Health Consultation

(Exposure Investigation–Phase II)

Spring Valley Neighborhood

(a.k.a. Spring Valley Chemical Munitions/American University)

Washington, District of Columbia

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Objective

This exposure investigation examined individuals in the Spring Valley neighborhood of Washington, D.C. The investigation focused on whether these individuals had been exposed to arsenic contamination in their yards. The investigation was conducted from July through November 2002 and is the follow-up to an earlier (March 2002) investigation. Urine arsenic levels were tested in 40 individuals: 34 adults and six children aged 21 months to 15 years. All of these individuals were residents of 19 homes where the yards showed elevated soil arsenic levels, or homes adjacent to properties under remediation for elevated soil arsenic levels.

Summary and Statement of Issues

Background

During World War I, at a site known as the American University Experimental Station in northwest Washington, D.C, the U.S. Army conducted chemical warfare research. During research and training operations, chemical weapons were detonated at several locations. Lewisite (which contains arsenic) and mustard gas were among the chemical warfare agents reportedly tested. Chemical agents—including hazardous substances, ordnance, and explosive waste—were buried in the area. Long after the Army vacated the former Experimental Station site, the entire area underwent extensive development. Today it is home to the American University campus and to residential homes that comprise the Spring Valley neighborhood [1].

In January 1993, a contractor digging a utility trench in Spring Valley uncovered buried ordnance. Once notified, the U.S. Army Corps of Engineers (Corps) launched Operation Safe Removal, extracting some 141 ordnance items including suspected chemical munitions containing mustard gas and fuming sulfuric acid. To identify other potentially impacted areas, the Corps reviewed historical records and conducted extensive geophysical surveys with electromagnetic instruments. In addition, to characterize the extent and nature of chemical contamination, the Corps collected soil samples in potentially affected areas. Discovery and remedial efforts continue in Spring Valley and related areas [2].

ATSDR Activities at Spring Valley

The Agency for Toxic Substances and Disease Registry (ATSDR) has been working with the following agencies and groups:

- The Department of the Army,
- the Army Corps of Engineers,
- the U.S. Environmental Protection Agency (EPA),
- the District of Columbia Department of Health (DC DOH),
- American University,
- the Spring Valley Science Advisory Panel,
- the Spring Valley Restoration Advisory Board, and area residents

to assess the public health impact of environmental contamination from hazardous substances. At the request of the DC DOH, the EPA, or the Corps, between June 1997 and the present ATSDR has prepared five health consultations and one technical assistance document assessing soil contamination at the site.

In December 2000, contaminated soil was identified at the Child Developmental Center at American University. Surface soil samples collected from the playground were contaminated with arsenic at an average concentration of 57 micrograms per gram of soil (µg/g) and a maximum concentration of 498 µg/g. During February 1–2, 2001, ATSDR conducted an exposure investigation at the Child Developmental Center. Hair samples were analyzed for arsenic several weeks after exposure had stopped. Hair samples from 28 children and four adults did not indicate elevated arsenic exposure in children or workers at this center. The property was subsequently remediated [3, 4].

In March 2002, a second exposure investigation examined individuals in the Spring Valley neighborhood for possible exposure to arsenic contamination in their yards. A total of 32 individuals were tested: 23 adults and nine children aged 16 months to 13 years. These individuals lived in 13 homes at which elevated composite soil arsenic levels were found in the yards. These individuals' urine and hair were tested and in each of their homes household dust was analyzed for arsenic. Urine and hair arsenic testing showed low levels of arsenic exposure not expected to cause health problems in this population [5].

Other Site-Related Activities

On February 10 and 15, 2001, Washington Occupational Health Associates, Inc. (WOHA), collected hair and urine samples from students and staff at American University. The target population for this exposure investigation included students and staff who attended the Center in the past 12 months, maintenance and grounds crew members, and athletes who use the intramural fields. Sixty-six persons (39 adults and 27 children) provided hair samples. Four adults provided urine samples. WOHA concluded that their exposure investigation indicated no elevated levels of arsenic in the population tested [6].

The Corps has continued to characterize soil contamination in residential properties in potentially affected Spring Valley areas. This testing documented arsenic levels in composite soil samples collected from residential areas. The samples ranged from background levels to a maximum of 202 parts per million (ppm). Residents of Spring Valley have expressed concern over possible health effects from exposure to this contamination. In response to these concerns, the DC DOH asked ATSDR to evaluate potential exposure to arsenic in residents of contaminated properties.

Rationale for an Exposure Investigation

The Spring Valley Science Advisory Panel recommended the second phase of this exposure investigation. The Panel was concerned that the first phase of the exposure investigation was conducted in early spring—a time of little outdoor activity and, consequently, little potential for soil contact. By performing the investigation at a time of presumed maximal exposure activities, ATSDR was able to exclude hair analysis (which is not considered a reliable indicator of arsenic exposure) and focus on arsenic levels in urine.

Within a few days following exposure, ingested arsenic is rapidly excreted from the body into the urine. Accordingly, ATSDR analyzed urine samples for arsenic as an indicator of exposure within the preceding few days [7]. The urine samples were analyzed for either total arsenic or speciated arsenic (inorganic arsenic, dimethyl arsenic acid, and methylarsonic acid). In this health consultation the term "inorganic arsenic" is used interchangeably with "speciated arsenic" and refers collectively to all inorganic forms of arsenic, including dimethyl arsenic acid and methylarsonic acid. By conducting speciated analysis, exposure to inorganic arsenic was differentiated from exposure to less toxic forms of arsenic found in food, such as fish and shellfish [8].

Methods

Target Populations

To assess exposure to arsenic, ATSDR tested urine in Spring Valley residents who were classified into one of three groups: (1) individuals who participated in the first exposure investigation, (2) individuals who were living on, or adjacent to, property under remediatation, and (3) individuals who had a single, elevated level of arsenic in their yard.

Consent/Confidentiality

Prior to testing, each participant—and a parent or legal guardian of each minor participant—was required to sign an informed consent/assent form. Sample copies of these forms are in Attachment A. In addition to completing a consent form, each family was asked a few questions about their exposure history.

Individual test results and an explanation of their meaning were provided to the participants in writing. An ATSDR physician was available to discuss individual results by phone and, during a community visit at the local hospital, in person. Recommendations for follow-up actions were made, if indicated. Individual test results were not made available to the public; confidentiality was protected according to federal and state laws.

Test Procedures

DC DOH staff distributed urine specimen cups and instructions to all participants in the exposure investigation. Participants were advised not to eat fish or shellfish for 3 days before donating a first-morning void urine sample. In an attempt to collect urine at the time of the highest likelihood of exposure—that is, during peak outside activities or during soil remediation—urine collection was spread over the late summer and fall.

The urine samples were sent to National Medical Services laboratories in Willow Grove, Pennsylvania. The samples were analyzed for total and speciated arsenic by graphite furnace atomic absorption spectroscopy and by atomic fluorescence spectroscopy. Urine creatinine was also analyzed. Test results were reported as micrograms of arsenic per liter of urine (µg/L) and as micrograms of arsenic per gram of creatinine (µg/g creatinine) [9].

Results

A "Brief Arsenic Exposure Questionnaire" (Attachment B) was administered at the time of urine sampling. This questionnaire revealed eight families who owned pets that spend time outdoors; thus the pets might be a source of soil being tracked into the house. Six individuals reported

having recent contact with soil in their yard and one individual reported being a smoker. Three persons reported eating seafood within a short time of providing the sample.

All individuals tested had total urinary arsenic levels between non-detect and 76 µg/L. The detection limit was 1.0 µg/L. Most (93%, 37/40) of the participants in this exposure investigation had inorganic urinary arsenic levels of less than 10 µg/L—interpreted by the National Medical Services as "non-detect" and by ATSDR as "not elevated." A few (7%, 3/40) of the individuals had reportable levels of inorganic arsenic in their urine: 10µg/L, 14 µg/L, and 29 µg/L. When adjusted for dilution using creatinine correction methods, these three individuals' inorganic arsenic levels were 7 µg/g creatinine, 24.5 µg/g creatinine, and 13.4 µg/g creatinine, respectively. Attachment C contains a table of individual results grouped by household.

During this investigation some inconsistencies appeared in the laboratory's procedures for analyzing urine arsenic. As stated in the exposure investigation protocol (Attachment D), ATSDR requested total and speciated arsenic analysis for all urine specimens. National Medical Services' policy, however, was only to speciate samples with a total arsenic level above 20 µg/L. Because the discrepancy between the policy and ATSDR's request was discovered midway through the investigation, some samples were only tested for total arsenic. National Medical Services also erred in only reporting speciated results for some samples rather than reporting both total and speciated results. However, none of these procedural inconsistencies compromised the overall assessment of arsenic exposure in this population. All elevated total arsenic samples were speciated and no speciated results were high enough to indicate the potential for adverse health effects.

Discussion

To evaluate exposure, arsenic is measured in urine, hair, or blood. Measurement of arsenic in blood is not a reliable indicator of chronic exposure to low levels of arsenic—it is cleared from the blood within a few hours and reflects only very recent exposure. Blood arsenic levels also are difficult to interpret because the relationship between levels of exposure and blood concentrations has not been well established [10].

Urine arsenic is the most reliable method for measuring arsenic exposure, particularly exposures occurring within a few days of the specimen collection. Fluctuations in urine excretion rates make a 24-hour collection an optimal sample. Ease of collection, however, has resulted in most exposure studies using a first-morning void or a random sample. In fact, the first-morning void urine results have correlated well with 24-hour results [7]. Speciated urinary arsenic is preferable to total urinary arsenic because the speciated forms can distinguish between exposure to inorganic arsenic and its metabolites and the relatively nontoxic forms of organic arsenic commonly found in seafood [7, 8].

Individuals in this exposure investigation had their urine tested for total arsenic (which could come from all sources—food, water, air, soil, and dust), for inorganic arsenic (which might be coming from contaminated soil and dust), or for both. The total urinary arsenic is mostly organic arsenic from food sources, which is much less toxic than inorganic arsenic. If the total urinary arsenic was not elevated, inorganic arsenic testing was not always performed.

This exposure investigation (EI) included individuals who (1) participated in the first phase of the exposure investigation, (2) who were living on, or adjacent to, property that was being

remediated, or (3) who had a single elevated level of arsenic in their yard. Nine of the 13 households from the first EI chose to participate in this second EI. Three of these families were having their yards remediated when the urine testing was done. An additional six households fell into the second group of those who had their urine tested while an adjacent property was under remediation. Four more households were added to this EI because they had one elevated arsenic level in their yard.

The American Conference of Industrial Hygienists maintains guidance values for assessing the level of contaminants in workers who are potentially exposed in occupational settings. For the monitoring of worker's urinary inorganic arsenic levels, concentrations up to 35 µg/L are considered acceptable. Although none of the Spring Valley residents were likely exposed to inorganic arsenic through an occupational environment, this level is relevant because it is below the point at which adverse health effects are expected in a worker population. None of the 40 exposure investigation participants had inorganic arsenic levels above 35 µg/L.

In summary, the urine arsenic levels in this exposure investigation show low levels of exposure, consistent with what might be found in the general population. These levels would not be expected to cause any health problems. Only three of the individuals tested had reportable inorganic arsenic levels (10 µg/L or higher). All three of the individuals with inorganic arsenic in their urine were adults. Two of the elevated inorganic arsenic levels were from the same household. When adjusting the results using creatinine correction methods, one of the individuals with a slightly elevated result (10 µg/L) had an adjusted inorganic arsenic level (7 µg/g creatinine) below the reportable limit.

All individuals tested had total urinary arsenic between non-detect and 76 µg/L. The detection level was 1.0 µg/L. It is not clear whether the detectable levels of inorganic arsenic in the three individuals are related to soil arsenic contamination. While dietary arsenic is comprised mostly of organic arsenic, it does contain a small percentage of inorganic arsenic [7]. Dietary arsenic from a seafood meal can contribute 10–15% inorganic arsenic to the total arsenic content [8]. The individual with the inorganic arsenic level of 14 µg/L had consumed seafood in the 3 days before testing.

Conclusions

1. Overall, urine arsenic testing showed no significant arsenic exposure in the population.
2. Three individuals had slight elevations in their urine inorganic arsenic levels.
3. These levels are not expected to cause health problems.

Recommendations

1. Individuals with mild elevations of inorganic arsenic should have follow-up urinalysis for arsenic.
2. All of the tested individuals should discuss their results with their personal health care provider.
3. Individuals, or their health care providers, can discuss their results with an ATSDR physician if they choose to do so.

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11. Norin H et al. Concentration of inorganic and total arsenic in fish from industrially polluted water. Chemosphere 1985;14:325-34.

Attachment A

Consent Form for Participation

Spring Valley Exposure Investigation

(Participant Consent for Specimen Testing)

An exposure investigation is being conducted to determine if you were exposed to arsenic.

The Washington, D.C., Department of Health and the Agency for Toxic Substances and Disease Registry (ATSDR) is offering free voluntary urine testing for arsenic exposure for residents with elevated levels of arsenic in the soil of your yard. Along with the free testing, exposure information will be collected by means of a brief questionnaire. Participation in this investigation will enable you to know your own levels of arsenic and will enable the local agencies to identify if public health actions are needed to reduce exposure.

Benefits

I understand that I will benefit from participating by learning whether I (or my child/ward) have had elevated exposures to arsenic. If elevated exposure has occurred, I will receive information on how to reduce current and future exposure. Written information about arsenic exposure will be available to me and to my physician, if I identify him or her in the questionnaire.

Procedure/Tests:

? Urine

A representative of the Washington, D.C., Department of Health will distribute urine specimen cups and instructions to all participants during the week before the exposure investigation. The participants will collect the first urine they make in the morning. This urine specimen will be picked up by a Department of Health staff member.

Participation

I understand that my participation is voluntary. Furnishing any information is voluntary and even if I agree to participate and sign this form, I can stop my participation or my child's/ward's participation at any time without penalty or loss of benefits. I understand and agree that there is no provision for compensation or medical treatment offered by ATSDR on the basis of the test results or in the event of injury from participation. I understand that I must sign this form to participate.

Results

I understand every effort will be made to provide the results of my tests in writing to me within approximately 2 months. However, unforeseen circumstances might delay the date. Results that are of immediate health concern will be reported to me as soon as they are known. If my results reveal an elevated value of arsenic, I understand that I should notify my personal physician.

Confidentiality

Confidentiality will be protected to the fullest extent possible according to state and federal laws. Any reports produced from this information will give only group information and not identify specific individuals. I understand that if I participate in a confidential manner, any forms containing my name or address will be kept in locked cabinets at ATSDR and the Washington, D.C., Department of Health. Test results may be released only to other federal, state, and local public health (and environmental) agencies, if permitted by me. I understand if I want my results sent to my physician, I must provide the contact information and my signature authorizing a release of this information.

Contact

If I have any additional questions about this investigation or the testing, I may contact Dr. Robert Johnson of ATSDR at 1 (888) 422-8737.

Consent

The risks and benefits of this exposure investigation have been explained to me. All of my questions have been satisfactorily answered. I hereby freely and voluntarily give my signed consent for participating in the testing described above.

I, (print)_____, the undersigned, agree to urine sampling and completing questionnaires for:

(___) Myself

I, (print)_____, the undersigned, agree to urine and hair sampling and completing questionnaires for:

(___) Myself

(___) My child/ward, _____, age -___

(___) My child/ward, _____, age -___

(___) My child/ward, _____, age -___

(___) My child/ward, _____, age -___

Signature: _____ Date: _____

Signature: _____ Date: _____

Address: _____

_____

_____

Phone #: _____

Witness: _____ _____

(print name) (signature)

Assent Form for Children

(7- 17 years of age)

A statement to be read to children in the presence of the parent/guardian:

"We want to find out if you have been exposed to arsenic. Arsenic is something that you cannot see but might cause illness. To know if you have arsenic in your body, we would like to take a sample of your urine. Providing a sample is considered very safe, and your mother/father/guardian has said that it would be all right for you to do this."

"Do you have any questions? May we take a sample of your urine?"

The above information has been read to me and I want to participate.

Name of Child: _____ Signature of Child:_____Age____

Name of Child: _____ Signature of Child:_____Age____

Name of Child: _____ Signature of Child:_____Age____

Name of Child: _____ Signature of Child:_____Age ___

Name of Child: _____ Signature of Child:_____Age____

Date: _____

Witness: _____ _____
(print name) (signature)

Attachment B

Brief Arsenic Exposure Questionnaire

Name:_____

Have you eaten seafood in the past 3 days?	Y	N
Do you smoke?	Y	N
Do you have contact with the soil in your yard (gardening, yard work, etc)?	Y	N
Have you recently used any pesticides or garden sprays?	Y	N
Have you eaten any vegetables grown in your garden?	Y	N
Have you worked with chemically-treated (for example, CCA) wood?	Y	N
Do you have pets which spend time outdoors?	Y	N

What is your current occupation?_____

Attachment C

Individual Urine Arsenic Results by Household

Household 1: composite soil arsenic = 88.8 ppm

Resident	Inorganic urine arsenic (µg/L)	Total urine arsenic (µg/L)
1	n.d.	--
2	n.d.	--

Household 2: composite soil arsenic = 81.2 ppm

Resident	Inorganic urine arsenic (µg/L)	Total urine arsenic (µg/L)
1	--	3.4
2	--	4.5
3	--	20
4	--	n.d.

Household 3: composite soil arsenic = 105 ppm

Resident	Inorganic urine arsenic (µg/L)	Total urine arsenic (µg/L)
1	29	58
2	--	13

Household 4: composite soil arsenic = 202 ppm

Resident	Inorganic urine arsenic (µg/L)	Total urine arsenic (µg/L)
1	n.d.	--
2	10	--
3	14	--
4	n.d.	--.

Household 5: composite soil arsenic = 69.5 ppm

Resident	Inorganic urine arsenic (µg/L)	Total urine arsenic (µg/L)
1	n.d.	--
2	n.d.	--

Household 6: composite soil arsenic = 172 ppm

Resident	Inorganic urine arsenic (µg/L)	Total urine arsenic (µg/L)
1	n.d.	--
2	n.d.	--
3	n.d.	--

Household 7: composite soil arsenic = 74.5 ppm

Resident	Inorganic urine arsenic (µg/L)	Total urine arsenic (µg/L)
1	n.d.	--
2	n.d.	--

Household 8: composite soil arsenic = 93.6 ppm

Resident	Inorganic urine arsenic (µg/L)	Total urine arsenic (µg/L)
1	n.d.	--
2	n.d.	--

Household 9: composite soil arsenic = 68.2 ppm

Resident	Inorganic urine arsenic (µg/L)	Total urine arsenic (µg/L)
1	n.d.	17
2	n.d.	41

Household 10: no soil data available

Resident	Inorganic urine arsenic (µg/L)	Total urine arsenic (µg/L)
1	n.d.	--

Household 11: no soil data available

Resident	Inorganic urine arsenic (µg/L)	Total urine arsenic (µg/L)
1	--	20

Household 12: no soil data available

Resident	Inorganic urine arsenic (µg/L)	Total urine arsenic (µg/L)
1	n.d.	27
2	--	4.9
3	--	7.5

Household 13: no soil data available

Resident	Inorganic urine arsenic (µg/L)	Total urine arsenic (µg/L)
1	n.d.	--
2	n.d.	--

Household 14: no soil data available

Resident	Inorganic urine arsenic (µg/L)	Total urine arsenic (µg/L)
1	n.d.	--
2	n.d.	--

Household 15: no soil data available

Resident	Inorganic urine arsenic (µg/L)	Total urine arsenic (µg/L)
1	n.d.	22
2	n.d.	20

Household 16: highest soil arsenic = 406 ppm

Resident	Inorganic urine arsenic (µg/L)	Total urine arsenic (µg/L)
1	n.d.	70
2	n.d.	76

Household 17: highest soil arsenic = 7.5 ppm

Resident	Inorganic urine arsenic (µg/L)	Total urine arsenic (µg/L)
1	n.d.	25
2	n.d.	25

Household 18: highest soil arsenic = 14.5 ppm

Resident	Inorganic urine arsenic (µg/L)	Total urine arsenic (µg/L)
1	n.d.	--

Household 19: no soil data available

Resident	Inorganic urine arsenic (µg/L)	Total urine arsenic (µg/L)
1	n.d.	9.4

Note: (n.d. = non-detect, also interpreted as non-reportable or < 10 µg/L)
(-- = test not performed)

Attachment D

Exposure Investigation Protocol

Spring Valley Neighborhood—Phase II

Washington, D.C.
July 20, 2002

Summary

During World War I, the U.S. Army conducted chemical warfare research at the site of the present Spring Valley neighborhood in Washington, D.C. Chemical weapons were detonated in several areas during research and training operations. Chemical agents and weapons were also buried in the same area. The area has since been developed, and it is now occupied by residential homes and the American University.

In December 2000, contaminated soil was identified at the Child Developmental Center (CDC) at the American University. Surface soil samples collected from the playground were contaminated with arsenic at an average concentration of 57 µg/g and a maximum concentration of 498 µg/g (ATSDR March 28, 2001). ATSDR conducted an exposure investigation (hair analyses for arsenic) at CDC on February 1-2, 2001. Hair samples from 28 children and four adults did not indicate elevated arsenic exposure in children or workers at this center, and the property has subsequently been remediated (ATSDR March 8, 2001).

On February 10 and 15, 2001, Washington Occupational Health Associates, Inc. (WOHA), collected hair and urine samples at American University. The target population for this exposure investigation included staff and students who attended the center in the past 12 months, maintenance and grounds crew members, and athletes who play on the intramural fields. Sixty-six people (39 adults and 27 children) provided hair samples. Four adults provided urine samples. WOHA concluded that results of its exposure investigation indicated no elevated levels of arsenic in the population tested (WOHA March 26, 2001).

Ongoing testing of residential soils in the Spring Valley neighborhood have shown composite soil levels ranging from background to over 200 µg/g (ppm). Residents of Spring Valley have expressed concern over possible exposures to arsenic they might have received during activities at their homes. In March 2002, ATSDR, in conjunction with the Washington, D.C., Department of Health, collected urine and hair samples from local residents and tested the samples for arsenic.

Rationale

In order to assess exposure to arsenic, ATSDR will conduct biological monitoring of potentially exposed residents. Arsenic that is ingested is rapidly excreted from the body into the urine within

a few days after exposure. Therefore, ATSDR will analyze urine samples for arsenic as an indicator of exposure to arsenic within the past few days. The urine samples will be analyzed for total arsenic and speciated arsenic (inorganic arsenic, dimethyl arsenic acid, and methylarsonic acid). By conducting these two separate analyses, ATSDR will be able to differentiate exposure to inorganic arsenic from exposure to less toxic forms of arsenic that occur naturally in fish and shellfish.

Target Population

In order to assess exposure to arsenic, ATSDR will conduct urine testing in individuals living in Spring Valley who fall into one of three groups: (1) individuals who participated in the first exposure investigation, (2) individuals who were living on, or adjacent to, property that is being remediated, and (3) individuals who had a single elevated level of arsenic in their yards.

Consent/Assent Form

Before testing, each resident and a parent or legal guardian of each minor participant will be required to sign an informed consent/assent form. A copy of these forms is in Appendix A.

Test Procedures

Arsenic can be measured in urine, hair, or blood to evaluate exposure. Measurement of arsenic in blood is not a reliable indicator of chronic exposure to low levels of arsenic because it is cleared from the blood within a few hours and reflects only very recent exposure. Blood arsenic levels also are difficult to interpret because the relationship between levels of exposure and blood concentrations has not been well-established.

Urine arsenic is the most reliable method for measuring arsenic exposure, particularly exposures occurring within a few days of the specimen collection. Although a 24-hour urine collection is considered an optimal sample due to fluctuations in excretion rates, most exposure studies have used a first-morning void or random sample due to ease of collection. Under steady state exposure conditions, as would be assumed for most residents of this community, random or spot urine results have correlated well with 24-hour results. Speciated urinary arsenic is preferable to total urinary arsenic since the speciated forms can distinguish between exposure to inorganic arsenic and its metabolites and the relatively nontoxic forms of organic arsenic commonly found in seafood.

Urine Testing

ATSDR staff will distribute urine specimen cups and instructions for sample collection to all participants in the exposure investigation. The participants will be advised not to eat fish or shellfish for 3 days prior to donating a first-morning void urine sample.

The urine samples will be sent by overnight mail to National Medical Services laboratories in Spring Willow, Pennsylvania. The sample will be analyzed for total and speciated arsenic by graphite furnace atomic absorption spectroscopy and atomic fluorescence spectroscopy. Urine

creatinine will also be analyzed. Test results will be reported as micrograms of arsenic per liter of urine (µg/L) and in micrograms of arsenic per gram of creatinine (µg/g creatinine). Inorganic urinary arsenic in unexposed individuals is normally < 20 µg/L. Total arsenic levels below 100 µg/g creatinine are expected for individuals without occupational or dietary exposures. (Kalman 1990)

Survey Forms

In addition to completing a consent form, each family will be asked to complete a short questionnaire that solicits information on the family members' exposure history.

Reporting Results

Individual test results and an explanation of their significance will be provided to the participants in writing. An ATSDR physician will be available to discuss individual results by phone. Recommendations for follow-up actions will be made, if warranted, including repeat testing or consultation with an occupational/environmental physician.

Individual test results will not be made available to the public, and confidentiality will be protected according to federal and state laws. At the conclusion of the investigation, ATSDR will prepare a report which will summarize the findings of the investigation, but will not reveal personal identifiers.

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