

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				In Mindray COVID-19 retrospective study, AI acquired Lym# & RDW-SD parameter (unpublished, requiring further verification) 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 In the deterioration process, Mon cell cluster appears some sudden change in SF CUBE (Mindray unpublished retrospective study).			0.12-1.2 x10 ⁹ /L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increased, could decrease in severe cases		Severe and critically ill patients will have high Ret count and IRF (Mindray unpublished retrospective study).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 recommended⁹)

CLIA Test Indices

Test Parameter	Reference Interval	Clinical Significance	Notes
cTnI	99th Percentile: 0.04 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^{1,9,10}. 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	Cut off for heart failure: 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	0.12-1.2 x10 ⁹ /L	<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	2.0-7.0 x10 ⁹ /L	<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.

