| **ROUTINE CHEMISTRY - BLOOD REFERENCE RANGES** | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Test** | **Units** | **Age / Gender** | **Reference Range** | **Additional information** | **Range rationale / origin** |
| Acetaminophen (Paracetamol) | mg/L |  | NO RANGE |  | Pathology Harmony Jan 2011 |
| Albumin | g/L | 0 to 4 days | 28 - 44 |  |  |
| 4 days to 14 years | 38 - 54 |
| Adult | 35 - 50 |
| 60 - 90 years | 32 - 46 |
| >90 years | 29 - 45 |
| Alpha-fetoprotein (AFP) | kIU/L | All | < 7 |  |  |
| Alkaline Phosphatase (ALP) | U/L | < 4 weeks | 70 - 380 |  |  |
| > 4 weeks to 16 years | 60 - 425 |
| Adult | 30 - 130 | Pathology Harmony Jan 2011 |
| Alanine transaminase (ALT) | U/L | All | 0 - 55 |  |  |
| Alpha-1-Antitrypsin (a1AT) | g/L | All | 0.9 - 2.0 |  |  |
| Amikacin | mg/L | All | 4 – 8 (Trough) | Recommended sampling time: pre-dose |  |
| Amylase, total | U/L | 0 - 14 days | 3 - 10 |  | CALIPER study DOI: 10.1515/cclm-2021-0336 |
| 15 days < 13 weeks | 2 - 22 |
| 13 weeks - < 1 year | 3 - 50 |
| 1 year - 18 years | 25 -101 |
| Adult | 28 - 100 |  |
| Amylase, pancreatic | U/L | All | 8 - 51 |  | Abbott (G90710R02 November 2017) |
| Angiotensin converting enzyme (ACE) | U/L | All | 20 - 70 |  |  |
| Anion gap | mmol/L | All | 8 - 17 |  | Internal audit AUD438 |
| Apolipoprotein A1 | g/L | **0 to 1 year** |  |  |  |
| Male | 0.61 - 1.64 |  |
| Female | 0.59 - 1.69 |  |
| **> 1 to 12 years** |  |  |
| Male | 0.93 - 1.72 |  |
| Female | 0.86 - 1.79 |  |
| **> 12 to 60 years** |  |  |
| Male | 0.95 - 1.86 |  |
| Female | 1.01 - 2.23 |  |
| **> 60 years** |  |  |
| Male | 0.73 - 1.86 |  |
| Female | 0.91 - 2.24 |  |
| Apolipoprotein B | g/L | **0 to 1 year** |  |  |  |
| Male | 0.16 - 1.24 |  |
| Female | 0.17 - 1.20 |  |
| **> 1 to 12 years** |  |  |
| Male | 0.48 - 1.25 |  |
| Female | 0.51 - 1.26 |  |
| **> 12 to 60 years** |  |  |
| Male | 0.49 - 1.73 |  |
| Female | 0.53 - 1.82 |  |
| **> 60 years** |  |  |
| Male | 0.54 - 1.63 |  |
| Female | 0.64 - 1.82 |  |
| Aspartate transaminase (AST) | U/L | All | 5 - 34 |  |  |
| AST:ALT ratio | N/A |  | NO RANGE | AST:ALT ratio > 1.0 has 49 % sensitivity and 87 % specificity for predicting cirrhosis in liver disease (NHS HTA 2015) |  |
| AST to platelet ratio Index (APRI) | N/A |  | NO RANGE | APRI > 0.75 – 1.0 has 75 % sensitivity and 78 % specificity for predicting cirrhosis in liver disease (NHS HTA 2015) |  |
| B-hydroxybutyrate (BOHB) | mmol/L |  | NO RANGE | Interpreted in light of concurrent glucose result |  |
| Bicarbonate | mmol/L | 0 - 16 years | 19 - 28 |  |  |
| Adult | 22 - 29 |  | Pathology Harmony Jan 2011 |
| Bile Acids, total | µmol/L | All | 1.0 - 6.0 (Fasting) |  |  |
| Bilirubin, total | μmol/L | >14 days to Adult | < 21 |  | Pathology Harmony Jan 2011 |
| CA 125 | kIU/L | All | < 35 |  | NICE CG122 Ovarian cancer: recognition and initial management (2011) |
| CA 153 | kIU/L | All | < 31 |  |  |
| CA 199 | kIU/L | All | 0 - 37 |  | Steinberg W. The clinical utility of the CA 19-9 tumor-associated antigen. Am J Gastroenterol. 1990 Apr;85(4):350-5. |
| Caeruloplasmin | g/L | All | 0.2 - 0.6 |  |  |
| Adjusted calcium | mmol/L | < 4 weeks | 2.00 - 2.70 | Adjusted calcium not available if: -  Children < 4 weeks – ionised calcium preferred  Children >4 weeks and < 1 year with albumin < 30 g/L  Adults with albumin < 20 g/L |  |
| > 4 weeks to 16 years | 2.20 - 2.70 |  |
| Adult | 2.20 - 2.60 | Pathology Harmony Jan 2011 |
| Carbamazepine | mg/L | All | 4 – 12 (Trough) | Recommended sampling time: pre-dose | Pathology Harmony Jan 2011 and Patsalos et al 2008 |
| Carcinoembryonic antigen (CEA) | µg/L | > 20 years | < 5 |  | Abbott kit insert |
| Chloride | mmol/L |  | 95 - 108 |  | Pathology Harmony Jan 2011 |
| Cholesterol, total | mmol/L |  | NO RANGE |  |  |
| Complement C3 | g/L | **1 to 14 years** |  |  |  |
| Male | 0.80 - 1.70 |
| Female | 0.82 - 1.73 |
| **> 14 to 80 years** |  |
| Male | 0.82 - 1.85 |
| Female | 0.83 - 1.93 |
| Complement C4 | g/L | **1 to 14 years** |  |  |  |
| Male | 0.14 - 0.44 |
| Female | 0.13 - 0.46 |
| **> 14 to 80 years** |  |
| Male | 0.15 - 0.53 |
| Female | 0.15 - 0.57 |
| Conjugated bilirubin | µmol/L | All | 0 - 7 |  | WAKO (411-23695 0318D5) |
| Cortisol | nmol/L |  | 102 – 535 (Before 10 am) |  |  |
|  | 80 – 477 (After 5 pm) |
| C-Peptide | pmol/L |  | 258 – 1718 (Fasting) |  |  |
| Creatine Kinase (CK) | U/L | Male | 40 - 320 |  | Pathology Harmony Jan 2011 |
| Female | 25 - 200 |
| Creatinine (enzymatic) | µmol/L | **0 to 15 days** | 29 - 82 |  |  |
| **15 days to 2 years** | 9 -32 |
| **2 months to 4 years** | 15 - 42 |
| **2 to 5 years** | 18 - 38 |
| **5 to 12 years** | 27 - 54 |
| **12 to 15 years** | 40 - 72 |
| **15 to 19 years** |  |
| Male | 55 - 96 |
| Female | 43 - 74 |
| > 19 years |  |
| Male | 64 - 104 |
| Female | 49 - 90 |
| Creatinine clearance | mL/min |  | 70 - 140 |  |  |
| C-Reactive Protein (CRP) | mg/L | All | < 5 |  |  |
| Digoxin | µg/L | All | 0.5 - 2.0 | Recommended sampling time: 6 - 8 h pre-dose. Assay must be at least 8 hours after previous dose. We suggest you assay before morning tablet is taken. | Pathology Harmony Jan 2011 |
| Estimated glomerular filtration (eGFR) | mL/min/1.73m2 | Adult | No range | CKD-EPI (2009) minus ethnicity (NG203) |  |
| Ferritin | µg/L | All | 22 – 275 |  |  |
| Folate | µg/L | All | 3.1 - 20.5 |  | Nutristasis SOP HT-SOP-VKARC-001 |
| Follicle stimulating hormone (FSH) | IU/L | **Male** | 1.0 - 12.0 |  | Roche (07027346500V2.0 2017-08) |
| **Female** |  |
|  | 3.0 - 8.1 (Follicular Phase) |
|  | 2.6 - 16.7 (Mid-Cycle Phase) |
|  | 1.4 - 5.5 (Luteal Phase) |
|  | 26.7-133.4 (Postmenopausal) |
| Free PSA | µg/L |  | 0.0 - 0.5 |  |  |
| Free androgen index | % | **Male** |  |  |  |
| 21 to 49 years | 24.5 – 113.3 |
| > 50 years | 19.3 -118.4 |
| **Female** |  |
| 21 to 49 years | 0.7 – 8.7 |
| > 50 years | 0.5 – 4.7 |
| Free triiodothyronine (FT3) | pmol/L | All | 2.4 - 6.0 |  | Abbott kit insert G71299R04 April 2020 |
| Free thyroxine (FT4) | pmol/L | All | 9.0 - 19.1 |  |  |
| Fructosamine | µmol/L | Adult | 205 - 285 |  |  |
| Gamma-glutamyl transferase (GGT) | U/L | Male | <55 |  |  |
| Female | <38 |
| Globulin | g/L | All | 20 – 35 |  | KCH range |
| Glucose | mmol/L |  | NO RANGE | Fasting glucose > 6.9 or Random glucose > 11 suggests diabetes mellitus.  Fasting glucose 6.1 – 6.9 suggests impaired fasting glycaemia. |  |
| Haptoglobin | g/L | **0 to 1 year** |  |  |  |
| Male | 0.00 - 3.00 |
| Female | 0.00 - 2.35 |
| **> 1 to 12 years** |  |
| Male | 0.03 - 2.70 |
| Female | 0.00 - 2.20 |
| **> 12 to 60 years** |  |
| Male | 0.14 - 2.58 |
| Female | 0.35 - 2.50 |
| **> 60 years** |  |
| Male | 0.40 - 2.68 |
| Female | 0.63 - 2.73 |
| HbA1c | mmol/mol |  | 20 - 41 |  | Local care pathways for Diabetes in South London which are derived from the NHS Diabetes Preventation Programme (NHSDPP) NHS England Publications Gateway Reference 05728 and NICE Type 2 diabetes: prevention in people at high risk (nice.org.uk/guidance/ph38 2012) |
| HDL Cholesterol | mmol/L |  | NO RANGE | HDL <1.0 mmol/L associated with increased cardiovascular risk |  |
| Human chorionic gonadotrophin (HCG) | IU/L | Male | <2 |  | Abbott kit insert |
| Non-pregnant female | <5 |
| Immunoglobulin A (IgA) | g/L | **0 to 3 months** |  |  |  |
| Male | 0.01 - 0.34 |
| Female | 0.01 - 0.34 |
| **> 3 months to 1 year** |  |
| Male | 0.08 - 0.91 |
| Female | 0.08 - 0.91 |
| **> 1 to 12 years** |  |
| Male | 0.21 - 2.91 |
| Female | 0.21 - 2.82 |
| **> 12 to 60 years** |  |
| Male | 0.63 - 4.84 |
| Female | 0.65 - 4.21 |
| **> 60 years** |  |
| Male | 1.01 - 6.45 |
| Female | 0.69 - 5.17 |
| Immunoglobulin G (IgG) | g/L | **0 to 1 month** |  |  |  |
| Male | 3.97 - 17.65 |
| Female | 3.91 - 17.37 |
| **> 1 month to 1 year** |  |
| Male | 2.05 - 9.48 |
| Female | 2.03 - 9.34 |
| **> 1 to 2 years** |  |
| Male | 4.75 - 12.10 |
| Female | 4.83 - 12.26 |
| **> 2 to 80 years** |  |
| Male | 5.40 - 18.22 |
| Female | 5.52 - 16.31 |
| Immunoglobulin M (IgM) | g/L | **< 3 months** |  |  |  |
| Male | 0.06 - 0.21 |
| Female | 0.06 - 0.21 |
| **3 months to 1 year** |  |
| Male | 0.17 - 1.43 |
| Female | 0.17 - 1.50 |
| **> 1 to 12 years** |  |
| Male | 0.41 - 1.83 |
| Female | 0.47 - 2.40 |
| **> 12 years** |  |
| Male | 0.22 - 2.40 |
| Female | 0.33 - 2.93 |
| Insulin | pmol/L |  | NO RANGE |  |  |
| Iron | µmol/L | Male | 11.6 to 31.3 |  |  |
| Female | 9.0 to 30.4 |
| Lactate dehydrogenase (LDH) | U/L | All | 125 - 220 |  |  |
| LDL Cholesterol (Direct) | mmol/L |  | NO RANGE |  |  |
| Lipase | U/L | All | ≤ 60 |  | Sentinel 1761601 - 2.0/02 2020/05/05 |
| Lipoprotein(a) | nmol/L |  | NO RANGE | Cardiovascular risk increases with Lp(a) > 75 nmol/L |  |
| Lithium | mmol/L |  | 0.4 - 1.0 | Recommended sampling time: 12 h post-dose | BNF (accessed 01/09/21), Pathology Harmony Jan 2011 and NPSA (NPSA/2009/PSA005 Dec 2009) |
| Luteinising hormone (LH) | IU/L | Male | 0.6 - 12.1 |  |  |
| Female | 1.8 - 11.8 (Follicular Phase) |
|  | 7.6 - 89.1 (Mid-Cycle Phase) |
|  | 0.6 - 14.0 (Luteal Phase) |
|  | 5.2 - 62.0 (Postmenopausal) |
| Macroprolactin | mIU/L | Male | 32-309 |  |  |
| Female | 39-422 |  |
| Magnesium | mmol/L | < 4 weeks | 0.6 - 1.0 |  |  |
| > 4 weeks to Adult | 0.7 - 1.0 |
| Methotrexate | µmol/L |  | NO RANGE | Local procedure |  |
| Neuron specific enolase (NSE) | μg/L | All | < 11.1 |  |  |
| Non-esterified fatty acids (NEFA) | mmol/L |  | NO RANGE | Results interpreted in light of concurrent glucose result |  |
| Non-HDL cholesterol | mmol/L |  | NO RANGE | Non-HDL cholesterol > 2.5 mmol/L associated with increased cardiovascular risk |  |
| NT-proBNP | ng/L | All | < 400 | <400 ng/L Heart failure unlikely;  400-2000 ng/L Requires review in heart failure clinic within 6 weeks (request ROUTINE appointment on e-referral)  >2000 ng/L Requires review in heart failure clinic within 2 weeks (request URGENT appointment on e-referral) | NICE guidelines CG108 Chronic Heart Failure in Adults: Management (2010) and SE and South London CVD therapies group Lambeth CCG guidelines (2018). |
| Oestradiol | pmol/L | Male | 40 - 162 |  |  |
| Female | 77 – 921 (Follicular Phase) |
| 140 – 2383 (Mid-Cycle Phase) |
| 77 – 1145 (Luteal Phase) |
| < 103 (Postmenopausal) |
| Parathyroid hormone (PTH) | ng/L | All | 15.0 - 68.3 |  |  |
| Phenobarbitone | mg/L |  | 10 - 40 |  | Pathology Harmony Jan 2011 |
| Phenytoin | mg/L |  | 5 - 20 | Timing of assay not important but we suggest you assay before next dose. Always interpret drug levels according to clinical context. Some patients are well controlled with levels of 3 mg/L while others show no toxic signs with levels of 20 mg/L. | Pathology Harmony Jan 2011 |
| Phosphate | mmol/L | < 4 weeks | 1.3 - 2.6 |  |  |
| > 4 weeks to 1 year | 1.3 - 2.4 |
| 1 to 16 years | 0.9 - 1.8 |
| > 16 years | 0.8 - 1.5 |
| Potassium | mmol/L | < 4 weeks | 3.4 - 6.0 |  | Pathology Harmony Jan 2011 |
| > 4 weeks to 1 year | 3.5 - 5.7 |
| 1 to 16 years | 3.5 - 5.0 |
| Adult | 3.5 - 5.3 |
| Procalcitonin | μg/L | Male | 0.0 - 0.08 | Probability of bacterial infection (Schuetz et al 2019, Clin Chem Lab Med):  Bacterial infection: UNCERTAIN PCT < 0.25 (< 0.5 in ICU) Low; bacterial infection unlikely PCT ≥ 0.25 (≥ 0.5 in ICU) High; bacterial infection likely  Bacterial infection: HIGHLY SUSPECTED PCT <0.25 (< 0.5 in ICU) Low; bacterial infection possible PCT ≥ 0.25 (≥ 0.5 in ICU) High; bacterial infection highly likely |  |
| Female | 0.0 - 0.05 |
| Progesterone | nmol/L | Male | < 1.6 |  |  |
| Female | < 1.6 (Follicular Phase) |
| 3.8 - 50.6 (Luteal Phase) |
| <1.6 (Postmenopausal) |
| Prolactin | mIU/L | Male | 73 - 407 |  |  |
| Female | 109 - 557 |
| PSA (Total) | µg/L | Male <40 years | NO RANGE |  | SEL cancer network guidelines, NICE guidance (NG12 Suspected cancer: recognition and referral last updated 15 December 2021). |
| 40 - 49 years | < 2.49 |
| 50 - 59 years | < 3.49 |
| 60 - 69 years | < 4.49 |
| 70 - 79 years | < 6.49 |
| ≥ 79 years | NO RANGE |
| Salicylate | mg/L |  | NO RANGE |  | Pathology Harmony Jan 2011 |
| Sex hormone binding globulin (SHBG) | nmol/L | Male | 17.1 - 77.6 |  |  |
| Female | 34.3 - 147.7 (Premenopausal) |
| 26.4-118.0 (Postmenopausal) |
| Sodium | mmol/L |  | 133 - 146 |  | Pathology Harmony Jan 2011 |
| Testosterone | nmol/L | **Male** |  |  |  |
| < 12 months | 0.4 - 15.1 |
| 1 - 5 years | 0.3 - 1.5 |
| 6 - 10 years | 0.5 - 2.0 |
| 11 - 14 years | 0.7 - 19.3 |
| 15 - 20 years | 4.7 - 41.7 |
| 20 - 49 years | 8.3 - 30.2 |
| ≥ 50 years | 7.7 - 24.8 |
| **Female** |  |
| < 49 years | 0.5 - 1.9 |
| ≥ 50 years | 0.4 - 1.2 |
| Theophylline | mg/L |  | 10 - 20 |  | Pathology Harmony Jan 2011 |
| TPO Antibodies | IU/mL | All |  |  |  |
| Thyroid stimulating hormone (TSH) | mIU/L |  | 0.35 - 4.94 |  |  |
| TSH receptor antibodies (TRAb) | IU/L |  | NO RANGE | Negative < 3.10  Positive ≥ 3.10 |  |
| Total Cholesterol/HDL ratio | None | All | NO RANGE |  |  |
| Total Protein | g/L | Premature | 36 to 60 |  |  |
| Newborn | 46 to 70 |
| Cord | 48 to 80 |
| 1 week | 44 to 76 |
| 7 months to 1 year | 51 to 73 |
| 1 to 3 years | 56 to 75 |
| > 3 years to Adult | 60 to 80 | Pathology Harmony Jan 2011 |
| Transferrin | g/L | **1 to 14 years** |  |  |  |
| Male | 1.86 - 3.88 |
| Female | 1.80 - 3.91 |
| **> 14 to 60 years** |  |
| Male | 1.74 - 3.64 |
| Female | 1.80 - 3.82 |
| **> 60 to 80 years** |  |
| Male | 1.63 - 3.44 |
| Female | 1.73 - 3.60 |
| Transferrin Saturation | % | All | 20 - 45 |  | N Engl J Med 2022;387:2159-70 DOI: 10.1056/NEJMra2119758 (upper limit)  Am. J. Hematol. 91:31–38, 2016 DOI: 10.1002/ajh.24201 (lower limit) |
| Triglycerides | mmol/L |  | NO RANGE | Fasting triglycerides > 1.70 mmol/L are associated with increased cardiovascular risk |  |
| Troponin I (High Sensitivity) | ng/L | 0 to <6months | ≤ 56 |  | CALIPHER paediatric reference ranges for the Abbott Alinity assay.  Source: PMID: 37021828 |
| 6 months to <19 years | ≤ 6 |
| Male | < 35 |  |
| Female | < 16 |  |
| Urea | mmol/L | < 4 weeks | 0.8 -5.5 |  | Pathology Harmony Jan 2011 |
| > 4 weeks to 1 year | 1.0 - 5.5 |
| 1 to 16 years | 2.5 -6.5 |
| Adult | 2.5 - 7.8 |
| Uric acid (Urate) | μmol/L | Male | 200 - 430 |  | Pathology Harmony Jan 2011 |
| Female | 140 - 360 |
| Valproate | mg/L |  | 50 – 100 (Therapeutic) |  | Patsalos PN et al. Antiepileptic drugs--best practice guidelines for therapeutic drug monitoring: a position paper by the subcommission on therapeutic drug monitoring, ILAE Commission on Therapeutic Strategies. Epilepsia. 2008 Jul;49(7):1239-76. |
| Vitamin B12, Active? |  |  |  |  |  |
| Vitamin D | nmol/L | All | >50 | <25 nmol/L – Deficient,  25 – 50 /L nmol/L – Insufficient  >50 nmol/L – Adequate | Nutristasis SOP HT-SOP-VKARC-001 |

| **ROUTINE CHEMISTRY - URINE REFERENCE RANGES** | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Test** | **Units** | **Age / Gender / Random or 24h** | **Reference Range** | **Additional information** | **Range rationale / origin** |
| Urine albumin | mg/L | Random | NO RANGE | Results should be interpreted with urine creatinine (i.e. urine ACR) |  |
| mg/24h | 24h Urine | < 30 |  |  |
| Urine albumin:creatinine ratio (ACR) | mg/mmol | Calculated | < 3 |  | NICE CG182 Chronic kidney disease in adults: assessment and management (2014) |
| Urine amylase | U/L | **Random** |  |  |  |
| Male | 16 - 491 |
| Female | 21 - 447 |
| **24h Urine** | 170 - 2000 |
| Urine calcium | mmol/L | Random | NO RANGE | Results should be interpreted with urine creatinine (i.e. urine calcium:creatinine ratio CACR; urine calcium/creatinine clearance ratio for FHH) |  |
| mmol/24h | 24h Urine | 2.5 - 7.5 |  | Pathology Harmony Jan 2011 |
| Urine calcium:creatinine ratio | mmol/mmol | 0 – 1 years | 0.05 – 1.50 | Calcium creatinine ratio reported in mmol/mmol creatinine. In the presence of hypocalcaemia a value greater than 0.3 is considered inappropriate. |  |
| 1 – 2 years | 0.05 – 1.25 |
| 2 – 5 years | 0.05 – 1.00 |
| 5 – 10 years | 0.05 – 0.70 |
| 10 – 18 years | 0.05 – 0.60 |
| 18 – 150 years | 0.20 – 0.60 |
| Urine calcium/creatinine clearance ratio for FHH | No units |  | UCCR is often <0.01 in familial hypocalciuric hypercalcaemia (FHH); a UCCR >0.02 is typical of primary hyperparathyroidism | UCCR calculated as (urine calcium X serum creatinine) / (serum calcium X urine creatinine). |  |
| Urine chloride | mmol/L |  | NO RANGE | Results should be interpreted with serum chloride |  |
| Urine creatinine (enzymatic) | mmol/L | **Random** |  |  |  |
| Male | 5.1 - 14.2 |
| Female | 3.9 - 9.4 |
| mmol/24h | **24h Urine** |  |
| Male | 7.7 - 21.3 |
| Female | 5.9 - 14.1 |
| Urine magnesium | mmol/L | Random | NO RANGE | Results should be interpreted with serum magnesium |  |
| mmol/24h | 24h Urine | 2.4 - 6.5 |  |  |
| Urine phosphate | mmol/L | Random | NO RANGE |  |  |
| mmol/24h | 24h Urine | 15 - 60 |
| Urine potassium | mmol/L | Random | NO RANGE | Results should be interpreted with serum potassium |  |
| 24h Urine | 25 - 125 |  |
| Urine protein | mg/L | Random | NO RANGE | Results should be interpreted with urine creatinine (i.e. urine PCR) |  |
| mg/24h | 24h Urine | < 150 |
| Urine protein:creatinine ratio (PCR) | mg/mmol | Random | < 15 |  | KDIGO 2012 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease |
| Urine sodium | mmol/L | **Random** | NO RANGE | Results should be interpreted with serum sodium |  |
| mmol/24h | **24h Urine** |  |  |
| Male | 40 - 220 |
| Female | 27 - 287 |
| Urine uric acid (urate) | mmol/24h |  | NO RANGE |  |  |
| Urine urea | mmol/L | Random | NO RANGE | Random urine urea measurements have limited clinical value. |  |
| mmol/24h | 24h Urine | 428 - 714 |  |