

Blood and Urine Collection

Venipuncture

Public Health Objectives:

Venipuncture is performed to obtain laboratory results that provide prevalence estimates of disease, risk factors for exam components, and baseline information on health and nutritional status of the population.

Staff:

Certified Phlebotomist

Protocol:

Methods:

Blood is drawn from the examinee's arm. In the laboratory the blood is processed, stored and shipped to various laboratories for analysis. The complete blood count (CBC) results are reported in the MEC and all other results are reported from NCHS to the participant. The volume of blood drawn by age follows.

- 1-2 years, 9 ml (0.3 ounces), 0.6 tablespoons
- 3-5 years, 22 ml (0.7 ounces), 1.5 tablespoons
- 6-11 years, 38 ml (1.2 ounces), 2.5 tablespoons
- 12+ 89-92 ml (3.0 ounces), 6.0 tablespoons

Time Allotment:

Depending on age of participant. Range 5-10 minutes

Health Measures:

Laboratory test results.

Eligibility:

Sample persons aged 1 year and older who do not meet any of the exclusion criteria

Exclusion Criteria:

- Hemophiliacs
- Participants who received chemotherapy within last 4 weeks
- The presence of the following on both arms: rashes, gauze dressings, casts, edema, paralysis, tubes, open sores or wounds, withered arms or limbs missing, damaged, sclerosed or occluded veins, allergies to cleansing reagents, burned or scarred tissue, shunt or IV.

Justification for using vulnerable populations:

- Minors are included in this component because they are an important target population group. Laboratory data are linked to other household interview and health component data and are used to track changes that occur in health over time.
- There is no reason to exclude mentally impaired or handicapped individuals because there is no contraindication.

Risks:

The following are known risks associated with venipuncture:

- Hematoma
- Swelling, tenderness and inflammation at the site
- Persistent bleeding
- Vasovagal response - dizziness, sweating, coldness of skin, numbness and tingling of hands and feet, nausea, vomiting, possible visual disturbance, syncope and injury fall from fainting.
- Rare adverse effects:
 - Thrombosis of the vein due to trauma
 - Infection which results in thrombophlebitis

Special precautions:

- Sterile equipment issued with all sample persons.
- Physician on call in case an adverse affect occurs.

Report of Findings:

Reported in the MEC:

Complete Blood Count (CBC)

Reported from NCHS:

Other laboratory results

Urine Collection

Public Health Objectives:

Urine is collected to obtain laboratory results that provide prevalence estimates of disease, risk factors for exam components, and baseline information on health and nutritional status of the population.

Staff:

MEC Coordinator

Protocol:

Methods:

Urine is collected from individuals ages 6 years and above.

Time Allotment:

2 minutes

Health Measures:

Laboratory test results.

Eligibility:

Sample persons aged 6 years and above.

Exclusion Criteria:

None

Justification for using vulnerable populations:

- Minors are included in this component because they are an important target population group. Laboratory data are linked to other household interview and health component data and are used to track changes that occur in health over time.
- There is no reason to exclude mentally impaired or handicapped individuals because there is no contraindication.

Risks:

None

Special precautions:

None

Report of Findings:

Reported in the MEC:

Pregnancy Test

Reported from NCHS:

Other laboratory results

Bone Markers

Laboratory Measures:

Bone alkaline phosphatase and Urinary NTX

Public Health Objectives:

Evaluation of bone mineral status will utilize measures of total bone mineral content and bone mineral density two markers of bone turnover: Bone alkaline phosphatase, a formative marker in serum and NTX, a resorptive marker in urine.

It has been estimated that the annual cost of osteoporosis is about \$10 billion. The magnitude of this problem is likely to increase dramatically over the next few decades as the population ages. The risk of hip fractures (the most costly fractures in terms of morbidity, mortality and health care costs) begins to increase exponentially after age 65.

Important pieces of data are not currently available about the changes in bone mass in the population, especially in minority populations. There are no data on total body bone measures from a nationally representative sample. Measures of total body bone mineral content or density will allow researchers to gain insights into age, sex, and racial/ethnic differences in the skeleton relative to other measures of body composition such as total muscle and fat mass, as well as behavioral factors such as diet and activity.

Childhood and adolescence are the periods to target for intervention strategies in osteoporosis. Measurement in younger individuals will provide insight into early racial/ethnic differences in the rate of bone accretion. Furthermore, correlation of DXA measures with bone markers over age can provide information about the utility of these markers as surrogates for bone density or content when seeking age of peak bone mass or indicators of high or low bone turnover. This information is crucial to understanding when the best and most effective dietary intervention can be implemented to maximize peak bone mass.

NHANES is the only nationally representative survey that can shed light on when peak bone mass is attained and the degree of total body bone loss with age. This information is vital to all aspects of treatment and prevention of this disease and is particularly critical to government funding of related research, medical screening, treatment, and reimbursement programs.

Data on bone status and its relationship to age among racial ethnic groups can be used to target osteoporosis prevention programs to the most important age groups. The data from the DXA scans and the bone marker studies will also provide important reference distributions and allow studies of the association between bone status, diet, activity, and other body composition measures.

Health Measures, Eligibility, Report of Findings:

Health Measure	Eligibility	Volume Required	Report of Findings Level		
			1	2	3
Bone alkaline phosphatase	10 and older	500 uL			
Urinary NTX	10 and older	2 mL			

Diabetes Profile

Laboratory Measures:

Glucose, Insulin, C-peptide and Glycohemoglobin

Public Health Objectives:

Diabetes mellitus will be assessed by measures of plasma glucose, insulin, c-peptide and glycohemoglobin in examinees ages 12 years and over.

Diabetes is a leading cause of disease and death in the United States. Eight million Americans are known to have diabetes, and an equal number have undiagnosed diabetes. In 1993, nearly 18 percent of all deaths for persons over the age of 25 were among people with diabetes. The prevalence of diabetes and overweight (one of the major risk factors for diabetes) continue to increase. Substantial new efforts to prevent or control diabetes have begun, including the Diabetes Prevention Trial and the National Diabetes Education Program.

Information on the prevalence of diabetes disease, especially in its early stages, and associated risk factors will be used to help develop early intervention and prevention programs for the disabling consequences of this condition. Specifically, the diabetes disease examination will provide population data to: 1) determine a national estimate of diabetes disease prevalence (diagnosed and undiagnosed), including those at high risk for the late complications of the disease (i.e., ulceration and amputation); 2) identify the risk factors of diabetes disease; 3) permit a national cohort to be established for follow-up studies of this condition; and 4) provide critical information to clinicians and public health officials for the development of preventive care and community-based interventions.

Health Measures, Eligibility, Report of Findings:

Health Measure	Eligibility	Volume Required	Report of Findings		
			Level 1	Level 2	Level 3
Glucose	12 and older	1 mL		✓	✓
Insulin/C-peptide	12 and older	1 mL			
Glycohemoglobin	12 and older	400 uL		✓	✓

Infectious Disease Profile

Laboratory Measures:

Cryptosporidium, Helicobacter pylori, Hepatitis viruses

Public Health Objectives:

Cryptosporidium

Cryptosporidium is an important cause of outbreaks of waterborne disease in the United States. In 1993, two outbreaks of cryptosporidiosis occurred in large metropolitan areas (Milwaukee and Las Vegas/Clark County) and were associated with deaths among immunocompromised persons. While these waterborne outbreaks are increasingly being recognized, it is unclear how much endemic waterborne cryptosporidiosis occurs due to low level contamination of drinking water. To provide an estimate of exposure to this organism, the prevalence of antibodies to Cryptosporidium will be measured in NHANES participants age 6-49 years. This estimate will support a CDC/EPA response to a Congressional mandate to evaluate the burden of waterborne disease in the United States.

Helicobacter pylori

This organism has been shown to be the causative agent in chronic-active gastritis, and evidence has almost completely satisfied Koch's postulates for this organisms' pathogenicity in primary duodenal ulcers. More recent evidence has suggested that chronic *H. pylori* infection as well as early age of *H. pylori*-acquisition is a critical precursor to gastric carcinoma. Although an explosion of research has occurred over the past decade, many fundamental questions remain to be answered. These questions must be addressed in a carefully considered manner that combines systematic, demographic epidemiology with the knowledge of *H. pylori* positivity or negativity. Furthermore, at-risk cohorts should be particularly examined to address unresolved controversies regarding route of transmission, environmental risk factors (i.e., food or water), inheritability or familial tendencies for infection susceptibility, factors leading to carcinogenesis, the demographics of susceptibility in very young children, and possible growth disturbances caused by *H. pylori* infection. Because NHANES will have numerous data on environmental exposures, these data can be analyzed to add information on potential route of transmission for this organism.

Hepatitis viruses

Viruses that primarily infect the liver constitute a major public health problem because of the morbidity and mortality associated with the acute and chronic consequences of these infections. New immunization strategies have been developed to eliminate transmission of hepatitis B and hepatitis A viruses in the United States. Because of the high rate of asymptomatic infection with both viruses, NHANES will provide the best means for determining the age-specific effectiveness of immunization strategies to prevent these infections. In addition, NHANES provides the means to better define the epidemiology of hepatitis viruses that were recently characterized, such as hepatitis C, E and G virus along with D and possibly F. In NHANES testing for markers of infection with the hepatitis viruses will be used to determine secular trends in infection rates across most age and racial/ethnic groups, and will provide a national picture of the epidemiologic determinants of these infections.

Health Measures, Eligibility, Report of Findings:

Health Measure	Eligibility	Volume Required	Report of Findings Level		
			1	2	3
Cryptosporidium	6-49	500 uL			
Helicobacter pylori	3 and older	200 uL			
Hepatitis viruses	2-5 (anti-HBs),6+	1 mL		✓	

Markers of Immunization Status

Laboratory Measures:

Measles, rubella, varicella.

Public Health Objectives:

Measles

Measles is a highly infectious disease which was targeted for elimination in the United States by the year 1996. The elimination strategy called for vaccination of all susceptible persons at age 12-15 months and at 4-11 years. NHANES will assess age-specific population immunity, taking into account vaccinees who never develop antibodies, persons who may lose immunity over time, and persons who are immune from natural disease. The U.S. measles elimination goal for 1996 came at a time when measles elimination was being considered as an achievable goal world-wide by the World Health Organization. If success can be demonstrated in the U.S. as well as other countries in the hemisphere, world-wide efforts to eliminate measles will be encouraged. The benefit from a study of measles seroprevalence will be to document age-specific immunity that is found following measles elimination efforts and to help judge the levels of immunity that are needed to eliminate measles.

Rubella

Congenital rubella syndrome (CRS) is the term used to describe the serious birth defects that occur among infants born to women infected with rubella while pregnant. A single rubella vaccination, usually given as measles-mumps-rubella (MMR) vaccine, is thought to confer lifelong immunity. Widespread use of the vaccine has resulted in near elimination of CRS in the United States. In recent years, an increasing proportion of rubella cases have been reported among adults, and outbreaks have occurred among persons of Hispanic ethnicity. Population-based rubella seroprevalence studies would provide valuable information about specific groups that lack rubella immunity and therefore could be targeted for immunization. Therefore serologic testing of NHANES participants will be conducted to document the level of immunity to rubella by race and ethnicity and allow comparison data from NHANES III.

Varicella

In March 1995, a vaccine for prevention of varicella (chicken pox) was licensed for use in persons 1 year of age and older. Wide use of the vaccine may change the epidemiology of the disease with a shift in incidence to older persons who are at higher risk than are younger persons for more severe disease and complications. Older persons may have severe complications such as encephalitis and/or death if they develop varicella. Additionally, pregnant women can pass on varicella if they develop it in the last weeks of gestation with severe life-threatening consequences to the newborn. NHANES provides a unique opportunity to assess changes in the seroprevalence of immunity to varicella after introduction of the vaccine. Demographic data on immune and susceptible persons will help target vaccination programs toward groups at risk for disease.

Health Measures, Eligibility, Report of Findings:

Health Measure	Eligibility	Volume Required	Report of Findings Level		
			1	2	3
Measles	6-49	100 uL			
Rubella	6-49	200 uL			
Varicella	6-49	100 uL			

Miscellaneous Laboratory Assays

Laboratory Measures:

C-reactive protein, Fibrinogen, Latex allergy, Standard Biochemical Profile includes Alanine Aminotransferase (ALT), Albumin, Alkaline Phosphatase (ALP), Aspartate Aminotransferase (AST), Bicarbonate (HCO_3), Blood Urea Nitrogen (BUN), Calcium, Cholesterol, Creatinine, Gamma Glutamyltransaminase (γ -GT), Glucose, Iron, Lactate Dehydrogenase (LDH), Phosphorus, Sodium, Potassium, and Chloride, Total Bilirubin, Total Protein, Triglycerides, and Uric Acid.

Public Health Objectives:

C-reactive protein

C-reactive protein is considered to be one of the best measures of the acute phase response to an infectious disease or other cause of tissue damage and inflammation. It is used to correct the iron status measures which are affected by inflammation. It can also be used to measure the body's response to inflammation from chronic conditions, such as arthritis, and environmental exposures to agents such as tobacco smoke.

Fibrinogen

Fibrinogen is an essential blood clotting factor and is also involved in a range of other functions, including platelet aggregation and smooth muscle proliferation. A growing body of evidence has identified fibrinogen as an important risk factor for cardiovascular disease, the major cause of death in the U.S. The objective of including this measure is to provide data on laboratory, clinical, and socio-demographic correlates of fibrinogen levels. Of particular importance in NHANES, the data will be used to study the relationship between fibrinogen levels and clinically measured lower extremity arterial blood flow as assessed by the Ankle-Brachial Index in the Lower Extremity Disease component.

Latex allergy

Since the late 1980's, the number of reports of hypersensitivity reactions to natural rubber latex has risen dramatically, occurring concomitantly with the increased demand for and use of latex products that resulted from the introduction of guidelines to prevent the transmission of blood borne pathogens (e.g., hepatitis B, HIV). The emergence of latex allergy now represents a significant public health problem. Serologic screening for latex-specific IgE in NHANES will provide an estimate of the prevalence of latex sensitization, enable determination of secular trends in the emergence of this problem and help delineate demographic factors (e.g., age, occupation) for the development of latex sensitization. Data collected during the survey will be used to identify other at-risk groups and to formulate strategies/guidelines for the prevention of latex sensitization and, ultimately, life-threatening hypersensitivity reactions.

Standard biochemical profile

This battery of measurements are used in the diagnosis and treatment of certain liver, heart, and kidney diseases, acid-base imbalance in the respiratory and metabolic systems, other diseases involving lipid metabolism and various endocrine disorders as well as other metabolic or nutritional disorders.

- a. Alanine Aminotransferase (ALT)
Alanine aminotransferase measurements are used in the diagnosis and treatment of certain liver diseases (e.g., viral hepatitis and cirrhosis) and heart diseases. Elevated levels of the transaminases can indicate myocardial infarction, hepatic disease, muscular dystrophy, or organ damage. Serum elevations of ALT activity are rarely observed except in parenchymal liver disease, since ALT is a more liver-specific enzyme than aspartate aminotransferase (AST).
- b. Albumin
Albumin measurements are used in the diagnosis and treatment of numerous diseases primarily involving the liver or kidneys.
- c. Alkaline Phosphatase (ALP)
Increased ALP activity is associated with two groups of diseases: those affecting liver function and those involving osteoblastic activity in the bones. In hepatic disease, an increase in ALP activity is generally accepted as an indication of biliary obstruction. An increase in serum phosphatase activity is associated with primary hyperparathyroidism, secondary hyperparathyroidism owing to chronic renal disease, rickets, and osteitis deformans juvenilia due to vitamin D deficiency and malabsorption or renal tubular dystrophies. Increased levels of ALP are also associated with Von Recklinghausen's disease with bone involvement and

- malignant infiltrations of bone. Low levels are associated with hyperthyroidism, and with the rare condition of idiopathic hypophosphatasia associated with rickets and the excretion of excess phosphatidyl ethanolamine in the urine.
- d. Aspartate Aminotransferase (AST)
AST measurements are used in the diagnosis and treatment of certain types of liver and heart disease. Elevated levels of the transaminases can signal myocardial infarction, hepatic disease, muscular dystrophy, or organ damage.
 - e. Bicarbonate (HCO_3^-)
Together with pH determination, bicarbonate measurements are used in the diagnosis and treatment of numerous potentially serious disorders associated with acid-base imbalance in the respiratory and metabolic systems.
 - f. Blood Urea Nitrogen (BUN)
BUN measurements are used in the diagnosis of certain renal and metabolic diseases. The determination of serum urea nitrogen is the most widely used test for the evaluation of kidney function. The test is frequently requested in conjunction with the serum creatinine test for the differential diagnosis of prerenal, renal, and postrenal uremia. High BUN levels are associated with impaired renal function, increased protein catabolism, nephritis, intestinal obstruction, urinary obstruction, metallic poisoning, cardiac failure, peritonitis, dehydration, malignancy, pneumonia, surgical shock, Addison's disease, and uremia. Low BUN levels are associated with amyloidosis, acute liver disease, pregnancy, and nephrosis. Normal variations are observed according to a person's age and sex, the time of day, and diet, particularly protein intake .
 - g. Calcium
Elevated total serum calcium levels are associated with idiopathic hypercalcemia, vitamin D intoxication, hyperparathyroidism, sarcoidosis, pneumocystic carinii pneumonia and blue diaper syndrome. Low calcium levels are associated with hypoparathyroidism, pseudohypoparathyroidism, chronic renal failure, rickets, infantile tetany, and steroid therapy.
 - h. Cholesterol
An elevated cholesterol level is associated with diabetes, nephrosis, hypothyroidism, biliary obstruction, and those rare cases of idiopathic hypercholesterolemia and hyperlipidemia; low levels are associated with hyperthyroidism, hepatitis, and sometimes severe anemia or infection.
 - i. Creatinine
Creatinine measurement serves as a test for normal glomerular filtration. Elevated levels are associated with acute and chronic renal insufficiency and urinary tract obstruction. Levels below 0.6 mg/dL are of no significance.
 - j. Gamma Glutamyltransaminase (γ -GT)
 γ -GT measurement is principally used to diagnose and monitor hepatobiliary disease. It is currently the most sensitive enzymatic indicator of liver disease, with normal values rarely found in the presence of hepatic disease. It is also used as a sensitive screening test for occult alcoholism. Elevated levels are found in patients who chronically take drugs such as phenobarbital and phenytoin.
 - k. Glucose
Glucose measurements are used in the diagnosis and treatment of pancreatic islet cell carcinoma and of carbohydrate metabolism disorders, including diabetes mellitus, neonatal hypoglycemia, and idiopathic hypoglycemia.
 - l. Iron
Iron (non-heme) measurements are used in the diagnosis and treatment of diseases such as iron deficiency anemia, chronic renal disease, and hemochromatosis (a disease associated with widespread deposit in the tissues of two iron-containing pigments, hemosiderin and hemofuscin, and characterized by pigmentation of the skin) .
 - m. Lactate Dehydrogenase (LDH)
LDH measurements are used in the diagnosis and treatment of liver diseases such as acute viral hepatitis, cirrhosis, and metastatic carcinoma of the liver; cardiac diseases such as myocardial infarction; and tumors of the lungs or kidneys .
 - n. Phosphorus

There is a reciprocal relationship between serum calcium and inorganic phosphorus. Any increase in the level of inorganic phosphorus causes a decrease in the calcium level by a mechanism not clearly understood. Hyperphosphatemia is associated with vitamin D hypervitaminosis, hypoparathyroidism, and renal failure. Hypophosphatemia is associated with rickets, hyperparathyroidism, and Fanconi syndrome. Measurements of inorganic phosphorus are used in the diagnosis and treatment of various disorders, including parathyroid gland and kidney diseases and vitamin D imbalance.

o. Sodium, Potassium, and Chloride

Hyponatremia (low serum sodium level) is associated with a variety of conditions, including severe polyuria, metabolic acidosis, Addison's disease, diarrhea, and renal tubular disease. Hyponatremia (increased serum sodium level) is associated with Cushing's syndrome, severe dehydration due to primary water loss, certain types of brain injury, diabetic coma after therapy with insulin, and excess treatment with sodium salts.

Hypokalemia (low serum potassium level) is associated with body potassium deficiency, excessive potassium loss caused by prolonged diarrhea or prolonged periods of vomiting and increased secretion of mineralocorticosteroids. Hyperkalemia (increased serum potassium level) is associated with oliguria, anuria, and urinary obstruction.

Low serum chloride values are associated with salt-losing nephritis, Addisonian crisis, prolonged vomiting, and metabolic acidosis caused by excessive production or diminished excretion of acids. High serum chloride values are associated with dehydration and conditions causing decreased renal blood flow, such as congestive heart failure.

p. Total Bilirubin

Elevated levels are associated with hemolytic jaundice, paroxysmal hemoglobinuria, pernicious anemia, polycythemia, icterus neonatorum, internal hemorrhage, acute hemolytic anemia, malaria, and septicemia. Low bilirubin levels are associated with aplastic anemia, and certain types of secondary anemia resulting from toxic therapy for carcinoma and chronic nephritis .

q. Total Protein

Total protein measurements are used in the diagnosis and treatment of a variety of diseases involving the liver, kidney, or bone marrow, as well as other metabolic or nutritional disorders .

r. Triglycerides

Triglyceride measurements are used in the diagnosis of diabetes mellitus, nephrosis, liver obstruction, and other diseases involving lipid metabolism and various endocrine disorders and in the treatment of patients with these diseases .

s. Uric Acid

Uric acid measurements are used in the diagnosis and treatment of numerous renal and metabolic disorders, including renal failure, gout, leukemia, psoriasis, starvation or other wasting conditions and in the treatment of patients receiving cytotoxic drugs.

Health Measures, Eligibility, Report of Findings:

Health Measure	Eligibility	Volume Required	Report of Findings Level		
			1	2	3
C-reactive protein	3 and older	300 uL			
Fibrinogen	40 and older	1 uL			
Latex allergy	12-59	500 uL			
Biochemistry profile	12 and older	1 mL		✓	✓
				✓	✓
				✓	✓
					✓
				✓	✓
				✓	✓
				✓	✓
					*
				✓	✓
					✓
					*
					*
					✓
				✓	✓
				✓	✓
				✓	✓
				✓	✓
				✓	✓
		*			
	✓	✓			

* Value reported from different assay

Kidney Disease Profile

Laboratory Measures:

Serum creatinine, blood urea nitrogen and diabetic status, urinary albumin and creatinine

Public Health Objectives:

The purpose of the kidney and urologic diseases portion of the NHANES is to determine prevalence of specific nephrologic and urologic conditions in the population; to determine the association between health conditions such as diabetes and hypertension and the development of kidney and urologic diseases; to monitor trends in the prevalence of these diseases and their risk factors over time. These data will be used to assist in planning for initiatives and other programs for the prevention and treatment of nephrologic and urologic diseases.

Blood specimens will be used to obtain measures of serum creatinine, blood urea nitrogen and diabetic status; urinary albumin and creatinine will be measured. Self-reported information on chronic analgesic use and incontinence will be collected.

The incidence of end stage kidney failure is increasing rapidly in the U.S. in adults of all age groups which implies that the prevalence of progressive renal impairment is also increasing. However, little information is known about the prevalence of chronic renal impairment on a national level. Urologic disease, including urinary incontinence affect a large proportion of the population. Little nationally representative data on the prevalence and risk factors associated with these conditions are available.

Health Measures, Eligibility, Report of Findings:

Health Measure	Eligibility	Volume Required	Report of Findings Level		
			1	2	3
Creatinine/blood urea nitrogen	12 and older	1 mL		✓	✓
Urinary albumin and creatinine	6 and older	2 mL			

Hormone Profile

Laboratory Measures:

Follicle stimulating hormone (FSH), Luteinizing hormone (LH), Thyroid stimulating hormone (TSH), thyroxin (T4), pregnancy test.

Public Health Objectives:

- Follicle stimulating hormone, luteinizing hormone
- Serum FSH and LH levels and questionnaire data on menstrual history will be used to classify women according to menopausal status. This information and data on exogenous hormone use are important for evaluating women's risk for certain health conditions such as cardiovascular disease and osteoporosis (see reproductive health questionnaire section).
- Thyroid stimulating hormone, thyroxine
- Serum TSH and T4 levels will be used to assess thyroid function and will provide population-based reference information on these hormone levels. Thyroid function will be examined in relation to measures of exposure to endocrine disrupting substances, which are hypothesized to effect thyroid function (see laboratory protocol for environmental exposure assessments).
- Pregnancy test
- Information on current pregnancy status will be used to exclude participants from the DXA examination and for interpretation of current nutritional status and body measures.

Health Measures, Eligibility, Report of Findings:

Health Measure	Eligibility	Volume Required	Report of Findings Level		
			1	2	3
Serum: FSH/LH	35-60 females	0.5 mL			✓
Serum: TSH/T4	12+ (1/3 sample)	1 mL		✓	✓
Urine: Pregnancy Test	18 – 59 females	1 mL			✓

Nutritional Biochemistries and Hematologies

Laboratory Measures:

Complete blood count
 Erythrocyte protoporphyrin
 Serum folate
 RBC folate
 Serum iron & TIBC
 Serum ferritin
 Serum vitamin A
 Serum vitamin E
 Serum carotenoids
 Plasma homocysteine
 Serum vitamin B₁₂

Public Health Objectives:

The objectives of this component are: 1) to provide data for monitoring secular trends in measures of nutritional status in the U.S. population; 2) to evaluate the effect of people's habits and behaviors such as physical activity and the use of alcohol, tobacco, and dietary supplements on people's nutritional status; and 3) to evaluate the effect of changes in nutrition and public health policies including welfare reform legislation, food fortification policy, and child nutrition programs on the nutritional status of the U.S. population.

These data will be used to estimate deficiencies and toxicities of specific nutrients in the population and subgroups, to provide population reference data, and to estimate the contribution of diet, supplements, and other factors to serum levels of nutrients. Data will be used for research to further define nutrient requirements as well as optimal levels for disease prevention and health promotion.

Health Measures, Eligibility, Report of Findings:

Health Measure	Eligibility	Volume Required	Report of Findings Level		
			1	2	3
Complete blood count	1 and older	300 uL		✓	✓
Erythrocyte protoporphyrin	1 and older	400 uL			✓
Serum folate	3 and older	1 mL		✓	✓
RBC folate	3 and older	100 uL		✓	✓
Serum iron & TIBC	1 and older	1.25 mL			✓
Serum ferritin	1 and older	1.25 mL		✓	✓
Transferrin saturation	1 and older	1.25 mL		✓	✓
Serum vitamin A	3 and older	400 uL		✓	✓
Serum vitamin E	3 and older	400 uL			
Serum carotenoids	3 and older	400 uL			
Retinyl esters	3 and older	400 uL			
Plasma homocysteine	3 and older	1 mL			
Selenium	3 and older	1 mL			
Methyl malonic acid	3 and older	1 mL			
Serum vitamin B ₁₂	3 and older	1 mL		✓	✓

Sexually Transmitted Disease Profile

Laboratory Measures:

Chlamydia trachomatis, Neisseria gonorrhoeae, Herpes simplex 1 and 2, HIV

Public Health Objectives:

Chlamydia trachomatis and Neisseria gonorrhoeae (Urine Test)

Sexually transmitted infections caused by Chlamydia trachomatis and Neisseria gonorrhoeae may lead to pelvic inflammatory disease, ectopic pregnancy, infertility, and chronic pelvic pain in women. They may also increase the risk of HIV transmission in women. Pregnant women may transmit infection to their newborn causing serious medical complications. At the present the prevalence of chlamydial and gonococcal infection in the general population of the United States is unknown. NHANES offers an opportunity to assess the prevalence of chlamydial and gonococcal infection in the general population and to monitor trends in prevalence as prevention programs are established and expanded.

Herpes simplex 1 and 2 (Blood Test)

Sera from NHANES subjects ages 14-49 will be tested for antibody to Herpes simplex 1 and 2 (HSV-1/2) to continue to monitor the prevalence of HSV-1/2 infection in the U.S. HSV-1 is a common chronic infection that is associated with lower socioeconomic status. HSV-2 is an index of sexually transmitted infections. In addition, questions about those sexual behaviors that are risk factors for sexually transmitted infections and that are the focus of major national HIV and sexually transmitted diseases risk reduction efforts will be included. The joint availability of sexually transmitted infection and risk factor data in a national sample on a periodic basis is a unique and invaluable resource for evaluation of national HIV/STD risk reduction efforts and for risk-based modeling of the frequency and trends of sexually transmitted infections.

HSV-2 infections are rarely life threatening, but morbidity due to recurrent genital ulcerations is substantial. Just as important, HSV-2 infection is the best current marker of sexual behavior risk factors leading to sexually transmitted infections, generally, because: (a) HSV-2 infections are common and, thus, HSV-2 rates are a sensitive measure of sexually transmitted infection risk factors; (b) HSV-2 infection is almost always a result of sexual transmission and, thus, a specific measure of sexually transmitted infection; (c) HSV-2 infections are not curable and, thus, HSV-2 risk is not influenced by health care seeking factors; and (d) sensitive, specific, and relatively inexpensive tests for HSV-2 antibody are available. HSV-2 is a very important index of the success of large national efforts, motivated by the acquired immunodeficiency epidemic, to reduce risky sexual behaviors.

HIV antibody (Blood or Urine Test)

The estimated prevalence of human immunodeficiency virus (HIV) infection in the United States population is an important measure of the extent of the medical and financial burden the nation faces due to this virus. NHANES III data on HIV infection during 1988-94 will serve as a baseline for monitoring the changes in the epidemic over time in the general population of the United States. In addition to HIV testing in NHANES, whole blood samples will be collected and stored for future CD4 testing once the HIV status of the sample is known. This will allow CDC to determine the distribution of CD4 cells in a random sample of HIV positive individuals. NHANES is now the only national survey collecting blood on a population based sample, therefore it will be a key element in future estimates. If the participant refuses phlebotomy but does not refuse the HIV test urine will be tested for HIV antibody.

Health Measures, Eligibility, Report of Findings:

Health Measure	Eligibility	Volume Required	Report of Findings Level		
			1	2	3
Chlamydia trachomatis/ Neisseria gonorrhoeae	14-39	4 mL		*	✓
Herpes 1 and 2 antibody	14-49	500 uL		*	✓
HIV antibody	18-49	500 uL		*	✓

* Persons with positive STD or HIV findings will be referred for counseling and treatment.

Justification for using vulnerable populations:

- Teenagers are included because they are at increasing risk for STD's. A pilot study in NHANES III demonstrated an increased prevalence chlamydial infection starting at age 14 years (whites 4%, blacks 12% Mexican Americans 6%).
- Mentally impaired persons will be excluded from the STD profile due to NCHS' inability to provide adequate support and counseling to this group with the test result.

Tobacco Use

Laboratory Measures:

Serum Cotinine

Public Health Objectives:

Tobacco use (primarily cigarette smoking) has been associated with acute and chronic lung cancer, asthma, increased incidence of respiratory illness, and cardiovascular disease among nonsmokers including pregnant women, fetuses and children. Data from NHANES III showed that almost 90% of non-tobacco users are exposed to environmental tobacco smoke.

The specific aims of the component are: 1) to measure the prevalence and extent of tobacco use from biochemical indicators (cotinine) and self-report; 2) to estimate the extent of exposure to environmental tobacco smoke (ETS), and determine trends in exposure to ETS; and 3) to describe the relationship between tobacco use (and/or ETS) and chronic health conditions (e.g., respiratory and cardiovascular diseases) and other biochemical measurements .

Staff:

MEC Interviewer, Certified Phlebotomist

Protocol:

Methods:

- The tobacco component for NHANES will include questionnaire items on current and past use of cigarettes, pipes, cigars and smokeless tobacco. Exposure to ETS at home and at work and in-utero ETS exposure among children will also be obtained. In addition, use of nicotine replacement products (e.g., gum and patch) will be collected using questionnaires.
- Nicotine exposure will be assessed for examinees 3 years of age and older through the measurement of serum cotinine, a metabolite of nicotine.

Time Allotment:

- Part of a 10 minute venipuncture
- Part of a 15-20 minute interview

Health Measures, Eligibility, Report of Findings:

Health Measure	Eligibility	Volume Required	Report of Findings Level		
			1	2	3
Cotinine	3-11	1.5 mL			
	12 and older	2 mL			

Blood lipids

Laboratory Measures:

Total Cholesterol, HDL- Cholesterol, LDL-Cholesterol, Triglycerides

Public Health Objectives:

The goals of this component are: 1) to monitor the prevalence and trends in major cardiovascular conditions and risk factors in the U.S.; 2) to establish baseline national data for the ankle-brachial (ankle-arm) pressure index; and 3) to evaluate prevention and treatment programs targeting cardiovascular disease in the U.S.

The main element of the cardiovascular disease laboratory component in NHANES is blood lipid levels. Cardiovascular disease is the leading cause of death in the United States. An estimated 4.8 million Americans have congestive heart failure. Increasing prevalence, hospitalizations, and deaths have made congestive heart failure a major chronic condition in the United States.

The data will be used to: 1) monitor the status of hypertension prevalence, awareness, treatment and control and the success of the National HBP Education Program; 2) monitor the status of hyperlipidemia and the success of the National Cholesterol Education Program; 3) estimate the prevalence of congestive heart failure and compare to the baseline data from the NHANES I; and 4) establish baseline national data on peripheral vascular disease as indicated by the ankle-brachial pressure index.

Health Measures, Eligibility, Report of Findings:

Health Measure	Eligibility	Volume Required	Report of Findings Level		
			1	2	3
Total cholesterol	3 and older	+++		✓	✓
HDL-Cholesterol	3 and older	+++			✓
LDL-Cholesterol	3 and older	calculated			✓
Triglycerides	3 and older	+++		✓	✓

+++ For all four assays 200 uL used for children 3-5 years and 2ml used for persons 6 years and older

Environmental Health Profile

Laboratory Measures:

Blood lead; blood cadmium; blood mercury; serum persistent pesticides; serum noncoplanar polychlorinated biphenyls (PCBs); serum dioxins, furans, and coplanar PCBs; serum and urine levels of phytoestrogens; urine levels of non-persistent pesticides and metabolites; urine heavy metals; urine phthalates; urine polyaromatic hydrocarbons.

Public health objective:

Lead

Lead is a known environmental toxin that has been shown to deleteriously affect the nervous, hematopoietic, endocrine, renal and reproductive systems. In young children, lead exposure is a particular hazard because children more readily absorb lead than do adults, and children's developing nervous systems also make them more susceptible to the effects of lead. The primary sources of exposure for children are lead-laden paint chips and dust as a result of deteriorating lead-based paint. The risk for lead exposure is disproportionately higher for children who are poor, non-Hispanic black, living in large metropolitan areas, or living in older housing. Among adults, the most common high exposure sources are occupational.

Blood lead levels measured in previous NHANES programs have been the cornerstone of lead exposure surveillance in the U.S. The data have been used to document the burden of and dramatic decline of elevated blood lead levels; to promote the reduction of lead use; and to help to redefine national lead poisoning prevention guidelines, standards and abatement activities.

Mercury

Uncertainties exist regarding levels of exposure to methyl mercury from fish consumption and potential health effects resulting from this exposure. Past estimates of exposure to methyl mercury has been obtained from results of food consumption surveys and measures of methyl mercury in fish. Measures of a biomarker of exposure are needed for improved exposure assessments. Both blood and hair mercury levels will be assessed in two subpopulations particularly vulnerable to the health effects from mercury exposure: children 1-5 years old and women of child bearing age. Women of childbearing age will also have a urine mercury test. Blood measures of total and inorganic mercury will be important for evaluation of exposure from exposure to mercury in interior latex paints.

Persistent organochlorines (persistent pesticides, PCBs, dioxins)

Organochlorines are diverse, synthetic chemicals that are persistent in the environment and tend to bioaccumulate. Most of these chemicals are banned in the U.S. Assessment of exposure to persistent organochlorines in a representative samples of the U.S. population is needed to determine current prevalence and level of exposure and the potential for human health threat from exposure to these chemicals.

Non-persistent pesticides

Pesticide residues and their metabolites in human tissues and fluids can be indicative of pesticide exposure and the total body burden of these pesticides. Little information is available concerning residential or household exposures to pesticides among the general population. Sufficient data do exist, however, from surveys or other focused research efforts to suggest that household exposure to certain common pesticides can be extensive and might be of significant public health concern. Pesticides of particular concern are: chlorpyrifos, 2,4-D, diazinon, permethrin, ortho-phenyl phenol, methyl parathion, and organophosphate pesticides.

Heavy metals

Trace metals have been associated with adverse health effects in occupational studies or laboratory studies, but have not been monitored in general population groups. Information on levels of exposure to these compounds is essential to determine the need for regulatory mechanisms to reduce the levels of hazardous pollutants to which

the general population is exposed and to establish population-based reference intervals for several potentially toxic metals.

Phthalates

Phthalate acid esters (phthalates) are used extensively as plasticizers in a wide range of applications such as children’s toys, food packaging, and medical supplies. Because some of these compounds are known to be estrogenic and have been associated with a host of health problems in rats, such as cancers and teratogenicity, governments in Europe and Japan have become increasingly concerned about levels in food packaging materials and children’s toys. Biomeasures of phthalates in humans is necessary to evaluate potential human health threats from exposure to these chemicals.

Polyaromatic Hydrocarbons (PAHs)

PAHs constitute a group of chemicals which are formed during the incomplete combustion of coal, oil and gas, garbage, and other organic substances. These compounds require metabolic activation prior to their interactions with cellular macromolecules. PAHs are ubiquitous, thus exposure to them is widespread. In general, people are exposed to mixtures of PAHs, the sources of which include vehicle exhausts, asphalt roads, coal, coal tar, wild fires, agricultural burning, charbroiled foods, and hazardous waste sites. Although most of the data regarding the carcinogenicity of these compounds comes from rats and mice, epidemiologic studies have shown increased mortality due to lung and bladder cancer in humans exposed to coke-oven emissions, roofing-tar emissions, and cigarette smoke. PAHs enter the body quickly and easily by all routes of exposure and are readily and predominantly metabolized to hydroxylated metabolites as well as glucuronide metabolites. These metabolites are excellent indicators of exposure to the parent PAHs. While background level ranges of PAHs in air and water are known, the equivalent metabolite background levels in humans are not known. Because of increased epidemiologic data relating PAH exposure to cancer incidence, biomonitoring PAH metabolites in humans is very important.

Phytoestrogens

Many different plants produce compounds, called phytoestrogens, that mimic or interact with estrogen. The major classes of phytoestrogens are lignans (present in flaxseed, carrots, berries, and grapes) and isoflavones (present in soybeans and other legumes). Biomeasures of phytoestrogens are necessary to establish reference ranges for these compounds and to evaluate their potential effects on human health.

Health Measures, Eligibility, Report of Findings:

Health measure		Eligibility	Volume required	Report of Findings Level		
				1	2	3
Blood	Lead/Cadmium	1 and older	0.2 mL (1-5 years) 0.5 mL (6+ years)		✓	

Blood		1-5			✓	
Urine	Mercury	women 16-49		0.5 mL		
Serum	<i>Persistent pesticides*</i> Alpha Chlordane Aldrin Beta-hexachloro- cyclohexane cis-Nonachlor Dieldrin Endrin Gamma Chlordane Gamma-Hexachloro- cyclohexane Hexachlorobenzene Heptachlor Epoxide Lindane Mirex Nitrobenzene o,p'-DDD o,p'-DDE o,p'-DDT Oxychlordane p,p'-DDD p,p'-DDE p,p'-DDT trans-Nonachlor	12+ (1/3 sample)		4 mL		

Serum	<i>Noncoplanar PCBs*</i> PCB 19 PCB 28 PCB 44 PCB 49 PCB 52 PCB 56 PCB 60 PCB 66 PCB 74 PCB 87 PCB 99 PCB 101 PCB 105 PCB 110 PCB 116 PCB 118 PCB 128 PCB 138 PCB 146 PCB 149 PCB 151 PCB 153 PCB 156 PCB 157 PCB 158 PCB 167 PCB 170 PCB 172 PCB 177 PCB 178 PCB 180 PCB 183 PCB 187 PCB 189 PCB 193 PCB 194 PCB 195 PCB 196 PCB 201 PCB 203 PCB 206 PCB 209 Total Polychlorinated Biphenyls (sum of all)	12+ (1/3 sample)	test conducted on same aliquot used for persistent pesticides.			
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Serum	<i>Dioxins, Furans, Coplanar PCBs*</i> 2,3,7,8-Tetrachloro-dibenzo-p-dioxin (tcdd) 1,2,3,7,8-Pentachloro-dibenzo-p-dioxin (pnccd) 1,2,3,4,7,8-Hexachloro-dibenzo-p-dioxin (hxcdd) 1,2,3,6,7,8-Hexachloro-dibenzo-p-dioxin (hxcdd) 1,2,3,7,8,9-Hexachloro-dibenzo-p-dioxin (hxcdd) 1,2,3,4,6,7,8-Heptachloro-dibenzo-p-dioxin (hpcdd) 1,2,3,4,6,7,9-Heptachloro-dibenzo-p-dioxin (hpcdd) 1,2,3,4,6,7,8,9-Octachloro-dibenzo-p-dioxin (ocdd) 2,3,7,8,-Tetrachloro-dibenzofuran (tcdf) 1,2,3,7,8-Pentachloro-dibenzofuran (pnCDF) 2,3,4,7,8-Pentachloro-dibenzofuran (pnCDF) 1,2,3,4,7,8-Hexachloro-dibenzofuran (hxcdf) 1,2,3,6,7,8-Hexachloro-dibenzofuran (hxcdf) 1,2,3,7,8,9-Hexachloro-dibenzofuran (hxcdf) 2,3,4,6,7,8,-Hexchloro-dibenzofuran (hxcdf) 1,2,3,4,6,7,8-Heptachloro-dibenzofuran (hpcdf) 1,2,3,4,7,8,9-Heptachloro-dibenzofuran (Hpcdf) 1,2,3,4,6,7,8,9-Octachloro-dibenzofuran (ocdf) 3,3',4,4',5-Pentachloro-biphenyl (pnCB) 3,3',4,4'-Tetrachloro-biphenyl (tCB) 3,3',4,4',5-Tetrachloro-biphenyl (tCB) 3,3',4,4',5,5'-Hexachloro-biphenyl (hxCB)	12+ (1/3 sample)	4 mL			
Serum, Urine	<i>Phytoestrogens*</i> Coumestrol Daidzein Enterodiol Enterolactone Equol Genistein Matairesinol o-Desmethylangolensin (O-DMA)	serum: 12+ (1/3 sample) urine: 6+ (1/3 sample)	serum: 4 mL urine: 3 mL			

Urine	<i>non-persistent pesticides*</i> 1-Naphthol 2,4,5-T 2,4,5-Trichlorophenol 2,4,6-Trichlorophenol 2,4-D 2,4-Dichlorophenol 2,5-Dichlorophenol 2-Isopropoxyphenol 2-Naphthol 3,5,6-Trichloropyridinol 3,4-Dichloroaniline 3-Phenoxy benzoic acid Alachlor mercapturate Atrazine mercapturate Carbofuranphenol DEET Dicamba Glyphosate Malathion di-acid Metolachlor mercapturate Oxypyrimidine Paranitrophenol Pentachlorophenol o-Phenyl phenol	6-11 (1/2 sample) 12+ (1/4 sample)	10 mL			
Urine	<i>organophosphate pesticide screen*</i> Dimethylphosphate Diethylphosphate Dimethylthiophosphate Diethylthiophosphate Dimethyldithiophosphate Diethyldithiophosphate	6-11 (1/2 sample) 12+ (1/4 sample)	10 mL			
Urine	<i>Heavy Metals*</i> Antimony Barium Beryllium Cesium Chromium Cobalt Iodine Lead Manganese Mercury (total) Molybdenum Platinum Thallium Thorium Tin Tungsten Uranium	6+ (1/3 sample)	10 mL			

Urine	<i>Phthalates*</i> Bisphenol A Mono-(2-ethyl)-hexyl phthalate Mono-benzyl phthalate Mono-cyclohexyl phthalate Mono-ethyl phthalate Mono-isodecyl phthalate Mono-isononyl phthalate Mono-n-butyl phthalate Mono-n-octyl phthalate Nonyl-phenol Octyl-phenol	6+ (1/3 sample)	3 mL			
Urine	<i>Polyaromatic hydrocarbons*</i> 1-Hydroxy-aniline 1-Hydroxy-benzo[b] fluoranthene 1-Hydroxy-chrysene 1-Hydroxy-naphthalene 1-Hydroxy-pyrene 2-Hydroxy-aniline 2-Hydroxy-naphthalene 2-Hydroxy-phenanthrene 3-Hydroxy-benz[a] anthracene 3-Hydroxy-benzo[3] pyrene 3-Hydroxy-benzo[a] pyrene 3-Hydroxy-benzo[b] fluoranthene 3-Hydroxy, dibenz [a,h] anthracene 3-Hydroxy-fluorene 3-Hydroxy-phenanthrene Hydroxy-acenaphthalene Hydroxy-benzo[a] fluoranthene Hydroxy-benzo[c] phenanthrene Hydroxy-benzo[g,h] perylene Hydroxy-benzo[j] fluoranthene Hydroxy-benzo[k] fluoranthene Hydroxy-fluoranthene Hydroxy-indeno[1,2,3-cd] pyrene Hydroxy-peryene	6+ (1/3 sample)	3 mL			

*See **Appendix 30**, Strategy for Reporting Environmental Analytes