LAB #: H000000-0000-0
PATIENT: Sample Patient
ID: PATIENT-S-00001
SEX: Male
AGE: 9

CLIENT #: 12345
DOCTOR:
Doctor's Data, Inc.
3755 Illinois Ave.
St. Charles, IL 60174

Toxic & Essential Elements; Hair

TOXIC METALS

		RESULT µg/g	REFERENCE INTERVAL	PERCENTILE 68th / 95th
Aluminum	(Al)	9.0	< 8.0	
Antimony	(Sb)	0.088	< 0.066	
Arsenic	(As)	0.14	< 0.080	
Barium	(Ba)	0.30	< 0.75	
Beryllium	(Be)	< 0.01	< 0.020	
Bismuth	(Bi)	0.13	< 2.0	
Cadmium	(Cd)	0.025	< 0.070	
Lead	(Pb)	0.92	< 1.0	
Mercury	(Hg)	1.1	< 0.40	
Platinum	(Pt)	< 0.003	< 0.005	
Thallium	(Tl)	< 0.001	< 0.002	
Thorium	(Th)	< 0.001	< 0.002	
Uranium	(U)	0.010	< 0.060	
Nickel	(Ni)	0.13	< 0.20	
Silver	(Ag)	0.14	< 0.14	
Tin	(Sn)	0.32	< 0.30	
Titanium	(Ti)	0.51	< 0.70	
Total Toxic Representation				

ESSENTIAL AND OTHER ELEMENTS

		RESULT µg/g	REFERENCE INTERVAL	PERCENTILE 2.5th / 16th / 50th / 84th / 97.5th
Calcium	(Ca)	157	160– 500	
Magnesium	(Mg)	11	12– 50	
Sodium	(Na)	100	20– 200	
Potassium	(K)	100	12– 140	
Copper	(Cu)	11	11– 32	
Zinc	(Zn)	350	110– 190	
Manganese	(Mn)	0.28	0.08– 0.50	
Chromium	(Cr)	0.60	0.40– 0.70	
Vanadium	(V)	0.079	0.025– 0.10	
Molybdenum	(Mo)	0.14	0.040– 0.090	
Boron	(B)	3.6	0.50– 3.5	
Iodine	(I)	0.48	0.25– 1.3	
Lithium	(Li)	0.010	0.007– 0.020	
Phosphorus	(P)	146	150– 220	
Selenium	(Se)	0.84	0.70– 1.1	
Strontium	(Sr)	0.21	0.21– 2.1	
Sulfur	(S)	50900	44000– 51000	
Cobalt	(Co)	0.009	0.004– 0.020	
Iron	(Fe)	10	7.0– 16	
Germanium	(Ge)	0.028	0.030– 0.040	
Rubidium	(Rb)	0.086	0.008– 0.080	
Zirconium	(Zr)	0.42	0.060– 0.70	

SPECIMEN DATA

COMMENTS:

Date Collected: 10/13/2011   Sample Size: 0.198 g
Date Received: 12/8/2011   Sample Type: Head
Date Completed: 12/10/2011   Hair Color: Brown
Methodology: ICP/MS   Treatment:
                                 Shampoo:

RATIOS

ELEMENTS	RATIOS	RANGE
Ca/Mg	14.3	4– 30
Ca/P	1.08	0.8– 8
Na/K	1	0.5– 10
Zn/Cu	31.8	4– 20
Zn/Cd	> 999	> 800

0001544

HAIR ELEMENTS REPORT
INTRODUCTION

Hair is an excretory tissue for essential, nonessential and potentially toxic elements. In general, the amount of an element that is irreversibly incorporated into growing hair is proportional to the level of the element in other body tissues. Therefore, hair elements analysis provides an indirect screening test for physiological excess, deficiency or maldistribution of elements in the body. Clinical research indicates that hair levels of specific elements, particularly potentially toxic elements such as cadmium, mercury, lead and arsenic, are highly correlated with pathological disorders. For such elements, levels in hair may be more indicative of body stores than the levels in blood and urine.

All screening tests have limitations that must be taken into consideration. The correlation between hair element levels and physiological disorders is determined by numerous factors. Individual variability and compensatory mechanisms are major factors that affect the relationship between the distribution of elements in hair and symptoms and pathological conditions. It is also very important to keep in mind that scalp hair is vulnerable to external contamination of elements by exposure to hair treatments and products. Likewise, some hair treatments (e.g. permanent solutions, dyes, and bleach) can strip hair of endogenously acquired elements and result in false low values. Careful consideration of the limitations must be made in the interpretation of results of hair analysis. The data provided should be considered in conjunction with symptomology, diet analysis, occupation and lifestyle, physical examination and the results of other analytical laboratory tests.

Caution: The contents of this report are not intended to be diagnostic and the physician using this information is cautioned against treatment based solely on the results of this screening test. For example, copper supplementation based upon a result of low hair copper is contraindicated in patients afflicted with Wilson's Disease.

Aluminum High

The Aluminum (Al) level in hair may be an indicator of exposure and assimilation of this element, provided that hair preparations have not added exogenous Al. Al is a nonessential element that can be toxic if excessively assimilated into cells.

Excess Al can inhibit the formation of alpha-keto glutarate and result in toxic levels of ammonia in tissues. Al can bond to phosphorylated bases on DNA and disrupt protein synthesis and catabolism. Al excess should be considered when symptoms of presenile dementia or Alzheimer's disease are observed. Hair Al is commonly elevated in children and adults with low zinc and behavioral/learning disorders such as ADD, ADHD and autism. Individuals with renal problems or on renal dialysis may have elevated Al.

Possible sources of Al include some antacid medications, Al cookware, baking powder, processed cheese, drinking water, and antiperspirant components that may be absorbed. Analyses performed at DDI indicate extremely high levels of Al are in many colloidal mineral products.

Al has neurotoxic effects at high levels, but low levels of accumulation may not elicit immediate symptoms. Early symptoms of Al burden may include: fatigue, headache, and symptoms of phosphate depletion.

A urine elements test can be used to corroborate Al exposure. Al can be effectively complexed and excreted with silicon (J. Environ. Pathol. Toxicol. Oncol., 13(3): 205-7, 1994). A complex of malic acid and Mg has been reported to be quite effective in lowering Al levels (DDI clients).

Antimony High

Hair is a preferred tissue for analysis of Antimony (Sb) exposure and body burden. Elevated hair Sb levels have been noted as long as a year after exposure.

Sb is a nonessential element that is chemically similar to but less toxic than arsenic. Food and smoking are the usual sources of Sb. Thus cigarette smoke can externally contaminate hair, as well as contribute to uptake via inhalation. Gunpowder (ammunition) often contains Sb. Firearm enthusiasts often have elevated levels of Sb in hair. Other possible sources are textile industry, metal alloys, and some antihelminthic and antiprotozoic drugs. Sb is also used in the manufacture of paints, glass, ceramics, solder, batteries, bearing metals, semiconductors and fire retardant fabrics.

Like arsenic, Sb has a high affinity for sulfhydryl groups on many enzymes. Sb is conjugated with glutathione and excreted in urine and feces. Therefore, excessive exposure to Sb has the potential to deplete intracellular glutathione pools.

Early signs of Sb excess include: fatigue, muscle weakness, myopathy, nausea, low back pain, headache, and metallic taste. Later symptoms include hemolytic anemia, myoglobinuria, hematuria and renal failure. Transdermal absorption can lead to "antimony spots" which resemble chicken pox. Respiratory tissue irritation may result from inhalation of Sb particles or dust.

A confirmatory test for recent or current exposure is the measurement of Sb in the urine or whole blood. Comparison of pre and post provocation (DMPS, DMSA, Ca-EDTA) urine Sb levels provides an estimate of net retention (body burden) of Sb.

Arsenic High

In general, hair provides a rough estimate of exposure to Arsenic (As) absorbed from food and water. However, hair can be contaminated externally with As from air, water, dust, shampoos and soap. Inorganic As, and some organic As compounds, can be associated with toxicity. Inorganic As accumulates in hair, nails, skin, thyroid gland, bone and the gastrointestinal tract. Organic As, such as that derived from shellfish, is rapidly excreted in the urine.

As can cause malaise, muscle weakness, vomiting, diarrhea, dermatitis, and skin cancer. Long-term exposure may affect the peripheral nervous, cardiovascular and hematopoietic systems. As is a major biological antagonist to selenium.

Common sources of As are insecticides (calcium and lead arsenate), drinking water, smog, shellfish (arsenobetaine), and industrial exposure, particularly in the manufacture of electronic components (gallium arsenide).

As burden can be confirmed by urine elements analysis. Comparison of urine As levels pre and post provocation (DMPS, DMSA, D-penicillamine) permit differentiation between recent uptake and body stores.

Mercury High

Hair mercury (Hg) is an excellent indiator of exposure to methylmercury from fish. Mercury is toxic
to humans and animals. Individuals vary greatly in sensitivity and tolerance to Hg burden.

Hg can suppress biological selenium function and may cause or contribute to immune dysregulation in
sensitive individuals. Hallmark symptoms of excess Hg include: loss of appetite, decreased senses
of touch, hearing, and vision, fatigue, depression, emotional instability, peripheral numbness and
tremors, poor memory and cognitive dysfunction, and neuromuscular disorders. Hair Hg has been reported
to correlate with acute myocardial infarction and on average each 1 µg/g of hair Hg was found to
correlate with a 9% increase in AMI risk (Circulation 1995; 91:645-655).

Sources of Hg include dental amalgams, fish, water supplies, some hemorrhoidal preparations, skin
lightening agents, instruments (thermometers, electrodes, batteries), and combustion of fossil fuels,
Ayurvedic herbs, some fertilizers, and the paper/pulp and gold industries. After dental amalgams are
installed or removed a transient (several months) increase in hair Hg is observed. Also, "baseline"
hair Hg levels for individuals with dental amalgams are higher (about 1 to 2 µg/g) than are baseline
levels for those without (below 1 µg/g).

Confirmatory tests for elevated Hg are measurement of whole blood as an indication of recent/ongoing
exposure (does not correlate with whole body accumulation) and measurement of urine Hg before and after
administration of a dithiol metal binding agent such as DMSA or DMPS (an indication of total body burden).

Tin High

Hair Tin (Sn) levels have been found to correlate with environmental exposure. Depending on
chemical form, Sn can be a potentially toxic element. Inorganic Sn has a low degree of toxicity,
while organic Sn has appreciable toxicity.

The main source of Sn is food. Other possible sources are: dental amalgams, cosmetics,
preservatives, food and beverage containers, pewter, bronze, and anticorrosive platings.
Symptoms of excess Sn include: skin, eye, and GI tract irritation, muscle weakness, anemia, and
testicular degeneration.

A confirmatory test for excessive accumulation of Sn is the measurement of Sn in urine before
and after provocation with a chelation/complexing agent (Ca-EDTA, DMPS, DMSA).

Calcium Low

Hair Calcium (Ca) levels have been correlated with nutritional intake, several disease syndromes, and
metabolic disorders. Interpretation of low hair Ca levels is difficult and other variables need to be
considered.

Ca is the most abundant element in the body. Although most Ca is contained in the skeletal system, Ca is
actively involved in muscle contraction, the nervous system, hormone secretion, and immunological
responses.

Causes of Ca deficiency include but are not limited to inadequate dietary Ca, protein or vitamin D, excess
dietary phosphorus and malabsorption. Malabsorption is likely if other essential elements such as

magnesium, cobalt, manganese, and chromium are also at low levels in hair. Other factors associated with poor Ca status include physical inactivity, chronic stress, hormonal imbalance, aluminum containing antacids, chronic use of diuretics or laxatives, high alcohol intake, and exposure to toxic elements (e.g. lead, cadmium).

Symptoms of Ca deficiency include: muscle cramps or tetany, myalgia, and skeletal pain. Chronic Ca deficiency (or negative balance) results in osteoporosis.

Hair is vulnerable to external contamination by Ca as a result of hair treatments (permanent solutions, dyes, bleach). Other means to assess Ca status include: dietary assessment, whole blood elements analysis, and measurement of bone density, serum vitamin D-3, and parathyroid hormone.

<div align="center">Magnesium Low</div>

Low hair Magnesium (Mg) levels may be indicative of Mg deficiency, but this has not been unequivocally demonstrated. When hair Mg is low, dietary intake and malabsorption should be considered. Mg is an essential element/electrolyte that is necessary for the activity of many important enzymes. Low hair Mg may or may not be associated with physiological dysfunction.

Causes of Mg deficiency include: consumption of a "junk food" diet or Mg-deficient foods, intestinal malabsorption, hypocalcemia with decreased Mg retention, chemical toxicity with renal wasting, alcoholism, alkalosis, prolonged diarrhea/laxative abuse, and iatrogenic causes (digoxin therapy, occasionally from oral contraceptives, hypercalcemic drugs, gentamicin, neomycin).

Symptoms of Mg deficiency include: muscle twitching, cramps, tremor or muscle spasms, paresthesia, and mental depression. Low Mg status is associated with arrythmias and increased cardiovascular risk.

Mg status can be difficult to assess; whole blood and packed red cell levels are more indicative than serum/plasma levels. Amino acid analysis can be helpful in showing rate-limited steps that are Mg-dependent such as phosphorylations. Taurine deficiency is often associated with urinary loss of Mg. The Mg challenge method may be indicative: baseline 24-hour urine Mg measurement, followed by 0.2 mEq/Kg intravenous mg, followed by 24-hour Mg measurement. A deficiency is judged to be present if less than 80% of the administrered Mg is excreted in the urine.

<div align="center">Copper Normal</div>

Hair Copper (Cu) levels are usually indicative of body status, except that exogenous contamination may occur giving a false normal (or false high). Common sources of contamination include: permanent solutions, dyes, bleaches, and swimming pools/hot tubs in which Cu compounds have been used as algaecides.

Cu is an essential element that activates specific enzymes. Erythrocyte superoxide dismutase (SOD) is a Cu (and zinc) dependent enzyme; lysyl oxidase which catalyzes crosslinking of collagen is another Cu dependent enzyme. Adrenal catecholamine synthesis is Cu dependent, because the enzyme dopamine beta-hydroxylase, which catalyzes formation of norepinephrine from dopamine, requires Cu.

If hair Cu is in the normal range, this usually means tissue levels are in the normal range. However, under circumstances of contamination, a real Cu deficit could appear as a (false) normal. If symptoms of Cu deficiency are present, a whole blood or red blood cell elements analysis can be performed for confirmation of Cu status.

Zinc High

A result of high hair Zinc (Zn) may be indicative of low Zn in cells, and functional Zn deficiency. Zn can be displaced from proteins such as intracellular metallothionein by other metals, particularly cadmium, lead, copper, and mercury (Toxicology of Metals, 1994), resulting in paradoxically elevated hair Zn. Zn may also be high in hair as a result of the use of Zn-containing anti-dandruff shampoo. Rough or dry, flaky skin is a symptom of Zn deficiency, so it is not uncommon for Zn deficient patients to use an anti-dandruff shampoo. A result of high hair Zn warrants further testing to assess Zn status.

Zn is an essential element that is required in many very important biological processes. However, Zn can be toxic if exposure is excessive. Although very uncommon, high hair Zn might be indicative of Zn overload which could result from Zn contaminated water (galvanized pipes), welding or gross, chronic over-supplementation (100 mg/day). Other sources of Zn include: manufacture of brass, bronze, white paint, and pesticide production. Symptoms of Zn excess include: gastrointestinal disorders, decreased heme synthesis (copper deficiency), tachycardia, blurred vision, and hypothermia.

Confirmatory tests for Zn status are whole blood or packed red blood cell elements analysis, urine amino acid analysis, and serum ceruloplasmin (low with Zn induced copper deficiency).

Boron High

Boron (B) is normally found in hair but the correlations among B absorption, and tissue and hair levels of B have yet to be determined. B has a low order of toxicity, but excessive intake induces riboflavinuria. Exogenous contamination of hair with B is possible since B is present in some soaps. B is also present in some cleaners, cements, ceramics, and glass.

Total Toxic Element Indication

The potentially toxic elements vary considerably with respect to their relative toxicities. The accumulation of more than one of the most toxic elements may have synergistic adverse effects, even if the level of each individual element is not strikingly high. Therefore, we present a total toxic element "score" which is estimated using a weighted average based upon relative toxicity. For example, the combined presence of lead and mercury will give a higher total score than that of the combination of silver and beryllium.