Assay	Clinical Significance
Serum	
AFP Tumor Marker	Alpha-fetoprotein (AFP) is of importance in diagnosing heptocellular carcinoma and is used as a tumor marker in nonseminomatous testicular carcinomas. Alpha-fetoprotein (AFP) is not recommended as a screening test to detect the presence of cancer in the general population. Pregnancy causes elevation of AFP.
BhCG	**In females**, this assay is used to diagnosis pregnancy, investigate suspected ectopic pregnancy, and in monitoring *in vitro* fertilization patients. Diagnosis of pregnancy can be confirmed as early as day 21 of the menstrual cycle or approximately 1 week after conception. A negative value does not rule out pregnancy. A patient with a negative result (less than or equal to 5 mIU/mL) should be redrawn in 2 days and assayed again because hCG values in normal pregnancy double every 48 hours in the first trimester. Beta HCG doubling times are longer than 2 days for ectopic and shorter for molar pregnancies. In vitro fertilization patients are monitored for beta HCG levels 12 days after embryo transfer. This assay aids in the diagnosis of testicular, ovarian, and uterine gestational trophoblastic tumors and germ cell tumors. Serial results can be used to follow tumor response to ablative surgical therapy or chemotherapy.
CA 19-9	CA 19-9 is useful in monitoring pancreatic, hepatobiliary, gastric, hepatocellular, and colorectal cancer.May be used for differentiating patients with cholangiocarcinoma and primary sclerosing cholangitis (PSC) from those with PSC alone.
CA 15-3	A 15-3 is detectable in serum and is widely used as a tumor marker for breast cancer. CA 15-3 has good specificity for both localized and metastatic breast cancer but does not exhibit good sensitivity for localized disease. Elevated CA 15-3 levels are found in the serum of about 60% of preoperative breast cancer patients and in 80% of patients with advanced metastatic breast cancer. CA 15-3 has been used as an indicator of distant metastases (M+ disease) in breast carcinoma and it measures the milk mucin secreted by the tumor. CA 15-3 is insufficiently sensitive in detecting primary or local disease and should not be used for routine screening, diagnosis of localized breast cancer, and follow-up of localized cancers. CA 15-3 is usually not elevated in patients with early stage breast cancer. Elevated levels are found in only 20% of patients with stage I and II disease. Three possible uses of CA 15-3 are: as an adjunct to bone scan, to provide confirmatory results as a screen for metastatic breast cancer, and to monitor patients in follow-up. A rise in CA 15-3 to abnormal levels is highly suggestive of the development of distant metastases. Elevated CA 15-3 levels have been associated with an increase relapse rate in patients who have gone into remission after initial therapy (lead time to relapse, 6.3 months) (1).
CA 125	Conditions that cause elevated CA 125 levels include: ovarian cancer, pregnancy, ovarian cysts, uterine leiomyomas, pelvic inflammatory disease, endometriosis and menstruation. CA 125 is the most important tumor marker for the management of ovarian cancer. It is best used as an adjunct test with ultrasound or in combination with a second tumor marker test. Predictive values approach 100%, when it is added to other diagnostic tests in postmenopausal women. However, because of its lack of specificity, CA 125 is NOT recommended as a general screen for ovarian cancer. Serial CA 125 measurements after surgical debulking and chemotherapy are useful as a prognostic indicator, and the rate of fall of CA 125 levels has a positive correlation with five year survival. Rising CA 125 level post-treatment can often occur before radiological evidence of recurrent disease by as much as 12 months (1).
CEA	Carcinoembryonic antigen (CEA) is a tumor associated antigen. The CEA assay is used as a marker for colorectal, lung, breast, pancreatic carcinoma, and as an adjunct test in the diagnosis of malignant pleural effusions. CEA assay should not be used as a screening test. CEA assays are a useful tool as a marker for recurrent disease and as a test of the effectiveness of treatment. The CEA assay is used to monitor response to therapy of patients following surgery and/or chemotherapy. A persistent elevation in circulating CEA following treatment is strongly indicative of occult metastatic and/or residual disease and a poor therapeutic response. Decreasing CEA values are generally indicative of a favorable prognosis and a good response to treatment. It is important to obtain a preoperative CEA level for prognosis and to assess the success of surgical resection in patients with colorectal and bronchogenic carcinoma. Patients with normal preoperative CEA values tend to have low recurrence rates and longer median survival times. The higher the preoperative CEA level, the shorter the postoperative disease-free period. CEA serum levels may be elevated 2-18 months prior to clinical detection of colorectal disease recurrence.
CK-MB	Determination of CK-MB (mass) in serum is useful in the assessment of myocardial fiber necrosis. This occurs in the acute coronary syndromes (e.g. acute myocardial infarction) and also in myocarditis. In these conditions CK-MB levels are elevated.

C Peptide	C-Peptide levels may aid in distinguishing type 1 and type 2 diabetes. C-Peptide is also useful in the determination of endogenous insulin secretion and the diagnosis of insulinoma. In insulinoma, C-Peptide levels should parallel those of insulin. Factitious hyperinsulinism (i.e., exogenous insulin administration) will have high insulin but low C-Peptide levels.
Cortisol	Cortisol is the main glucocorticoid (representing 75-90% of the plasma corticosteroids). It plays a central role in glucose metabolism, in the body's response to stress, and in protein catabolism. Cortisol is **elevated** in Cushing's disease (pituitary adenoma producing ACTH), in cortisol-secreting adenomas and carcinomas of the adrenal gland and in ectopic ACTH-secreting tumors. Cortisol levels are **decreased** in primary adrenal insufficiency (increased ACTH), secondary adrenal insufficiency (decreased ACTH) and in congenital adrenal hyperplasia. **This test is not useful for following dosage of exogenous, synthetic corticosteroids.**
DHEA-S	Measurement of dehydroepiandrosterone sulfate (DHEA-SO4, DHEAS), an adrenal steroid, is important in the investigation of abnormal hair growth (hirsutism) and balding (alopecia) in women. It is also of value in the assessment of adrenarche and delayed puberty.
Estradiol	Measurement of estradiol is used clinically in the investigation and management of fertility disorders, gynecomastia, estrogen-producing ovarian and testicular tumors and in hyperplasia of the adrenal cortex. Serum E_2 is measured to determine the estrogen status of women, such as in some cases of amenorrhea, and as a guide to monitoring follicular development during ovulation induction and to avoid hyper-stimulation.
Ferritin	Serum ferritin concentration, when analyzed with other factors such as serum iron, iron-binding capacity, and tissue iron stores, is valuable in the diagnosis of iron-deficiency anemia, anemia of chronic disease, and conditions such as thalassemia major and hemochromatosis that are associated with iron overload. Measurement of serum ferritin is particularly valuable in distinguishing iron-deficiency anemia caused by low iron stores from those resulting from inadequate iron utilization.
Folate	Both folate and vitamin B_{12} deficiency can cause macrocytic anemia. Appropriate treatment depends on the differential diagnosis of the deficiency. Folate deficiency is usually due to: malnutrition, malabsorption due to disease of the proximal small bowel, increased requirement as in pregnancy and chronic hemolytic states, or acute illness. Folate deficiency may result in depression or macrocytic anemias.
Free T3	Clinically, the FT3 measurement is a second or third level test of thyroid function. It is useful for evaluating the biochemical status of clinically euthyroid patients who have an altered distribution of binding proteins, such as pregnant patients and patients with dysalbuminemia. It also provides a further confirmatory test for hyperthyroidism to supplement the FT4 and sensitive thyrotropin assays. Some investigators recommend the FT3 assay for monitoring thyroid replacement therapy, although it's clinical role is not precisely defined.
Free T4	Free T_4 levels give a more accurate picture of the thyroid status in patients with abnormal T_4-binding globulin levels such as those who are pregnant or those who are receiving treatment with estrogens, androgens, dilantin, or salicylates.
FSH	FSH levels are used as an adjunct in the evaluation of menstrual irregularities, in the workup of patients with suspected hypogonadism, in the prediction of ovulation, in the evaluation of infertility and in the diagnosis of pituitary disorders.
HAV Antibody, IgM	This assay is a qualitative procedure for detecting the presence or absence of hepatitis A virus IgM in serum and plasma specimens. The HAV IgM test is used as an aid in the diagnosis of an acute or recent (usually six months or less) hepatitis A viral infection. This test should be ordered when acute Hepatitis A infection is suspected. IgM antibodies are present at the onset of symptoms and peak approxima The symptoms of hepatitis A may include fatigue, poor appetite, fever and vomiting. Urine may become darker in color, and then jaundice may appear. The disease is rarely fatal and most people recover in a few weeks without any complications. Infants and young children tend to have very mild symptoms and are less likely to develop jaundice than older children and adults.tely 4 weeks later. IgM antibodies usually disappear 3 - 6 months after the onset of disease. The presence of HAV- specific IgM in serum indicates a current or recent infection. The incubation period is 10 - 50 days with a mean incubation time of 1 month.
HAV Antibody, IgG	The presence of anti-HAV IgG in human serum or plasma is indicative of past infection or immunization with Hepatitis A virus. The test for Anti-HAV IgG is used to determine previous exposure to hepatitis A virus. The result of this assay may be used to assess immune status or for epidemiological studies.
HBc Antibody, IgM	This assay aids in the diagnosis of acute or recent (usually six months or less) hepatitis B viral infection. IgM anti-HBc arises early in the illness of patients with acute hepatitis B, but it rapidly decreases in titer. HBV core IgM levels are generally not detectable 6 - 24 months after the onset of illness. The incubation period for hepatitis B is approximately 70 days (range, 30 - 180 days)

HBc Antibody, Total	A positive result indicates acute, recent, resolving or past infection with hepatitis B. Both total and IgM hepatitis B core antibody will be positive in the “core window” when hepatitis B surface Ag is negative.
HBs Antibody	This assay aids in the diagnosis of Hepatitis B **Immune Status**.
HBsAg/Conf	HBsAg assay is used to aid in the diagnosis of hepatitis B, to monitor the status of infected individuals (i.e., whether the patient has resolved infection or has become a chronic carrier of the virus), and to evaluate the efficacy of anti-viral drugs. The CDC recommends a prenatal screening of all pregnant women so that newborns from HBV carrier mothers may obtain prophylactic treatment. The incubation period for hepatitis B is approximately 70 days (range, 30 - 180 days) HBsAg appears in the serum 2-7 weeks before the onset of symptoms. It usually persists in the blood throughout the illness and disappears with convalescence.
HCV IgG Antibody	The hepatitis C antibody assay can assist in the diagnosis of chronic Hepatitis C infections. The incubation period is approximately 50 days (range, 15-150 days). (1) HCV antibody tests cannot detect acute hepatitis C infection because seroconversion may not occur for 8-16 weeks after exposure. Anti-HCV invariably becomes positive later in the course of the disease. Patients with initially seronegative samples should be retested in 3-6 months.
HIV 1/2 AB, p24 Ag	The initial screen is a 4th generation assay that detects both HIV-1 p24 antigen and antibodies to HIV-1 (groups M and O) and HIV-2. The new screen will detect acute HIV infection, on average 7 to 10 days earlier than the previously used antibody-only screen. Positive screen confirmation antibody testing to distinguish HIV-1 from HIV-2 will be performed in-house within 24 hours of initial testing. Western blots (currently a send-out test) will no longer be ordered. Rarely, additional molecular-based confirmation testing for HIV-1 and/or HIV-2 will be performed (Send Out) as delineated in the algorithm below. All test results will be included in a single report with a final interpretation. HIV-1 IgG is first detectable 3-12 weeks after infection in nearly all cases except neonates. Once established, HIV antibody levels usually persist throughout the lifetime of the patient. The presence of antibody does not imply immunity to the virus but rather, that the patient is assumed to be infected, and infectious. Little is known about the antibody response to HIV-2 infection. The response is presumed to be similar to HIV-1.
Homocysteine	Elevated homocysteine levels are found in patients with recessively inherited metabolic defects such as cystathionine ß-synthase deficiency and decreased methyl tetrahydrofolate reductase activity. Individuals with cystathionine ß-synthase deficiency may have serum homocysteine levels up to 200 micromoles/L. Homocysteine levels may be elevated in vitamin B6, B12, and folate deficiencies. Homocysteine has been shown to be an independent risk factor for atherosclerotic vascular disease. Homocysteine levels greater than the 90th percentile of normal are associated with increased risk for acute myocardial infarction. The risk for coronary vascular disease increases progressively with homocysteine concentration. There is a 13-fold increase in risk associated with a level of 19 micromoles/L as compared to a 9 micromoles/L homocysteine concentration.
Insulin	Insulin assay is used for the quantitative measurement of insulin in serum. This test is used as aid in the diagnosis of insulin-producing neoplasms (islet cell tumor, insulinoma), pancreatic islet cell hyperplasia, to evaluate hypoglycemia, and to evaluate insulin production in diabetes mellitus. Insulinoma is a rare, islet-cell tumor with insulin hypersecretion. Nintey percent of these tumors are benign. Patients with insulinoma present with hypoglycemia that is the result of the inappropriate secretion of insulin by the tumor. Plasma insulin concentrations decrease progressively in normal fasting patients. Patients with an insulinoma present with high insulin levels and hypoglycemia. Plasma insulin-to-glucose ratios are also purportedly useful to diagnose insulinoma (1).
LH	LH levels are used as an adjunct in the evaluation of menstrual irregularities, in the workup of patients with suspected hypogonadism, in ovulation timing, in the evaluation of infertility, and in the diagnosis of pituitary disorders.
Myoglobin	Serum myoglobin is used in the assessment of skeletal or myocardial muscle injury. Increases in serum myoglobin are usually detected earlier than increases in CK, CK-MB, or troponin in patients with acute myocardial infarction. This assay is also used to diagnose rhabdomyolysis. Myoglobin levels increase with muscle trauma or ischemia, malignant hyperthermia, exertion, dermatomyositis, polymyositis, and muscular dystrophies.
Progesterone	The determination of progesterone is utilized in fertility diagnosis for the detection of ovulation, assessment of the luteal phase, and to monitor progesterone replacement therapy. After ovulation, there is dramatic rise in progesterone levels (1-21 ng/mL) that persists for about two weeks. If pregnancy occurs, corpus luteum survival is prolonged until progesterone is secreted by the placenta. In in-vitro fertilization (IVF) patients progesterone levels are maintained at concentrations (greater than 40 ng/mL) with additional progesterone replacement. Decreased levels of progesterone are seen in the short and inadequate luteal phase, and in the first trimester of abnormal pregnancies. Progesterone is secreted by the adrenal gland in adult males and in children. In addition, high levels of progesterone can indicate tumors of the adrenals or ovaries.

Prolactin	Prolactin levels aid in the diagnosis of pituitary tumors, amenorrhea, galactorrhea, infertility, and hypogonadism. Prolactin levels aid in monitoring therapy of prolactin-producing tumors. Prolactin values greater than 200 ng/mL usually indicate prolactinomas. For most other causes listed above Prolactin values are less than 200 ng/mL.
PSA, Free	The % fPSA is used to determine the risk of prostate cancer. Recent studies have suggested that fPSA testing may improve the sensitivity of the PSA test for prostate cancer detection and can minimize unnecessary prostate biopsies in patients with tPSA values between 2.5 and 10 ng/mL. The ultimate decision to perform prostate biopsy should be made by the clinician, based on all relevant clinical and laboratory findings. Elevated levels of Prostate Specific Antigen (PSA) have been associated with benign and malignant prostatic disorders. Studies indicate that in men 50 years or older measurement of PSA is a useful addition to the digital rectal exam in the early detection of prostate cancer. In addition, PSA decreases to undetectable levels following complete resection of the tumor and may rise again with recurrent disease or persist with residual disease. Thus, PSA levels may be of assistance in the management of prostate cancer patients.
PSA, Total	PSA is a serine protease (Kalikrein family) produced by epithelial cells of the acini and ducts of prostate gland. Normally, very little PSA is secreted into the blood. Increased PSA levels may be due to increases in glandular size and tissue damage caused by benign prostatic hypertrophy, prostatitits, and/or prostate cancer. The tPSA assay is used to monitor patients with a history of prostate cancer, both as an indicator of tumor recurrence and response to therapy. The American Cancer Society recommends annual examination with digital rectal examination (DRE) and serum tPSA beginning at age 50 for men with a life expectancy of at least 10 years after detection, Men in a high risk group (African Americans) or those with strong familial predisposition, testing may begin at a younger age.
Testosterone, Total	Serum testosterone assays aid in the evaluation of males with erectile dysfunction, gynecomastia, osteoporosis, infertility, delayed or precocious puberty, and for monitoring replacement therapy, evaluation of women with hirsutism, virilization, and oligomenorrhea, and in the evaluation of infants with ambiguous genitalia and/or virilizing syndromes.
Troponin I	Increases in troponin I occur in acute coronary syndromes with myocardial necrosis as well as myocardial infarction with ST elevation. Troponin I is detectable about 3-4 hours after the occurrence of cardiac symptoms. Following acute myocardial ischemia, troponin I remains in the serum for several days and can help to detect myocardial events that have occurred up to 7-10 days earlier. Increases are also associated with direct myocardial damage (e.g., myocarditis, pericarditis, contusion, cardioversion), myocardial strain (e.g., CHF, pulmonary hypertension, pulmonary embolus) and demand ischemia (e.g., sepsis, hypotension, atrial fibrillation). Troponin may also be elevated in entities such as renal failure, intracranial hemorrhage and amyloidosis. The mechanism for the latter elevations is unclear. An elevated troponin level is a predictor for poor outcome regardless of its cause.
TSH	TSH levels aid in evaluating thyroid function and replacement therapy. They are especially useful in the differential diagnosis of primary (thyroid) from secondary (pituitary) and tertiary (hypothalamus) hypothyroidism. In primary hypothyroidism, TSH levels are significantly elevated, while in secondary and tertiary hypothyroidism, TSH levels are low or normal. When testing patients on thyroid hormone replacement, blood should be obtained shortly before the patients next dose. Testing shortly after thyroid hormone intake should not affect TSH results, however it may result in an apparently elevated free T4. If a patient's dose of thyroid hormone is changed, it is recommended that 6-8 weeks be allowed to elapse before retesting.
Vitamin B12	Vitamin B_{12} deficiency is usually due to malabsorption resulting from: deficiency of intrinsic factor, disease or resection of the terminal small bowel, or utilization of the vitamin by excessive bacterial flora in the gut. It may also occur in strict vegetarians where insufficient Vitamin B_{12} is present in the diet. Vitamin B12 deficiency can result in: macrocytic anemia, neuropathy, psychiatric changes, mental impairment (dementia), and infertility. Since macrocytic anemia often requires measurement of both Vitamin B12 and folate levels it may be more economical and convenient to perform both tests at the same time.
BNP	Recommendations for use are: When CHF is suspected, but the diagnosis is not clear cut. Consider re-ordering BNP 1-2 days prior to hospital discharge, looking for a decrease of greater than 50% of admission level or an absolute level of less than 500 pg/mL. Patients with this type of decline are much less likely to be re-admitted because of CHF in the next few weeks. Frequent or daily monitoring of BNP is not appropriate and is strongly discouraged.

PCT	Procalcitonin (PCT) has been shown to help decrease inappropriate antibiotic use and thereby decrease the rate of rise of antibiotic resistance**. It should only be ordered in patients if it will change antibiotic management.** It has been studied in a number of disease states, but the best evidence for use is as an aid in deciding whether to start antibiotics in patients with potential lower respiratory tract disease, as well as an aid in deciding to stop antibiotics in patients with suspected/confirmed sepsis. It should not be used in isolation, i.e. without incorporating other clinical & lab data. Cannot be used in localized infections, e.g. cellulitis, meningitis. Cannot distinguish between infection and colonization, e.g. asymptomatic bacteriuria vs. UTI. Should not be used to alter accepted management of documented infections, e.g. pyelonephritis, Staphylococcus aureus bacteremia, etc. NOTE: Use of PCT will be audited by the Antimicrobial Stewardship Team and feedback to providers on appropriateness will be performed on an ongoing basis. PCT is a precursor of calcitonin and is thought to increase during bacterial infections as a result of bacterial blockade of calcitonin synthesis. In patients with bacterial infections it rises rapidly (detectable within 2-4 hours and peaks within 6-24 hours) and declines with control of infection. Unlike many other inflammatory biomarkers (e.g. C-reactive protein, ESR) PCT is not elevated in most non-infectious processes or non-bacterial infections. It is undetectable in healthy patients.
Sex Hormone Binding Globulin	SHBG may be useful in the differential diagnosis of hirsutism and in the assessment of bioavailable testosterone.
Vitamin D, 25-OH Total	This assay is used to diagnose vitamin D deficiency and aids in the differential diagnosis of hypo and hypercalcemia. Increased vitamin D levels may lead to hypertension, nephrolithiasis, and metastatic calcifications.
iPTH	A significant difficulty with parathyroid surgery is the possibility of missing an ectopic hyperfunctioning gland. Prior to surgery a baseline PTH level is drawn. If the PTH does not decrease by 50%, the surgeon may first send a frozen section to confirm that parathyroid tissue was indeed removed, and based on this result explore for an undetected enlarged gland. In most cases intra-operative PTH testing will save surgical time and minimize the need for follow-up surgery.

Peritoneal	
CA 19-9	Useful initially, in the classification of an effusion as an exudate or a transudate. Measuring CA 19-9 in peritoneal fluid can be used as an adjunct to cytology to differentiate between malignancy-related ascites and benign causes of ascites formation. Do not use peritoneal fluid carbohydrate antigen CA 19-9 (CA 19-9) levels as absolute evidence of the presence or absence of malignant disease. The evaluation and diagnosis of malignancy-related ascites is based on the patient clinical history, ascites fluid analysis and imaging tests.

Pleural	
CA 19-9	Useful initially, in the classification of an effusion as an exudate or a transudate.

Pancreatic	
CEA	Testing is used to determine whether a pancreatic cyst is likely to be benign or malignant. However these results cannot be used in isolation and should be used in conjunction with clinical information, imaging studies, and cytology. The higher the CEA concentration the more likely a cyst is a mucinous cyst with increased likelihood of malignancy. CEA greater than 200 ng/mL is very suggestive but not diagnostic of a mucinous cyst. Much lower CEA concentrations are usually seen with non-mucinous cysts. Results should be used in conjuction with clinical information, imaging studies, cytology, and pancreatic cyst tumor markers.
CA 19-9	Testing is used to determine whether a pancreatic cyst is likely to be benign or malignant. However these results cannot be used in isolation and should be used in conjunction with clinical information, imaging studies, and cytology.CA 19-9 concentrations less than or equal to 37 U/mL indicate a low risk for a mucinous cyst, and are more consistent with serous cystadenoma or pseudocyst. However, very low concentrations should be viewed with caution since CA 19-9 is a modified Lewis(a) blood group antigen and may not be produced by Lewis non-secretors.