Sampling: 10 mL random urine, keep refrigerated. If forensic, take precautions to make sure the sample is not substituted, diluted or chemicals added for drug destroy or test disturbance. Ph of the urine is included in the test, further precautions are specific gravity, creatinine to rule out adulteration.

D-Xylose Absorption Test, Serum see Xylose Absorption Test, Serum

Echinococcosis, Serology f

Background: Larval stages of the cestodes (tapeworms) E. granulosus, E. multilocularis and E. vogeli causes diseases in humans.

E. granulosus is one of the smallest tapeworms composed of a scolex and 3 proglottides. Definitive hosts are dogs or other canids, the intermediate host are sheep, caribou, deer, moose, pigs or men. The life cycle involves the canid's intestine where eggs are liberated and may be ingested by the intermediate host. The oncosphere embryos emerge in the small intestine and migrate primarily to the liver but also to the brain, the lung or into bones where they develop in a unilocular fluid filled hydatid cyst. The inner layer produces protoscoleces which may infect dogs by contaminated food.

E. multilocularis: Main definitive hosts are foxes; the intermediate hosts are various rodents. Human infection is due to accidental ingestion of food contaminated with fox feces, affecting primarily hunters and trappers. Endemic areas are in northern Europe, Siberia, Western Canada, and Alaska. In the human liver, the larvae form multiloculated cysts with few protoscoleces. Since an outer fibrous capsule is not build up, cysts can proliferate and honeycomb like tissue may form (alveolar form).

Polycystic hydatid disease of E. vogeli very rarely occurs in humans.

Limitations: Serologic sensitivity for the alveolar form is higher, also higher for the liver than for pulmonary infection. Non specific cross reactivity with other helminths is up to 50%. False positive results are rarely seen in patients with cirrhosis and lupus. False negative in sometimes with large cysts or dead cysts.

Sampling: 1 mL serum

Reference Interval: Report of diagnostic finding of the immunoblot antibody assays for E. granulosus and E. multilocularis

Echo Virus, Serology f

Background: Echo is an acronym for enteric cytopathic human orphan. Echoviruses have a similar structure as other enteroviruses which are members of the single stranded RNA picornavirus family. The transmission mode of the more than 40 serotypes is the fecal oral route. The viruses in the group are the cause of aseptic meningitis, upper respiratory tract infection, febrile

illnesses, with or without rash, diarrhea, hemorrhagic conjunctivitis. There is no vaccine available and immunity after infection dos not last life long.

Sampling: 1 mL serum obtained at onset of the disease and after 2 - 3 weeks.

Reference Interval: Differentiation of immunoglobulin class

IgA antibody negative	< 30 IU/mL
Borderline	30 - 50 IU/mL
Positive	> 50 IU/mL
IgG antibody negative	< 80 IU/mL
Borderline	80 - 100 IU/mL
Positive	> 100 IU/mL

Electrolytes, Liquor see Cerebrospinal Fluid (CSF, Liquor)

ENA see Ribonucleoprotein U1-snRNP Antibody Smith (SM) Antibody
SS-A/Ro and SS-B/La Antibodies

Endomysial Antibodies f

Related Information: Gliadin IgG/IgA Antibodies

Background: Endomysium is an intracellular antigen, mainly a collagen associated enzyme, the tissue transglutinase, occurring in the oesophagus and jejunum. Gliadin is a substrate of the tissue transglutinase. Gliadin is a major constituent of wheat protein and other cereal proteins in rye and barely. Gliadin consists of approx 50 components with a MW of 15-40 KD, triggering antibody production of all classes. Particularly IgA class antibodies are triggered to endomysium, IgG and IgA to gliadin.

Celiac disease, the cause of sprue or gluten sensitive enteropathy is a disease of the jejunum and proximal ileum characterized by villous atrophy. Clinically sprue presents with malabsorption, diarrhea, flatus, steatorrhea, impaired growth, and anemia or weight loss. Normal cholesterol concentration may rule out celiac disease, low serum iron (< 60 ug/dL), low ferritin (50 ug/dL), low Hb may indicate celiac disease. There is an association with HLA-DQ2 and HLA-DQ8. The onset is in infants at the age of 4 - 24 month and rarely later between 20 - 30 years. Dermatitis herpetiformis, a bullous skin disease, is associated with celiac diseases.

The sensitivity of the test for sprue is 94% - 98%, specificity 95% - 100%. There is a good correlation between the antibody titer and the severity of the enteropathy and the degree of histopathology changes. During gluten free diet, titers decrease after 6 - 12 month.

Sampling: 2 ml serum or plasma

Reference Interval: IgA and IgG autoantibody titer negative: < 1:10

Entamoeba histolytica see Amoeba, Direct Examination, Stool

Entero Viruses see Coxsackie Virus, Serology and Echo Viruses, Serology

Enterohemorrhagic Escherichia coli (EHEC), E.coli O157:H7 f

Background: The verotoxin producing E. coli is associated with hemorrhagic colitis presenting with abdominal pain and bloody diarrhea and with the hemolytic-uremic syndrome (HUS) characterized by hemolytic anemia, thrombocytopenia and acute renal failure. Besides the most frequent E.coli strain O157:H7, several other serotypes have also been isolated.

Pathogenesis: Plasmid encodes adherence factors and cytotoxin production are pathogenic factors. The typical O157:H7 strain produces a stripe-like cytotoxin acting on renal endothelial cells and causes lesions (A/E type) on the gut enterocytes characterized by localized destruction of brush border microvilli, intimate bacterial adhesion and cross cytoskeletal reorganization. Atypical EHEC strains do not produce A/E lesions or do not possess the typical 60 MDa plasmid.

There are mild clinical courses known with non-bloody diarrhea and severe hemorrhagic forms particularly in children and the elderly.

Treatment is controversial since antibiotic treatment results in higher rates of HUS due to lysis of bacteria which may increase the release of toxins.

Sampling: approx. 2 g of stool

Reference Interval: Report of diagnostic finding
culture result

Enteropathogenic Escherichia coli (EPEC) f

Related Information: Enterohemorrhagic Escherichia coli (EHEC), E.coli O157:H7

Background: EPEC is important as a cause of diarrhea in infants and in young children. Clinically EPEC presents with mild non-bloody diarrhea or a more severe form. The organism causes lesions (A/E type) on the gut enterocytes is similar to the EHEC form, characterized by affecting microvilli and intimate adherence of bacteria to the epithelium cell membrane. Attachment is mediated by Bfp which is encoded by EAF plasmids, inducing various signaling pathways. Intimate adherence to the epithelial cells is mediated by an outer membrane protein and three other secreted proteins play a role in A/E histopathology.

Antibiotic treatment has shown in some studies to be of some benefit.

Sampling: 2 g stool

Reference Interval: Report of diagnostic finding
culture result

Eosinophil Cationic Protein (ECP) f

Related Information: Eosinophil Count
Immunoglobulin E (IgE)
Pregnancy Associated Protein A, Serum

Background: Eosinophiles are the hallmarks of immune reaction in parasite infection and allergic responses. The intracytoplasmatic granules contain four basic proteins: Major basic protein (MPB) surrounded by eosinophil cationic protein (ECP), the eosinophilic neurotoxin (EDN), and the eosinophil peroxidase (EPO). ECP is a zinc metalloenzyme with a MW of 16 - 22 kDa, gene location is on chromosome 14, six forms are known, and serum half life time 1h.

Main functions of ECP are cytotoxicity on parasites, tumor cells, bacteria, and viruses. Inhibitory to T-cell proliferation, stimulation of histamine release from basophiles, release of mucus from airway cells, interaction with the complement system and adhesion molecules. Procoagulant properties, inhibitory to heparin and ECP may contribute to thrombosis.

Used in evaluation of pulmonary diseases such as asthma, (correlation with degree), idiopathic inflammatory bowl disease, eosinophilic cellulites (Wells syndrome, ECP and IL-5 elevated and correlates with clinical activity).

Limitations: The amount of released ECP from the cells may be influenced by temperature, transit time, and other factors.

Sampling: 1 mL of serum, separate immediately, stable for 1 day at 4°C.

Reference Interval: < 24 ng/mL
Children: 95 percentile 19 µg/L
Adults: 95% interval 2.3 - 15.9 µg/L
Diurnal variation with morning peak.

Epinephrine, Plasma see Catecholamines, Plasma

Epinephrine, Urine see Catecholamines, Urine

Epstein Barr Virus (EBV), Serology f

Background: EBV (common name) is a human herpesvirus (double stranded DNA, external lipid envelope, internal nucleocapsid, 150 - 300 nm in diameter), according to taxonomy classified as human herpesvirus-4, subfamily Gammaherpesvirinae, genus Lymphocryptovirus. EBV seroprevalence is 70 - 95% and the virus is transmitted by oral secretions. The primary sites of infection are epithelial cells of the oropharynx. It gains access to B-cells and acts as a B cell mitogen, stimulating growth and immortalization of B-cells by preventing apoptosis. EBV also alters the interaction of the virus with the immune system. Sites of latency are B-cells, possibly epithelial cells of the nasopharynx and the submandibular glands.

Clinically infectious mononucleosis (glandular fever) presents as fever, malaise (may persist for weeks), sore throat, cervical lymphadenopathy, hepatomegaly splenomegaly, hemolytic anemia. Occasionally encephalitis, myocarditis, pericarditis, neuropathy. Ampicillin treatment may lead to a rash, but does not indicate a life long ampicillin allergy. Chronic courses and relapses have been described. Incubation period 3 - 5 weeks.

In the rare X-linked lymphoproliferative (Dunca«s syndrome) form of EBV infection young males have an immune defect responding to EBV infection. The course of the infection is a fulminant mononucleosis, hepatitis, aplastic anemia.

Burkitt lymphoma (90% association with EBV) patients are young and have large swollen lymph nodes involving the jaws and orbital cavities. Nasopharyngeal carcinoma (100% association) occurs in older males in South East Asia. Hairy leukoplakia and polyclonal lymphoid hyperplasia are also associated with EBV.

The role of EBV in the Hodgkin s disease remains still to be clarified.

Immunocompromised Patients are on risk to develop lymphoproliferative disorders after EBV infection. In AIDS patients, EBV is associated with lymphocytic intestinal pneumonia and in the diffuse form of rapidly progressing encephalitis.

A conventional screening test for infectious mononucleosis are heterophil antibodies (Monospot^{R} or Paul-Bunnell) but up to 20% may be negative in the early phase, disappearing after approx. 3 month, however false positive in this conventional test occur in hepatitis, parvovirus infection, lymphoma, leukemia, rubella, malaria, SLE.

Interpretation:

	no infection	current infection	previous infection
IgG anti VCA	negative	positive	positive
IgM anti VCA	negative	positive	negative
IgG anti EBNA	negative	negative	positive

Early antigen antibodies are detectable for a very short time. Persistent absence of antibody response to viral capsid is strong evidence against infection.

Sampling: 1 mL serum

Reference Interval: Differentiation of immunoglobulin class

Anti-EBNA (EBV nuclear antigen) IgG antibody	negative:	< 15 U/mL
	borderline:	15 – 20 U/mL
	positive:	> 20 U/mL
Anti-VCA (virus capsid antigen) IgG antibody	negative:	< 15 U/mL
	borderline:	15 – 20 U/mL
	positive:	> 20 U/mL
Anti-VCA IgM antibody	negative:	< 15 U/mL
	borderline:	15 – 20 U/mL
	positive:	> 20 U/mL
Anti-early Antigen IgG antibody	negative:	< 10 U/mL
	borderline:	10 – 20 U/mL
	positive:	> 20 U/mL

Improved diagnostic procedure by immunoblot.

Erythema Chronicum Migrans see Borrelia, Serology

Erythema Infectiosum see Parvovirus B19, Serology

Erythropoietin (EPO), Serum f

Related Information: Ferritin, Serum or Plasma
Iron and Total Iron Binding Capacity/Transferrin, Serum
Reticulocyte Count

Background: Erythropoietin, a 18kDa protein mapped on chromosome 7 and produced in the kidney (fetal in the liver) is hypoxia inducible, stimulates proliferation, growth, and differentiation of erythroid precursor cells, increasing erythrocyte count and has a minor effect on megacaryocytes. For maximal stimulation of BFU-E, IL-3 and GM-CSF are required.

Disorders:

Polycythemia Vera (PV) presents with autonomous, EPO independent erythropoiesis, usually with depressed EPO. In other, secondary forms of polycythemias, EPO is normal or elevated. In PV patients, leucocytosis, thrombocytosis, splenomegaly, pruritus erythromelalgia may be present.

EPO may be increased in cyanotic heart diseases, venous arterial shunts, pulmonary causes of hypoxia, in patients with mutant hemoglobins, in Cushing syndrome, renal cysts and arterial stenosis. Drugs which may elevate EPO are anabolic steroids, androgens, TSH, ACTH, angiotensin, epinephrine, fenoterol, and growth hormone.

Decreased in nephrotic syndrome due to renal protein loss, in amphotericin B, cisplatin, furosemide, theophylline treatment.

Sampling: 1 ml serum. To achieve best results, a morning sample is preferred due to circadian rhythm. Maximum EPO occurs at midnight, minimum in the morning. Stable for 2 weeks at room temperature.

Reference Interval:

Children 1-18 years	1 - 21 mU/mL
Adults	2.6 - 34 mU/mL

Higher in pregnancy before week 24.
The normal EPO level is a function of the hematocrit, with an increases of EPO if hematocrit < 40%.

Estradiol, Serum f

Related Information: Follicle Stimulating Hormone (FSH), Serum
Luteinizing Hormone (LH)
Progesterone, Serum

Synonyms: 17-beta-Estradiol; Estradiol-17 beta

Background: Estradiol is the most active estrogen, synthesized mainly by the ovary under the control of FSH. During pregnancy, the placenta is a source too. In males, 75% is derived from testosterone, catalyzed by an aromatase in the periphery tissue, 25% is testis derived.
Diagnosis of decreased values: If test is combined with LH and FSH determination, useful diagnosis of primary (FSH and LH increased) and secondary ovarian failure.
Test may help to decide on the second dose of gonadotropin medication in assisted reproduction.
Rare tumors produce estradiol.
Ethinyl estradiol with or without norgestrel is used for emergency contraception.

Sampling: 1 mL serum, stable for 1 day at room temperature. Note on the request form please phase of menstrual cycle.

Reference Interval:

Children 6 month to 6 years	< 15 pg/mL
Male	< 52 pg/mL
Female	
follicular phase	10 – 165 pg/mL
ovulatory peak	50 – 530 pg/mL
luteal phase	30 – 200 pg/mL
post menopausal	< 38 pg/mL

Ethanol, Blood or Serum or Urine f

Related Information: Acetaminophen, Serum
Alanine Aminotransferase (ALT), Serum
Alkine Phosphatase, Serum
Aspartate Aminotransferase (AST), Serum
Cannabinoids (Marijuana Metabolites) Immunological Drug Screen, Urine
Cocaine, Urine
Gamma- Glutamyl Transferase (Gamma-GT), Serum
Osmolality, Serum

Synonyms: Alcohol; Ethyl Alcohol; EtOH

Background: Ethanol peak levels are reached after 20 - 30 min post ingestion. The kinetics of decline is linear: for example, a 70 kg man metabolizes 7 - 10 g of ethanol per hour.

Endogenous alcohol production in the gastrointestinal tract (GI) may account for up to 0.005%. EtOH levels are monitored during i.v. ethanol treatment in methanol or ethylene glycol intoxication. Ethanol should be considered as a cause of coma, mimicking diabetic, cerebral trauma or drug overdose conditions.

The fetal alcohol syndrome includes low birth weight and small size with failure to meet size or weight target, and/or mental retardation, and/or birth defects particularly facial and cardiac abnormalities.

Interactions: Acetaminophen in therapeutic use and regular ethanol intake can cause severe liver injury. Synergistic effects occur with barbiturates and benzodiazepines.

Sampling: 1 mL of blood or 0.5 mL of Heparin or EDTA plasma or 0.5 mL of serum or 1 mL urine. Prepare venipuncture site with alcohol-free disinfectant (e.g. Betadine or Zephiran). Immediate transport to laboratory in tightly closed tube. 12% - 18% higher values in serum or plasma than in whole blood.

Reference Interval: not detectable
Critical Values: Clinical intoxication 180 – 700 mg/dL
fatal > 700 mg/dL, but critical values are lower with ingested other drugs such as hypnotics or tranquilizers.

Ethosuximide, Serum f

Related Information: Phenytoin, Serum or Plasma

Synonyms: Suxinutin® ; Zarontin®

Background: Ethosuximide is a safe and efficient first choice drug in absence seizures treatment. The drug reduces low threshold Ca2+ currents particularly since reaching therapeutic levels in thalamic neurons. The T-type calcium currents provide in the thalamic neurons a pacemaker responsible for generating the rhythmic cortical discharge typical for the absences.

The drug is metabolized completely to the inactive hydroxylzed form.

Interaction with valproic acid: decrease in ethosuximide clearance and higher steady state

concentration.

Toxicity: psychosis, CNS depression, ataxia, stupor, coma, hypotension. Chronic: Lethargy, confusion, skin rush, ataxia, proteinuria, hematuria, hepatic alteration.

Urinary excretion 10% - 40%; plasma binding < 1%; volume of distribution 0.7 L/kg; half life 35 - 55h decreased in children; peak time 2 - 5h; peak concentration 24 - 44 µg/mL after 250 mg orally steady state.

Sampling: 2 mL serum. Steady state is reached after 5 -15 days.

Reference Interval:	Therapeutic:	40 -100 µg/mL
	Toxic:	> 120 µg/mL

Extractable Nuclear Antigen (ENA) see Ribonucleoprotein U1-snRNP Antibody
Smith (SM) Antibody; SS-A/Ro and SS-B/La Antibodies

Factor II Mutation (Prothrombin Mutation) f

Background: A common hereditary predisposition to venous thrombosis is linked to a mutation at position 20210 in the prothrombin encoding protein on chromosome 1q23. The heterozygous form is present in 2% of the population and in 6% of patients with venous thrombosis. In familial thrombosis it is present in 18%. Homozygous or heterozygous individuals reveal an increased risk for venous thrombosis. The risk for arterial thrombosis is still under discussion.

Sampling: 2 mL EDTA or citrate blood. Do not freeze, store at room temperature or at 4°C. Ship to laboratory within 5 days.

Reference Interval:	Report on diagnostic findings
	Normal: G20210A Mutation not present

Factor V Leiden Screening Test see Activated Protein C Resistance Protein

Factor V Mutation (Leiden Mutation) f

Related Information:	Activated Partial Thromboplastin Time
	Activated Protein C Resistance Protein
	Antithrombin III
	Protein C
	Protein S, Total

Background: The factor V Leiden mutation is a point mutation on chromosome 1q23 replacing guanine at position 1691 by an adenine, which substitutes arginine with glutamine at amino acid residue 506 leading to activated protein C resistance. There is at least one more, very rare factor V mutation. The DNA based method allows determination of heterozygosity and homozygosity