P- 53 Antibody, Serum f

Background: Mutations in the suppressor gene p53 are thought to be essential for cancer development. This gene is one of the important regulators of transcription, cellular cycle, DNA repair and apoptosis.

Inactivation of gene p53 leads to uncontrolled cell division, and further to transformation of normal cells into the carcinous cells. Observations that mutations in gene p53 appear under conditions of occupational and environmental exposures to chemical and physical carcinogens, such as vinyl chloride, radon, or aflatoxin B1, have proved to be of importance for the occupational and environmental health.

Because p53 mutations and subsequent changes in the protein encoded can induce an immune response occurring early in the carcinogenic process for some tumors that p53 autoantibodies may be a useful biomarker for risk of development of cancer. The prevalence of anti-p53 antibodies correlate with the degree of cancer malignancy. The increased incidence of anti-p53 antibodies statistically is also associated with higher frequency of mutations in gene p53.

-Asbestosis

There is statistically evidence for the relationship between p53 autoantibodies and the subsequent development of malignancy with a positive predictive value and an average lead-time to diagnosis up to 4 years.

-Prostate cancer

patients with prostate cancer have significantly higher total prostate specific antigen and p53-Abs than patients with benign prostatic disease (BPD), but serum p53-antibodies may not be related to clinical stage

-Ovarian

There is only low sensitivity for serum p53 antibodies in ovarian carcinomas alone, and no major additional effect of the detection rate of CA125 reported (but CA125 correlates with serum p53 antibodies). No associations are reported between p53 antibodies and clinical stage, age, and histology.

- Carcinoma of the uterus

Up to 23% of patients with carcinoma of the uterus have been reported with serum p53 antibody

- Breast cancer

Between 8% and 11% are positive for p 53 antibodies in screening assays.

- Pleural mesotheliomas

Up to 7% of patients with pleural malignant mesothelioma are positive for p53 antibodies, for lung cancer the sensitivity is 15% - 17%.

- Esophageal squamous cell carcinoma

Up to 27% - 30% of the patients are positive for serum p53 antibodies. A high concentration after tumor resection is a predictive marker for recurrence. A high concentration of p53 is an independent prognostic factor, a high concentration also indicates an advanced stage of esophageal carcinoma. The positive rate for serum-p53 antibodies may be higher as

compared to CEA in patients with squamous cell carcinoma.

- Adenocarcinoma

  Serum p53 antibodies are detected in up to 18% - 63% of patients with adenocarcinoma and but only in 3% of patients with adenoma. As compared to the two other markers for adenocarcinoma, carcinoembryonic antigen (CEA) and carbohydrate antigen CA19-9, which showed no significant difference between superficial colorectal adenocarcinoma and adenoma, p 53 can differentiate between the two dysplasias.

False positive in normal human serum: 0% - 1.1% and up to 3.6% in respiratory diseases. No false positives in SLE or Sjœgren's syndrome or during pregnancy so far reported.

Sampling: 2 mL serum

Reference Interval: Negative:
median value of serum-p53 antibodies in healthy control individuals:
0.33 U/mL (range: 0.0 - 4.39 U/mL)
Positive: > 1.3 U/mL
High positive: > 10 U/mL

Pacerone® see Amiodarone, Serum

Pancreatic Amylase, Serum see Amylase, Isoenzymes, Serum

Pancreatic Elastase see Fecal Pancreatic Elastase 1

Papillomavirus (HPV) DNA see Human Papillomavirus (HPV) DNA

Paracetamol see Acetaminophen, Serum

Parainfluenza Virus, Serology f

Background: Laryngotracheitis (croup), characterized by barking cough, inspiratory stridor and hoarseness is the most common disease in children caused by parainfluenza virus types 1, 2 or 3. Parainfluenza viruses also cause otitis media, conjunctivitis and common cold. Respiratory syncytial virus is the predominant cause of serve acute respiratory illness in children, followed by parainfluenza viruses. There is no protective immunity after parainfluenza infection.

Limitations: Cross reactivity with other viruses such as mumps may occur. Antibody production particularly in infants may be low.

Sampling: 1 mL serum during the acute phase and reconvalescent serum required. 3 fold rise in titer is diagnostic for infection.

Reference Interval: Antibody titer for types 1, 2, 3 and 4: negative < 1:40

Parasites Microscopy, Feces a

Overview: please see

Amebas
Giardia lamblia (cyst form)
Helminth (eggs)

Sampling: Approx. 2 g stool in sterile tube

Parathyroid Hormone Intact, Serum f

Related Information: Calcium (Ca), Total, Serum or Urine
Creatinine, Serum or Plasma
Osteocalcin, Serum or Plasma
Phosphate Inorganic, Serum
Vitamin D, Serum

Synonyms: Parathormone; PTH; PTH 1-84

Background: PTH is synthesized and secreted by the parathyroid gland. Intact PTH is a single chain polypeptide of 84 amino acids and a MW of 9500kDa. The secretion is regulated in a negative feed back loop by ionized calcium and by ionized magnesium, which are required for appropriate PTH release, and negatively by 1,25 Dihydroxyvitamin D3.

Function: Maintaining calcium levels in the extracellular fluid (ECF) by up regulating bone resorption and release of calcium and phosphate, by stimulation of calcium reabsorption from the renal tubulus and by stimulation of renal synthesis of 1,25 (OH_2) vitamin D3, increasing intestinal calcium and phosphate absorption, thus increasing serum calcium levels and decrease serum phosphate levels.

PTH has a half life of < 4 min and is cleared by the kidney and liver. In the liver, the PTH is cleaved into fragments, the inactive carboxy terminal fragments circulate approx. 30 min, since they are cleared by glomerular filtration.

Diagnostic used in patients with

Hypercalcemia: More than 90% of the patients with hypercalcemia are diagnosed with primary hyperparathyroidism (PHP) and humoral hypercalcemia of malignancy (HHM). Other, rare causes are familial hypocalciuric hypercalcemia (FHH), granulomatous diseases, thyrotoxicosis, vitamin D intoxication, lithium and thiazides medication, Addison disease, hypothyroidism, and PTH receptor defects.

FHH, an autosomal dominant disease caused by a defect in the calcium sensing receptor, is characterized by low urine calcium levels with the urine calcium: creatinine ratio usually < 0.01

and with an elevated serum PTH.

HHM is characterized by appropriate PTH levels and caused either by a parathyroid hormone related protein with similar biological activity as PTH, which is synthesized by tumors, a or by cytokines released by tumors (particularly from myeloma) stimulationg osteolytic hypercalcemia.

Hypocalcemia: May be caused by hypoparathyroidism, rickets, low serum albumin, acute pancreatitis, sepsis, tumor lysis, renal insufficiency, and magnesium deficiency.

Hypoparathyroidism is a risk in thyroid surgery, in conditions leading to organ destruction as iron overload, autoimmunity, granulomatous diseases, metastasis and retardation in development (Di George syndrome).

Hypocalcemia can be drug induced by calcitonin, mithramycin, phosphates, phenytoin in combination with phenobarbital, foscarnet.

Sampling: 1 mL serum, centrifuge and freeze soon.

Reference Interval: 15 - 65 pg/mL

Parietal Cell Antibody f

Related Information: Vitamin B 12, Plasma or Serum
Folic Acid, Serum
Glutamic Acid Decarboxylase Antibody
Intrinsic Factor Antibody (IFA)
Liver Kidney Microsomal Antibodies (LKM Antibodies)

Background: Gastric parietal cells secrete intrinsic factor which binds to vitamin B 12, thus allowing its absorption in the ileum. Parietal cells also secrete hydrochloric acid, cathepsin and other proteins, resulting in case of autoimmune gastritis atrophic gastritis with achlorhydria and vitamin B 12 deficiencies (pernicious anemia).

Useful parameter in the diagnosis, through not very specific, in pernicious anemia (50% - 95% of the patients have antibodies). There is no correlation with the degree of malabsorption of vitamin B 12. In 20% - 30% of the patients cross reactivity of the antibodies in thyroiditis and diabetes mellitus was observed.

Limitations: Parietal cell antibodies are detectable in 30% - 60% of patients with chronic atrophic gastritis, in 20% with gastric ulcers, in 30% with Sjœgren syndrome, in 30% of first degree relatives of patients with pernicious anemia and in healthy adults, increasing with age from 2% in young adults to 10% in 80 years old individuals.

Sampling: 1 mL serum

Reference Interval: Negative (titers < 1:40)

Partial Thromboplastin Time (PTT) see Activated Partial Thromboplastin Time

Parvovirus B19, Serology f

Background: Parvovirus, a non-enveloped, small (22 nm), single negative stranded DNA virus with icosahedral symmetry, causes a wide variety of symptoms.

Transmission occurs by respiratory droplets, transplacental and blood transfusions. In the US 50% of the adult population are seropositive for antibodies. There are no animal reservoirs known. Infection of erythroblasts causes transient aplastic anemia, particularly in patients with sickle cell anemia, thalassemia, and spherocytosis. Immune complexes causes rash, together with infection of endothelial cells of the blood vessels the erythema infectiosum or slapped cheek syndrome or fifth disease may be explained, as well as arthritis. (The other four maculopapular rash diseases during childhood are measles, rubella, scarlet fever, roseola).

Infection of the fetus during the first trimester may cause fetal death, during the second trimester hydrops fetalis. Third trimester infection usually does not cause clinical alterations.

Detection of specific IgM during the second week post infection to up to 6 month. IgG titers rise shortly after IgM rise and lasts for years. Absence of antibodies cannot exclude infection, particularly in immunocompromised patients.

Usually, a lifelong immunity results from infection.

Sampling: 1 mL serum

Reference Interval: Differentiation of immunoglobulin class
IgG antibody
negative: < 0.9 COI
IgM antibody
negative: < 0.9 COI
Validation test is performed by immunoblot

Paternity Testing f

Background: Parternity testing now, by applying the DNA profiling method allows direct investigation of the genetic material inherited from the parents to the child. Using recent PCR technology DNA analysis enables the determination of paternity or maternity with an accuracy of 99,99% and higher.

To determine suspected paternity, the examination of the child, the mother and the putative father(s) is required. If it is not possible to include the child's mother, paternity still can be determined with the child and the father, though at a lower level of certainty. This also applies to cases where the putative father can not be examined as in case of death. Descent can be clarified by testing the paternal grand parents or siblings of the putative father.

More complex family relationships may be confirmed or excludes by means of DNA analysis. As potential success varies with the degree of relationship of the respective persons, preceding consultation is strongly recommended.

DNA testing is available for:

- determination of suspected paternity
- determination of suspected maternity
- determination of grand parentage
- paternity testing without the mother
- determination of suspected family relationships
- prenatal testing (amniotic fluid or chorionic villus sample required)
- testing of biopsy tissue material
- determination of identical or non-identical twins
- DNA-profile and blood groups

DNA testing is performed by using polymerase chain reaction (PCR)) method. DNA fragments with repetitive sequence motifs, short tandem repeats (STR), are enzymatically amplified and subsequently measured for their lengths. Depending on the case to be solved up to 30 STR loci may be analyzed.

Sampling: Materials necessary for proper collection and shipping of samples are provided by the laboratory. The following specimens are suited for analysis:

- 1 mL blood anticoagulated by EDTA
- 2 - 4 buccal swabs (each person to be examined)
- tissue material from autopsy or biopsy; dried blood spots; hairs with roots (at least 5 - 10)
- amniotic fluid: 10 - 20 mL of native, untreated fluid or cultured amniocytes
- chorionic villus sample: 100 mg of sample or 20 mL of cultured cells

Specimen should be collected by a physician or medical staff familiar with blood collection. Collection has to be documented on a special form to ensure identity of samples to be examined.

Pertussis see Bordetella pertussis

Phenprocoumon, Serum f

Synonyms: Marcumar®

Background: As an oral anticoagulant phenprocoumon is a vitamin K antagonist. Parent compounds are 4-hydroxycoumarin and indan-1,3-dione, other derived compounds are warfarin, 4-hydroxycoumarin, dicumarol, acenocoumarol or anisindione.

Coagulation factors II, VII, IX, X and the anticoagulant proteins C and S are synthesized in the liver and inactive unless 9 to 12 amino terminal glutamic acid residues are carboxylated. The carboxyglutamate residues bind Ca^{2+} which is necessary for the catalytic complex. The reaction requires carbon dioxide, oxygen and reduced vitamin K. To generate reduced vitamin K, an exposide reductase reduces the vitamin K epoxide. The enzyme is inhibited by oral anticoagulants.

Phenprocoumon has a longer half life (5 days), a longer duration of action (7 - 14 days) and a slower onset as compared to warfarin.

Sampling: 2 mL serum

Reference Interval: Therapeutic Values 1.5 - 3.5 µg/mL
Toxic values: > 5 µg/mL

Phenytoin, Serum or Plasma f

Related Information: Carbamazepine, Serum
Ethosuximide, Serum or Plasma
Phenobarbital, Serum or Plasma
Primidone, Serum or Plasma
Valproic Acid, Serum or Plasma

Synonyms: Antisacer®; Cerebyx®; Dilantin®; Dintoina®; Diphenylan Sodium®; DPH; Diphenylhydantoin ; Ditan®; Epanutin®; Epinat®; Fenitoina; Fenytoin®

Background: Introduced in 1938, phenytoin is a diphenyl-substituted hydantoin with low sedative properties. The soluble form is the phosphoester fosphenytoin which is rapidly converted into phenytoin in the plasma. Phenytoin acts on the conductance of the membranes for ions, in therapeutic concentrations particularly sodium channels, on membrane potentials, on the concentration of norepinephrine, acetylcholine and gamma aminobutyric acid. In high concentrations the release of serotonin and norepinephrine is inhibited, dopamine uptake is enhanced, and monoamine oxidase activity is inhibited. Calcium permeability is inhibited, so calcium dependent release of hormones and neurotransmitters may be affected.

The absorption of the drug is dependent on the formulation; phenytoin sodium is nearly completely absorbed from the gut, plasma peak time ranges from 3 h to 12 h post ingestion. Fosphenytoin is well absorbed after im injection. Phenytoin accumulates in brain, liver, muscle, and fat tissue.

Phenytoin is almost totally metabolized to inactive metabolites and excreted with the urine. If the metabolization capability of the liver is saturated, drug level increases rapidly to toxic levels, therefore only small increase of the daily dose of 30 mg each time is recommended. Steady state is reached after 5 - 7 days for low dosage, for high levels it takes 4 - 6 weeks. Since phenytoin is highly plasma bound, other plasma bound drugs can displace phenytoin. Metabolized by polymorphic cytochrome P450 2C9 and 2C19.

Limitations: Fosphenytoin is measured not as reliable as phenytoin.

Bioavailability 87% - 93%; urinary excretion 6% - 10%; plasma binding 70% - 99% decreased in renal disease, hepatitis, neonates, hypalbuminemia, cirrhosis, nephritic syndrome, pregnancy, burn patients; volume of distribution 0.6 - 0.7 L/kg increased in neonates, renal disease; half life time 6 - 24 h (children 10 h) increased in premature newborns and decreased in renal disease; peak time 3 - 12 h; peak concentration 5 - 30 µg/mL after a 300 mg dose orally in steady state.

Sampling: 2 mL serum

Reference Interval:	Therapeutic values	10 - 20 µg/mL
	Toxic values	> 25 µg/mL
	Lethal	> 100 µg/mL
	may precipitate seizures at	> 40 µg/mL

Phosphatase acid see Acid Phosphatase total, Plasma

Phosphatase alkaline see Alkaline Phosphatase, Serum

Phosphatase alkaline, Isoenzyme

see Alkaline Phosphatase, Liver- Intestine- Bone Isoenzymes, Serum
see Alkaline Phosphatase, Placental Isoenzyme, Serum

Phosphate Inorganic, Serum a

Related Information: Amino Acid, Screening, Plasma or Urine
Calcium (Ca), Total, Serum
Calcium (Ca), Urine
Ethanol, Blood, Serum or Urine
Parathyroid Hormone, Intact, Serum
Vitamin D, Serum

Background: 99% of the body phosphate is stored in bone and striated muscle and only 1% in plasma. Clinically, hypophosphatemia is characterized by chronic myopathy, osteopenia, osteomalacia, and rhabdomyolysis. Phosphate also alters cardiac function with arrhythmias and cardiomyopathy. Low phosphorus levels also alter oxygen release from hemoglobin and may lead to hemolysis.
Useful in the evaluation of hyperphosphatemia associated with exercise, hypovolemia, acromegaly, hypoparathyroidism, skeletal metastasis, hypervitaminosis D, sarcoidosis, milk alkali syndrome, pulmonary embolism, renal failure (more than 80% function impairment) and liver failure, diabetes mellitus. In thrombocytosis, serum concentrations are elevated, but plasma concentrations are normal.
Decreased phosphate levels occur in hypoparathyroid state, antacid-, steroid-, diuretic-, medication, vitamin D deficiency, sepsis, renal disorders, dialysis, emesis, and diarrhea.
Limitation: Up to 40% of the adult population may have serum levels below or at the lower limit of the reference interval. Multiple sampling is recommended.
Sampling: 1 mL serum or plasma, assay can not be run with oxalate or citrate plasma. There is a diurnal nadir at noon, a peak at midnight and a plateau in the afternoon. Variation is about 0.2 mg/dL. Avoid hemolysis, keep sample refrigerated.

Reference Interval:	Infants	1.45 - 2.42 mmol/L
	Children	4.29 - 1.94 mmol/L
	Adults	0.81 - 1.45 mmol/L
	Hypophosphatemia	< 0.5 mmol/L

Phosphate Inorganic, Urine f

Related Information: Calcitonin, Serum or Plasma
Calcium (Ca), Total, Serum
Calcium (Ca), Urine
Parathyroid Hormone, Intact, Serum
Somatotropin, Serum

Background: High urinary phosphate level occurs in primary hyperparathyroidism, vitamin D deficiency, renal tubular acidosis, state of elevated calcitonin, atrial natriuretic hormone or vasopressin.

Decreased urinary excretion occurs in malnutrition, hypoparathyroidism and vitamin D intoxication, metabolic alkalosis and elevated levels of glucosteroids or growth hormone.

Some drugs such as aluminium salts, diltiazem, aspirin, bicarbonate, corticosteroids, and diuretics may alter the excretion of phosphate.

Sampling: Ship to the laboratory a 5 mL aliquot of a 24 h urine collection. Note total quantity.

Reference Interval: Adults on unrestricted diet:
15 - 48 mmol/24h
Children age 0 - 6 years:
There is a decrease of the phosphate to creatinine ratio from 18 (first year of life) to 1 at the age of > 6 years (mol/mol).

Phospholipid-Antibodies, Serum f

Related Information: Cardiolipin Antibody
Lupus Anticoagulants / Lupus Inhibitors, Serum or Citrateplasma
Applies to Phosphatidylcholine-, phosphatidylethanolamine-, phosphatidylglycerine-, phosphatidylinositol- and phosphatidylserine antibody

Background: Lupus anticoagulant, anticardiolipin antibodies (ACA) and phosphatidylcholine-phosphatidylethanolamine-, phosphatidylglycerine-, phosphatidylinositol-, phosphatidylserine antibodies are part of the heterogenous class of antilipid antibodies (APA).

Useful parameter in the assessment of SLE, the anti phospholipid syndrome (APS), in the diagnosis of recurrent thrombotic events, and in the diagnosis of recurrent thrombocytopenias of unknown origin.

Primary APS is defined as recurrent thrombosis or recurrent miscarriage without other risk fac-

tors, secondary APS as thrombotic events in known SLE or collagenosis.
APA is part of the diagnostic criteria of SLE according to the American College of Rheumatology.
Limitation: May be transient positive during infections or medication.
Sampling: 2 mL serum
Reference Interval: Negative

Plasmin Inhibitor see $Alpha_2$ - Antiplasmin, functional

Plasminogen, Plasma f

Background: Plasminogen is converted to plasmin by tissue plasminogen activator (tPA) or by an urokinase type activator (uPA). Plasmin lysises fibrin clots, fibrinogen and inactivates factors Va and VIIIa. Decreased plasminogen conditions are liver diseases, thrombolytic therapy, disseminated intravascular coagulation (DIC), and the rare hereditary plasminogen deficiency syndrome, predisposing patients to venous thrombosis. Incidence of the latter disorder is 0.3% - 0.7% in the general population and up to 2% in patients with venous thrombosis and 1.4% in patients with arterial thrombosis. The serve form may present with ligneous conjunctivitis.
Limitations: Plasminogen levels can increase during pregnancy; newborn levels are lower at 60% and increase to 100% by the age of 6 month.
Sampling: 2 mL citrate plasma. Separate plasma as soon as possible, freeze plasma immediately and ship frozen.
Reference Interval: 85% - 110%

Plasminogen Activator Inhibitor 1 f

Related Information: Plasminogen, Plasma
Synonyms: PAI-1
Background: PAI-1 is present in the liver, endothelial and platelets. PAI-1 inhibits tissue plasminogen activator (tPA) and urokinase type plasminogen activator (uPA).
Increased PAI-1 levels are associated with increased incidence of myocardial infarction, however the association is not significant in all studies and is not an independent factor. High plasma glucose levels or high insulin levels are associated with synthesis of PAI-1.
Limitation: As an acute phase reactant elevated levels occur after a thrombotic event. It also increases during pregnancy.
Sampling: 1 mL of citrate plasma. PAI-1 has a circadian rhythm with a morning peak and low in the afternoon. Plasma must be separated immediately, since platelets contain PAI-1. Store up to 2 h on ice or freeze immediately. Ship frozen.
Test system used: Functional assay
Reference Interval: < 10 U/mL

Platelet Antibodies Free or Bound f

Related Information: Platelet Count

Test includes: Antiplatelet antibodies attached to platelets and antiplatelet antibodies not bound to platelets.

Background: Platelet antibodies develop either as autoimmune antibodies in idiopathic thrombocytopenic purpura, (ITP), or are inducible by drugs (DIT) such as heparin (heparin-induced thrombocytopenia HIT), or are due to alloimmune reactions such as neonatal alloimmune thrombocytopenia (NAIT), posttransfusion purpura (PTP), post-transfusion refractoriness.

- ITp is characterized by an isolated thrombocytopenia induced by autoantibodies against the platelet glycoprotein IIb/IIIa or Ib/IX. Platelets are either normal in size or enlarged. In children, ITp is an acute disorder with good prognosis, in adult the chronic form is predominant.
- NAIT is a condition during pregnancy due to maternal antibody reaction against father derived platelet antigen (the PI^{A1} antigen of the glycoprotein IIb/IIIa group) of the fetus. Newborn platelet counts are < 100 000 / µL, becoming normal within 2 weeks after birth. Incidence is approx. 1:1000.
- PTP is a condition where antibody responses induced by transfused platelets which express PI^{A1}antigen not only destroy the transfused but also the patients own platelets. Onset is usually one to two weeks after transfusion with sudden and severe thrombocytopenia (< 10 000 / µL), resolving within 2 weeks.
- DIT which may be severe (< 10000 / µL), but resolve within 1 - 2 weeks after discontinuing, is either caused by antibodies (immune cause), by bone marrow suppression or by platelet destruction. Immune reactions are found after quinidine, quinine, sulfonamides, sulfonylureas, salicylates and other drugs but in most of them with poor pharmaceutical proof to cause DIT. Bone marrow suppression is caused by ethanol, thiazide, procarbazine cytostatic drugs and platelets may be destroyed by ristocetin, bleomycin, and protamine.
- Post transfusion platelet refractoriness occurs after multiple transfusions which induce antibody production against HLA-A or HLA-B and less frequent other antigens.

Sampling: 5 mL EDTA whole blood and in addition 1 mL serum

Reference Interval: Antibodies not detectable

Platelet Count a

Related Information: Activated Partial Thromboplastin Time
Blood Count, Complete
Lupus Anticoagulants / Lupus Inhibitors, Serum or Citrateplasma
Platelet Antibodies (free, bound)
Reticulocyte Count

Background: Thrombocytes are cells without nucleolus, 2 - 3 µm in diameter. Platelet production is under the control of thrombopoietin. Circulation time in the blood of platelets is 7 - 10 days; macrophages of the RES remove the cells from the circulation. Platelets are pooled to

30% - 35% in the spleen, 65% - 70% are circulating with circadian rhythm peaking during mid-day. Activated platelets are changing form and immunity by antigen expression on the surface by granula transport from the core to the surface membrane.
Platelet count is a useful parameter in the diagnosis of bleeding, in monitoring during cytostatic or radiation therapy, in the assessment of malignancies of the bone marrow, and in the diagnosis of autoimmune diseases.

Thrombocytosis:

Mild	500 - 700 /nL
Moderate	700 - 900 /nL
Severe	> 900 /nL

Causes for thrombocytosis:

- Primary: Disease of the bone marrow such as defects in stem cells associated with polycythemia vera, chronic myelogenous leukemia, idiopathic myelofibrosis, essential thrombocythemia (incidence 2 - 3 per million, peak in the age group of 40 - 60 years and in late puberty).
- Secondary: Either due to release of thrombocytes from the spleen during stress (increase up to 50%, rapid decline within 1h), post partum, after surgery (initially decreasing, then increasing up to 2.5 fold after 1 week, decreasing to normal within 2 weeks), exercise, rebound following thrombocytopenia, bone marrow activation after bleeding episodes, iron deficiency, infections (particularly in children counts > 700/nL), inflammation or carcinomatosis.

Primary thrombocytosis is usually associated with higher platelet counts and both arterial and venous thrombosis, secondary thrombocytosis with venous complications only and in co-association with other risk factors.

Thrombocytopenia:

Moderate	100 - 50 /nl
Serve	< 50 /nl

Clinically thrombocytopenia presents with petechia, purpura, bleeding of mucous membranes, epistaxis, gastrointestinal, urogenital bleeding,
Causes are either decreased production or increased destruction of platelets:

- Decreased production (account for 5% - 10% of cases of thrombocytopenia)
  Hereditary forms:
  Wiskott Aldrich Syndrome, Chediak-Higashi Syndrome, Alport-Syndrome, Fechtner Sy drome, Trousseau Syndrome, May Hegglin Syndrome, v. Willebrand TypIIB, Bernard Soulie Syndrome, mediterran macrothrombocytopenia,
  Acquired forms:
  Aplastic anemias, malignancies of the bone marrow, leukemias, chemotherapy, radiation.
- Increased destruction:
  Immune mediated:
  IgG binding to the glycoproteins of the membrane of the human platelet antigen system tri

gering an enhanced clearance of the complex. The form is in part drug induced (1 in 1 million individuals prescribed a drug develop thrombocytopenia).
Non immune mediated:
disseminated intravascular coagulation (DIC), sepsis or after multiple blood transfusions (usally severe thrombocytopenia).
Mild thrombocytopenia occurs in patients with splenomegaly due to platelet pooling (up to 90% in the spleen).

A heparin induced, non-immunologic form begins within 1 - 5 days after heparin therapy (incidence 25%). A heparin induced immunologic form begins 5 - 20 days after heparin therapy and is associated with thromboembolism (incidence 1%)
Carcinoma associated thrombocytopenia's are due to invasive bone marrow metastasis, splenomegaly, carcinoma related DIC or chemotherapy.
During pregnancy 15% of pregnant women display a platelet count of less than 150 /nL, 8% of the women even less than 130 /nL.
Sampling: 3 ml EDTA blood
Reference Interval: 150 - 450 /nL (150 000 - 450 000 /µL)
Platelet counts in healthy term infants and preterm infants less than 1500g is comparable to that in adults. The counts rises during the first months. Counts between 500 /uL and 750 /uL have been observed in infants under 2 years apparently healthy.
Intra day variation: 7% - 10%

high risk for bleeding	< 10 /nL
high risk for thromboses	> 1000 /nL

Pneumococcal Antibody, Serology f

Background: Pneumococcal polysaccharide vaccines contain more than 20 types of capsular polysaccharides, accounting for 80 - 90% of all bacteremic pneumococcal diseases. 80 - 95% of the individuals receiving vaccination respond by demonstrable antibodies. Vaccination is recommended for adults at high risk of complications from respiratory infections particularly those with cardiovascular and chronic pulmonary diseases, for adults and children older than 2 years at high risk of pneumococcal disease such as splenic dysfunction or asplenia, Hodgkin's disease, multiple myeloma, chronic liver disease renal failure, CSF leaks, immunocompromised state including HIV, and for healthy elderly (> 65 years). Revaccination to consider after 3 - 5 years. Safety in pregnant woman has not been evaluated sufficiently. The efficiency of vaccines for children under 2 years is under investigation.
Sampling: 1 mL serum
Reference Interval: Immunity present > 15 mg/L

Pneumocystis carinii, DNA Detection f

Background: In immunocompromised patients (transplantation, hematologic malignancies, AIDS, corticosteroid therapy), Pneumocystis carinii (PC) causes pneumonia and may affect to a lesser degree lymph nodes, liver, spleen bone marrow. In HIV infected patients, PC pneumonia may be the first sign of HIV infection.

Sampling: Sputum or bronchoalveolar lavage (BAL)

Reference Interval: Report of diagnostic finding
Direct detection by PCR: DNA not detectable

Poliomyelitis Virus Type I, II, III, Serology f

Background: Poliomyelitis virus is now, due to vaccination programs, rarely seen, but still present and has to be considered in patients with acute aseptic meningitis if the patient has not been immunized.

Sampling: 1 mL serum

Reference Interval: Protective immunity

Negative	< 9 IU/mL	(no immunity present)
Borderline	9 - 12 IU/mL	(immunity questionable)
Positive	> 12 IU/mL	(immunity present)

Porphobilinogen, Urine f

Related Information: Delta(5)-Aminolevulic Acid, Urine
Porphyrins, Quantitative, Urine or Stool

Background: Porphobilinogen is a heme precursor. The excretion increases in acute porphyrias, making it a good screening test for acute intermittent porphyria, hereditary coproporphyria and for variegata porphyria. During the latent phase of the diseases often within the reference interval.

Sampling: 10 mL aliquot of a 24 h urine, keep cool and protect from light, note total quantity. Specific results are obtained when collected during acute attack of abdominal pain, pain of the extremities, tachycardia, hypertension, nausea, vomiting, neurologic abnormalities, dark urine.

Reference Interval: < 0.5 mg/g creatinine
< 1.6 mg /24 h

Porphyrins Quantitative, Urine or Stool f

Related Information: Delta-Aminolevulinic Acid, Urine
Iron (Fe), Serum or Urine
Transferrin and Total Iron Binding Capacity, Serum
Porphobilinogen, Urine

Test Includes: Uroporphyrins (octacarboxylporphyrins), heptacarboxylporphyrins, hexa-carboxylporphyrins, pentacarboxylporphyrins, coproporphyrins (tetracarboxylporphyrins)

Background: Porphyrins are heme precursors which accumulate in case of an enzyme defect in the heme synteresis pathway. The accumulation pattern indicates the defective enzyme.

In secondary porphyrias, the most common form is toxic inhibition of porphobilinogen synthetase leading to an increased excretion of porphobilinogen (PBG) and delta-aminolevulinic acid (ALA).

Clinically, porphyria presents with abdominal pain in absence of fever and leukocytosis, peripheral neuropathy, in some cases seizures, psychosis, and abnormalities of the CNS.

The test is used in combination with porphobilinogen to diagnose porphyria as a first choice approach. If both tests are negative, erythropoietic protoporphyria (accumulating the water insoluble protoporphyrin without urinary excretion) has to be considered. In case of delta –aminolevulinic acid dehydrogenase deficient porphyria, only ALA accumulates and urinary excretion increases.

In the autosomal recessive congenital erythropoietic porphyria, early infancy onset with severe hemolysis and photosensitivity, uroporphyrinogen III cosynthase activity is reduced. Onset in early childhood presenting with elevated urinary levels of uroporphyrin and coproporphyrin (red urine), elevated fecal levels of uroporphyrin, coproporphyrin and zinc protoporphyrin. Plasma levels of uroporphyrin and coproporphyrin I levels are elevated. (see Uroporphyrinogen III Synthetase). In the erythrocytes uroporphyrin, coproporphyrin and zinc-protoporphyrin are increased.

The rare, early infancy onset, autosomal recessive hepatoerythropoietic porphyria (uroporphyrinogen decarboxylase deficiency) is characterized by elevated urinary uroporphyrin and heptacarboxylporphyrin III levels, elevated plasma uroporphyrin and an increase in erythrocytic zinc-protoporphyrin.

In acute intermittent porphyria (onset in adulthood), the second most common porphyria and with autosomal dominant inheritance, the porphobilinogen deaminase enzyme is defect. It presents with ALA, PBG, uroporphyrin, and coproporphyrin elevation in the urine as well as increased plasma porphyrins during the acute episode.

The acute attack of hereditary coproporphyria, a rare autosomal dominant form with, coproporphyrinogen oxidase defect, seen in adulthood presentes with increased urinary coproporphyrin, ALA and PBG as well as elevated fecal and plasma coproporphyrin III levels.

Porphyria variegate (autosomal dominant, protoporphyrinogen oxidase defect) presents in adulthood with urinary coproporphyrin higher than uroporphyrin during the acute phase and increased urinary ALA and PGB levels. Fecal protoporphyrin is higher than coproporphyrin.

Porphyria cutanea tarda, the most common form of porphyria, known as type I, (acquired) and type II and III (autosomal dominant), defined as an enzyme defect of uroporphyrinogen decarboxylase and presenting with increased urinary excretion of uroporphyrin and heptacarboxylporphyrin but normal PBG excretion. Fecal isocoproporphyrin and heptacarboxylporphyrin III are elevated. Plasma uroporphyrin is elevated.

Lead poisoning presents with urinary ALA higher than PBG (PBG often within normal range), elevated urinary coproporphyrin and increased free erythrocyte protoporphyrin.

Sampling: Urine: 10 mL aliquot of a 24 h urine collected in a clean, dark container to protect from light. Keep at 4°C during the collection period and for transport.
Note total quantity.
Stool: approx. 5 g stool
Erythrocytes: 1 mL EDTA blood

Reference Interval:

Urine (µg/24h)	
Uroporphyrins (octacarboxyl)	3 - 25
Heptacarboxylporphyrins	< 7
Hexacarboxylporphyrins	< 6
Pentacarboxylporphyrins	< 7
Coproporphyrins (tetracarboxyl)	
Male	25 - 150
Female	8 - 110
Feces	< 34 µg/g of stool

Potassium, Serum or Plasma a

Related Information: Aldosterone, Serum or Plasma
Amino Acid, Screening, Plasma or Urine
Calcium, Serum
Chloride, Serum, Plasma, Blood
Digoxin, Serum
Magnesium, Serum
Potassium, Urine
Renin, Plasma
Sodium, Serum or Plasma

Synonyms: Kalium

Background: Useful in elderly patients, in intravenous alimented patients, therapeutic diuretic medication, renal diseases, evaluation of hypertension. Evaluation of muscular weakness, confusion, gastrointestinal disorders, laxative abuses, fistula and tube drainages, cardiac arrhythmias, mineralocorticoid dysbalance,

Hypokalemia:

Occurs in 90% of hypertensive patients with primary aldosteronism. Also found in patients with secondary hyperaldosteronism and in patients with Cushing syndrome,

Loss of potassium from the gastrointestinal tract occurs by vomiting, diarrhea, laxatives, tumors, jejunoileal bypass, enteric fistulas, malabsorption,

Occurs in burns, alkalosis, Bartter syndrome, Gitelman syndrome, alcoholism, anabolic status, folic acid deficiency.

Drugs which may cause hypokalemia: caffeine, verapamil overdose, chloroquine overdose, diuretics, mineralocorticoids, high dose penicillin, nafcillin, ampicillin, carbenicillin, aminoglyco-

sides, cisplatin, foscarnet, amphotericin B, beta adrenergic agonists, theophylline overdose, insulin overdose.

Hyperkalemia:

May be associated with trauma, potassium containing medication, high dose trimetoprim –sulfamethoxazole, ACE inhibitors, Addison disease, ketoacidosis in diabetes mellitus, in status of increased serum osmolality, in renal diseases, malignant hyperthermia, in renal tubular acidosis. Suppression of aldosterone release by heparin may lead to hyperkalemia.

Limitations: False hyperkalemia is caused by hemolysis, which may be undetectable, after collection. False high values may occur in the serum of patients with thrombocythemia, since platelets release Potassium during coagulation. WBC also release potassium when clotting, particularly in patients with chronic myelogenous leukemia. Low sodium intake may mask the hypokalemia in aldosteronism.

Serum/plasma potassium is ph dependent. Increase of ph of 0.1 decreases potassium by 0.6 mmol/L. Therapeutic increase in ketoacidosis will decrease plasma/serum potassium. During insulin administration, plasma/serum potassium decrease due to move of potassium into cells.

Sampling: Avoid small needles. Hand clenching and stasis increase potassium values ! Avoid any hemolysis. Separate serum or plasma within 1h.

Reference Interval: Plasma 3.5 - 5.5 mmol/L

Serum values may be 0.1 mmol/L higher.

Even slight hemolysis increase values substantially since red cell potassium concentration is approx 100 mmol/L.

Critical values: Newborns < 2.5 mmol/L and > 7.0 mmol/L

Adults < 2.5 mmol/L and > 6.5 mmol/L

Prednisolone, Serum f

Related Information: Aldosterone, Serum or Plasma
Aldosterone, Urine
Adrenocorticotropic Hormone, ACTH, Plasma
Cortisol, Serum or Plasma
Cortisol, Free, Urine
Sodium, Serum
Potassium, Serum

Synonyms: Delta-cortef®; Econopred®; Pediapred®; Hydelta-t.b.a.®

Background: Corticosteroids have numerous and widespread effects, including alteration of carbohydrate, protein and lipid metabolism, maintenance in fluid and electrolyte balance, preservation of the appropriate function in cardiovascular, immune, kidney, muscle, and the endocrine system, and in stress coping.

Mainly affected components of the immune defense are:

- Macrophages and monocytes: arachidonic acid, prostaglandins and leukotrienes are inhibited by induction of lipocortin, an inhibitor of phospholipase A2. Inhibition of release or production of Interleukin-1, IL-6, TNF-alpha.
- Endothelial cells: IL and arachidonic acid: same effects as in macrophages. Effects on endothelial leukocyte adhesion molecule-1 and intracellular adhesion molecule-1.
- Basophils: Histamine and leukotriene IgE dependent release is inhibited.
- Fibroblasts: Suppression of growth factor induced DNA synthesis.
- Lymphocytes: Inhibition of IL-1, IL-2, IL-3, IL-6, TNF-alpha, GM-CSF, Interferon-gamma.

Corticosteroids are grouped according their antiinflammatory and sodium retaining potency:

	Antiinflammatory potency	Sodium retaining potency	Half life time (hours)	Equivalent dose oral, I.V.(mg)
Cortisol	1	1	8 - 12	20
Cortisone	0.8	0.8	8 - 12	25
Fludrocortisone	10	125	12 - 36	
Prednisone	4	0.8	12 - 36	5
Prednisolone	4	0.8	12 - 36	5
6 alpha-methylprednisolone	5	0.5	12 - 36	4
Triamcinolone	5	0	12 - 36	4
Betamethasone	25	0	36 - 72	0.75
Dexamethasone	25	0	36 - 72	0.75

Sampling: 2 mL serum
Reference Interval: - 30 ng/mL

Pregnancy-Associated Protein A, Serum f

Related Information: Alpha$_1$-Fetoprotein (AFP), Serum
Chorionic Gonadotropin (HCG, β-HCG), Serum
Estriol
Down Syndrome Risk Calculation

Synonyms: PAPP-A

Background: Useful to asses the risk of trisomy 21 (Down syndrome) in the first trimester screening with PAPP-A and either hCG or free beta HCG in maternal serum is feasible, since trisomy 21 is associated with high concentrations of beta HCG or HCG, low concentrations of PAPP-A and high values of fetal nuchal translucency by ultrasound.
MEDLAB offers a Down Syndrome Risk Calculation.

Primidone, Serum f

Related Information: Carbamazepine, Serum
Folic Acid, Red Blood Cells
Folic Acid, Serum
Phenobarbital, Serum
Phenytoin (Diphenylhydantoin, DPH), Serum
Valproic Acid, Serum or Plasma

Synonyms: Desoxyphenobarbital, Hexamidinum; Majsolin®, Mylepsin®, Mysoline®,Primaclone, Prysolin®

Test includes: Metabolites: Most active: Phenobarbital. Phenylethylmalonamide (PEMA)

Background: Therapeutic levels are reached after 48h. Phenobarbital to primidone ratio is approx. 2.5 and higher in patients on additional anticonvulsants, lower during chronic non-compliance.

Primidone decreases activity of oral anticoagulants.

Primidone and phenobarbital are renal excreted and transformed.

Half life: adults 4 - 12 h, children 4 - 6 h. Protein binding: 20%

Sampling: 2 mL serum or plasma. For monitoring, consistent sampling time recommended.

Reference Interval: Primidone:

Children < 5 years	7 - 10 µg/mL
Adults	5 - 12 µg/mL

Phenobarbital, serum: 15 - 40 µg/mL

Critical values: >12 µg/mL primidone causes CNS depression, vertigo, visual disturbance, areflexia, somnolence, lethargy. Clinical symptoms correlate best with primidone levels. Biphasic overdose: First peak after a few hours and second after 48 h after ingestion.

Toxic: >15 µg/mL

Procalcitonin (PCT), Plasma f

Related Information: C- Reactive Protein, Serum
Interleukin 6 (IL-6)

Background: PCT is a 13 kD protein of 116 amino acids identical to the sequence at position 60-91 of the human prohormone of calcitonin. PCT is known in two froms both measured in the assay, but PCT-1 as the predominant form in serum.

PCT production is upregulated by endotoxins, TNF-alpha, and Interleukin-6 to a significant increase after 6 - 8 h, peaking after 12 - 50 h and declining with a half life time of 25 - 35 h. Renal impairment increases half life up to 40%; hemofiltration may method dependent decrease PCT. As compared to C-reactive protein, PCT increase earlier, the decline respond faster to therapy and the specificity is higher for bacterial infections. .

The parameter is indicated in

- Infectious diseases to differentiate non-bacterial causes in which PCT does not increase such as viral infections, autoimmune diseases, allergies, local limited bacterial infections, chronic inflammatory diseases, toxic ARDS against bacterial infections including sepsis, bacterial meningitis, pancreatitis, septic ARDS, and malaria. In septic patients the marker indicates progression and indicates the degree of systemic inflammatory involvement.
- in monitoring postoperative patients undergoing extensive surgery, patients with severe injuries, shock, and rhabdomyolysis, which are conditions increasing PCT.

Sampling: 2 mL serum

Reference Interval:

Normal	0.005 - 0.05 ng/mL (higher in newborns)
clinical cut off	< 0.5 ng/mL
inflammatory diseases rheumatoid arthritis, Crohn's disease, Colitis ulcerosa, scleroderma, sarcoidosis, systemic lupus erythematodes)	< 0.5 ng/mL
Viral infections (including meningitis)	< 1 ng/mL
Local bacterial infections	< 2 ng/mL
Pneumonias caused by mycoplasma or chlamydia	< 2 ng/mL
Non bacterial infections	< 0.5 ug/L, rarely 1 - 2 ng/mL
ARDS non septic	< 2 ng/mL
Bacterial infections, severe sepsis, septic shock	2 - 10 ng/mL

Procollagen Type I Propeptide f

Related information: Alkaline Phosphatase, Serum
Osteocalcin, Serum or Plasma

Synonyms: Procollagen Extension Peptides, PINP

Background: Type I collagen makes up more than 90% of bone matrix, which is released from osteoblasts as extended amino and carboxyl terminal procollagen and transformed in the liver. The specificity for bone formation is limited due to collagen Type I formation in the skin and by fibroblasts. In combination with other markers valuable for monitoring bone turnover and therapy.

Sampling: 2 mL Serum, unstable at 37°C, refrigerate at 4°C.

Reference Interval: Male: 30 - 202 µg/L
Female: 50 - 170 µg/L

Procollagen Type III Propeptide f

Background: Osteoblasts secrete procollagen molecules which will be cleaved at both ends. The products are cleared by the liver.

Increase parallels non skeletal collagen turnover.

May be elevated in schistosomiasis, subdural hematoma hemorrhage, chronic and acute liver disease, myelofibrosis, skin fibrosis after burn trauma, and polycythemia vera.

Sampling: 2 mL serum

Reference Interval: 0.3 - 0.8 E/mL

Progesterone, Serum f

Related information: Chorionic Gonadotropin (HCG, §-HCG), Serum
Estradiol, Serum
17-alpha-Hydroxyprogesterone (17-OHP)

Background: Progesterone is synthesized in the corpus luteum and after 8 weeks of pregnancy by the placenta. Levels rise during the luteal phase. During pregnancy, increase at the end of the first trimester. Low values in case of miscarriage or ectopic gestation. Beta hCG and progesterone are both lowered in abnormal pregnancy.

For evaluation of infertility, determine luteinizing hormone and progesterone on day 21, progesterone >10 ng/mL, in two tests 3 - 4 days apart indicates adequate luteinization.

High concentrations of 17 hydroxyprogesterone may increase progesterone measurement.

Sampling: 2 mL serum, stable at room temperature for 24 h, at 4°C for 7 days, frozen for 3 month. Please indicate trimester of pregnancy or day of menstrual cycle.

Reference Interval:

male	adult		0.01 - 0.5 ng/mL
female	prepubertal		0.1 - 0.6 ng/mL
	follicular		< 1 ng/mL
	luteal		3 - 25 ng/mL
	pregnancy	first trimester	9.0 - 47 ng/mL
		second trimester	16.8 - 146 ng/mL
		third trimester	55.0 - 255 ng/mL
	postmenopausal		< 1 ng/mL (3.2 nmol/L)

(converting: ug/L x 3.18=nmol/L)

Prograf® see Tacrolimus (FK 506), Whole Blood

Progressive Systemic Sclerosis Antibody see Scl-70 Antibody

Prolactin, Serum f

Related Information: Dehydroepiandrosterone Sulphate (DHEA-S), Serum
Estradiol, Serum
Follicle Stimulating Hormone (FSH), Serum

Background: Prolactin is an anterior pituitary hormone for initiation and maintenance of lactation. Prolactin is secreted in pulses superimposed on a circadian rhythm. Prolactin secretion is increased by physiologic stimuli such as sleep, exercise, hyperglycemia and as side effect of many drugs.

Tumors: Amenorrhea, irregular menses and galactorrhea may indicate prolactinomas. The interpretation of prolactin values in screening for prolactin secreting tumors must consider that non secretory tumors compressing the pituitary stalk may cause increased prolactin secretion. Prolactin values must be interpreted with imaging to confirm a prolactin secretion > 1000 ng/mL by a pituitary adenoma > 1cm. Values between 250 and 1000 ng/mL require careful evaluation.

A second pitfall is due to various forms of circulating prolactin. One form, macro-prolactin, a complex of autoantibody IgG- prolactin, is biologically inactive but immunological in the test reactive. Estimations are up to 25% of diagnosed hyperprolactinism may be caused by macro-prolactin.

Male infertility: A therapeutic option in subfertile men with elevated prolactin levels is bromocriptine. Gynecomastia does not correlate with prolactin levels.

Sampling: 2 mL serum

Reference interval:

0 - 1 month			0 - 90 ng/mL
2 - 11 month			0 - 30 ng/mL
children			2.6 - 21 ng/mL
Male			3 - 30 ng/mL
Female			3 - 30 ng/mL
	pregnancy	1. trimester	< 50 ng/mL
		2. trimester	< 100 ng/mL

Prostate Specific Antigen, Free, Serum f

Related Information: Prostate Specific Antigen, Free, Serum
Prostate Specific Antigen, Serum

Synonyms: fPSA; Free PSA

Background: Since in adenocarcinoma of the prostate a higher amount (> 90%) of PSA will be complexed, free and complexed PSA values may be useful if PSA values are between 4 - 10 ng/mL. Free PSA / Total PSA is typically > 25% in healthy men but < 25% in men with prostatic adenocarcinoma. A cut off of 25% detect 98% of carcinomas at age 50 - 59 years, dropping to 90% at 70 - 75 years in patients presenting a total PSA between 4 - 10 ng/mL.

Sampling: 1 mL serum, stable for 48h refrigerated. Patient's preparation: Avoid prostatic digital examination or biopsy at least 48 h, better 3 - 4 weeks prior to test. PSA has little diurnal variation.

Reference Interval: < 0.5 ng/mL

Prostate Specific Antigen (PSA), Serum f

Related Information: Acid Phosphatase, Total, Plasma
Prostate Specific Antigen, Free, Serum
Prostate Specific Antigen, Serum

Background: PSA is a serine protease, produced nearly exclusively by epithelial cells of prostatic tissue, and function as a liquefaction of seminal coagulum.

Although PSA is a useful marker in diagnosis and monitoring adenocarcinomas after surgery and metastasis of the carcinoma, it may be increased in 25% - 46% of the patients with benign prostatic hyperplasia, depending on the cut off. Proportion of patients with beginn prostatic hypertrophy are < 4 ng/mL in 91%, 4 - 10 ng/mL in 8% and > 10 ng/mL in 1%.

Overall, about one third of patients with levels > 4 ng/mL prostatic carcinoma will be confirmed by biopsy, in two thirds diagnosis will be rejected. 20% - 40% of patients with carcinoma have PSA levels > 4 ng/mL, but PSA may be below the cut off in advanced carcinoma stages. By range, proportion of patients with prostate carcinoma are < 4 ng/mL in 15%, 4 - 10 ng/mL in 20%, >10 ng/mL in 65%.

Interference: Finasteride used in treatment of benign hyperplasia of the prostate causes an up to 50% increase of PSA levels.

Sampling: 1 mL serum, stable for 48 h refrigerated. Patients preparation: Avoid prostatic digital examination or biopsy at least 48 h, better 3 - 4 weeks prior of taking the sample.

Reference Interval: Male < 4 ng/mL. Higher cut off would decrease sensitivity but would decrease biopsy rates because of higher specificity.

By age:	Age (years)	upper limit PSA (ng/mL)
	40 - 50	2.5
	50 - 59	3.5
	60 - 69	5
	70 - 79	6.5
	80 - 89	7.5

Prostatic Acid Phosphatase, Serum f

Related information: Acid Phosphatase, Total, Plasma
Prostate Specific Antigen, Free, Serum
Prostate Specific Antigen, Serum

Synonyms: Tartrate inhibitable phosphatase, PAP

Background: In males, approx. half of the normal total acid phosphatase is of prostatic origin and can be inhibited by tartrate. Metastasis into bone by prostatic adenocarcinoma increases PAP. Sensitivity to detect adenocarcinoma of the prostatic gland in the elderly is in early stages low at 20%, in late stage up to 90%. Sensitivity for detection of metastasis of prostatic adenocarcinoma is approx. 60%.

Sampling: 1 mL serum, within 3 h approx. 20% loss of activity at room temperature occur. Patients preparation: Avoid prostatic digital examination or biopsy at least 48 h prior of sample drawing. High serum bilirubin (> 3 mg/dL) interferes with determination of serum tartrate resistant phosphatase.
Reference Interval: < 4 U/L (total acid phosphatase has also to be measured)

Protein, Liquor see Cerebrospinal Fluid (CSF, Liquor)

Protein C f

Related information: Activated Protein C Resistance
Antithrombin III
Protein S

Background: Protein C with protein S as a cofactor regulates anticoagulation activity. Protein C is a vitamin K dependant zymogen of a serine protease, MW 62000 and function as an anticoagulant together with protein S by degrading activated factor V and VIII. Activation of protein C takes place by interaction with a thrombin-thrombomodulin complex on the surface of endothelial cells. Protein C also promotes fibrinolysis. Type I protein C deficiency is quantitative, Type II results from qualitatively abnormal protein C. As first step of diagnosis a functional assay to detect Type I and Type II disorders is recommended, an antigen assay is needed if the functional assay value is decreased.
Hereditary protein C deficiency is present in 0.14% to 0.5% of the general population and accounts up to 9% of patients with thrombosis and younger than 70 years. Heterozygote protein C deficient patients have a sevenfold increased risk of for venous thrombosis at activity values of 35% to 65%. Homozygous deficiencies are rare with 1:500 000, presenting as newborns with purpura fulminans and disseminated intravascular coagulation (DIC).
Acquired conditions for protein C decrease are decreased hepatic synthesis in liver diseases or L-asparaginase therapy as well as vitamin K deficiency or warfarin therapy. DIC or consumption from thrombosis or surgery may decrease protein C values. Nephrotic syndrome may change protein C levels. Increases are reported with oral contraceptives and pregnancy.
Rare cases of autoantibodies to protein C have been reported.
Warfarin (Coumadin R) decreases protein C levels, patient should be off therapy for 10 days for protein C test.
Half life time is short with 6 - 8 h; decrease is an early indicator for liver dysfunction in coagulopathies.
Sampling: 1 mL citrate plasma. Transport to laboratory soon, or separate plasma and store on ice for up to 4 h, or freeze plasma.
Reference Interval:

Activity (qualitative):	Adult: 70% - 140% Children: at birth 17% - 53%, rising to 50% by the age of 6 month and reach adult values by the age of 16
Immunogenic (quantitative):	1.7 - 3.1 mg/L

Protein Electrophoresis, Serum f

Related information: Albumin, Serum
Alpha$_1$ Antitrypsin, Serum or Phenotyping
Immunoglobulin A (IgA), Serum, Saliva, CSF
Immunoglobulin G (IgG), Serum, Urine, CSF
Immunoglobulin G Subclasses (IgG subclasses)
Immunoglobulin M (IgM)
Protein, Total, Serum

Test includes: Total protein value

Background: Different net charges of proteins are used in separation. Protein concentrations are altered as a result of diseases or stages.

Diagnostic use: multiple myeloma, Waldenstrœm macroglobulinemia, amyloidosis, monoclonal gammopathy. Useful in disease staging in acute or chronic inflammation, autoimmune hepatitis, cirrhosis, humoral immunodeficiency, alpha 1 antitrypsin abnormalities, monoclonal, -oligoclonal, -polyclonal gammopathies.

Indications: Back pain, osteoporosis, osteolytic lesions, hypercalcemia, Bence Jones proteinuria, elevated serum creatinine, recurrent infections, peripheral neuropathy, congestive heart failure, nephrotic syndrome, hepatomegaly, splenomegaly, screening for alpha 1 antitrypsin deficiency, evaluation of chronic liver disease.

Interpretation:

Symptom	Protein	Disease
acute inflammation	normal to decreased albumin increased α_1 and or α_2 globulin increased γ globulin	acute phase reaction
chronic inflammation	normal to deceased albumin elevated α_1 and/or α_2 globulin increased γ globulin	autoimmune disorder, chronic inflammation, chronic liver disease, primary biliary cirrhosis, cancer
hypoalbuminemia	decreased albumin	cancer, malnutrition, protein loosing diseases
hypogammaglobulinemia	normal to decreased albumin decreased γ globulin	congenital immunodeficiencies
polyclonal gammopathy	elevated γ globulin	autoimmune disease, chronic infection, autoimmune hepatitis, cirrhosis
liver cirrhosis	decreased albumin elevated γ globulin	
protein loosing state	decreased albumin elevated α_2 globulin decreased γ globulin	nephrotic syndrome, gastroenteropathies, exudative skin disorders
monoclonal gammopathy	increased γ globulin	AIDS, Gaucher disease, myeloma, CCL, lymphoma, macrolobulinemia
antitrypsin deficiency	decreased α_1 globulin	
hyperbetaglobulinemia	normal to decreased albumin increased β globulin	hyperlipidemia, diabetes mellitus, iron deficiency anemia

Sampling: 1 mL serum, separate serum soon and refrigerate

Reference Intervals:

Albumin	55.0 - 68.9%	35.0 - 55.0 g/L
alpha 1 Globulin	2.0 - 4.5%	1.3 - 3.9 g/L
alpha 2 Globulin	5.9 - 11.1%	4.5 - 8.5 g/L
beta Globulin	8.0 - 13.9%	5.9 - 11.4 g/L
gamma Globulin	10.0 - 20.0%	8.0 - 16.0 g/L

Protein Quantitative, Urine f

Related information: Albumin, Serum
Creatinine, Serum or Plasma
Creatinine, Urine
Creatinine Clearance
Glycosylated Hemoglobin A1c , Blood
Osmolality, Urine
Protein Electrophoresis, Serum
Protein Total, Serum

Background: Useful in the evaluation of proteinuria, renal diseases, complicated diabetes mellitus, nephrotic syndrome, metal poisoning, renal vein thrombosis, systemic lupus erythematosus, constrictive pericarditis, amyloidosis, hypertension, glomerulonephritis, Goodpasture syndrome, Henoch-Schoenlein purpura, thrombotic thrombocytopenic purpura, collagen diseases, cryoglobulinemia, preeclampsia, drug induced nephrotoxicity, allergic reactions, renal tubular lesions, monitoring of myelomas and macroglobulinemia Waldenstrœm (Bence Jones), evaluation of hypoproteinemia, Wilson's disease and Fanconi syndrome.
Usually > 3.5 g/24h reflects a glomerular lesion in adults, in children >1 g/m^2/24h.
Tubular lesions: usually < 1g/24h
In patients with orthostatic proteinuria, combined with an overnight 12 h up to 180 mg value and during the 12 h ambulatory up to 1000 mg, needs further work up.
Interference: Tolbutamide, penicillin, cephalosporins, sulfonamides may increase values.
Sampling: 24 h urine (see section sample collection page)
Reference Interval: < 150 mg/24 h
up to 250 mg/24 h after intensive exercise.
Urinary protein tends to increase with age, exercise and standing posture.
Critical values: Nephrotic syndrome: children > 1g/m^2/24 h
adults: > 3.5 g/24 h

Protein S-100, Serum see S-100, Serum

Protein S Total f

Related Information: Antithrombin III
Factor V Mutation (Leiden Mutation)
Protein C

Background: Protein S together with Protein C and regulates anticoagulant activity by degrading activated factor V and VIII. 60% of total protein S is bound to C4b binding protein and inactive, 40% unbound and active. Quantitative deficiencies (Type I) and Qualitative (Type IIb and IIa) are distinguished.

Protein S levels are decreased by estrogen, pregnancy or warfarin. Warfarin influences protein S levels for up to 10 days after cessation of warfarin.

Factor VIII levels > 200% decrease protein S in functional PTT based assays, Factor VIII should be measured as well, Factor V Leiden may also lower values. Functional Test cannot be performed under hirudin or argatroban anticoagulation therapy.

Use: First perform functional assays to detect all subtypes of deficiency, if decreased, perform free antigen assay in addition, if decreased, perform total (free and bound) antigen assay.

Additional information:

A) Hereditary

Protein S deficiency is present in 0.7% of the population, but up to 8% in patients younger than 70 years with thrombosis, onset usually between 10 and 50 years in heterozygotes and levels at 20% - 60%. Skin necrosis induced by coumarin possible.

Homozygotes rare and fatal present in newborns with DIC or Purpura fulminans.

Classification: All hereditary deficiencies have low functional protein S values.

- normal free protein S values: Type IIb only,
- low total protein S values: Type I only,

B) Acquired

- during liver diseases, levels of protein C may be normal, but protein S and antithrombin are usually decreased, since protein S is also synthesized in endothelial cells and megakaryocytes.
- asparaginase treatment
- vitamin K deficiency or warfarin treatment
- consumption status from thrombosis or DIC
- up to 2 month after pregnancy or estrogen therapy
- acute phase reactions (due to C4b elevation)
- nephrotic syndrome
- varicella infection (possibly via autoantibodies)
- HIV

Sampling: Citrate plasma, 1 mL, invert gently, fill vial completely, deliver to laboratory soon, or separate cells and store on ice up to 4 h, or freeze plasma.

Reference Interval: Activity 60% - 130% Lower for women
Birth to 6 month: Activity 12% - 60% of adult values
free Protein S: 60 - 140 %

Protein Total, Serum a

Related information: Albumin, Serum
Alpha$_1$ Antitrypsin, Serum
Alpha$_1$ Antitrypsin Phenotyping
Immunoglobulin A (IgA), Serum, Saliva, CSF
Immunoglobulin G (IgG), Serum, Urine, CSF
Immunoglobulin G Subclasses (IgG subclasses)
Immunoglobulin M (IgM)
Protein Electrophoresis, Serum
Protein, Quantitative, Urine

Background: Useful in evaluation of protein status, nutritional status, edema, protein altering diseases. Hemolysis can falsely elevate total protein.

Limitation: Increased by phenazopyradine, sulfasalazine, anabolic steroids, angiotensin, bumetanide, corticosteroids, digitalis, furosemide, oral contraceptives, hetastarch, laxatives, tacrolimus.

Interpretation:

Increased:

Dehydration, chronic liver diseases such as autoimmune hepatitis, cirrhosis, neoplasms such as myelomas, macroglobulinemia, tropical diseases such as kala-azar, granulomatous diseases such as sarcoidosis, collagen diseases such as lupus erythematosus, and other inflammatory diseases.

Decreased:

Pregnancy, cirrhosis, liver diseases especially in chronic alcoholism, prolonged immobilization, hear failure, nephrotic syndrome, glomerulonephritis, neoplasia, enteropathies, Crohn disease, Colitis ulcerosa, starvation, malabsorption, hyperthyroidism, burns, serve skin diseases, chronic stages of diseases.

Sampling: 1 mL serum or plasma, transport to laboratory soon or separate cells and refrigerate. Venous stasis during venipuncture can cause increased values.

Reference Intervals:

Adult:	66 - 87 g/L
Early childhood:	61 - 76 g/L

Note: Plasma contains fibrinogen, elevating the plasma protein concentration up to 4 g/L as compared to serum protein concentrations.

Ambulatory values may be slightly higher than those found in recumbency.

Proteinase-3 (PR3) see Antineutrophil Cytoplasmatic Antibody (ANCA)

Prothrombin Mutation see Factor II mutation

Prothrombin Time a

Related Information: Activated Partial Thromboplastin Time
Fibrinogen, Functional
Protein C
Protein S, Total
Thrombin Time

Synonyms: PT; Thromboplastin Time; Quick's Value

Background: PT is defined as the time from activation of Factor VII to the formation of the fibrin clot, testing the function of the extrinsic pathway and the subsequent common pathway of coagulation. (The intrinsic pathway is measured by the activated partial thromboplastin time, PTT.)
Prolongation of PT occur:
Hereditary: such as factor VII deficiency (normal PTT) or possibly combined with PTT prolongation in fibrinogen, factor II, V and X deficiencies.
Acquired: Vitamin K deficiencies, warfarin therapy, liver diseases (PTT slightly and later affected than PT) Disseminated intravascular coagulation (PT changes earlier and greater than PTT)
Heparin therapy (PT normal to minor changes, PTT affected)
Hirudin / argatroban (PT and PTT values change)
Lupus anticoagulants (PT or PTT may be prolonged)
Limitations: PT prolongs at single factor deficiencies more than 15% to 45%. PT is not affected in factor VIII, IX, XI, XII prekallikrein or high-molecular weight kininogen deficiencies, but PTT is affected. Factor XIII deficiency does affect neither PT nor PTT.

Sampling: 2 mL citrate plasma. Avoid strictly contamination with heparin! Separate plasma within 2 days.

Reference Interval:

Normal:	70% - 130% or INR Value 0.85 - 1.18
Therapeutic value:	12% - 33% or INR Value 2.0 - 4.5

O-P

Protoporphyrin Free, Erythrocyte f

Related Information: Delta-Aminolevulinic Acid, Urine
Ferritin, Serum or Plasma
Transferrin and Total Iron Binding Capacity, Serum
Porphobilinogen, Urine
Porphyrins, Quantitative, Urine or Stool

Synonyms: FEP; Free Erythrocyte Protoporphyrin; RBC Protoporphyrin

Background: FEP is a heme precursor. It is increased in erythropoietic porphyria, lead poisoning, iron deficiency. For the latter two zinc protoporphyrin is as better parameter.
Erythropoietic porphyria is an autosomal dominant disorder caused by ferrochelatase deficiency with an onset in childhood and is classified as a nonacute cutaneus porphyria. Usually, the fecal excretion of protoporphyrins as well as plasma and erythrocytic levels are increased

Sampling: To obtain best results, patients should be fasting, alcohol abstinent for 1 day
1 mL EDTA whole blood
Reference Interval: 1 - 10 µg/dL of erythrocytes

Pseudocholinesterase, Serum f

Related Information: Pseudocholinesterase Inhibition Assay
Background: The true cholinesterase is a red cell, lung or brain enzyme, the pseudocholesterinesterase (PChE) is an enzyme in the serum.
The assay is used to screen patients preoperatively for inherent succinylcholine anesthetic sensitivity to prevent prolonged anesthetic apnea, as the laboratory part of the assesment of the cholinergic syndrome. Theses patients need as little as 0.04mg/kg of succinylcholine to result in neuromuscular blockade due to hereditary low PChE activity.
The assay is also used in the evaluation of organophosphorus exposure or intoxication, which leads to a decrease PChE activity.
Limitations: Estrogens, oral contraceptives and liver diseases may lower PChE activity. Low serum PChE does not rule out succinylcholine caused anesthetic incidents.
Sampling: 1 mL serum or heparin plasma. Avoid hemolysis.
Reference Interval: Within the first two month of life lower.
Thereafter: Male: 5 320 - 12 920 U/L
Female: 4 260 - 11 250 U/L

Pseudocholinesterase Inhibition Assay f

Related Information: Pseudocholinesterase, Serum
Background: Dibucaine and fluoride inhibits the normal form of pseudocholinesterase, whereas abnormal forms are less inhibited. 4% of the populations have abnormal forms.
At least four alleles code for the sensitivity to succinylcholine and the inhibition produced by fluoride and dibucaine. E1a codes for inhibition resistance by dibucaine, E1f for fluoride resistance, E1s for a very low enzyme activity, E1u for the usual allele.
It may be possible to conclude from the dibucaine count to the genotype:

Alleles	Dibucaine percent inhibition
E1u E1u	84
E1u E1a	73
E1a E1a	32
E1s E1s	81
E1u E1f	0

Limitations: Not all variants of abnormal PChE can be detected by the dibucaine or the fluoride test.

Sampling: 1 mL serum or heparin plasma.

Reference Interval:	Assay with fluoride	percent inhibition
	Normal homozygous:	40 - 60%
	Atypical homozygous:	74 - 84%
	Atypical heterozygous:	50 - 66%
	Assay with dibucaine	percent inhibition
	Normal homozygous:	80 - 88%
	Atypical homozygous:	15 - 25%
	Atypical heterozygous:	60 - 68%

Pyridinolines f

Synonyms: Deoxypyridinoline, Hydroxylysylpyrolidine, Lysylpyroidine, Pyridinium Collagen Cross-Links, Pyridinoline Crosslinks

Background: Markers for bone matrix resorption and degeneration. As a bone resorption marker, values fall within 2 - 12 weeks during remodeling, during bone formation the marker fall within 3 - 6 month.

Elevated in osteoporosis, Paget disease, metastatic bone resorption, primary and secondary hyperparathyroidism, hyperthyroidism.

Decrease of cross links in hypothyroidism.

Also useful in assessment of patient s risk of fracture, therapy monitoring.

Limitation: Variation day by day up to 20%, affected by renal clearance.

Sampling: Urine, 5 mL, but a 24 h urine collection is preferred due to diurnal variation. Protect from light. Refrigerate. Freeze for storage longer than 2 days.

Reference Interval: Assay measures de(s)oxypyridinoline: 10 - 50 µg/g creatinine

Pyridoxal-5-Phosphate see Vitamin B 6, Plasma or Serum

Pyridoxine see Vitamin B 6, Plasma or Serum

Q Fever see Coxiella burnetii

Quick`s Value (Prothrombin Time) see Prothrombin Time