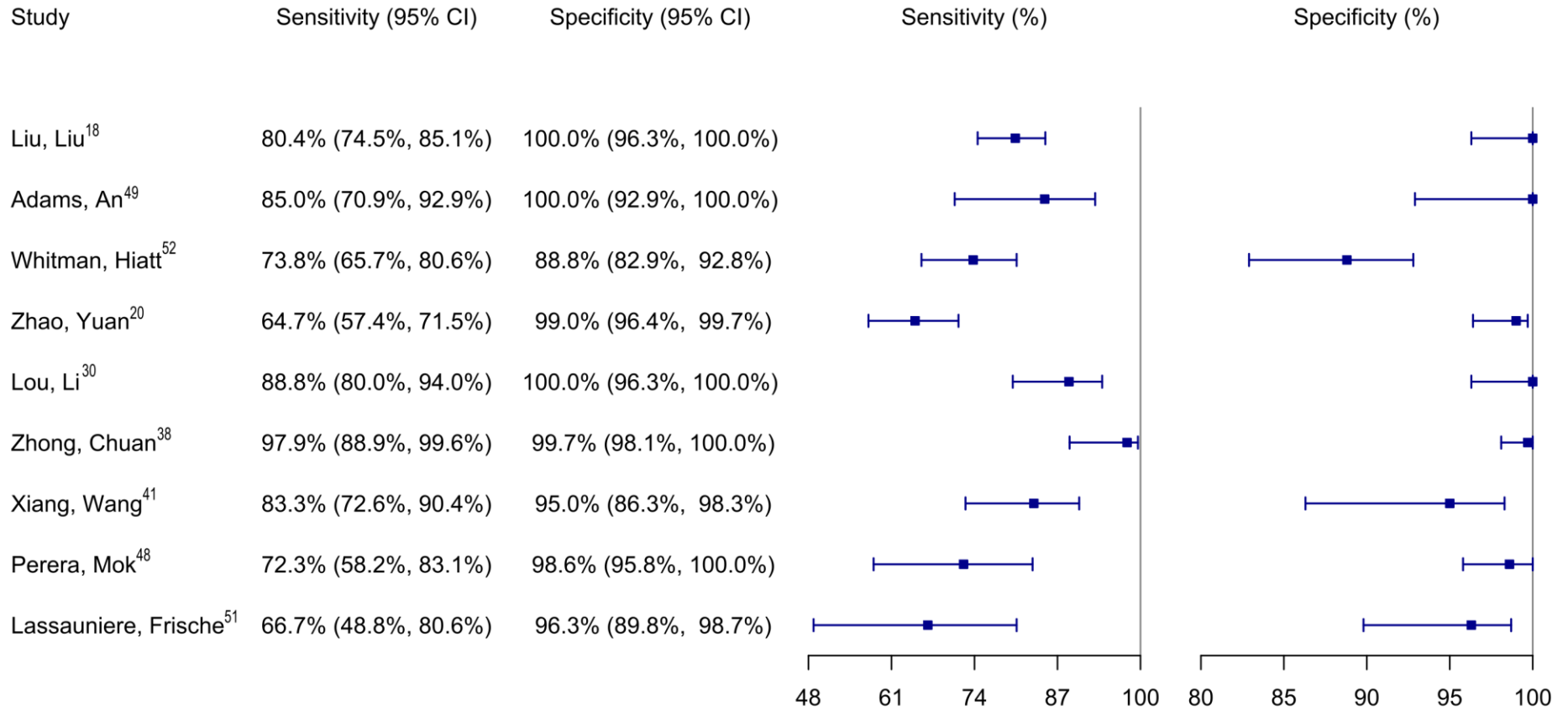
ELISA IgG and/or IgM



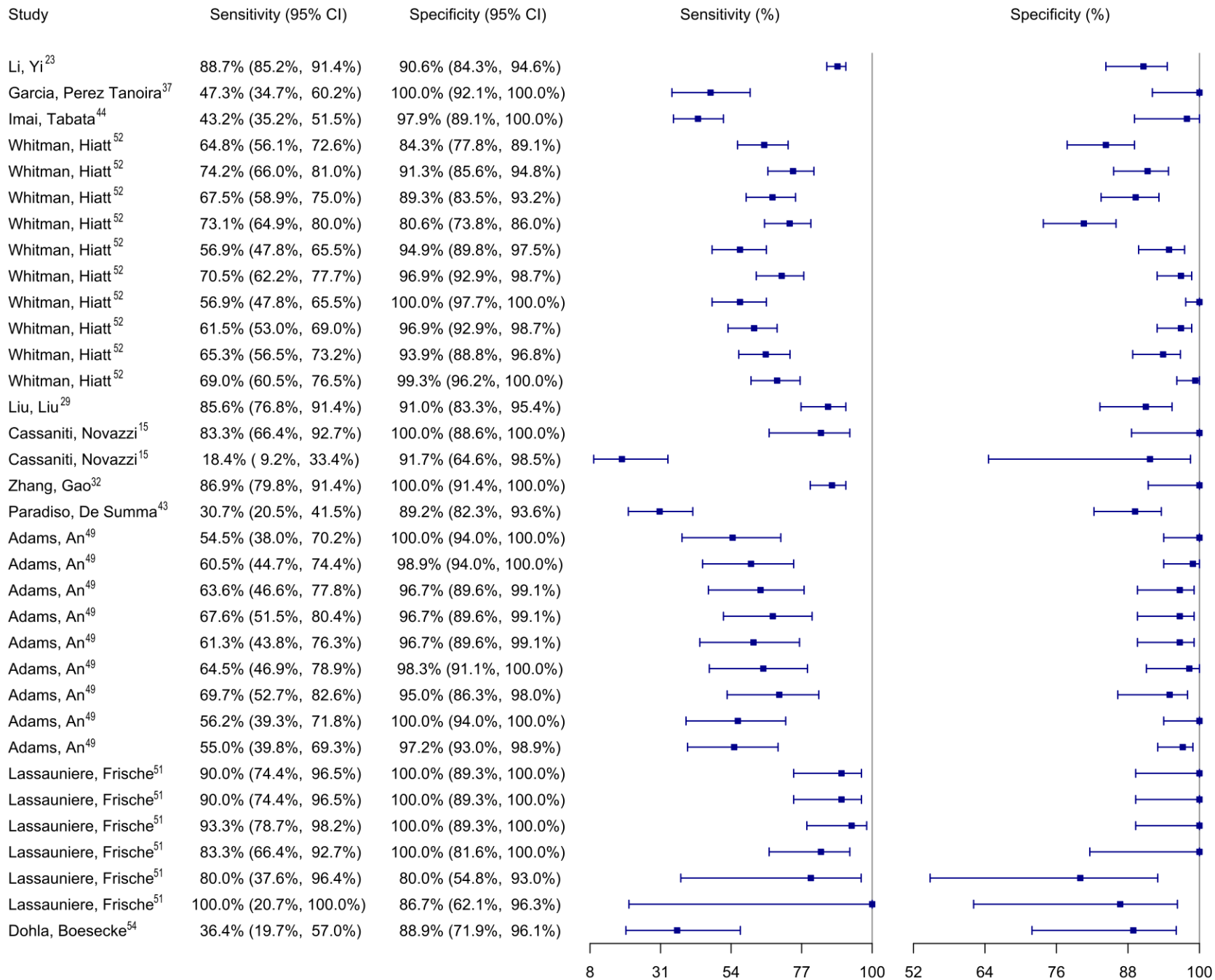
ELISA IgM



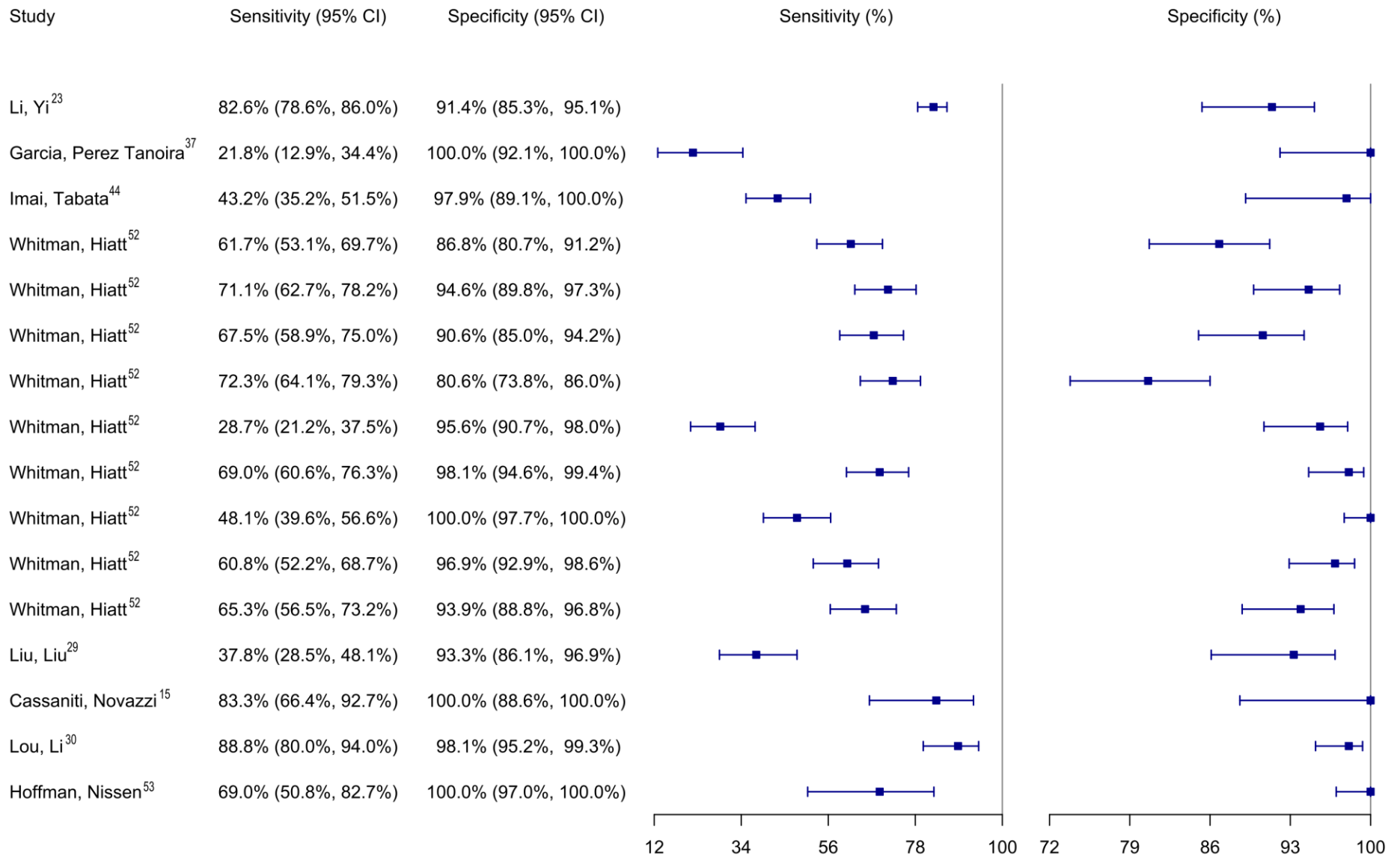
ELISA IgG



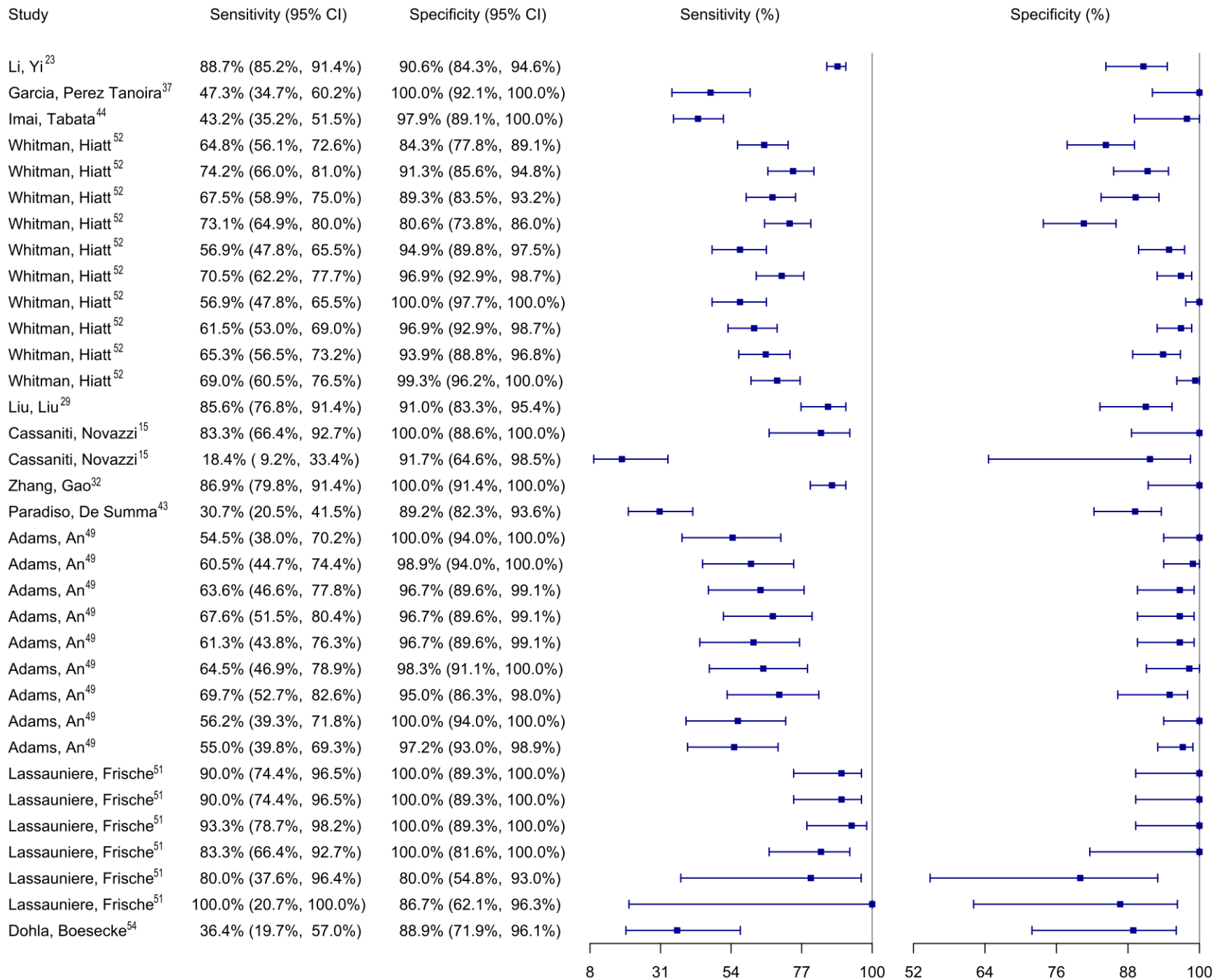
LFIA IgG and/or IgM



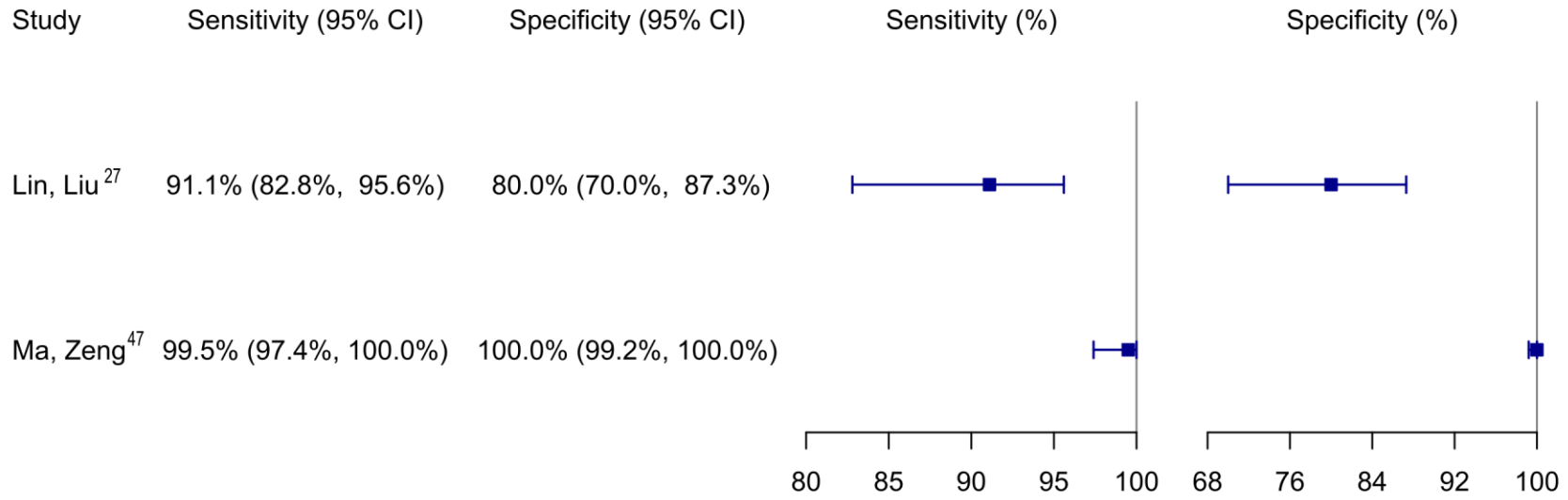
LFIA IgM



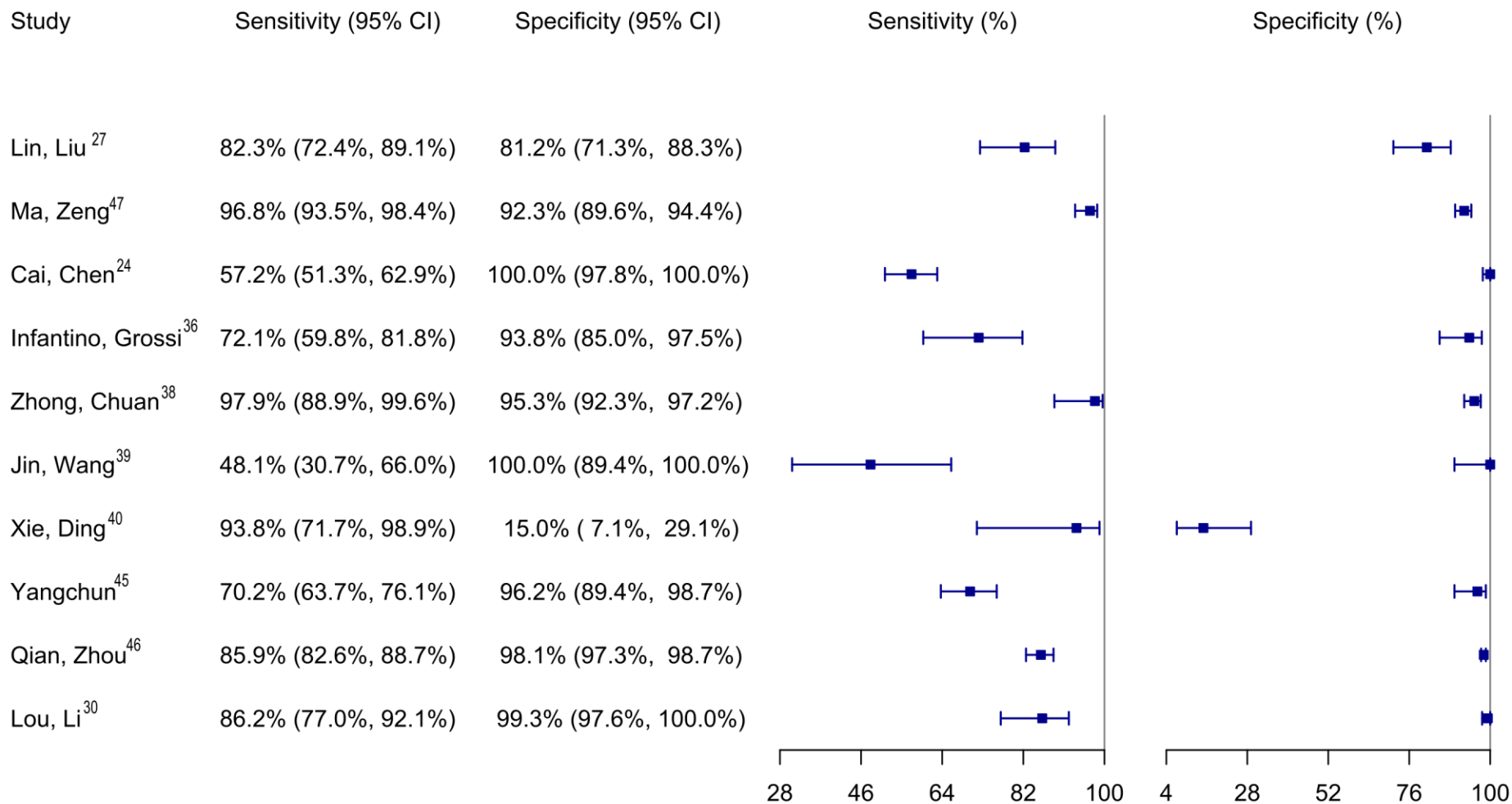
LFIA IgG and/or IgM



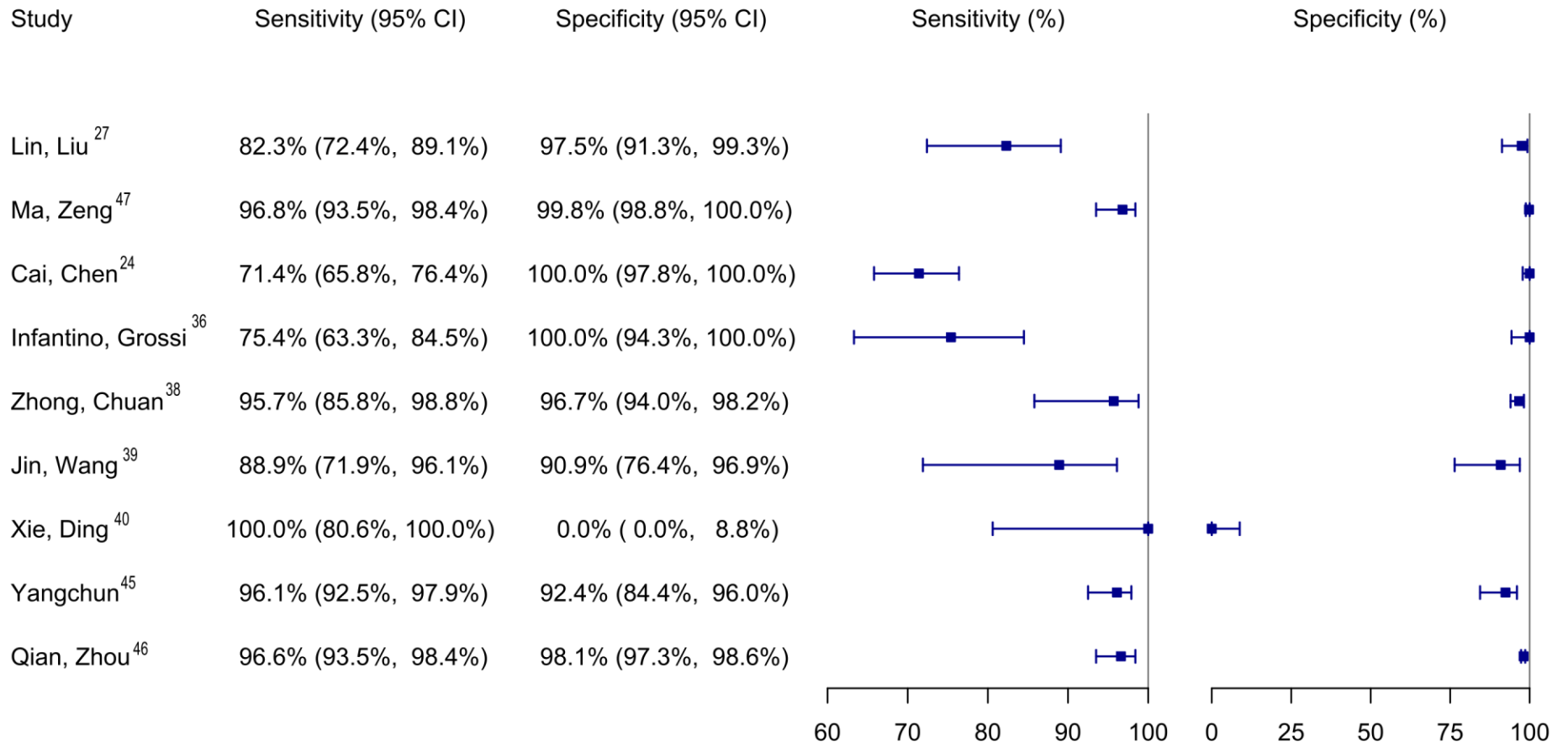
CLIA IgG and/or IgM



CLIA IgM



CLIA IgG



Supplement References

**Numbering begins at # 15 in order to match referencing in the main article

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