Letter Health Consultation

PANTHER CREEK AREA ARSENIC BIOMONITORING
(A/K/A BLACKBIRD MINE)

COBALT, IDAHO

EPA FACILITY ID: IDD980725832

MARCH 16, 2009

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

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LETTER HEALTH CONSULTATION

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Prepared By:

Idaho Department of Health & Welfare
Under Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

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February 5, 2009

Fran Allans
EPA Idaho Operations Office
1435 North Orchard Street
Boise, Idaho 83706

RE: **Panther Creek Area Arsenic Biomonitoring (related to upstream Superfund Site: Blackbird Mine), Cobalt, ID**

Dear Ms. Allans:

The Bureau of Community and Environmental Health, ATSDR Cooperative Agreement Program, has completed an evaluation of urine monitoring results for two individuals living near the confluence of Panther Creek and Blackbird Creek. What follows in this letter is the final evaluation based on data available to date, along with our conclusions and recommendations.

BACKGROUND

Exposure Situation

High levels of arsenic have been confirmed in soil and indoor dust in the Panther Creek Area by EPA and ATSDR, beginning in 1997 and resuming recently in early 2008. A previous exposure investigation was completed by ATSDR September 10, 1998 in this same area, but now there are new residents, including a 21-month old child. In May 2008, the contamination was renewed by flooding, resulting in environmental arsenic levels that are higher than they were 10 years ago. Indoor dust levels are a particular concern currently because 9 structures were above the EPA cleanup level (100 mg arsenic/kg dust) based on the 2008 sampling; the range of these 9 structures was 100-680 mg arsenic/kg dust. A few of the residents paid to have their hair tested by a private lab and were concerned about the results because some amount of arsenic was detected in their hair. BCEH explained to these residents that hair analysis captures arsenic that is bound to the surface of the hair in addition to what has passed through the body and is thus a poor indicator of the dose of arsenic getting into the body. BCEH thus recommended urine analysis to assess the arsenic dose entering the body.

Purpose

EPA contacted BCEH to help interpret risk around Panther Creek. This document evaluates the health risk to two subjects who submitted urine samples for analysis. Findings are being communicated to the subjects and to EPA. Subjects have given written consent for BCEH to share the findings with EPA.

Sampling

Two subjects (one adult, one 21 month old child) submitted two urine samples each, for a total of four samples. Samples were collected on December 4, 2008, in collaboration with our Centers for Disease Control and Prevention (CDC)-funded Chemical Terrorism Lab Coordinator, Dr. Ian Elder, according to CDC protocol. Samples were transported on dry ice to Boise, then on dry ice to CDC in Atlanta. Consent was obtained at the time of sampling.

Analysis

Samples were analyzed for both total arsenic and speciated arsenic by the Division of Laboratory Science, National Center for Environmental Health at CDC. The method used for total arsenic analysis was: Urine Multi-Element ICP-DRC-MS_ITU001B. The method for speciated arsenic was: HPLCICPDRCNS_ITU003A.

Inorganic Arsenic Toxicity

At a sufficient dose, inorganic arsenic is considered a known human carcinogen. It has also been associated with heart and vascular system disorders. Total arsenic analysis provides the combined level of both inorganic (toxic) and organic (non-toxic) forms of arsenic and thus provides less accurate information about risk to human health. Speciated arsenic analysis allows us to differentiate levels of organic from levels of inorganic forms of arsenic.

Reference Ranges

The lab results were compared to reference ranges (RRs) derived from the most recent studies available that characterize levels of urine arsenic in human populations. The adult RR is based on the results of the 2003-2004 National Health and Nutrition Examination Survey (NHANES) (Caldwell et al. 2009). This population is representative of the general US population. The child RR is based on a population of 77 children ages 0-7 years old; this is the only published study of child urine arsenic with a sufficient number of subjects to be considered valid (Tsuji et al. 2005). In the child study, while arsenic was present in soil near some homes and in dust in some homes, the levels were quite low where present, and the children's urine arsenic values can be considered representative of a generally 'non-exposed' population. Values that exceed the upper end of the normal RR reference ranges are highlighted in the tables below. CDC considers urine levels below the 95th percentile to be within a 'normal' range for individuals in the general U.S. population (CDC 2005; Sampson 2008). It must be noted that these RRs are not based on dose-response but rather on the distribution of what levels are found in a general population of individuals. RRs are a screening level, not a clear cut indication of a health hazard. Levels above the 95th percentile indicate that a person should take steps to avoid ongoing exposure and should receive ongoing monitoring until urine arsenic declines.

RESULTS

Table 1: Total Arsenic Results Compared to a Reference Range (RR)

Sample	Comment	Total As	LOD	50% RR	95%RR	~GM RR	~Max RR
Adult Sample1		2.72	0.6	7.7	65.4		
Adult Sample2		2.28	0.6	7.7	65.4		
Child Sample1	diaper	22.11	0.6			15.1	59.6
Child Sample2	clean	9.99	0.6			15.1	59.6

values are in µg/L
*Adult RR: Caldwell et al. 2009
~Child RR: Tsuji et al. 2005

Comments:
diaper—this sample was collected inside a diaper
clean—this sample was collected as a clean catch into a specimen cup

LOD: Limit of Detection—the lowest level that can be determined by the analysis.
50% RR: the 50th percentile of the reference range dataset.
95% RR: the 95th percentile of the reference range dataset.
GM RR: Geometric Mean RR—the geometric mean of the reference range dataset. The study by Tsuji et al. reported this statistic rather than an average or median value. It is not possible to determine percentiles from the data reported in the study.

For the child, a ‘clean’ sample was collected according to adult sampling protocol, directly into an acid-washed approved container. A diaper sample was collected on sterile gauze and cannot be quality assured; therefore, this sample cannot be considered valid. However, the results will be discussed below.

Table 2: Speciated Arsenic results compared to Adult Reference Range (RR)

Sample	Analyte	Final Results	Limit of Detection (LOD)	*50% RR	*95%RR
Adult Sample1	UAS3	< LOD	1.2	<LOD	<LOD
	UAS5	< LOD	1	<LOD	1.1
	UASB	< LOD	0.4	1	35
	UASC	< LOD	0.6	<LOD	<LOD
	UDMA	< LOD	1.7	3.9	16
	UMMA	< LOD	0.9	<LOD	2.4
	UTMO	< LOD	1	<LOD	<LOD
Adult Sample2	UAS3	< LOD	1.2	<LOD	<LOD
	UAS5	< LOD	1	<LOD	1.1
	UASB	< LOD	0.4	1	35
	UASC	< LOD	0.6	<LOD	<LOD
	UDMA	< LOD	1.7	3.9	16
	UMMA	< LOD	0.9	<LOD	2.4
	UTMO	< LOD	1	<LOD	<LOD
Child Sample1	UAS3	< LOD	1.2	<LOD	<LOD
(diaper sample)	UAS5	3.51	1	<LOD	1.1
	UASB	< LOD	0.4	1	35
	UASC	< LOD	0.6	<LOD	<LOD
	UDMA	12	1.7	3.9	16
	UMMA	1.38	0.9	<LOD	2.4
	UTMO	< LOD	1	<LOD	<LOD
Child Sample2	UAS3	< LOD	1.2	<LOD	<LOD
(clean sample)	UAS5	< LOD	1	<LOD	1.1
	UASB	< LOD	0.4	1	35
	UASC	< LOD	0.6	<LOD	<LOD
	UDMA	7.08	1.7	3.9	16
	UMMA	1.01	0.9	<LOD	2.4
	UTMO	< LOD	1	<LOD	<LOD

values are in µg/L

Analyte Code	Analyte Name
UAS3	Urinary Arsenous Acid
UAS5	Urinary Arsenic Acid
UASB	Urinary Arsenobetaine
UASC	Urinary Arsenocholine
UDMA	Urinary Dimethylarsonic Acid
UMMA	Urinary Monomethylarsonic Acid
UTMO	Urinary Trimethylarsine

*Adult RR: Caldwell et al. 2009

--Note: child RRs for speciated arsenic do not include all species so are not shown here
Please refer to Table 3 for comparison to child RRs

Inorganic Arsenic
UAS3 is an abbreviation for arsenous acid and Arsenic+3. It is an inorganic, toxic form of arsenic.
UAS5 is an abbreviation for arsenic acid and Arsenic+5. It is an inorganic, toxic form of arsenic.
UDMA is an abbreviation for dimethylarsonic acid. It is a metabolite (compound produced by the body after ingestion) of UAS3 and UAS5.
UMMA is an abbreviation for monomethylarsonic acid. It is a metabolite (compound produced by the body after ingestion) of UAS3 and UAS5.

Organic Arsenic
UASB is an abbreviation for arsenobetaine. It is a low toxicity compound present in seafood and other foods.
UASC is an abbreviation for arsenocholine. It is a low toxicity compound present in seafood and other foods.
UTMO is an abbreviation for trimethylarsine. It is a low toxicity compound present in seafood and other foods.

Table 3: Child-only Speciated Arsenic results compared to child (0-7 yrs) RR

Sample	Analyte	Final Results	~Min RR	~GeoMean RR	~Max RR
Child Sample1	Inorganic 3+5	3.51	0.31	0.81	2.1
(diaper sample)	UDMA	12	0.27	2.5	13.8
	UMMA	1.38	0.12	0.54	2.1
	Total Inorganic	16.89	0.89	4	17.7
Child Sample2	Inorganic 3+5	<1	0.31	0.81	2.1
(clean sample)	UDMA	7.08	0.27	2.5	13.8
	UMMA	1.01	0.12	0.54	2.1
	Total Inorganic	8.09	0.89	4	17.7

values are in µg/L

~Child RR: Tsuji et al. 2005
The Adult RR dataset did not report summations of speciated arsenic so those results are not reported here.

Comments:
diaper—this sample was collected inside a diaper
clean—this sample was collected as a clean catch into a specimen cup
LOD: Limit of Detection—the lowest level that can be determined by the analysis.
50% RR: the 50th percentile of the reference range dataset.
95% RR: the 95th percentile of the reference range dataset.
GM RR: Geometric Mean RR—the geometric mean of the RR reference range dataset. The study by Tsuji et al. reported this statistic rather than an average or median value. It is not possible to determine percentiles from the data reported in the study.

DISCUSSION

Health Assessment Approach

The purpose of this letter health consultation is:

- to compare urine arsenic from two subjects to normal reference ranges that might be expected in both adults and children
- to interpret these results and make recommendations to reduce exposure to arsenic as needed

Sample Timing, Sampling Method, and Concordance Between Samples

The samples were taken within 3 hours of each other and 24-27 hours after the subjects had been away from the contaminated area. We would expect the total arsenic and speciated arsenic values to be roughly the same between each subject's two samples, and the ratio of different arsenic species to be the same between the samples, assuming no external contamination occurred. This was true for the adult's two samples, but not for the child's samples.

The first urine sample taken from the child was collected on a pad of sterile gauze within a diaper. This sample appears to have been contaminated with arsenic from some external source. While the level of inorganic arsenic found in 'Child Sample1' would be a concern if it had passed through the body, it is clear by the large difference between the results of the two samples from the child that the arsenic was not excreted by the child. BCEH believes the diaper sample is not valid due to external contamination and does not provide a reliable value that can be used to assess risk.

Since the second child sample was collected directly into the approved sampling container, BCEH believes this sample is valid.

Total Arsenic

None of the samples exceeded RRs for total arsenic.

Speciated Arsenic

UAS5 (Arsenic+5) and total Inorganic Arsenic (UAS3/Arsenic+3 and UAS5/Arsenic+5) greatly exceeded the RRs in the invalid Child Sample1 (the diaper sample). As discussed above, BCEH believes the sample was contaminated after the urine was excreted by the child, and we do not consider it a valid sample.

The child RR comes from a study of children whose homes had low levels of arsenic in and around them. By comparison, the environment where this child lives has much more arsenic in soil and dust, yet the urine level of arsenic species (in Child Sample2) is between the 50-75th percentile of the RR reference range. This suggests that the parents have been successful in limiting the exposure despite the environment.

Exposure Uncertainty

Biomonitoring studies are conducted to determine if exposure has occurred. Urine samples are indicative of exposure 0-3 days pre-sampling. Subjects had been away from their home for 24-27 hours at the time the urine samples were taken and were thus within the window for detecting excreted arsenic in urine.

Reference Range Uncertainty

The adult reference ranges were determined by using the same laboratory analytical method (CDC) as was used in this study of individuals from the Panther Creek area. The child reference ranges were determined using different analytical methods (EPA 1996a,b), however, 1 in every 20 samples was sent to CDC to determine concordance between the methods (Tsuji et al. 2005). Results of both labs were highly correlated for total arsenic ($R^2 = 0.99$) and reasonably correlated for speciated arsenic ($R^2 = 0.67$). The limit of detection for CDC and EPA methods was similar. While the child reference range of Tsuji et al. may be slightly affected by these differences, it is reasonable to assume that the results in this report are comparable to those determined by Tsuji et al.

CONCLUSIONS

The adult's urine arsenic levels (total and speciated) are below the median levels for the general U.S. population reference range (Tables 1 and 2). The child's urine arsenic level is higher than the adult's but is still below the high end of the reference ranges. The environment where this child lives has much more arsenic in soil and dust than the environment where the child reference population was sampled, yet the child's urine level of arsenic species (in Child Sample 2) is between the 50-75th percentile of the reference range. This suggests that the child is not being exposed to elevated doses of arsenic despite the environment. CDC considers urine levels below the 95th percentile to be within a 'normal' range for the general population (CDC 2005; Sampson 2008). Again, these RRs are not based on dose-response but rather on the distribution of what levels are found in a population of healthy individuals. RRs are a screening level, not a clear cut indication of a health hazard. Levels above the 95th percentile indicate that a person should take steps to avoid ongoing exposure and should receive ongoing monitoring until urine arsenic declines. While the child's urine arsenic levels did not exceed the 95th percentile, BCEH recommends that the child be tested again by the family's physician to be protective of health.

RECOMMENDATIONS

Further recommendations are:

1. Ongoing urine monitoring of these two subjects on a seasonal basis since arsenic-containing soil is currently covered by snow. The subjects should be monitored by their physician. BCEH will consult with the physician if necessary to aid in interpretation of results.
2. The indoor spaces on the property will be remediated by EPA contractors this winter; when this occurs, exposure levels are expected to drop considerably. However, since remediation will not eliminate arsenic exposures due to the widespread distribution of arsenic in the Panther Creek area, BCEH will continue to encourage behaviors to prevent the take-home pathway for arsenic and to prevent the child from contacting surfaces where arsenic is most likely to remain.

PUBLIC HEALTH ACTION PLAN

1. The subjects will be directed to visit their physician for ongoing monitoring of urine arsenic. Idaho Bureau of Labs may pay for shipping and analysis of urine samples submitted by the physician, at their discretion and based on availability of funds.
2. BCEH will meet with the subjects again this spring to interpret further results and will provide information to the subjects via email and phone as necessary prior to this meeting.
3. EPA contractors funded by the Blackbird Mine Site Group will remediate indoor spaces on the subjects' property beginning in January 2009. Contractors are expected to perform further soil remediation in spring 2009 once snow has melted.

If you have questions, please feel free to contact BCEH any time.

Best regards,

Kai Elgethun Ph.D., MPH
Public Health Toxicologist
Idaho Dept. of Health and Welfare

Attachment: References

REFERENCES

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CERTIFICATION

The health consultation for the Panther Creek (Blackbird Mine) site was prepared by the Idaho Department of Health and Welfare under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was initiated. Editorial review was completed by the cooperative agreement partner.

Gregg V. Ulirsch

Technical Project Officer, CAT, CAPEB, DHAC

The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this health consultation, and concurs with its findings.

Team Leader, CAT, CAPEB, DHAC, ATSDR