













MAKMAL PATOLOGI KIMIA, JABATAN PATOLOGI, HSAJB
 SENARAI REFERENCE RANGE (DISEMAK DAN DIKEMASKINI PADA 1 MAC 2017)








Notes:






	NEW Reference range AND unit
	NEW Reference range
	No changes from previous reference range





SECTION A: GENERAL CHEMISTRY						
Note: Requests for all tests within the same section and using the same type of sample container may be send with one(1) request form and one(1) blood container (adult) .						
Tests	Standard			Method	New Reference Range (Patients Result PDF)	Old reference range
	Sample type	Container				
Alanine Aminotransferase (ALT)	Blood	Lithium heparin (Green Cap)		IFCC modification (without pyridoxal phosphate activation)	Newborn to 12 m: 13-45 U/L 12m-60yr,M: 10-40 U/L 12m-60yr,F: 7-35 U/L 60-90yr,M:13-40 U/L 60-90yr,F:10-28 U/L >90yr,M: 6-38 U/L >90yr,F: 5-24 U/L	0-40 U/L
Albumin	Blood	Lithium heparin (Green Cap)		colorimetric, bromcresol green (BCG)	1) Adult: 18-39 yr: 35-52 g/L 60-69yr: 32-46 g/L >90 yr: 29-45 g/L 2) Children: 0-4d: 28 - 44 g/L 5d-14yr: 38 - 54 g/L 15-18yr: 32-45g/L	30-52 g/L





Alkaline Phosphatase (ALP)	Blood	Lithium heparin (Green Cap)		colorimetric, IFCC method	<p>1) Adult Male: 40-129 U/L Female: 35-104 U/L</p> <p>2) Children/adolescents: <1 yr: <390 U/L 1-3 yr <409 U/L 4-6 yr: <347 U/L 7-12 yr female: <312 U/L 7-12 yr male: <316 U/L 13-17 yr female: <329 U/L 13-17 yr male: <381 U/L</p>	Adult : 35-129 U/L Children : <390 U/L
Ammonia (NH ₃)	Blood	(K ₂ -EDTA/purple cap) Note: Send sample in ice		enzymatic method with glutamate dehydrogenase	<p>Male : 16-60 µmol/l Female: 11-51 µmol/l</p>	10.0-70.0 umol/l
Amylase	Blood	Lithium heparin (Green Cap)		enzymatic colorimetric. IFCC based-EPS.	28-100 U/L	0-120 U/L
Aspartate Aminotransferase (AST)	Blood	Lithium heparin (Green Cap)		IFCC modification (without pyridoxal phosphate activation)	<p>0 - 10 days : 47 - 150 10 days - 24 month: 9 - 80 2 - 60 yr, M: 15 - 40 2 - 60 yr, F: 13 -35 60-90 yr, M: 19 - 48 60-90yr, F: 9 -36 >90 yr, M: 11-38 >90yr, F: 18 - 30</p>	16-40 U/L
Bilirubin, direct	Blood	Lithium heparin (Green Cap)		Diazo method, doumas standardization	<p>1) Adult: ≤3.4 µmol/L 2) Neonates: ≤10 µmol/L</p>	0-6 µmol/L
Bilirubin, indirect	Blood	Lithium heparin (Green Cap)		calculated value Indirect bilirubin = Total bilirubin - direct bilirubin	(calculated parameter,reference range is not reported)	3-23.0 µmol/L

Bilirubin, total	Blood	Lithium heparin (Green Cap)		colorimetric diazomethod	<p>1) Adults: $\leq 21 \mu\text{mol/L}$</p> <p>2) Newborns, children</p> <p>1 day: $<150 \mu\text{mol/L}$</p> <p>2 day: $<193 \mu\text{mol/L}$</p> <p>3 days: $<217 \mu\text{mol/L}$</p> <p>4 days: $<216 \mu\text{mol/L}$</p> <p>≥ 5 days: $5 - 21 \mu\text{mol/L}$</p>	0.0-25 $\mu\text{mol/L}$
Calcium	Blood	Lithium heparin (Green Cap)		5-nitro-5'methyl-BAPTA (NM BAPTA)	<p>1) Adults:</p> <p>18-60yrs: 2.15-2.50 mmol/L</p> <p>60-90 yrs: 2.20 - 2.55 mmol/L</p> <p>>90 yrs: 2.05 - 2.40 mmol/L</p> <p>2) Children:</p> <p>0-10 days: 1.90-2.60 mmol/L</p> <p>10 days-2 yrs: 2.25-2.75 mmol/L</p> <p>2-12 years: 2.20-2.70 mmol/L</p> <p>12yr-18yr: 2.10-2.55 mmol/L</p>	2.05-2.50 mmol/L
Calcium corrected	Blood	Lithium heparin (Green Cap)		<p>calculated value</p> <p>corrected calcium (mmol/L) = calcium measured (mmol/L) + 0.02x {40-albumin (g/L)}</p> <p>or</p> <p>corrected calcium (mmol/L) = calcium measured (mmol/L) - 0.02x {(albumin (g/L) -45)}</p>	same as calcium	2.05-2.50 mmol/L
Chloride	Blood	Lithium heparin (Green Cap)		ISE indirect	98-107 mmol/L	98-108 mmol/L
Cholestrol HDL	Blood	Lithium heparin (Green Cap)		Homogenous enzymatic colorimetric Cholesterol esterase and cholesterol oxidase with PEG	<p>$<1.0 \text{ mmol/L}$: Low (Major risk factor for CVD)</p> <p>$\geq 1.6 \text{ mmol/L}$: High (Negative risk factor for CVD)</p> <p>(Malaysian CPG, Management of Dyslipidemia, 2011; from ATP III/NCEP)</p>	0.8-1.2 mmol/L









Cholesterol LDL	Blood	Lithium heparin (Green Cap)		<p>Calculated value (Friedwald's equation) $LDL-C = TC - HDL-C - TG/2.2$</p> <p>Note: LDL-C calculation is not valid when $TG > 4.5$ mmol/L</p>	<p><2.6 mmol/L : optimal 2.6 - 3.3 mmol/L : near optimal 3.4 - 4.1 mmol/L : borderline high 4.1 - 4.9 mmol/L : high > 4.9 mmol/L: very high</p> <p>(Malaysian CPG, Management of Dyslipidemia, 2011; from ATP III/NCEP)</p>	0-3.9 mmol/L
Cholesterol Non-HDL	Blood	Lithium heparin (Green Cap)		<p>Calculated value Non HDL-C = Total-C - HDL-C</p>	<p>Target non-HDL-C level: CHD and CHD-risk equivalent patient: <3.4 mmol/L Patients with multiple risk factors: <4.1 mmol/L Patients with 0-1 risk factor: <4.9 mmol/L</p> <p>(Malaysian CPG, Management of Dyslipidemia, 2011; from ATP III/NCEP)</p>	Not available
Cholesterol Total	Blood	Lithium heparin (Green Cap)		<p>enzymatic colorimetric Cholesterol esterase</p>	<p><5.2 mmol/L : desirable 5.2 - 6.2 mmol/L : borderline high ≥ 6.2 mmol/L : high</p> <p>(Malaysian CPG, Management of Dyslipidemia, 2011; from ATP III/NCEP)</p>	3.6-5.2 mmol/L
Cholinesterase	Blood	Lithium heparin (Green Cap)		Butyrylthiocholine	5320-12920 U/L	5.4-13.2 KU/L
Complement C3c	Blood	Lithium heparin (Green Cap)		Immunoturbidimetric assay	0.9-1.8 g/L	0.9-1.8 g/L
Complement C4	Blood	Lithium heparin (Green Cap)		Immunoturbidimetric assay	0.1-0.4 g/L	0.1-0.4 g/L
C-reactive protein	Blood	Lithium heparin (Green Cap)		Particle enhanced immunoturbidimetric assay	<p>1) Adult: <5 mg/L</p> <p>2) Children; <3wk : 4.1 mg/L 2mths-15 yrs: 2.8 mg/L</p>	<p>Adults : <5 mg/L Newborns: 0 day: < 0.6 mg/L 1 day: < 3.2 mg/L 1 week: < 1.6 mg/L</p>



Creatine Kinase (CK)	Blood	Lithium heparin (Green Cap)		IFCC modification (NAC activator/Imidazole buffer)	Male: 39 - 308 U/L Female: 26 - 192 U/L	45-235 U/L
Creatinine	Blood	Lithium heparin (Green Cap)		Jaffe, rate blanking	1) Adult Male : 62-106 µmol/L Female : 44-80 µmol/L 2) Children neonates (full term): 21 - 75 µmol/L 2 - 12 m : 15 - 37 µmol/L 1-<3 yr : 21 - 36 µmol/L 3 - <5yr : 27 -42 µmol/L 5 - <7yr : 28 -52 µmol/L 7 - <9 yr : 35 - 53 µmol/L 9 - <11yr: 34 -65 µmol/L 11- <13 yr : 46 - 70 µmol/L 13- < 15y : 50 -77 µmol/L	Male : 62-160 Female:44-80 µmol/L
Gamma-Glutamyl transferase, GGT	Blood	Lithium heparin (Green Cap)		Modified Szasz methods γ-glutamyl-3-carboxy-4-nitroanilide	Male: 8-61 U/L Female: 5-36 U/L	0-50 U/L
Globulin	Blood	Lithium heparin (Green Cap)		calculated value Globulin= Total protein - albumin	Calculated parameter Reference range is not reported	19-36 g/L
Glucose, Random	Blood	Na-F/K-Oxalate (Gray cap)		Hexokinase	Random Glucose: < 4 mmol/L : hypoglycemia 4 - 7.7 mmol/L : normal ≥ 11.1 : Diabetes Mellitus (if symptomatic) (Malaysian CPG 2015, Management of type 2 DM)	3.6 -6.1 mmol/L

Glucose, Fasting	Blood	Na-F/K-Oxalate (Gray cap)		Hexokinase	<p>Fasting Glucose: < 4 mmol/L: hypoglycemia 4 - 6.0 mmol/L : normal 6.1 - 6.9: Impaired Fasting Glucose ≥ 7.0 : Diabetes Mellitus</p> <p>Pregnant women: ≥ 5.1 mmol/L : Gestational Diabetes Mellitus</p> <p>(Malaysian CPG 2015, Management of type 2 DM)</p>	3.6 -6.1 mmol/L
Glucose, Pre Breakfast/Pre Lunch/Pre Dinner	Blood	Na-F/K-Oxalate (Gray cap)		Hexokinase	<p>Target pre prandial glucose: 4.4 - 7.0 mmol/L</p> <p>Target pre-prandial glucose (pregnant women): ≤5.3 mmol/L</p> <p>(Malaysian CPG 2015, Management of type 2 DM)</p>	3.6 -6.1 mmol/L
Glucose, Post Breakfast/Post Lunch/Post Dinner	Blood	Na-F/K-Oxalate (Gray cap)		Hexokinase	<p>Target post prandial glucose : 4.4 - 8.5 mmol/L</p> <p>Target post prandial glucose (pregnant women): 1 hour post prandial: ≤ 7.8 mmol/L 2 hours post prandial: ≤ 6.7 mmol/L</p> <p>(Malaysian CPG 2015, Management of type 2 DM)</p>	3.6 -6.1 mmol/L
Glucose, Post OGTT, Post mOGTT	Blood	Na-F/K-Oxalate (Gray cap)		Hexokinase	<p>Glucose 2 hours post OGTT: <7.8 mmol/L: Normal 7.8 - 11.0 mmol/L: Impaired Glucose Tolerance ≥ 11.1 mmol/L: Diabetes Mellitus</p> <p>Glucose 2 hours post mOGTT: ≥7.8 mmol/L: Gestational Diabetes Mellitus</p> <p>(Malaysian CPG 2015, Management of type 2 DM)</p>	3.6 -6.1 mmol/L

Immunoglobulin A, IgA	Blood	Lithium heparin (Green Cap)		Immunoturbidimetric assay	<p>1) Adult 0.7-4 g/L</p> <p>2) Children 0 - 1 yr: 0.00 - 0.83 g/L 1- 3 yrs : 0.20 - 1.00 g/L 4 - 6 yrs: 0.27 - 1.95 g/L 7 - 9 yrs : 0.34 - 3.05 g/L 10 - 11 yrs: 0.53 - 2.04 g/L 12-13 yrs: 0.58 - 3.58 g/L 14 - 15 yrs: 0.47 - 2.49 g/L 16 - 19 yrs: 0.61 - 3.48 g/L</p>	0.7-4 g/L
Immunoglobulin G, IgG	Blood	Lithium heparin (Green Cap)		Immunoturbidimetric assay	<p>1) Adult 7 - 16 g/L</p> <p>2) Children 0 - 1 yr: 2.32 - 14.11 g/L 1- 3 yrs : 4.53 - 9.16 g/L 4 - 6 yrs: 5.04 - 14.65 g/L 7 - 9 yrs : 5.72 - 14.74 g/L 10 - 11 yrs: 6.89 - 15.60 g/L 12-13 yrs: 7.59 - 15.50 g/L 14 - 15 yrs: 7.16 - 17.11 g/L 16 - 19 yrs: 5.49 - 15.84 g/L</p>	7-16 g/L
Immunoglobulin M, IgM	Blood	Lithium heparin (Green Cap)		Immunoturbidimetric assay	<p>1) Adult 0.4 - 2.3 g/L</p> <p>2) Children 0 - 1 yr: 0.00 - 1.45 g/L 1- 3 yrs : 0.19 - 1.46 g/L 4 - 6 yrs: 0.24 - 2.10 g/L 7 - 9 yrs : 0.31 - 2.08 g/L 10 - 11 yrs: 0.31 - 1.79 g/L 12-13 yrs: 0.35 - 2.39 g/L 14 - 15 yrs: 0.15 - 1.88 g/L 16 - 19 yrs: 0.23 - 2.59 g/L</p>	0.4-2.3 g/L
Iron	Blood	Lithium heparin (Green Cap)		Ferrozine method without deproteinization	5.83-34.5 µmol/L	8.8-29.9 µmol/L





Lactate	Blood	Na-F/K-Oxalate (Gray cap) Note: send sample in ice		Enzymatic-Lactate oxidase	0.5-2.2 mmol/L	tiada
Lactate Dehydrogenase (LDH)	Blood	Lithium heparin (Green Cap)		IFCC modification (rate reaction Lactate to pyruvate)	1) Adults: male: 135-225 U/L female: 135-214 U/L 2) Children < 1 yr: < 451 U/L 1 - 3 yrs: < 344 U/L 4 - 6 yr: < 314 U/L 7 - 12 yr: < 332 U/L 13 - 17 yrs: < 279 U/L	135-225 U/L
Magnesium	Blood	Lithium heparin (Green Cap)		colorimetric end point. Xylidyl blue in alkaline solution	1) Adult: 0.66-1.07 mmol/L 2) Children Newborn: 0.62 - 0.91 mmol/L 5 months - 6 years : 0.70 -0.95 mmol/L 6 - 12 yrs: 0.70 - 0.86 mmol/L 12 - 20 yrs: 0.70 - 0.91 mmol/L	0.60-1.20 mmol/L
Phosphate	Blood	Lithium heparin (Green Cap)		Phosphomolybdate formation	1) Adult: 0.81-1.45 mmol/L 2) Children: 1-30 d: 1.25 - 2.25 mmol/L 1 - 12 m: 1.15 - 2.15 mmol/L 1 - 3 yr: 1.00 - 1.95 mmol/L 4 - 6 yr: 1.05 - 1.80 mmol/L 7 - 9 yr: 0.95 - 1.75 mmol/L 10-12yr: 1.05 - 1.85 mmol/L 13-15yr: 0.95 - 1.65 mmol/L 16 - 18 yr: 0.85 - 1.60 mmol/L	0.60-1.50 mmol/L





Potassium	Blood	Lithium heparin (Green Cap)		ISE indirect	3.4 - 4.5 mmol/L (plasma) Note: serum sample (plain tube/bullet tube): 3.5 - 5.1 mmol/L	3.5-5.2 mmol/L
Rheumatoid Factors	Blood	Lithium heparin (Green Cap)		Immunoturbidimetric assay	<14 IU/mL	0-14 IU/mL
Sodium	Blood	Lithium heparin (Green Cap)		ISE indirect	136-145 mmol/L	130-145 mmol/L
Total Iron Binding Capacity, TIBC	Blood	Lithium heparin (Green Cap)		Calculated value TIBC = Total Iron + UIBC	(calculated parameter, reference range is not reported)	50-100 µmol/L
Total Protein	Blood	Lithium heparin (Green Cap)		biuret end point	1) Adult 64-83 g/L 2) Children Newborn: 46 - 70 g/L 1 week: 44 - 76 g/L 7 mths - 1 year: 51 - 73 g/L 1 - 2 yr: 56 - 75 g/L >3 yr: 64 - 83 g/L	58-83 g/L
Transferin saturation	Blood	Lithium heparin (Green Cap)		calculated value Transferin saturation = (total Iron / TIBC) x 100	16- 45%	tiada
Triglycerides	Blood	Lithium heparin (Green Cap)		Lipase/Glycerol Kinase/GPO-PAP	<1.7 mmol/L : normal 1.7 - 2.3 mmol/L : borderline high 2.3 - 5.7 : high ≥ 5.7 mmol/L : very high (Malaysian CPG, Management of Dyslipidemia, 2011; from ATP III/NCEP)	0.7-1.9 mmol/L
Unbound Iron Binding Capacity, UIBC	Blood	Lithium heparin (Green Cap)		Direct determination with FerroZine	Males: 22 - 62 µmol/L Females: 24 - 70 µmol/L	20-60 µmol/L


Urea	Blood	Lithium heparin (Green Cap)		Kinetic test with urease and glutamate dehydrogenase	2.8 - 8.1 mmol/L	1.0-7.5 mmol/l
Uric Acid	Blood	Lithium heparin (Green Cap)		Uricase/Peroxidase	Male: 202-417 µmol/L Female: 143 - 339 µmol/L	202-416 µmol/L




SECTION B: IMMUNOASSAY





Note:
Requests for all tests within the **same section** and using the **same type of sample container** may be send with **one(1) request form** and **one(1) blood container (adult)**.

Immunoassay Tests	Standard		Method	New Reference Range	Old reference range	
	Sample type	Container				
Alpha fetoprotein	Blood	Lithium heparin (Green Cap)		Electrochemiluminescence immunoassay, ECLIA, sandwich principle	≤ 7.0 ng/ml	0.0-7.0 ng/ml
Cancer antigen 125 (CA 125)	Blood	Lithium heparin (Green Cap)		Electrochemiluminescence immunoassay, ECLIA, sandwich principle	≤ 35 U/mL	0 - 35 U/mL
Carcinoembryonic antigen, CEA	Blood	Lithium heparin (Green Cap)		Electrochemiluminescence immunoassay, ECLIA, sandwich principle	≤ 4.7 ug/L	0-5.2ug/L
Cortisol	Blood	Lithium heparin (Green Cap)		Electrochemiluminescence immunoassay, ECLIA, competition principle	Morning (6-10am): 133-537 nmol/L Afternoon (4-8pm): 68 -327 nmol/L	Morning: 171-536 nmol/l Afternoon 64-327 nmol/L






Estradiol (E2)	Blood	Lithium heparin (Green Cap)		Electrochemiluminescence immunoassay, ECLIA, competition principle	Female Follicular phase: 98 - 571 pmol/L Ovulation phase: 177 - 1153 pmol/L Luteal phase: 122 - 1094 pmol/L Postmenopausal <18 - 183 pmol/L Male: 99 - 192 pmol/L	Female Follicular Phase : 46 - 607 pmol/L Ovulation Phase : 315 - 1828 pmol/L Luteal Phase : 161 - 774 pmol/L Post Menopausal : <18.4 - 201 pmol/L Male : 28 - 156 pmol/L
Folate	Blood	Lithium heparin (Green Cap)		Electrochemiluminescence immunoassay, ECLIA, competition principle	10.4 - 42.4 nmol/L	7.0-39.7 nmol/L
Follicle Stimulating Hormone (FSH)	Blood	Lithium heparin (Green Cap)		Electrochemiluminescence immunoassay, ECLIA, sandwich principle	Female: Follicular phase: 3.5 -12.5 IU/L Ovulation phase: 4.7 - 21.5 IU/L Luteal phase: 1.7 - 7.7 IU/L Postmenopausal: 25.8 - 134.8 IU/L Male: 1.5 - 12.4 IU/L	Female Follicular phase : 3.5-12.5 IU/L Ovulation Phase : 4.7-21.5 IU/L Luteal Phase : 1.7-7.7 IU/L Post menopausal : 25.8-134 IU/L Male ; 1.5-12.4IU/L
Free Thyroxine, FT4	Blood	Lithium heparin (Green Cap)		Electrochemiluminescence immunoassay, ECLIA, competition principle	1) Adult 12.0-22.0 pmol/L 2) Children: Newborn: 11.0 - 32.0 pmol/L 6day - 3 mths: 11.5 - 28.3 pmol/L 4 - 12 months: 11.9 - 25.6 pmol/L 1 - 6 yrs: 12.3 - 22.8 pmol/L 7 - 11 yrs: 12.5 - 21.5 pmol/L 12 - 20 yrs: 12.6 - 21.0 pmol/L Reference range in pregnancy available upon request.	12.0-22.0 pmol/L







Free Triiodothyronine, FT3	Blood	Lithium heparin (Green Cap)		Electrochemiluminescence immunoassay, ECLIA, competition principle	<p>1) Adult 3.1 - 6.8 pmol/L</p> <p>2) Children: Newborn: 2.65 - 9.68 pmol/L 6day - 3 mths: 3.00 - 9.28 pmol/L 4 - 12 months: 3.30 - 8.95 pmol/L 1 - 6 yrs: 3.69 - 8.46 pmol/L 7 - 11 yrs: 3.88 - 8.02 pmol/L 12 - 20 yrs: 3.93 - 7.70 pmol/L</p> <p>Reference range in pregnancy available upon request.</p>	3.1-6.8 pmol/L
Luteinizing hormone (LH)	Blood	Lithium heparin (Green Cap)		Electrochemiluminescence immunoassay, ECLIA, sandwich principle	<p>Female Follicular phase: 2.4 - 12.6 IU/L Ovulation phase: 14.0 - 95.6 IU/L Luteal phase: 1.0 - 11.4 IU/L Postmenopausal: 7.7 - 58.5</p> <p>Male: 1.7 - 8.6 IU/L</p>	<p>Female Follicular phase : 2.4-12.6 IU/L Mid Cycle Phase : 14.0-95.6 IU/L Luteal Phase : 1.0-11.4 IU/L Post menopausal : 7.7-58.5 IU/L</p> <p>Male : 1.7-8.6 IU/L</p>
Myoglobin	Blood	Lithium heparin (Green Cap)		Electrochemiluminescence immunoassay, ECLIA, sandwich principle	<p>Male: 28 - 72 ng/ml Female; 25 - 58 ng/ml</p>	25 - 75 ng/ml
Progesterone	Blood	Lithium heparin (Green Cap)		Electrochemiluminescence immunoassay, ECLIA, competition principle	<p>Female Follicular phase: 0.6 - 4.7 nmol/L Ovulation phase: 2.4 - 9.4 nmol/L Luteal phase: 5.3 - 8.6 nmol/L Postmenopausal: 0.3 - 2.5 nmol/L</p> <p>Male: 0.7 - 4.3 nmol/L</p>	<p>Female Follicular phase : 0.6-4.7 nmol/L Ovulation Phase : 2.4-9.4 nmol/L Luteal Phase : 5.3-8.6 nmol/L Post menopausal : 0.3-2.5 nmol/L</p> <p>Male : 0.7-4.3 nmol/L</p>
Prolactin	Blood	Lithium heparin (Green Cap)		Electrochemiluminescence immunoassay, ECLIA, sandwich principle	<p>Female, non-pregnant : 102-496 μU/ml Male : 86-324 μU/ml</p>	<p>Female, non-pregnant : 102-496mIU/L Male : 86-324 mIU/L</p>











Testosterone	Blood	Lithium heparin (Green Cap)		Electrochemiluminescence immunoassay, ECLIA, competition principle	<p>Men 20-49 years : 8.64-29.0 nmol/L ≥ 50 years : 6.68-25.7 nmol/L</p> <p>Female 20-49 years : 0.290-1.67 nmol/L ≥ 50 years : 0.101-1.42 nmol/L</p> <p>Reference values for males and females (7-18 yrs) characterized by Tanner Stage available upon request.</p>	Men : 9.9-27.8 nmol/L Female : 0.22-2.86 nmol/L
Thyroid Stimulating Hormone, TSH	Blood	Lithium heparin (Green Cap)		Electrochemiluminescence immunoassay, ECLIA, sandwich principle	<p>1) Adult: 0.27-4.2 mIU/L</p> <p>2) Children: Newborn: 0.70 - 15.2 mIU/L 6days-3 mths: 0.72 - 11.0 mIU/L 4-12 mths: 0.73 - 8.35 mIU/L 1-6 yrs: 0.7 - 5.97 mIU/L 7-11 yrs: 0.60 - 4.84 mIU/L 12-20 yrs: 0.51 - 4.30 mIU/L</p>	0.27-4.2 mIU/L
Thyroid Stimulating Hormone, TSH Cord blood	Blood	Lithium heparin (Green Cap)		Electrochemiluminescence immunoassay, ECLIA, sandwich principle	<p>Cord blood TSH: >60 mIU/L : High 21 - 60 mIU/L: Borderline < 21 mIU/L: Normal</p> <p>Cord blood Free T4: <15 pmol/L: Low</p> <p>(National Screening Programme For Congenital Hypothyroidism, MOH Malaysia, 2011)</p>	tiada

Total BHCG	Blood	Lithium heparin (Green Cap)		Electrochemiluminescence immunoassay, ECLIA, sandwich principle	<p>Women: Non pregnant, pre-menopausal: ≤ 1 mIU/ml Post menopausal: ≤ 7 mIU/ml</p> <p>Men: <2 mIU/mL</p> <p>Reference range of Total BHCG in pregnancy is available upon request.</p>	Female : Premenopause : 0-1.1 IU/L Postmenopause : 0-7.0 IU/L Pregnancy : >5.8 IU/L Men : 0-2.0 IU/L
Total Prostate Specific Antigen, Total PSA	Blood	Lithium heparin (Green Cap)		Electrochemiluminescence immunoassay, ECLIA, sandwich principle	≤ 4.0 ug/L Age Specific tPSA reference range available upon request.	0.003-4.1 ug/L
Troponin T (high sensitive)	Blood	Lithium heparin (Green Cap)		Electrochemiluminescence immunoassay, ECLIA, sandwich principle	<14ng/L (upper reference limit at 99th percentile)	cut off value 0.01 ng/ml
Vitamin B 12	Blood	Lithium heparin (Green Cap)		Electrochemiluminescence immunoassay, ECLIA, sandwich principle	145-569 pmol/L	145-637 pmol/L

SECTION C: MISCELLANEOUS



Miscellaneous Tests	Standard		Method	New Reference Range	Old Reference Range
	Sample type	Container			
HbA1c	Blood	(K2-EDTA/purple cap) 	HPLC	<p>HbA1c level for Diagnosis of Diabetes Mellitus: Normal: <5.6 % (38 mmol/mol) Pre-diabetes: 5.6 - 6.2% (38 - 44 mmol/mol) Diabetes: ≥6.3% (45 mmol/mol)</p> <p>HbA1c level for Monitoring of Diabetes Mellitus: *Target for control of DM: ≤6.5% (48 mmol/mol)</p> <p><i>*Other HbA1c target may be considered based on patients' profile.</i></p> <p>(Malaysian CPG, Management of type 2 Diabetes Mellitus, 5th edition, 2015)</p>	>8.0% Action suggested 7.0-8.0%: good control <7.0%:goal 6.0-7.0%: Near normal glycaemia <6.0: non diabetic level DCCT/NGSP
Plasma Osmolality	Blood	Lithium heparin (Green Cap) 	Freezing point depression	275 - 300 mOsm/kg	275 - 300 mOsm/kg
Urine Osmolality	Urine	Urine Container 	Freezing point depression	50 - 1400 mOsm/kg	50 - 1400 mOsm/kg
Arterial Blood Gas, ABG pH pO2 pCO2 HCO3 BE	Blood	Heparinized syringe with cap/ stopper (Send in ice) 	pH, pCO2: Potentiometric pO2: Amperometric HCO3, BE: Calculated	pH : 7.35 - 7.45 pCO2: 35 - 45 mmHg pO2: 80 - 100 mmHg HCO3: 22 - 26 mmol/L BE: -2 - +2	tiada
Venous Blood Gas, VBG pH pO2 pCO2 HCO3 BE	Blood	Heparinized syringe with cap/ stopper (Send in ice) 	pH, pCO2: Potentiometric pO2: Amperometric HCO3, BE: Calculated	pH: 7.32 - 7.43 pCO2: 41 - 50 mmHg pO2: 25 - 40 mmHg HCO3: 23 - 27 mmol/L	tiada

SECTION D: URINE TESTS						
Urine Tests	Standard			Method	New Reference Range	Old reference range
	Sample type	Container				
Urine albumin creatinine ratio (Urine microalbumin)	Random Urine	Urine Container		Immunoturbidimetric assay	Normal: <2.5 mg/mmol (Male) <3.5 mg/mmol (Female) Microalbuminuria: ≥ 2.5 - 30 mg/mmol (Male) ≥ 3.5 - 30 mg/mmol (Female) Macroalbuminuria: > 30 mg/mmol (Malaysian CPG, 2011 Management of CKD in adults)	Normal: <2.5 mg/mmol (male) <3.5 mg/mmol (female) Microalbuminuria: Male: ≥ 2.5 - 30 mg/mmol Female: ≥ 3.5 - 30 mg/mmol Macroalbuminuria: > 30 mg/mmol
24 hour urine albumin	24 Hr Urine Collection	24 Hour Urine Container		Immunoturbidimetric assay	Normal: <30 mg/24hr Microalbuminuria: 30 - 300 mg/24hr Macroalbuminuria: >300 mg/24hr (Malaysian CPG, 2011 Management of CKD in adults)	tiada
Urine Amylase	Random Urine	Urine Container		enzymatic colorimetric. IFCC based-EPS.	Men: 16 - 491 U/L Women: 21 - 447 U/L	0 - 1000 U/L
24 Hour Urine Calcium	24 Hr Urine Collection	24 Hour Urine Container		5-nitro-5'methyl-BAPTA (NM BAPTA)	2.5 - 7.5 mmol/24 Hr	2.5-8.0 mmol/24Hr
Urine Chloride	1st morning Urine	Urine Container		ISE indirect	1st morning urine: 46 - 168 mmol/L	20 - 371 mmol/L
24 Hour Urine Chloride	24 Hr Urine Collection	24 Hour Urine Container		ISE indirect	110 - 250 mmol/24h	tiada

Urine creatinine	1st morning Urine	Urine Container		Jaffe, rate blanking	1st morning urine Males: 3.45 - 22.90 mmol/L Females: 2.47 - 19.20 mmol/L	8 - 27 mmol/L
24 Hour urine creatinine	24 Hr Urine Collection	24 Hour Urine Container		Jaffe, rate blanking	Males: 9 - 21 mmol/24 h Females: 7 - 14 mmol/24 h	7.1 - 15.9 mmol/24Hr
24 Hour Creatinine Clearance	24 Hr Urine Collection AND Blood (sample taken during period of urine collection)	24 Hour Urine Container AND Li-heparin tube	 AND 	Calculated Creatinine Clearance (mL/min) = (U Creat x Vol x 16.7) / (Pl Creat x time) Urine creatinine concentrations in mmol/L Plasma creatinine concentration in umol/L Volume in mL Time in Hours	52 - 110 mL/min	1.2 - 2.0 ml/sec
24 Hour Urine Magnesium	24 Hr Urine Collection	24 Hour Urine Container		colorimetric end point. Xylidyl blue in alkaline solution	3.0 - 5.0 mmol/24 Hour	tiada
Urine phosphate	1st morning Urine	Urine Container		Phosphomolybdate formation	1st morning urine 13 - 44 mmol/L	tiada
24 Hour urine phosphate	24 Hr Urine Collection	24 Hour Urine Container		Phosphomolybdate formation	13 - 42 mmol/24 Hr	6.5 - 32 mmol/24 Hr
Urine potassium	1st morning Urine	Urine Container		ISE indirect	1st morning urine 20 - 80 mmol/L	11 - 145 mmol/L
24 hour urine potassium	24 Hr Urine Collection	24 Hour Urine Container		ISE indirect	25 - 125 mmol/24h	tiada
Urine sodium	1st morning Urine	Urine Container		ISE indirect	1st morning urine 54 - 190 mmol/L	15 - 301 mmol/L

24 hour urine sodium	24 Hr Urine Collection	24 Hour Urine Container		ISE indirect	40 - 220 mmol/24h	tiada
Urine Total Protein	Random Urine	Urine Container		Turbidimetric method Benzethonium chloride	<0.15 g/L	0.06 - 0.12 g/L
24 hour urine total protein	24 Hr Urine Collection	24 Hour Urine Container		Turbidimetric method Benzethonium chloride	<0.14 g/24h	<0.1 g/24Hr
Urine Protein Creatinine Ratio, (Urine PCR) Note: Urine PCR previously reported as urine PCI	Random Urine	Urine Container		Calculated Urine PCR = Urine protein (g/L) x1000 / Urine creatinine (mmol/L)	<15 mg/mmol (Malaysian CPG, 2011 Management of CKD in adults)	Previously reported as Urine PCI Formula Urine PCI = Urine protein (g/L) / Urine creatinine (mmol/L) x 0.001 Reference range: 0 - 29 g/mol
Urine urea	Random Urine	Urine Container		Kinetic test with urease and glutamate dehydrogenase	286 - 595 mmol/L	150 - 500 mmol/L
24 hour urine urea	24 Hr Urine Collection	24 Hour Urine Container		Kinetic test with urease and glutamate dehydrogenase	428 - 714 mmol/24h	tiada
Urine Uric Acid	Random Urine	Urine Container		Uricase/Peroxidase	1st morning urine: 2.2-5.5 mmol/L	2.2-5.5 mmol/L
24 hour Urine Uric Acid	24 Hr Urine Collection	24 Hour Urine Container		Uricase/Peroxidase	1.2-5.9 mmol/24h	0 - 1.2 mmol/24Hr
24 hour urine free cortisol	24 Hr Urine Collection	24 Hour Urine Container		Electrochemiluminescence immunoassay, ECLIA, competition principle	100 - 379 nmol/24hr	116-600 nmol/24 hour

SECTION D: CSF TESTS

Csf Tests	Standard		Method	New Reference Range	Old reference range
	Sample Type	Container			
CSF Glucose	CSF	Bijou bottle 	Hexokinase	2.2 - 3.9 mmol/L	2.5 - 5.6 mmol/L
CSF Protein	CSF	Bijou bottle 	Turbidimetric method Benzethonium chloride	0.15 - 0.45 g/L	0.15 - 0.45 g/L