

Routine Laboratory Test Indices for COVID-19 Patient Management

Hematology Test Indices

	Test Parameter	Reference Interval	Symptom* Onset	Admission	Hospitalization		Discharge** <small>(Reference from COVID-19 Designated Hospitals, China)</small>
			9 days (median)		12 days (median)		
WBC	White blood cells (WBC)	4.0-10.0 x10 ⁹ /L	Normal, or slightly elevated		Survivals	Shifting with slight increase within the reference range ¹	> 3.0 x10 ⁹ /L
				None-survivals	Exceeding the upper reference range ¹		
	Lymphocyte number (Lym#)	0.8-4.0 x10 ⁹ /L	Normal, or slightly decreased		Survivals	Progressively decreasing, followed by recovering climbing back.	> 1.0 x10 ⁹ /L
				None-survivals	Persistent decrease, fluctuating at low level (below 0.8 x10 ⁹ /L) ¹		
				In Mindray COVID-19 retrospective study, AI acquired Lym# & RDW-SD parameter (unpublished, requiring further verification) > 0.794 could predict severe progression.			
	Monocyte number (Mon#)	0.12-1.2 x10 ⁹ /L	Normal, or slightly decreased		Monocyte deform to phagocyte, engulfing virus. In the deterioration process, Mon cell cluster appears some sudden change in SF CUBE (Mindray unpublished retrospective study).		0.12-1.2 x10 ⁹ /L
	Neutrophil number (Neu#)	2.0-7.0 x10 ⁹ /L	Normal, or slightly elevated		Survivals	Progressively increasing, rising slowly within the reference range ¹	> 1.5 x10 ⁹ /L
				None-survivals	Progressively increasing, exceeding the upper reference range ¹		
Eosinophil number (Eos#)	0.02-0.5 x10 ⁹ /L	Normal, or slightly decreased		Progressively decreasing, some will fall out of the lower reference range ³		0.02-0.5 x10 ⁹ /L	
High fluorescent Cell number (HFC#)	0.00 x10 ⁹ /L	Normal, or slightly increased		Some results will be flagged with atypical lymphocyte.		0.00 x10 ⁹ /L	
Neutrophil-to-lymphocyte ratio (NLR)	Cutoff: 3.13 ²	Normal, or slightly increased		Elderly patients (>50 years) with NLR>3.13 are recommended to transfer to ICU ²		NA	
NLR & RDW-SD	Cutoff: 1.06 ⁴	Normal, or slightly increased		Patients with NLR & RDW-SD > 1.06 can be classified as the severe progression for more intervention therapy ⁴		NA	
RBC / RET	Reticulocyte number (Ret#)	0.02-0.20 x10 ¹² /L	Normal, or slightly increased, could decrease in severe cases		Severe and critically ill patients will have high Ret count and IRF (Mindray unpublished retrospective study).		> 0.02 x10 ¹² /L
	Immature Reticulocyte Fraction (IRF)	0.0-25.0 %					0.0-25.0 %
	Hemoglobin (HGB)	110-160 g/L	Normal, or slightly decreased		Progressively decreasing, then rising back during recovery		> 90 g/L
	Red blood cell distribution width – standard deviation (RDW-SD) ⁵	35.0-56.0 fl	Normal, or slightly increased		Progressively increasing, can be combined with other parameters for severity identification or prediction.		35.0-56.0 fl
PLT	Platelet count (PLT)	100-300 x10 ⁹ /L	Normal, or slightly increased, could decrease in severe cases		In the well-controlled cases, PLT rises progressively, then declining during recovery		> 80 x10 ⁹ /L
					Decreasing with septic deterioration ⁶ , then rising back during recovery		
	Platelet Distribution Width (PDW)	6.5-12.0 fl	Normal, or slightly increased		Progressively increasing, then going down during recovery		6.5-12.0 fl
	Immature Platelet Fraction (IPF)	0.9-10.0 %	Normal, or slightly increased		Progressively increasing, then going down during recovery		0.9-10.0 %
Platelet-large cell count (P-LCC)	30-90 x10 ⁹ /L	Normal, or slightly increased		Progressively increasing, then going down during recovery		30-90 x10 ⁹ /L	
CRP	Full-range C-reactive protein (FR-CRP)	0.00-4.00 mg/L	Slightly increased		Progressively increasing, CRP > 34mg/L plus age > 60 years indicating high probability of mortality in 12 days ⁷		0.00-4.00 mg/L

*Symptoms: fever, cough, breathing difficulties, headache, diarrhea

**Discharge: Under the premise that the patient's nucleic acid test result is negative for two consecutive days (alveolar lavage fluid is recommended⁸)

CLIA Test Indices

Test Parameter	Reference Interval	Clinical Significance	Notes
cTnI	99th Percentile: 0.04 ng/mL cutoff of CL-series TnI assay for determining AMI is 0.5 ng/mL	<ul style="list-style-type: none"> Acute cardiac injury (elevation of cTnI to >99th percentile) is associated with more severe COVID-19 disease^{9,10}. COVID-19 patients with elevated cTnI is associated with worse prognosis¹¹. 	Assays for troponins and BNP should be obtained only for such patients who have clinical signs of acute myocardial infarction (MI) or heart failure, respectively.
BNP	Cutoff of CL-series BNP assay for determining heart failure is 100 pg/mL	<ul style="list-style-type: none"> For COVID-19 patients with clinical evidence for heart failure, BNP could aid in the diagnosis of congestive heart failure¹². Natriuretic peptide estimates a potentially useful approach in patients with severe COVID-19 to distinguish between cardiac and pulmonary cause of dyspnea, to risk-prognosticate the patients, and to guide and monitor therapy¹³. 	
PCT	<0.05 ng/mL	<ul style="list-style-type: none"> SARS-CoV-2 infection could not cause an elevated PCT concentration. Procalcitonin is typically normal on admission, but may increase among those admitted to the ICU¹⁴. Increased PCT is a risk factor associated with in-hospital death, and of the COVID-19 patients who died around half had a secondary bacterial infection leading to sepsis and death¹. 	PCT is not a substitute for good clinical judgement and cannot be used in isolation.
FERR	Male: 27-375 ng/mL, Female: 12-135 ng/mL	<ul style="list-style-type: none"> Increased ferritin level might correlate to secondary bacterial infection and associated with poor clinical prognosis¹⁵. Elevated ferritin is a marker to assess COVID-19 severity¹⁶. An elevated serum ferritin test is an indicator for systemic inflammatory response syndrome, which could cause rapid deterioration of COVID-19 patients¹⁷. 	
IL-6*	/	<ul style="list-style-type: none"> In patients with COVID-19, IL-6 levels are significantly elevated and associated with adverse clinical outcomes¹⁸. Given the association of elevated IL-6 with severe COVID-19 and mortality, clinicians should use this as a potential marker to recognize severe disease¹⁹. 	Available soon on Mindray CLIA systems

Biochemistry Test Indices

Test Parameter	Reference Interval	Clinical Significance
LDH	Male: < 248 U/L , < 4.13 μkat/L Female: < 247 U/L, < 4.12 μkat/L	LDH level can reflect the injury degree of lung, kidney and heart. Most COVID-19 patients had elevated LDH. ¹⁸ LDH level can help evaluate the prognosis and predict the mortality of COVID-19 patients.
CRP	<5.0mg/L	The significant increase of CRP has been reported in most COVID-19 patients. ¹⁹ CRP testing is useful in the evaluation of coronavirus infection and reflect the inflammation status.
FER	Male: 30-400 ng/mL Female: 15-150 ng/mL	<ul style="list-style-type: none"> All patients with severe COVID-19 should be screened for hyperinflammation using laboratory trends (eg, increasing ferritin, decreasing platelet counts, or increasing erythrocyte sedimentation rate). The serum ferritin has a role in predicting in-hospital mortality. Levels of serum ferritin was clearly elevated in non-survivors compared with survivors throughout the clinical course, and increased with illness deterioration.¹
D-Dimer	≤1.0 μg/mL	Many studies found that D-dimer levels significantly increased with increasing severity of COVID-19. Having D-dimer level greater than 1 μg/mL is a factor that could help clinicians to identify patients with poor prognosis at an early stage. ¹

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Mindray's total laboratory solutions assisted frontline health workers in fighting COVID-19 in China's Leishenshan and Huoshenshan Hospitals, two emergency specialty filed hospitals built in mere a few days in response to the coronavirus.

