

#### ♦ منابع مورد استفاده جهت استخراج مقادیر عدم دقت و خطای مجاز

همان‌طور که در بالا بیان گردید برای دستیابی به خطای مجاز هر یک از معیارهای مورد اشاره می‌تواند مورد استفاده قرار گیرد.

در این مجموعه آخرین اطلاعات براساس معیار CLIA (استخراج شده از کتاب Tietz) و محدوده تغییرات بیولوژیک، Minimum Specification (استخراج شده از سایت وستگارد) طی جدول ۱۹-۲ در اختیار همکاران قرار گرفته است بدیهی است با توجه تغییرات مداوم در این منابع بهتر است مسئول فنی یا کارشناس مرتبط آخرین نتایج مربوطه را از منابع مورد تایید استخراج و همیشه آن‌ها را به روز نماید.

*که پیشنهاد نویسندگان این مجموعه برای دستیابی به خطای مجاز به ترتیب معیار CLIA، Minimum Specification، محدوده تغییرات بیولوژیک و یا سایر منابع اطلاعاتی استخراج شده در برنامه‌های ارزیابی خارجی کیفیت در دسترس است. در صورت عدم دسترسی به هریک از این منابع، روش Tonks پیشنهاد می‌شود.*

در جدول ۱۹-۲ در ستون اول، نام نوع نمونه، در ستون دوم نام آنالیت، در ستون سوم سطح تصمیم‌گیری بالینی و در ستون چهارم واحد مربوطه بیان گردیده است. در ستون پنجم، ششم و هفتم مقادیر SD ماکزیمم (M.SD)، Acceptable Performance (AP) (ماکزیمم Total Error بر حسب %) و ماکزیمم Total Error مجاز بر حسب واحد (TEa) براساس معیار CLIA که از کتاب Tietz استخراج گردیده است، نشان داده شده است. در ستون‌های هشتم و نهم مقادیر  $CV_I$  (Within-Subject) و  $CV_G$  (Between-Subject) براساس تغییرات بیولوژیک و در ستون‌های دهم، یازدهم و دوازدهم به ترتیب مقادیر CV، Bias و TE (بر حسب درصد) براساس معیار Minimum Specification که از سایت وستگارد استخراج گردیده است، بیان شده است.

جدول ۱۹-۲: مقادیر سطح تصمیم‌گیری، عدم دقت مجاز براساس معیارهای CLIA و تغییرات بیولوژیک

Specimen	Analytic	Decision Level, Xc	Unit	CLIA			Biological Variation		Minimum Specification		
				M.SD	A.P.(%)	TEa	CVi	CVG	CV(%)	Bias(%)	TE(%)
Serum	$\alpha$ 1-Antitrypsin	80	mg/dL	0.75SD	3SD	3SD	5.9	16.3	4.4	6.5	13.8
Plasma	$\alpha$ 2-Antiplasmin						6.2		4.7		
Serum	$\alpha$ 2-Macroglobulin						3.4	18.7	2.6	7.1	11.3
Serum	$\alpha$ -Amylase	100	U/L	7.5	30%	30	8.7	28.3	6.5	11.1	21.9
Serum	$\alpha$ -Fetoprotein (non hepatic carcinoma)	10	$\mu$ g/L	0.75SD	3SD	3SD	6.0				
Serum	$\alpha$ -Tocopherol						13.8	15	10.4	7.6	24.7
Serum	Acid phosphatase tartrate resistant (TR-ACP)						8	13.3	6	5.8	15.7
Plasma	Activated partial thromboplastine time (APTT)	40	S	1.5	15%	6	2.7	8.6	2	3.4	6.7
Serum	Alanine aminopeptidase						4.1		3.1		
Serum	Alanine aminotransferase	50	U/L	2.5	20%	10					
Serum	Albumin	3.5	g/dl	0.09	10%	0.35	3.1	4.75	2.4	2.1	6.1
Serum	Albumin, glycated						5.2	10.3	3.9	4.3	10.8
Serum	Alkaline phosphatase	150	U/L	11	30%	45					
Serum	Alkaline phosphatase, bone Isoform						6.2	37.4	4.7	14.2	21.9
Serum	Alanin Aminotransferase	50	U/L	2.5	20%	10					
Serum	Amyloid A						25	61			
Serum	Androstendione	260	ng/dl								
Plasma	Antithrombin III						5.2	15.3	3.9	6.1	12.5
Serum	Apolipoprotein A1						6.5	13.4	4.9	5.6	13.6
Serum	Apolipoprotein B						6.9	22.8	5.2	8.9	17.5
Serum	Aspartate aminotransferase	30	U/L	1.5	20%	6					
Serum	$\beta$ 2-Microglobulin						5.9	15.5	4.4	6.2	13.5
Blood	Alcohol	0.1	g/dl	0.006	25%	0.025					
Serum	Bilirubin total	1	mg/dl	0.1	0.4%	0.004					
Serum	Bilirubin total	20	mg/dl	1.0	20%	4					

ادامه جدول ۱۹-۲: مقادیر سطح تصمیم‌گیری، عدم دقت مجاز بر اساس معیارهای CLIA و تغییرات بیولوژیک

Specimen	Analytic	Decision Level, Xc	Unit	CLIA			Biological Variation		Minimum Specification		
				M.SD	A.P(%)	TEa	CVi	CVG	CV(%)	Bias(%)	TE(%)
Plasma	C Protein						5.8	55.2	4.4	20.8	28
Serum	CA 15.3 antigen						6.1	62.9	4.6	23.7	31.2
Serum	Ca ,Total	7	mg/dl	0.25	1%	0.07	1.9	2.8	1.4	1.3	3.6
Serum	Ca ,Total	10.8	mg/dl	0.25	1	0.11	1.0				
Serum	Ca ,Total	13	mg/dl	0.25	1	0.13	1.0				
Plasma	Calcium, ionized						1.7	1.9	1.3	1	3.1
Serum	Carbohydrate deficient transferrin						7.1	38.7	5.3	14.8	23.5
(B) Gas	Carbon dioxide						4.0	4.8	3.0	2.3	7.3
Serum	Carnitine, Free						8.05	16.65	6.0	6.9	16.9
Serum	Ceruloplasmin(Ferroxidase)						5.8	11.1	4.4	4.7	11.9
Serum	Chloride	90	mmol/L	1.1	5%	4.5	1.2	1.5	0.9	0.7	2.2
Serum	Chloride	110	mmol/L	1.4	5%	5.5	0.6				
Serum	Cholesterol	200	mg/dl	5	10%	20	2.7				
Serum	Cholinesterase concentration						7.1		5.3		
Serum	Cholinesterase, activity						6.1	18.2	4.6	7.2	14.7
Serum	C3 complement	100	mg/dl	0.75SD	3SD	3SD					
Serum	C4 complement	20	mg/dl	0.75SD	3SD	3SD	4.5				
Serum	Cortisol	5	µg/dl	0.31	25%	1.25	10.5				
Serum	Cortisol	30	µg/dl	1.88	25%	7.5	10.5				
Blood Gas	Carbon dioxide						4.0	4.8	3.0	2.3	7.3
Serum	Carnitine free						8.05	16.65	6.0	6.9	16.9
Serum	Collagen type I C propeptide (PICP)						7.8	26.7	5.9		
Serum	Collagen type III N propeptide (PIIINP)						13.6	87.2	10.2	33.1	49.9
Serum	Creatine kinase (CK)	200	U/L	15	30%	60					
Serum	Chorionic gonadotropin	25	IU/L	0.75SD	3SD	3SD					
Serum	Chorionic gonadotropin	10000	IU/L	0.75SD	3SD	3SD					

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Specimen	Analytic	Decision Level, Xc	Unit	CLIA			Biological Variation		Minimum Specification		
				M.SD	A.P(%)	TEa	CVI	CVG	CV(%)	Bias(%)	TE(%)
Serum	Copper						4.7	13.6	3.5	5.4	11.2
Serum	Creatine kinase MB, mass	13	µg/L	0.75SD	3SD	3SD					
Serum	Creatinine	1	mg/dl	0.08	30%	0.3					
Serum	Creatinine	3	mg/dl	0.11	15%	0.45					
Plasma	Cysteine						5.9	12.3	4.4	5.1	12.4
Serum	Dehydroepiandrosterone sulfate (DHEA)	2000	µg/L				6.35	30.7	4.8	11.8	19.6
Blood	Erythrocytes, count						3.25	6.3	2.4	2.7	6.7
Blood	Erythrocyte count (RBC)	4.5	M/µL	0.07	6%	0.27					
Blood	Erythrocyte count (RBC)	5.9	M/µL	0.09	6%	0.35					
Plasma	Factor V coagulation						3.6		2.7		
Plasma	Factor VII coagulation						6.8	19.4	5.1	7.7	16.1
Plasma	Factor VIII coagulation						4.8	19.1	3.6	7.4	13.3
Plasma	Fibrinogen	150	mg/dl	7.5	20%	30					
Serum	Free thyroxine (FT4)	0.8	ng/dl	0.75SD	3SD	3SD	3.8				
Serum	Free thyroxine (FT4)	4.0	ng/dl	0.75SD	3SD	3SD	3.8				
Plasma	Factor X Coagulation						5.9		4.4		
Serum	Fructosamine						3.4	5.9	2.6	2.6	6.8
Serum	Globulins, total						5.5	12.9	4.1	5.3	12.1
Serum	Glucose	50	mg/dl	1.5	12%	6					
Serum	Glucose	126	mg/dl	3.15	10%	12.6					
Serum	Glucose	200	mg/dl	5	10%	20					
Serum	Glutathione peroxidase						7.2	21.7	5.4	8.6	17.5
Blood	Hematocrit	35	%	0.53%	6%	2.1	2.7	6.41	2.0	2.6	5.9
Blood	Hematocrit	50	%	0.75%	6%	3%	2.7	6.41	2.0	2.6	5.9
Blood	Hemoglobin	12	g/dl	0.21	7%	0.84	2.85	6.8	2.1	2.8	6.3
Blood	Hemoglobin	17	g/dl	0.30	7%	1.19	2.85	6.8	2.1	2.8	6.3



ادامه جدول ۱۹-۲: مقادیر سطح تصمیم‌گیری، عدم دقت مجاز براساس معیارهای CLIA و تغییرات بیولوژیک

Specimen	Analytic	Decision Level, Xc	Unit	CLIA			Biological Variation		Minimum Specification		
				M.SD	A.P.(%)	TEa	CVi	CVG	CV(%)	Bias(%)	TE(%)
Blood	Hemoglobin A1 C						1.85	5.7	1.4	2.2	4.5
Serum	HDL cholesterol	35	mg/dl	2.6	30%	10.5					
Serum	HDL cholesterol	65	mg/dl	4.9	30%	19.5					
Serum	HDL 1 cholesterol						5.5	27.2	4.1	10.4	17.2
Serum	HDL 3 cholesterol						7	14.3	5.3	6	14.6
Plasma	Homocysteine						9	40.3	6.8	15.5	26.6
Serum	Immunoglobulin A	400	mg/dl	0.75SD	3SD	3SD					
Serum	Immunoglobulin E	200	IU/ml	0.75SD	3SD	3SD					
Serum	Immunoglobulin G	500	mg/dl	31	25%	125					
Serum	Immunoglobulin G	2000	mg/dl	125	25%	500					
Serum	Immunoglobulin M	300	mg/dl	0.75	3SD	3SD					
Serum	Immunoglobulins K chain						4.8	15.3	3.6	6	12
Serum	Immunoglobulins I chain						4.8	18	3.6	7	12.9
Serum	Iron	150	µg/dl	7.5	20%	30					
Serum	Lactate dehydrogenase (LDH)	300	U/L	15	20%	60					
Serum	Lactate dehydrogenase 1 isoform (LDH1)	100	U/L	7.5	30%	30	2.3	8.3	1.7	3.2	6.1
Serum	Lactate dehydrogenase 2 isoform (LDH2)	100	U/L	7.5	30%	30	3.3	2.4	2.5	1.5	5.6
Serum	Lactate dehydrogenase 3 isoform (LDH3)	100	U/L	7.5	30%	30	2.8	3.8	2.1	1.8	5.2
Serum	Lactate dehydrogenase 4 isoform (LDH4)	100	U/L	7.5	30%	30	5.9	5.3	4.4	3	10.3
Serum	Lactate dehydrogenase 5 isoform (LDH5)	100	U/L	7.5	30%	30	8	9.6	6	4.7	14.6
Plasma	Leukocytes, count (WBC)	3.5	K/µL	0.13	15%	0.52					
Plasma	Leukocytes, count (WBC)	11	K/µL	0.41	15%	1.65					
Blood	Leukocytes diff					3SD	3SD				
Serum	Lithium	0.5	mmol/L	0.08	0.3	0.3					

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Specimen	Analytic	Decision Level, Xc	Unit	CLIA			Biological Variation		Minimum Specification		
				M.SD	A.P(%)	TEa	CVi	CVG	CV(%)	Bias(%)	TE(%)
Serum	Lithium	1.5	mmol/L	0.08	20%	0.3					
Serum	LDL Cholesterol						7.8	20.4	5.9	8.2	17.8
Blood	Lymphocytes CD4								18.8		
(B)Erythr-	Magnesium						5.6	11.3	4.2	4.7	11.7
Serum	Magnesium (Mg)	2	mg/dl	0.13	25%	0.5	3.6	6.4	2.7	2.8	7.2
(B)Erythr-	Mean corpuscular hemoglobin (MCH)						1.4	5.2	1.1	2	3.8
(B)Erythr-	Mean corpuscular hemoglobin concentration (MCHC)						1.06	1.2	0.8	0.6	1.9
(B)Erythr-	Mean corpuscular volume (MCV)						1.4	4.85	1.1	0.7	2.3
(B)Plat-	Mean platelet volume (MPV)						4.3	8.1	3.2	3.4	8.8
Serum	Osmolality						1.3	1.2	1	0.7	2.3
Serum	Osteocalcin						6.35	30.9	4.8	11.8	19.7
Blood	PCO2	35	mm Hg	1.3	5	5					
Blood	PCO2	50	mm Hg	1.3	5	5					
Blood	PH (PH units)	7.35		0.01	0.04	0.04					
Blood	PH (PH units)	7.45		0.01	0.04	0.04					
Plasma	Partial thromboplastin Time	40	S	1.5	15%	6					
Plasma	Plasminogen						7.7		5.8		
Blood	Platelets, count	50	k/ $\mu$ L	3.12	25%	12.5					
Blood	Platelets, count	500	k/ $\mu$ L	31.2	25%	125					
Blood	Po2	30	mmHg	0.75SD	3SD	3SD					
Blood	Po2	80	mmHg	0.75SD	3SD	3SD					
Blood	Platelet distribution wide						2.8		2.1		
Serum	Potassium	3	mmol/L	0.13	0.5	0.5	4.6	5.6	3.5	2.7	8.4
Serum	Potassium	6	mmol/L	0.13	0.5	0.5	4.6	5.6	3.5	2.7	8.4
Plasma	Protein S						5.8	63.4	4.4	23.9	31.1

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Specimen	Analytic	Decision Level, Xc	Unit	CLIA			Biological Variation		Minimum Specification		
				M.SD	A.P(%)	TEa	CVi	CVG	CV(%)	Bias(%)	TE(%)
Serum	Protein, total	7	g/dl	0.18	10%	0.7	2.75	4.7	2.1	2	5.4
Plasma	Prothrombin time	INR3.6	X	INR0.14	15%	INR0.54	4	6.8	3	3	7.9
Patient	Reabsorption tubular Phosphate						2.7	3.3	2	1.6	4.9
Blood	Red cell distribution wide (RDW) cated						3.5	5.7	2.6	2.5	6.8
Serum	Protein glycolated						0.9	11.6	0.7	4.4	5.5
(B)Erythr-	Sodium						1.8	12.4	1.4	4.7	6.9
Serum	Sodium	130	mmol/L	1	4	4	0.6	0.7	0.5	0.3	1.1
Serum	Sodium	150	mmol/L	1	4	4	0.6	0.7	0.5	0.3	1.1
Serum	Thyroid stimulating hormone (TSH)	0.3	mIU/L	0.75SD	3SD	3SD					
Serum	Thyroid stimulating hormone (TSH)	5	mIU/L	0.75SD	3SD	3SD					
Serum	T3 uptake	25	%	0.75SD	3SD	3SD					
Serum	Thyroxine binding globulin (TBG)						0.09	0.06	0.1	0	0.2
Serum	Thyroxine (T4)	3	µg/dl	0.25	1	1	4.9	10.6	3.7	4.4	10.4
Serum	Thyroxine (T4)	13	µg/dl	0.65	20%	2.6	4.9	10.6	3.7	4.4	10.4
Serum	Transferrin	375	mg/dl				3	4.3	2.3	2	5.7
Serum	Triglyceride	160	mg/dl	10	25%	40					
Serum	Triiodothyronine (T3)	80	ng/dl	0.75SD	3SD	3SD					
Serum	Triiodothyronine (T3)	200	ng/dl	0.75SD	3SD	3SD					
Serum	T4 Tyroxine free	0.8	ng/dl	0.75SD	3SD	3SD					
Serum	T4 Tyroxine free	4	ng/dl	0.75SD	3SD	3SD					
Serum	Uric Acid	6	mg/dl	0.25	17%	1.02					
Serum	Urea nitrogen	27	mg/dl	0.6	9%	2.4					
Serum	Vascular cell adhesion molecule-1 (VCAM-1)						5.2	16	3.9	6.3	12.7

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Specimen	Analytic	Decision Level, Xc	Unit	CLIA			Biological Variation		Minimum Specification		
				M.SD	A.P(%)	TEa	CVi	CVG	CV(%)	Bias(%)	TE(%)
Plasma	Vascular endothelial growth factor						14.1	18.1	10.6	8.6	26.1
Plasma	Von Willebrand factor antigen						2.5	27.3	1.9	10.3	13.4
Serum	Water						3.1	0.1	2.3	1.2	5
Blood	Alcohol, blood	0.10	g /dl	0.006	25%	0.025					
Serum	Carbamazepine	8	mg /L	0.5	25%	2					
Serum	Carbamazepine	12	mg /L	0.75	25%	3					
Serum	Digoxin	0.8	µg/L	0.05	0.2	0.2					
Serum	Digoxin	2	µg/L	0.1	20%	0.4					
Serum	Ethosuximide	40	mg /L	2	20%	8					
Serum	Ethosuximide	100	mg/L	5	20%	20					
Serum	Gentamicin	10	mg/L	0.6	25%	2.5					
Blood	Lead, blood	10	µg/dl	1	4%	0.4					
Blood	Lead, blood	40	µg/dl	1	4%	1.6					
Serum	Phenobarbital	15	mg /L	0.75	20%	3					
Serum	Phenobarbital	40	mg /L	2	20%	8					
Serum	Phenytoin	10	mg /L	0.6	25%	2.5					
Serum	Phenytoin	20	mg /L	1.2	25%	5					
Serum	Primidone	5	mg /L	0.3	25%	1.3					
Serum	Primidone	12	mg /L	0.75	25%	3					
Serum	Procainamide	4	mg /L	0.25	25%	1					
Serum	Procainamide	20	mg /L	1.25	25%	5					
Serum	Quinidine	7	mg /L	0.45	25%	1.8					
Serum	Theophylline	10	mg /L	0.63	25%	2.5					
Serum	Theophylline	20	mg /L	1.2	25%	5					
Serum	Valproate	50	mg /L	3.1	25%	12.5					
Serum	Valproate	100	mg /L	6.2	25%	25					



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## QUALITY REQUIREMENTS

### Desirable Biological Variation Database specifications

The 2014 edition of Desirable Specifications for imprecision, inaccuracy, and total allowable error, calculated from data on within-subject and between-subject biologic variation. This database was updated and compiled by Dr. Carmen Ricos and colleagues, before the EFLM took the helm. As of May 2019, EFLM is managing the new biological variation database. We were honored to host this database for 15 years.

### Desirable Specifications for Total Error, Imprecision, and Bias, derived from intra- and inter-individual biologic variation

This most recent and extensive listing of biologic goals has been provided by Ricos C, Alvarez V, Cava F, Garcia-Lario JV, Hernandez A, Jimenez CV, Minchinela J, Perich C, Simon M. "Current databases on biologic variation: pros, cons and progress." Scand J Clin Lab Invest 1999;59:491-500. [This database was last updated in 2014.](#)  
[\(/biodatabase-2014-update.htm\)](#)

### PLEASE NOTE: The EFLM now hosts the latest database on [biological variation!](https://biologicalvariation.eu/)

Annex I, Part I: Within-subject and between-subject CV values of analytes and Desirable Analytical Quality Specifications for imprecision, bias and total error

[11-Desoxycortisol through a-Fetoprotein](#)  
[Albumin through CA 549 antigen](#)  
[Calcium through Cystine](#)  
[Dehydroepiandrosterone sulfate through Hydroxylproline](#)  
[Immunoglobulin A through Lycopene](#)  
[Magnesium through Oxalate. output](#)  
[pCO2 through Rheumatoid factor](#)  
[SCC antigen through Zinc](#)

[See The Reference List \(/biodatabase3.htm\)](#)

[See The References \(/biodatabase2.htm\)](#)

[See The original Guest Essay \(/quest17.htm\)](#)

#### Note on abbreviations:

**CV<sub>I</sub>** = within-subject biologic variation

**CV<sub>G</sub>** = between-subject biologic variation

**I** = desirable specification for imprecision

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### Other Articles

- [1999 Stockholm Consensus Statement \(/stockholm.htm\)](#)
- [2016 State of the Art Hematology Performance Specifications \(/rcpa.htm\)](#)
- [A selection of SEKK-DMax specifications \(/sekk-dmax.htm\)](#)
- [Belgium EQA performance specifications \(/belgium-eqa-goals.htm\)](#)
- [Biological Variation](#)

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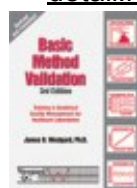
Dispersion Calculator and Critical Number of Test Samples  
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**B = desirable specification for inaccuracy**  
**TE = desirable specification for allowable total error**

	Analyte	Number of Papers	Biological Variation		Desirable specification		
			CV <sub>I</sub>	CV <sub>G</sub>	I(%)	B(%)	TE(%)
S-	11-Desoxycortisol	2	21.3	31.5	10.7	9.5	27.1
S-	17-Hydroxyprogesterone	2	19.6	50.4	9.8	13.5	29.7
U-	4-hydroxy-3-methoximandelate (VMA)	1	22.2	47.0	11.1	13.0	31.3
S-	5' Nucleotidase	2	23.2	19.9	11.6	7.6	26.8
U-	5'-Hydroxyindolacetate, concentration	1	20.3	33.2	10.2	9.7	26.5
S-	α1-Acid Glycoprotein	3	11.3	24.9	5.7	6.8	16.2
S-	α1-Antichymotrypsin	1	13.5	18.3	6.8	5.7	16.8
S-	α1-Antitrypsin	3	5.9	16.3	3.0	4.3	9.2
S-	α1-Globulins	2	11.4	22.6	5.7	6.3	15.7
U-	α1-Microglobulin, concentration, first morning	1	33.0	58.0	16.5	16.7	43.9
P-	α2-Antiplasmin	1	6.2	---	3.1	---	---
S-	α2-Globulins	2	10.3	12.7	5.2	4.1	12.6
S-	α2-Macroglobulin	4	3.4	18.7	1.7	4.75	7.56
U-	α2-Microglobulin output, first morning	1	29.0	32.0	14.5	10.8	34.7
P-	α-aminobutyric acid	1	24.7	32.3	12.4	10.2	30.5
S-	α-Amylase	7	8.7	28.3	4.4	7.4	14.6
S-	α-Amylase (pancreatic)	2	11.7	29.9	5.9	8.0	17.7
U-	α-Amylase (pancreatic)	2	69.5	105.0	34.75	31.48	88.82
U-	α-Amylase concentration, random	1	94.0	46.0	47.0	26.2	103.7
P-	α-Carotene	1	24.0	65.0	12.0	17.3	37.1
S-	α-Carotene	1	48.0	65.0	24.0	20.2	59.8
S-	α-Fetoprotein(non hepatic carcinoma)	2	12.2	45.6	6.1	11.8	21.9
S-	α-Tocopherol	3	13.8	15.0	6.9	5.1	16.5
S-	Acid phosphatase	2	8.9	8.0	4.5	3.0	10.3
S-	Acid phosphatase tartrate-resistant (TR-ACP)	2	8.0	13.3	4.0	3.9	10.5
S-	Acid phosphatase prostatic activity (PAP)	1	33.8	---	16.9	---	---
P-	Activated partial thromboplastine time	3	2.7	8.6	1.4	2.3	4.5
S-	Adiponectin	1	18.8	51.2	9.4	13.6	29.1
S-	Adenosine deaminase (ADA)	1	11.7	25.5	5.9	7.0	16.7
S-	Alanine	1	14.7	55.8	7.4	14.4	26.6
S-	Alanine aminopeptidase	1	4.1	---	2.1	---	---
S-	Alanine aminotransferase (ALT)	9	19.40	41.6	9.7	11.48	27.48

[Back to top](#)

	Analyte	Number of papers	Biological Variation		Desirable specification		
			CV <sub>I</sub>	CV <sub>G</sub>	I(%)	B(%)	TE(%)
S-	Albumin	24	3.2	4.75	1.6	1.43	4.07
U-	Albumin, concentration, first morning	3	36.0	55.0	18.0	16.4	46.1
U-	Albumin, output, night urine	3	29.5	58.0	14.8	16.3	40.6
S-	Albumin, glycated	1	5.2	10.3	2.6	2.9	7.2
S-	Aldosterone	2	29.4	40.1	14.7	12.4	36.7
U-	Aldosterone	1	39.4	40.1	19.7	14.05	46.56
S-	Alkaline phosphatase	22	6.45	26.1	3.23	6.72	12.04
S-	Alkaline phosphatase bone	4	6.2	37.4	3.1	9.5	14.6

[Database reference list \(/biodatabase3.htm\)](#)

- [Biological Variation Database references \(/biodatabase2.htm\)](#)
- [Biological Variation in Patients with Disease \(/biodatabasedisease.htm\)](#)
- [CLIA Requirements for Analytical Quality \(/clia.htm\)](#)
- [Clinical Quality Requirements \(/clinical.htm\)](#)
- [Consolidated Comparison of Chemistry Performance Specifications \(/consolidated-goals-chemistry.htm\)](#)
- [Consolidated Comparison of Hematology Performance Specifications \(/hematology-goals.htm\)](#)
- [Desirable Biological Variation Database specifications \(/biodatabase1.htm\)](#)
- [European Biologic Goals \(/europe.htm\)](#)
- [Final Milan Hierarchy \(/milan-mandate.htm\)](#)
- [French EQA performance specifications \(/french-eqa-goals.htm\)](#)
- [Milan 2014 Consensus Draft on Quality Specifications \(/milan-2014-draft1.htm\)](#)
- [Minimum analytical quality requirements \(/minimum-requirements.htm\)](#)
- [Minimum Specifications from Biological Variation database \(/minimum-biodatabase1.htm\)](#)
- [Optimal Biological](#)

S-	Alkaline phosphatase, bone	4	0.2	37.4	3.1	9.0	14.0
S-	Alkaline phosphatase, liver	1	10.0	27.0	5.0	7.2	15.4
S-	Alkaline phosphatase, placental	1	19.1	---	9.6	---	---
U-	Ammonia, output, 24h	1	24.7	27.3	12.4	9.2	29.6
S-	Amyloid A	1	25.0	61.0	12.5	16.5	37.1
S-	Androstendione	2	15.8	38.8	7.9	10.47	23.51
S-	Anion gap		9.5	10.1	4.8	3.5	11.3
P-	Antithrombin III	4	5.2	15.3	2.6	4.0	8.3
S-	Apolipoprotein A1	11	6.5	13.4	3.3	3.7	9.1
S-	Apolipoprotein B	9	6.9	22.8	3.5	6.0	11.6
P-	Arginine	1	19.3	34.1	9.7	9.8	25.7
S-	Aristeasase activity, non inhibited	1	3.8	37.2	1.9	9.3	12.5
P-	Ascorbate (Vitamin C)	1	20.0	21.0	10.0	7.3	23.8
S-	Ascorbate (Vitamin C)	3	26.0	31.0	13.0	10.1	31.6
P-	Asparagine	1	12.3	28.0	6.2	7.6	17.8
S-	Aspartate aminotransferase (AST)	13	12.3	23.1	6.15	6.54	16.69
P-	Aspartic acid	1	31.2	55.1	15.6	15.8	41.6
S-	β-2-Microglobulin	1	5.9	15.5	3.0	4.1	9.0
P-	β-Carotene	1	18.0	48.0	9.0	12.8	27.7
S-	β-Carotene	4	36.0	39.7	18.0	13.4	43.1
S-	β-Cryptoxantin	1	36.7	---	18.4	---	---
S-	β-Globulins	2	10.1	9.1	5.1	3.4	11.7
B-	Base excess	1	76.4	43.2	38.2	21.9	85.0
B-	Basophile, count	3	28.0	54.8	14.0	15.4	38.5
S-	Bilirubin total	11	21.8	28.4	10.90	8.95	26.94
S-	Bilirubin conjugated	2	36.8	43.2	18.4	14.2	44.5
P-	C Protein	1	5.6	55.2	2.9	13.9	18.7
S-	C reactive protein	3	42.2	76.3	21.1	21.8	56.6
S-	C reactive protein - high sensitivity	1	49.70	89.23	24.85	25.53	66.54
S-	C3 Complement	2	5.2	15.6	2.6	4.1	8.4
S-	C4 Complement	2	8.9	33.4	4.5	8.6	16.0
S-	CA 125 antigen	4	24.7	54.6	12.4	15.0	35.4
S-	CA 15.3 antigen	5	6.1	62.9	3.1	15.8	20.8
S-	CA 19.9 antigen	2	16.0	130.5	7.98	32.87	46.03
S-	CA 549 antigen	1	9.1	33.4	4.6	8.7	16.2

[Back to top](#)

	Analyte	Number of papers	Biological Variation		Desirable specification		
			CV <sub>1</sub>	CV <sub>g</sub>	I(%)	B(%)	TE(%)
S-	Calcium	24	2.1	2.5	1.05	0.82	2.55
S-	Calcium, complexed	1	5.3	4.5	2.7	1.7	6.1
U-	Calcium, concentration, 24h	4	27.5	36.6	13.8	11.4	34.1
S-	Calcium, ionized	2	1.7	1.9	0.9	0.6	2.0
S-	Calcium, protein bound	1	4.1	6.1	2.1	1.8	5.2
S-	Calcium, ultrafiltrable	1	2.2	2.7	1.1	0.9	2.7
S-	Carbohydrate deficient transferrin	1	7.1	38.7	3.6	9.8	15.7
B-	CO <sub>2</sub> , total	1	4.0	4.8	2.0	1.56	4.86
S-	Carcinoembryonic antigen (CEA)	10	12.7	55.6	6.4	14.3	24.7
S-	Carnitine, Acyl-free	1	11.35	24.3	5.68	6.71	16.07
S-	Carnitine, free	1	8.05	16.65	4.03	4.62	11.26
S-	Carnitine, total	1	8.85	11.80	4.43	3.69	10.99
S-	Ceruloplasmin (ferroxidase)	2	5.8	11.1	2.9	3.1	7.9
S-	Chloride	19	1.2	1.5	0.6	0.5	1.5
S-	Cholesterol	46	5.95	15.3	2.98	4.1	9.01
S-	Cholinesterase, concentration	2	7.1	---	3.6	---	---

[Variation database specifications \(/optimal-biodatabase1htm.htm\)](#)

- [Quality Requirements for Dogs, Cats, and Horses? \(/quality-requirements-for-dogs-cats-and-horses.htm\)](#)
- [RCPA Allowable Limits of Performance for Biochemistry \(/rcpa-biochemistry.htm\)](#)
- [Rilibak - German Guidelines for Quality \(/rilibak.htm\)](#)
- [Spanish Minimum Consensus Performance Specifications \(/minimum-consensus-specifications.htm\)](#)
- [The New Era of Biological Variation: EUBIVAS \(/eubivas.htm\)](#)

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## What's New

[Plateau-ing on progress at the pre-analytical phase \(/2019-preanalytical-quality.htm\)](#)

[FV Hospital Sigma Verification of Performance \(/sigma-vc-fv-hospital.htm\)](#)

[Can hematology analyzers hit EFLM goals? \(/eflm-hematology-failures.htm\)](#)

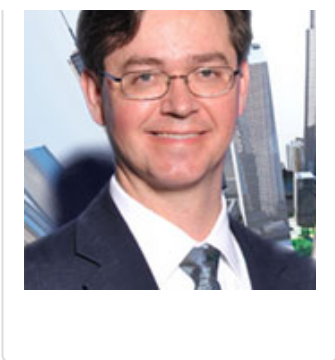
[Establishing Appropriate Risk-Based QC Frequency \(/appropriate-qc-frequency.htm\)](#)

[2019 Comparison of TT4 methods \(/tt4-comparison-methods.htm\)](#)





S-	Cholinesterase, activity	3	6.1	18.2	3.1	4.8	9.8
P-	Chromogranin A	1	12.8	26.3	6.4	7.3	17.9
P-	Citrulline	1	21.4	43.9	10.7	12.2	29.9
S-	Collagen type I C propeptide (PICP)	3	7.8	26.7	3.9	7.0	13.4
S-	Collagen type I N propeptide (PINP)	3	7.4	57.3	3.7	14.4	20.5
S-	Collagen type III N propeptide (PIIINP)	1	13.6	87.2	6.8	22.1	33.3
U-	Color, first morning	1	30.9	47.4	15.5	14.1	39.6
P-	Copper	3	8.0	19.0	4.0	5.2	11.8
S-	Copper	2	4.7	13.6	2.35	3.6	7.47
P-	Cortisol	1	21.7	46.2	10.85	12.76	30.66
S-	Cortisol	3	15.2	38.1	7.6	10.26	22.8
S-	C Peptide	3	16.6	23.2	8.3	7.1	20.8
S-	Creatine kinase (CK)	9	22.8	40.0	11.4	11.5	30.3
S-	Creatine kinase MB, %	1	6.9	48.2	3.5	10.8	16.5
S-	Creatine kinase MB, activity	4	19.7	24.3	9.9	7.8	24.1
S-	Creatine kinase MB, mass	1	18.4	61.2	9.2	14.88	30.06
S-	Creatinine	28	5.95	14.7	2.98	3.96	8.87
U-	Creatinine, concentration, 24h	8	24.0	24.5	12.0	8.6	28.4
U-	Creatinine, concentration, first morning	8	23.2	25.7	11.6	8.7	27.8
U-	Creatinine, concentration, random	8	36.3	32.4	18.2	12.2	42.1
U-	Creatinine, output, 24h	8	11.0	23.0	5.5	6.4	15.4
S-	C-Terminal telopeptide type I collagen (CTY I)	5	10.85	30.6	5.43	8.12	15.45
S-	Cyfra 21.1 Antigen	2	22.2	31.1	11.1	9.6	27.9
P-	Cystatin C	1	5.5	---	2.8	---	---
S-	Cystatin C	4	5.0	13.0	2.5	3.48	7.61
P-	Cysteine	1	5.9	12.3	3.0	3.4	8.3
P-	Cystine	1	38.3	48.5	19.2	15.4	47.0



[Back to top](#)

	Analyte	Number of Papers	Biological Variation		Desirable specification		
			CV <sub>I</sub>	CV <sub>g</sub>	I(%)	B(%)	TE(%)
S-	D-Dimer (MoM)	1	23.3	26.5	11.65	8.82	28.04
S-	Dehydroepiandrosterone sulfate (DHEAS)	3	6.35	30.70	3.188	7.84	13.08
U-	Deoxypyridinoline/creatinine, 24h	2	16.0	30.7	8.0	8.7	21.9
U-	Deoxypyridinoline/creatinine, first morning	2	13.8	34.6	6.9	9.3	20.7
U-	Deoxypyridinoline/minute, first morning	2	15.4	30.3	7.7	8.5	21.2
P-	Dipeptidyl-peptidase IV (ACE)	2	8.2	14.5	4.1	4.2	10.9
S-	Dipeptidyl-peptidase IV (ACE)	1	12.5	27.7	6.3	7.6	17.9
P-	Elastase	1	12.4	15.1	6.2	4.88	15.11
B-	Eosinophils, count	3	21.0	76.4	10.5	19.8	37.1
(B)Plat-	Epinephrine	1	25.3	---	12.7	---	---
P-	Epinephrine	1	48.3	---	24.2	---	---
B-	Erythrocytes, count	7	3.2	6.3	1.6	1.7	4.4
B-	Erythrocyte distribution wide		3.5	5.7	1.8	1.7	4.6
U-	Estradiol	1	30.4	---	15.2	---	---
S-	Estradiol	5	22.5	24.4	11.25	8.3	26.86
S-	Estradiol, free	1	22.8	---	11.40	---	---
U-	Estradiol, free	1	38.6	---	19.3	---	---
P-	Factor V coagulation	1	3.6	---	1.8	---	---
P-	Factor VII coagulation	2	6.8	19.4	3.4	5.1	10.7



P-	Factor VIII coagulation	2	4.8	19.1	2.4	4.9	8.9
P-	Factor X coagulation	1	5.9	---	3.0	---	---
S-	Ferritin	6	14.2	15.0	7.1	5.2	16.9
P-	Fibrinogen	5	10.7	15.8	5.4	4.8	13.6
(B)Erthry-	Folate	1	12.0	66.0	6.0	16.8	26.7
S-	Folate	1	24.0	73.0	12.0	19.2	39.0
S-	Follicle stimulating hormone (FSH)	5	11.0	47.2	5.5	12.12	21.19
S-	Fructosamine	3	3.4	5.9	1.7	1.7	4.5
S-	Galactosyl hydroxylysine	1	11.8	25.8	5.9	7.1	16.8
P-	$\gamma$ -Fibrinogen	1	14.1	27.25	7.05	7.67	19.3
S-	$\gamma$ -Globulins	2	14.6	12.3	7.3	4.8	16.8
S-	$\gamma$ -glutamyltransferase (GGT)	10	13.4	42.15	6.7	11.06	22.11
S-	Globulins, total	1	5.5	12.9	2.8	3.5	8.0
P-	Glucose	1	4.5	5.8	2.3	1.8	5.5
S-	Glucose	15	5.6	7.5	2.8	2.34	6.96
(B)Erythr-	Glucose-6-phosphate-1-dehydrogenase (G6PDH)	1	32.8	31.8	16.4	11.4	38.5
B - spot	Glucose-6-phosphate-1-dehydrogenase (G6PDH)	1	7.3	10.3	3.7	3.2	9.2
P-	Glutamic acid	1	46.4	79.9	23.2	23.1	61.4
P-	Glutamine	1	12.1	22.0	6.1	6.3	16.3
S-	Glutathion peroxidase	1	7.2	21.7	3.6	5.7	11.7
P-	Glycine	1	11.8	40.3	5.9	10.5	20.2
P-	Haptoglobin	1	20.0	27.9	10.0	8.6	25.1
S-	Haptoglobin	3	20.4	36.4	10.2	10.4	27.3
S-	HDL cholesterol	25	7.3	21.2	3.65	5.61	11.63
S-	HDL 1 cholesterol	1	5.5	27.2	2.8	6.9	11.5
S-	HDL 2 cholesterol	6	15.7	40.7	7.9	10.9	23.9
S-	HDL 3 cholesterol	6	7.0	14.3	3.5	4.0	9.8
B-	Hematocrit	11	2.7	6.41	1.35	1.74	3.97
B-	Hemoglobin	13	2.85	6.8	1.43	1.84	4.19
B-	Hemoglobin A1 C	8	1.9	5.7	0.9	1.5	3.0
B-	Hemoglobin A2	1	0.7	7.7	0.35	1.93	2.51
P-	Histidine	1	9.7	27.2	4.9	7.2	15.2
P-	Homocysteine	3	8.3	33.5	4.15	8.63	15.48
S-	Hyaluronic acid	1	62.00	---	31.00	---	---
S-	Hydroxybutyrate dehydrogenase	1	6.6	---	3.3	---	---
P-	Hydroxyproline	1	34.5	56.7	17.3	16.6	45.1
U-	Hydroxyproline/minute, first morning	1	36.1	38.8	18.1	13.2	43.0
U-	Hydroxyproline/minute, second void	1	40.5	32.9	20.3	13.0	46.5

[Back to top](#)

	Analyte	Number of papers	Biological Variation		Desirable specification		
			CV <sub>I</sub>	CV <sub>g</sub>	I(%)	B(%)	TE(%)
S-	Immunoglobulin A	7	5.4	35.9	2.7	9.1	13.5
S-	Immunoglobulin G	6	4.5	16.5	2.3	4.3	8.0
S-	Immunoglobulin M	5	5.9	47.3	3.0	11.9	16.8
S-	Immunoglobulins $\kappa$ chains	3	4.8	15.3	2.4	4.0	8.0
S-	Immunoglobulins $\lambda$ chains	3	4.8	18.0	2.4	4.7	8.6
S-	Inhibin B	1	10.0	25.0	5	6.73	14.98
S-	Insulin	4	21.1	58.3	10.6	15.5	32.9
S-	Insulin-like growth factor (IGF-1)	2	14.6	45.4	7.3	11.9	24.0
S-	Insulin-like growth factor binding protein 3 (IGFBP-3)	1	10.1	63.9	5.1	16.2	24.5

		3)						
S-	Intercellular adhesion molecule-1 (ICAM-1)	1	1.9	21.0	1.0	5.3	6.8	
(B)Leuc-	Interferon receptor	1	14.0	20.0	7.0	6.1	17.7	
S-	Interleukin 1-β	1	30.0	36.0	15.0	11.7	36.5	
S-	Interleukin-8	1	24.0	31.0	12.0	9.8	29.6	
S-	Iron	11	26.5	23.2	13.3	8.8	30.7	
P-	Isoleucine	1	15.5	45.5	7.8	12.0	24.8	
S-	Kallicrein 6	1	11.80	27.6	5.9	7.5	17.24	
B-	Lactate	1	27.2	16.7	13.6	8.0	30.4	
S-	Lactate dehydrogenase (LDH)	11	8.6	14.7	4.3	4.3	11.4	
S-	Lactate dehydrogenase 1 isoform (LDH1)	2	2.3	8.3	1.2	2.2	4.1	
S-	Lactate dehydrogenase 2 isoform (LDH2)	1	3.3	2.4	1.7	1.0	3.7	
S-	Lactate dehydrogenase 3 isoform (LDH3)	1	2.8	3.8	1.4	1.2	3.5	
S-	Lactate dehydrogenase 4 isoform (LDH4)	1	5.9	5.3	3.0	2.0	6.9	
S-	Lactate dehydrogenase 5 isoform (LDH5)	1	8.0	9.6	4.0	3.1	9.7	
P-	Lactoferrin	1	11.8	23.7	5.9	6.6	16.4	
S-	LDL Cholesterol	6	7.8	20.4	3.9	5.46	11.9	
P-	LDL Cholesterol (oxidized)	1	21.0	50.0	10.5	13.6	30.9	
S-	LDL Cholesterol, small dense	1	9.1	20.0	4.55	5.49	13.0	
S-	LDL receptor mRNA	1	21.5	13.6	10.8	6.4	24.1	
P-	Leucine	1	14.8	44.0	7.4	11.6	23.8	
B-	Leukocytes count	8	11.4	21.3	5.73	6.05	15.49	
S-	Lipase	3	32.2	31.8	16.1	11.31	37.88	
S-	Lipoprotein (a)	3	20.8	18.1	10.4	6.9	24.1	
P-	Lutein	1	13.0	21.0	6.5	6.2	16.9	
S-	Lutein	1	23.7	---	11.9	---	---	
S-	Luteinizing hormone (LH)	5	23.0	27.4	11.5	8.94	27.92	
P-	Lycopene	1	22.0	33.0	11.0	9.9	28.1	
S-	Lycopene	2	40.1	33.0	20.1	13.0	---	
B-	Lymphocytes, count	1	10.2	35.3	5.1	9.19	17.6	
B-	Lymphocytes CD4	5	25.0	---	12.5	---	---	
P-	Lysine	1	11.5	38.2	5.8	10.0	19.5	

[Back to top](#)

	Analyte	Number of Papers	Biological Variation		Desirable specification		
			CV <sub>I</sub>	CV <sub>G</sub>	I(%)	B(%)	TE(%)
(B)Erythr-	Magnesium	2	5.6	11.3	2.8	3.2	7.8
(B)Leuc-	Magnesium	1	18.5	12.4	9.25	5.57	20.83
(B)Mon -	Magnesium	1	18.1	20.3	9.1	6.8	21.7
S-	Magnesium	9	3.6	6.4	1.8	1.8	4.8
U-	Magnesium, ionized	1	1.9	5.1	1.0	1.4	2.9
U-	Magnesium, output, 24h	2	38.3	37.6	19.2	13.4	45.0
(B)Erythr-	Mean corpuscular hemoglobin (MCH)	4	1.4	5.2	0.7	1.35	2.5
(B)Erythr-	Mean corpuscular hemoglobin concentration (MCHC)	5	1.06	1.2	0.53	0.4	1.27
(B)Erythr-	Mean corpuscular volume (MCV)	7	1.4	4.85	0.7	1.26	2.42
(B)Plat-	Mean platelet volume (MPV)	3	4.3	8.1	2.15	2.29	5.84
P-	Metionine	1	14.7	43.4	7.4	11.5	23.6
B-	Monocytes, count	3	17.8	49.8	8.9	13.2	27.9
S-	Myeloperoxidase	1	36.0	30.0	18.0	11.7	41.4
S-	Myoglobin	2	12.0	20.0	7.0	6.1	17.7

S-	Myoglobin	2	13.9	29.6	7.0	8.2	19.6
U-	N-Acetyl Glucosaminidase, concentration, first morning	2	52.9	22.0	26.5	14.3	58.0
U-	N-Acetyl Glucosaminidase/Creatinine	2	51.1	21.8	25.6	13.9	56.0
B-	Neutrophiles, count	5	17.1	32.8	8.55	9.25	23.35
U-	Nitrogen, output	1	13.9	24.2	7.0	7.0	18.4
B(Plat)-	Norepinephrine	1	9.5	---	4.8	---	---
P-	Norepinephrine	1	19.5	---	9.8	---	---
U-	N-Telopeptide type I collagen	3	15.5	37.6	7.75	10.17	22.95
S-	N-terminal (NT)-proBNP	2	10.0	16.0	5.0	4.7	13.0
P-	Ornithine	1	18.4	54.9	9.2	14.5	29.7
P-	Osmolality	1	1.3	1.5	0.7	0.5	1.6
Saliva-	Osmolality	1	9.5	35.8	4.8	9.3	17.1
S-	Osmolality	1	1.3	1.2	0.7	0.4	1.5
U-	Osmolality, first morning	1	28.3	57.9	14.2	16.1	39.5
S-	Osteocalcin	5	6.35	30.9	3.18	7.89	13.13
U-	Oxalate, concentration, 24h	1	44.0	18.0	22.0	11.9	48.2
U-	Oxalate, output, 24h	1	42.5	19.9	21.3	11.7	46.8

[Back to top](#)

	Analyte	Number of papers	Biological Variation		Desirable specification		
			CV <sub>I</sub>	CV <sub>G</sub>	I(%)	B(%)	TE(%)
B-	pCO2	1	4.8	5.3	2.4	1.8	5.7
B-	pH [H <sup>+</sup> ]	1	3.5	2.0	1.8	1.0	3.9
B-	pH (pH units)	1	0.2	---	0.1	---	---
S-	Paraoxonase 1	1	13.4	84.0	6.7	21.3	32.3
S-	Paraoxonase 1 substrate inhibition (PON 4SI)	1	3.9	80.1	1.9	20.0	23.2
S-	Paraoxonase, activity (salt stimulated)	1	8.0	86.4	4.0	21.7	28.3
P-	Parathyroid hormone (PTH)	1	25.3	43.4	12.65	12.56	33.43
S-	Parathyroid hormone (PTH)	1	25.9	23.8	13.0	8.8	30.2
S-	Phenylacetate	1	6.6	25.2	3.3	6.5	12.0
P-	Phenylalanine	1	9.5	40.6	4.8	10.4	18.3
S-	Phosphate	17	8.15	10.8	4.08	3.38	10.11
U-	Phosphate, output, 24h	5	18.0	22.6	9.0	7.2	22.1
Patient-	Phosphate tubular reabsorption	1	2.7	3.3	1.4	1.1	3.3
S-	Phospholipids	1	6.5	11.1	3.3	3.2	8.6
P-	Plasminogen	1	7.7	---	3.9	---	---
B-	Platelets, count	7	9.1	21.9	4.6	5.9	13.4
B-	Platelet distribution wide	2	2.8	---	1.4	---	---
B-	Plateletcrit	2	11.9	---	6.0	---	---
U-	Porphobilinogen	1	17.0	31.0	8.5	8.8	22.9
U-	Porphyrins (total)	1	40.0	---	20.0	---	---
(B)Leuc-	Potassium	1	13.6	13.4	6.8	4.8	16.0
S-	Potassium	20	4.6	5.6	2.3	1.81	5.61
U-	Potassium, output	4	24.4	22.2	12.2	8.2	28.4
S-	Prealbumin	1	10.9	19.1	5.5	5.5	14.5
S-	Pregnancy-associated plasma protein A (PAPP-A)	1	12.6	14.0	6.3	4.71	15.1
P-	Prolactin	1	39.2	65.1	19.6	19.0	51.34
S-	Prolactin	4	23.0	35.0	11.5	10.5	29.4
P-	Proline	1	17.0	104.4	8.5	26.4	40.5
P-	Prolyl endopeptidase	2	16.8	13.9	8.4	5.5	19.3
S-	Properdin factor B	1	9.5	11.2	4.7	3.7	11.5
S-	Prostatic specific antigen (PSA)	3	18.1	72.4	9.1	18.7	33.6
S-	Protein	18	2.75	4.7	1.38	1.36	3.63

S-	Protein, glycated	1	0.9	11.6	0.5	2.9	3.7
U-	Protein, output, 24h	2	35.5	23.7	17.8	10.7	40.0
P-	Prothrombin time	2	4.0	6.8	2.0	2.0	5.3
U-	Pyridinoline	1	19.4	23.6	9.7	7.6	23.6
B-	Pyruvate	1	15.2	13.0	7.6	5.0	17.5
S-	Receptor for advanced glycation end-products (RAGE)	1	14.6	56.5	7.3	14.59	26.63
B-	Red cell distribution wide (RDW)	4	3.5	5.7	1.8	1.7	4.6
B-	Reticulocyte highly fluorescent, count	1	10.0	62.0	5.0	15.7	24.0
B-	Reticulocyte low fluorescent, count	1	1.6	4.9	0.8	1.3	2.6
B-	Reticulocyte medium fluorescent, count	1	13.0	33.0	6.5	8.9	19.6
B-	Reticulocyte, count	1	11.0	29.0	5.5	7.8	16.8
P-	Retinol	1	6.2	21.0	3.1	5.5	10.6
S-	Retinol	2	13.6	19.0	6.8	5.8	17.1
S-	Rheumatoid factor	1	8.5	24.5	4.3	6.5	13.5

[Back to top](#)

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	Analyte	Number of papers	Biological Variation		Desirable specification		
			CV <sub>I</sub>	CV <sub>g</sub>	I(%)	B(%)	TE(%)
S-	SCC antigen	1	39.4	35.7	19.7	13.3	45.8
P-	S Protein	1	5.8	63.4	2.9	15.9	20.7
P-	Selenium	1	12.0	14.0	6.0	4.6	14.5
B-	Selenium	1	12.0	12.0	6.0	4.2	14.1
P-	Serine	1	12.8	42.8	6.4	11.2	21.7
S-	Sex hormone binding globulin (SHBG)	2	13.05	36.35	6.53	9.66	20.42
(B)Erythr-	Sodium	1	1.8	12.4	0.9	3.1	4.6
(B)Leuc-	Sodium	1	51.0	36.4	25.5	15.7	57.7
S-	Sodium	21	0.6	0.7	0.3	0.23	0.73
B-	Sodium Bicarbonate	1	4.0	4.8	2.0	1.6	4.9
S-	Sodium Bicarbonate	7	4.8	4.7	2.4	1.7	5.6
Sweat-	Sodium Chloride	1	15.0	25.0	7.5	7.3	19.7
U-	Sodium, output, 24 h.	4	28.7	16.7	14.4	8.3	32.0
P-	Soluble CD163	1	9.0	35.9	4.5	9.3	16.7
U-	Specific gravity	1	0.4	1.0	0.2	0.27	0.60
Semen-	Spermatozoa, concentration	1	26.8	56.4	13.4	15.6	37.7
Semen-	Spermatozoa, morphology	1	19.6	44.0	9.8	12.0	28.2
Semen-	Spermatozoa, progressive motility	1	15.2	32.8	7.6	9.0	21.6
Semen-	Spermatozoa, fast progressive motility	1	18.8	51.8	9.4	13.8	29.3
Semen-	Spermatozoa, total motility	1	18.4	29.8	9.2	8.8	23.9
Semen-	Spermatozoa, vitality	1	10.3	25.8	5.2	6.9	15.4
S-	Superoxide dismutase	1	17.1	10.5	8.6	5.0	19.1
(B)Erythr-	Superoxide dismutase	1	12.3	4.9	6.2	3.3	13.5
P-	Taurine	1	30.6	44.0	15.3	13.4	38.6
P-	Testosterone	1	12.6	40.80	6.3	10.68	21.07
S-	Testosterone	7	9.25	22.05	4.63	5.98	13.61
Saliva-	Testosterone	1	17.3	28.8	8.7	8.4	22.7
U-	Testosterone	1	25.0	---	12.5	---	---
S-	Testosterone, free	3	9.3	---	4.7	---	---
U-	Testosterone, free	1	51.7	---	25.9	---	---
S-	Thyroglobulin	2	14.0	39.0	7.0	10.4	21.9
S-	Thyroalobulin antibody	1	8.5	82.0	4.3	20.6	27.6



S-	Thyroid peroxidase antibody	1	11.3	147.0	5.7	36.9	46.2
P-	Thyroid stimulating hormone (TSH)	1	29.30	48.4	14.65	14.14	38.2
S-	Thyroid stimulating hormone (TSH)	9	19.3	24.6	9.7	7.8	23.7
S-	Thyrotropin receptor antibody	1	4.8	---	2.4	---	---
S-	Thyroxine (T4)	11	4.9	10.9	2.5	3.0	7.0
P-	Thyroxine, free (FT4)	1	7.1	9.1	3.55	2.89	8.74
S-	Thyroxine, free (FT4)	5	5.7	12.1	2.9	3.3	8.0
S-	Thyroxine binding globulin (TBG)	2	0.09	0.06	0.0	0.0	0.1
P-	Tirosine	1	10.5	61.0	5.3	15.5	24.1
S-	Tissue polypeptide antigen (TPA)	1	31.1	63.7	15.6	17.7	43.4
S-	Tissue polypeptide specific antigen (TPS)	1	36.1	108.0	18.1	28.5	58.3
U-	Total catecholamines, concentration, 24h	1	24.0	32.0	12.0	10.0	29.8
S-	Transferrin	5	3.0	4.3	1.5	1.3	3.8
P-	Treonine	1	17.9	33.1	9.0	9.4	24.2
S-	Triglyceride	31	19.9	32.7	9.95	9.57	25.99
P-	Triiodothyronine (T3)	1	9.4	18.5	4.7	5.19	12.94
S-	Triiodothyronine (T3)	10	6.9	12.3	3.45	3.53	9.22
S-	Triiodothyronine, free (FT3)	4	7.9	17.6	4.0	4.8	11.3
P-	Troponin I	1	37.1	179.2	18.55	45.75	76.36
S-	Troponin I	5	14.05	63.75	7.03	16.32	27.91
S-	Troponin T	1	30.5	90.0	15.3	23.7	48.9
P-	Tryptophan	1	22.7	152.6	11.4	38.6	57.3
S-	Tumor Necrosis Factor- $\alpha$ (TNF- $\alpha$ )	1	43.0	29.0	21.5	13.0	48.4
S-	Urate	16	8.6	17.5	4.3	4.87	11.97
U-	Urate, output, 24h	2	16.8	14.4	8.4	5.53	19.39
S-	Urea	20	12.1	18.7	6.05	5.57	15.55
U-	Urea, output, 24h	4	17.4	25.4	8.7	7.7	22.1
P-	Valine	1	10.6	40.1	5.3	10.4	19.1
U-	Vanilmandelic Acid concentration, 24h	1	22.2	47.0	11.1	13.0	31.3
S-	Vascular cell adhesion molecule-1 (VCAM-1)	1	5.2	16.0	2.6	4.2	8.5
P-	Vascular endothelial growth factor	1	14.1	18.1	7.1	5.7	17.4
B-	Vascular endothelial growth factor	1	14.3	28.8	7.2	8.0	19.8
S-	Vascular endothelial growth factor	1	10.7	47.6	5.4	12.2	21.0
P-	Vitamin B1	1	4.8	12.0	2.4	3.2	7.2
B-	Vitamin B2 (Riboflavin)	1	5.8	10.0	2.9	2.9	7.7
(B)Eryth-	Vitamin B2 (Riboflavin)	1	6.4	11.0	3.2	3.2	8.5
(B)Eryth-	Vitamin B2 status (glutathion reductase activation)	1	5.2	40.0	2.6	10.1	14.4
(B)Eryth-	Vitamin B12	1	15.0	69.0	7.5	17.7	30.0
(B)Eryth-	Vitamin B6	1	14.0	24.0	7.0	6.9	18.5
B-	Vitamin B6	1	20.0	34.0	10.0	9.9	26.4
(B)Eryth-	Vitamin E (Tocopherol)	1	7.6	21.0	3.8	5.6	11.9
(B)Eryth-	Vitamin K (Phylloquinone)	1	38.0	44.0	19.0	14.5	45.9
S-	VLDL Cholesterol	2	27.6	---	13.8	---	---
P-	Von Willebrand factor	3	2.5	27.3	1.3	6.9	8.9
S-	Water	1	3.1	0.1	1.6	0.8	3.3
S-	Zeaxanthine	1	34.7	---	17.4	---	---

	Exam	1	2	3	4	5	6
S-	Zinc	1	9.3	9.4	4.7	3.3	11.0
P-	Zinc	3	11.0	14.0	5.5	4.5	13.5

[Back to top](#)

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