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ARSENIC LEVELS IN U.S. FOODS AND BEVERAGES

A Two-Study Feature

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ABOUT THE COVER



Two of our feature articles this month describe studies that investigated arsenic ingestion in the context of consumption patterns. “Arsenic Consumption in the United States” examines the risks

of arsenic exposure in consumers of food and drink items such as juice (especially apple), rice, milk, broth, and infant formula. Although now prohibited, arsenic has a long history in pesticide use and persists in many previously treated soils. In “Arsenic Content in American Wine,” the author examined arsenic levels in wine samples from the top four wine-producing states and found all samples exceeded U.S. EPA’s exposure limit for drinking water of 10 parts per billion. The presence of arsenic in U.S. wine is a health risk to regular consumers of wine.

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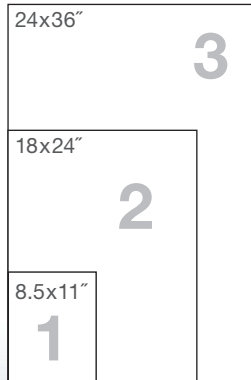


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► PRESIDENT'S MESSAGE



Bob Custard,
REHS, CP-FS

We Haven't Told Our Story

Advocacy—the Merriam-Webster dictionary defines the word as “the act or process of supporting a cause or proposal.” That same dictionary goes on to define “cause” as “a principle, aim, or movement that, because of a deep commitment, one is prepared to defend or advocate.” So, in environmental health, what is the cause we are so deeply committed to that we are prepared to defend it and advocate for it?

Some might say, based on the visible lack of significant advocacy for environmental health in the U.S., that there is no such cause. On this point, I strongly disagree. Every environmental health professional I know is deeply committed to safer and healthier homes, schools, workplaces, and communities. We, as environmental health professionals, have chosen our profession not for the financial rewards, but for the ability to make a positive difference in the health and safety of our communities.

So why aren't we advocating for environmental health? I believe there are three primary reasons:

1. We have forgotten our history. In our day-to-day work we often see slow and uneven progress towards creating safer and healthier environments in our communities. We miss the big picture. Environmental health interventions like drinking water chlorination, milk pasteurization, safe sewage disposal, inspection of food establishments, and mosquito control are largely responsible for increasing the life expectancy in the U.S. by 32 years since 1900.
2. Many of us work for public agencies where we are encouraged not to talk to elected

*It is long past
time for all of us
as environmental
health professionals
to stand up
and speak up.
Environmental
health is a
contact sport.*

officials or the media lest we rock the boat. As a result, we go about our daily work conducting inspections, assessing risks, and preventing injuries and disease without ever telling our story.

3. We assume that the value of environmental health is self-evident to everyone. After all, who is against water that is safe to drink, food that is safe to eat, or air that is safe to breathe?

In his keynote address at this year's Annual Education Conference & Exhibition, NEHA's new Executive Director Dr. David Dyjack described environmental health as a profession shrouded in a “cloak of invisibility.” Indeed environmental health has been so successful at quietly doing its job that the

general public is not even aware we exist except in those relatively rare instances when our efforts fail to prevent an outbreak of disease. We are victims of our own success!

Absolutely no one questions the importance of safe drinking water, but almost everyone takes it for granted that water in the U.S. has always been safe to drink ... because we haven't told our story.

No one questions the importance of having food that is safe to eat, but few even think about food safety when they go to the grocery store ... because we haven't told our story.

No one questions the importance of proper sewage disposal, but no one ever thinks of the sanitarian who designed their septic system when they flush ... because we haven't told our story.

Somehow we believe that everyone should intuitively know the value of environmental health. Clearly that is not the case.

Today our country's environmental public health programs are under attack at all levels of government. For example, in the area where I live, many county and city vector control programs have been severely cut or totally eliminated despite the looming threats of chikungunya and dengue. The recent National Association of County and City Health Officials' “Forces of Change” survey showed that local health departments have lost 51,700 jobs since 2008 and that 27% of local health departments expect further budget cuts in the coming year.

At the federal level, the current (July 29) mark up for the FY16 budget in the U.S. Senate will cut funding for the Centers for Disease Control and Prevention's National Center for

Environmental Health (NCEH) by 19%. The Safe Water Program, which includes funding for investigating the causes of waterborne disease outbreaks, response to major toxic contamination and natural disasters affecting drinking water supplies, and the recreational water program that led development of the Model Aquatic Health Code, will be totally eliminated. Funding for the Environmental Public Health Tracking Network, which provides the data that allow environmental health professionals to focus resources where they will have the most impact, will be cut by 51%.

It is long past time for all of us as environmental health professionals to stand up and speak up. Environmental health is a contact sport.

What Role Will NEHA Play?

We are imagining a new NEHA that is

- the unified voice of the environmental health profession,
- the recognized leader of a national dialogue on environmental health issues, and
- an effective advocate for making environmental health a national priority.

As an organization, we are making a new commitment to

- be at the table whenever and wherever national environmental health policy is being discussed,
- actively partner with other health and environmental organizations on environmental health issues,
- increase NEHA's influence on national environmental health policy by opening a satel-

lite NEHA office in Washington, DC, as soon as possible, and

- equip you, our members and affiliates, with the information and training you need to effectively engage your local community on environmental health issues.

What Role Can You Play?

For far too long environmental health professionals have quietly done inspections, assessed risks, and implemented public health interventions while failing to engage the broader community. Few of the people in our communities know what we do or even understand how foundational environmental health is to their quality of life. Environmental health needs to tell its story.

As an environmental health professional you can tell the environmental health story. Start some conversations about the importance of environmental health with your friends and family. Help them imagine what life would be like if environmental health professionals were not there to protect their community. Here are some conversation starters:

- When I travel to Mexico, people always tell me, "Don't drink the water or you'll get Montezuma's Revenge." When people travel to the U.S. they aren't warned, "Don't drink the water or you'll get Uncle Sam's Revenge." Did you ever wonder why?
- Do you worry about the safety of the food you buy in the grocery store? What gives you confidence in the safety of that food?

In the course of your daily work, take the time to explain what you are doing and why.

Put your work in its broader context. For example:

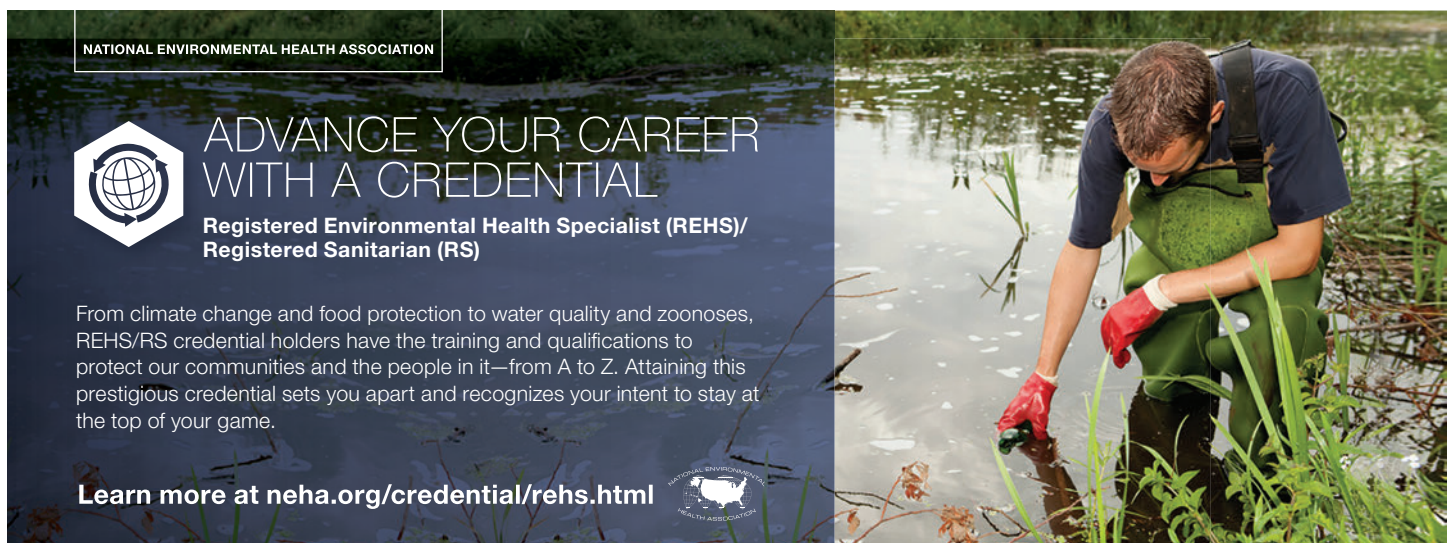
- "Did you know that unintentional injuries are the number-one cause of death in children ages one to four? Almost one-third of these deaths are due to drowning, even more than those caused by motor vehicles. One of the goals of our aquatic health program is to prevent as many of these deaths as possible."
- "Screens are important in keeping mosquitoes out of your house. Did you know that before screens were in common use that malaria and outbreaks of yellow fever were common in the U.S.? Today we worry more about West Nile virus and emerging diseases like dengue fever. Vector control is still really important to community health, but unfortunately many vector control programs are losing their funding."

Finally, please get to know your elected officials. Help them understand what you do and why it is important. If possible, arrange for them to shadow you for a day at work. Then when legislation affecting environmental health is before Congress or your state legislature, call them.

Environmental health is shrouded in a cloak of invisibility because we haven't told our story. Join me in imagining a time when everyone in your community knows what environmental health is and why it is important ... because you and I told them. 🐸

Bob Custard

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Arsenic Consumption in the United States

Denise Wilson

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Abstract Exposure limits for arsenic in drinking water and minimal risk levels (MRLs) for total dietary exposure to arsenic have long been established in the U.S. Multiple studies conducted over the last five years have detected arsenic in foods and beverages including juice, rice, milk, broth (beef and chicken), and others. Understanding whether or not each of these foods or drinks is a concern to certain groups of individuals requires examining which types of and how much arsenic is ingested. In this article, recent studies are reviewed and placed in the context of consumption patterns. When single sources of food or drink are considered in isolation, heavy rice eaters can be exposed to the most arsenic among adults while infants consuming formula containing contaminated organic brown rice syrup are the most exposed group among children. Most food and drink do not contain sufficient arsenic to exceed MRLs. For individuals consuming more than one source of contaminated water or food, however, adverse health effects are more likely. In total, recent studies on arsenic contamination in food and beverages emphasize the need for individual consumers to understand and manage their total dietary exposure to arsenic.

Introduction

Arsenic is ubiquitous in air, water, and living things (Azcue, 1995) and is a component of more than 245 minerals (Mandal & Suzuki, 2002). The weathering of rocks converts the arsenic sulfides in these minerals to arsenic trioxide that then enters into the environment as dust and dissolves in rain, rivers, and groundwater (Mandal & Suzuki, 2002; U.S. Geological Survey, 2011). Although now prohibited, arsenic-based pesticides have a long history in agriculture and persist in previously treated soils. Humans can be exposed

to arsenic in both inorganic and organic forms. Organic arsenic (e.g., monomethylarsonic acid [MMA] and dimethylarsinic acid [DMA]) exposure occurs mostly through fish and shellfish and is typically excreted and not absorbed by the body. Historically, organic arsenic is largely thought to be nontoxic and most arsenic-induced toxicity in people is thought to be a result of exposure to inorganic arsenic (Agency for Toxic Substances and Disease Registry [ATSDR], 2007). Recent studies of trivalent MMA and DMA, however, may put these historical assumptions about

organic arsenic into question (see Roberge and co-authors, 2009, for discussion of this topic), but this review remains focused on inorganic species. Inorganic arsenic is typically found in two forms: trivalent As(III) or arsenite and pentavalent As(V) or arsenate (ATSDR, 2007). Recent studies show that many foods contain significant amounts of inorganic arsenic including milk and dairy products; beef, pork, and poultry; and certain fruits, grains, and vegetables that have high uptake rates from contaminated soils.

Safety Standards

Since arsenic is such a common contaminant in groundwater, exposure limits have been established for drinking water. The U.S. Environmental Protection Agency (U.S. EPA) has established a maximum contaminant level (MCL) for total arsenic of 10 parts per billion (ppb) (U.S. EPA, 2010). The MCL is a legal limit that dictates how much substance is allowed in public water systems under the Safe Drinking Water Act of 1974 (U.S. EPA, 2015). The MCL does not apply to private well water, bottled water, or other sources of water outside these public systems. California has recently enacted regulations for bottled water, however, which require testing for heavy metal contaminants, reporting the results to the state, and potentially notifying consumers via labeling requirements (Bottled, Vended, Hauled, and Processed Water, 2008).

No exposure limits are established for private well water. Individual well users are responsible for testing such water and limiting their exposure to arsenic. Around the world, exposure limits similar to that of U.S.

TABLE 1

Arsenic Contamination in Beverages (Recent Studies in the U.S.)

Beverage	Arsenic Type	Contamination (ppb) ^a			% of U.S. EPA MCL ^a		
		Min	Mean	Max	Min	Mean	Max
Cider (apple) ^b	Total arsenic	5.4	10	15	54	100	150
	Inorganic arsenic	3.9	9.7	15	39	97	150
Juice (apple) ^b	Total arsenic	11	18	30	110	180	300
	Inorganic arsenic	6.9	15	25	69	150	250
Juice (apple) ^c	Primarily inorganic	3.7	7.5	13	37	75	130
Juice (apple blend) ^c	Primarily inorganic	3.5	9.2	20	35	92	200
Juice (grape) ^{b*}	Total arsenic	7.0	22	48*	70	220	480
	Inorganic arsenic	5.2	20	51*	52	200	510
Milk ^b	Total arsenic	2.6	2.7	2.8	26	27	28
	Inorganic arsenic	0.45	0.96	2.0	4.5	9.6	20
Water (bottled) ^d	Total arsenic	0.08	0.62	1.9	0.8	6.2	19
Wine ^e	Primarily inorganic	10	23	76	100	230	760

^appb = parts per billion; U.S. EPA MCL = U.S. Environmental Protection Agency maximum contaminant limit.

^bRoberge et al., 2009.

^cWilson et al., 2012.

^dSullivan & Leary, 2011.

^eWilson, 2015.

*Computed from mean values of multiple batches; variance within mean values may cause max inorganic arsenic to exceed max total arsenic.

EPA have been established for drinking water. The World Health Organization (WHO) provides a provisional guideline value for arsenic in drinking water of 10 µg/L or 10 ppb, identical to U.S. EPA's exposure limit (WHO, 2010). The European Union adheres to this standard, requiring all member countries to use 10 ppb or lower as a regulatory limit on drinking water (European Commission, 2012). Arsenic is not regulated in the U.S. in other beverages, but the Food and Drug Administration (FDA) has proposed an action level of 10 ppb for arsenic in apple juice (FDA, 2013).

To cover other dietary sources of arsenic, some agencies have identified total dietary intake thresholds for arsenic. In particular, the Agency for Toxic Substances and Disease Registry (ATSDR) in the U.S. has estimated minimal risk levels (MRLs) for total dietary intake of arsenic dependent on arsenic species. An MRL is the estimate of daily human exposure that is likely to cause no adverse noncarcinogenic health effects over a certain duration of exposure. For chronic exposures (365 days or more), the MRLs estimated by

the ATSDR for various species of arsenic are 0.3 µg As/kg body weight per day for inorganic arsenic, 0.01 mg As/kg body weight per day for MMA (organic) arsenic, and 0.02 mg/kg body weight per day for DMA (organic) arsenic (ATSDR, 2007).

This review places recent studies of arsenic contamination of food and beverages into the context of U.S. EPA's MCL for drinking water (10 ppb) and the ATSDR total dietary intake MRL for inorganic arsenic (0.3 µg As/kg body weight per day).

Health Impacts

Chronic exposure to arsenic is a global public health problem that continues to be a subject of research. A growing body of evidence supports the fact that even low exposures to arsenic can damage the body, making it vulnerable to a broad range of cancers and other pathological effects. Arsenic is well known to cause skin, lung, and bladder cancers as well as skin lesions, diabetes, cardiovascular disease, and other disorders in humans (Hughes, Beck, Chen, Lewis, & Thomas, 2011). A full review of adverse health effects resulting from

arsenic exposure is outside the scope of this article but excellent recent reviews have been conducted for bladder cancer (Christoforidou et al., 2013), immune system damage (Dangleben, Skibola, & Smith, 2013), neurodevelopment in children (Rodriguez-Barranco et al., 2013), diabetes (Thayer, Heindel, Bucher, & Gallo, 2012), and hypertension (Abhyankar, Jones, Guallar, & Navas-Acien, 2012).

Exposure levels as low as 50 µg/L in drinking water have been linked to statistically significant increases in bladder cancer around the world including regions of Michigan, Florida, and Idaho in the U.S. (Christoforidou et al., 2013). Even lower levels of 32 µg/L in drinking water among subjects in New Hampshire in the U.S. have been linked to decreased apoptosis (natural cell death that prevents uncontrolled proliferation of cells) and diminished expressions of both defense and inflammatory genes during chronic exposures (Andrew et al., 2008). Mean arsenic levels as low as 43 µg/L in drinking water caused significant changes in motor function among children (Parvez et al., 2011), and overall, a 50% increase in arsenic exposure in drinking water caused a significant decrease of -0.56 points in Full Scale IQ (Rodriguez-Barranco et al., 2013). In U.S. studies of drinking water with even lower arsenic levels (medians of 2 µg/L and 8.3 µg/L), hypertension was shown to increase with increasing arsenic exposure (Abhyankar et al., 2012). Thus, while the adverse nature of chronic arsenic exposure has been known and acknowledged for many decades, the evolving body of evidence in the scientific literature continues to expand the type of damage, the implications for long-term diseases including cancer, and the exposure limits at which these adverse effects begin.

Nevertheless, further investigation of humans who are chronically exposed to arsenic is essential to more fully understand connections between arsenic exposure levels and disease. Although this review evaluates recent studies of arsenic in food and water on the basis of existing exposure limits, any conclusions and recommendations made as a result of these exposure levels must be interpreted with caution. As in any such review, conclusions may need to be reevaluated based on emerging knowledge regarding the adverse health effects of environmental toxins.

Sources of Contamination

A range of recent studies published in the scientific literature confirms that arsenic is almost as ubiquitous in the food and beverage supply as it is in the environment (Tables 1, 2).

Beverages (Table 1): In response to California’s regulations regarding heavy metal contamination in bottled water (Bottled, Vended, Hauled, and Processed Water, 2008), Sullivan and Leavey (2011) examined heavy metal content including arsenic in six sources of bottled spring waters. Results indicated that arsenic content in all waters tested was well below the U.S. EPA MCL of 10 ppb in drinking water. Likewise, milk samples tested by Roberge and co-authors (2009) indicated low levels of arsenic (below 3 ppb) in several different kinds of milk including whole, low fat, and fat free. In contrast, arsenic contamination in apple cider (Roberge et al., 2009), apple juice (Consumer Reports, 2012; Roberge et al., 2009; Wilson, Hooper, & Shi, 2012), apple blend juices (Wilson et al., 2012), and grape juices (Roberge et al., 2009) were substantially higher, ranging from 3.5 ppb to 51 ppb total arsenic, with a majority of species determined to be inorganic. Contamination in red wines was even greater than in apple, apple blend, and grape juices. A recent study of wines (Wilson, 2015) originating in California, New York, Oregon, and Washington demonstrated total arsenic concentrations ranging from 10 ppb to over 70 ppb. While arsenic levels in most juices and all wines exceeded the 10 ppb MCL, only 5.4% of tap water systems in the U.S. (and an estimated three million Americans served by these supplies) exceeded this limit (Natural Resources Defense Council, 2000).

Foods (Table 2): Recent studies have established baselines for and reinforced historic reports of arsenic contamination levels in several at-risk foods. While inorganic arsenic content in most beef and chicken broth (Roberge et al., 2009) and non-soy infant formula (Jackson et al., 2012a) remained below the 10 ppb MCL, arsenic levels in infant formula are of concern because infants and children have more immature detoxification capabilities than adults and do not process arsenic or other heavy metal contamination as well as adults. Children also drink and eat more per unit body weight, thereby increasing their total exposure (Rodriguez-Barranco et al., 2013).

TABLE 2

Arsenic Contamination in Foods (Recent Studies)

Food Item	Arsenic Type	Contamination (ppb) ^a			% of U.S. EPA MCL ^a		
		Min	Mean	Max	Min	Mean	Max
Food (liquid)							
Broth (beef) ^b	Total arsenic	7.5	11	19	75	110	190
	Inorganic arsenic	1.3	4.5	13	13	45	130
Broth (chicken) ^b	Total arsenic	6.2	7.9	11	62	79	110
	Inorganic arsenic	0.27	1.1	1.8	2.7	11	18
Infant formula 1 ^{c*}	Inorganic arsenic	0.34	0.98	1.6	3.4	9.8	16
Infant formula 2 ^{c*}	Inorganic arsenic	8.00	NA	9.00	80.0	85.0	90.0
Infant formula 3 ^{c*}	Inorganic arsenic	15.0	NA	25.0	150	200	250
Food (solid)							
Cereal bars ^c	Total arsenic	8.0	51	130	NA Total dietary intake minimal risk levels are more appropriate for solid food		
	Inorganic arsenic**	38	71	92			
Infant 1st stage food ^{c*}	Total arsenic***	0.32	3.6	20			
Infant 2nd/3rd stage food ^{c*}		1.7	12	22			
Rice (U.S.) ^d	Total arsenic	NA	181	753			
Seafood (amberjack) ^e		1,600	6,300	11,000			
Seafood (octopus) ^e	Total arsenic****	2,200	6,200	15,000			
Seafood (salmon) ^e		270	920	1,800			
Seafood (tuna) ^e		430	1,800	4,400			

^appb = parts per billion; U.S. EPA MCL = U.S. Environmental Protection Agency maximum contaminant limit.
^bRoberge et al., 2009.
^cJackson et al., 2012a, 2012b.
^dDuxbury & Zavala, 2005.
^eMorgano et al., 2014.
^{*}Estimated based on powder formula reconstituted with arsenic-free water: infant formula 1 = no organic brown rice syrup (OBRS); infant formula 2 = dairy with OBRS; infant formula 3 = soy with OBRS. 1st stage food = single vegetable and fruit purees; 2nd/3rd stage food = multiple foods, containing a combination of meat, grain, vegetable, or fruit.
^{**}Speciated in only 12 of 29 total samples.
^{***}72%–91% of arsenic in these samples was inorganic.
^{****}Approximately 10% of total arsenic was inorganic in these samples.

Rice has long been a concern with regard to arsenic contamination, although this concern is greater in countries outside of the U.S. where rice is a primary staple in the diet. Even so, total arsenic content in rice grown in the U.S. has been found to be as high as 753 ppb, with a majority being inorganic in nature. Due to concern over a connection between added sugar in infant formula and childhood obesity (Moskin, 2008), some infant formulas use organic brown rice syrup (OBRS) as a “healthier” alternative to added sugar. Derived from rice, OBRS is used as a healthy alternative sweetener to high-fructose corn syrup and

has been implicated in the arsenic contamination of not only infant formula but cereal bars and other foods (Jackson et al., 2012b). In contrast to rice and rice products, arsenic in seafood is primarily organic (less toxic) in nature, with only about 10% of arsenic detected in most fish appearing as inorganic species (Duxbury & Zavala, 2005).

Summary: Comparing arsenic levels in food and beverages to the safety standards (U.S. EPA MCL) for drinking water is only one approach to understanding its impact on the U.S. consumer. An alternative approach is to consider total dietary arsenic as a function of both arsenic contamination and consump-

TABLE 3

Total Inorganic Arsenic Dietary Intake Estimated by Beverage and Consumption Pattern

Beverage (Inorganic Arsenic)	Individual	Estimated Arsenic/Day (μg)			% of ATSDR MRL ^a		
		Min	Typical	Max	Min	Typical	Max
Juice* (20 ppb ^a)	Child (girl)	1.6	2.3	2.5	16	24	26
	Child (boy)	2.0	2.4	2.6	21	26	27
	Adolescent (girl)	1.9	2.1	2.2	10	11	12
	Adolescent (boy)	2.0	2.2	2.7	9.3	11	13
	Adult (woman)	1.4	2.3	2.5	6.3	10	11
	Adult (man)	1.6	2.3	3.5	6.2	8.6	13
Milk* (0.96 ppb)	Child (girl)	0.16	0.24	0.25	0.05	0.08	0.08
	Child (boy)	0.60	0.79	0.81	0.20	0.27	0.27
	Adolescent (girl)	0.07	0.11	0.12	0.36	0.59	0.62
	Adolescent (boy)	0.11	0.17	0.23	0.52	0.80	1.1
	Adult (woman)	0.08	0.16	0.18	0.36	0.61	0.75
	Adult (man)	0.10	0.16	0.20	0.36	0.61	0.75
Water, bottled** (0.62 ppb)	Child	0.10	0.14	0.27	1.0	1.5	2.8
	Adult (female)	0.27	0.38	0.47	1.2	1.7	2.1
	Adult (male)				1.0	1.4	1.8
Wine** (23 ppb)	Adult (female)	0	0.28	2.7	0	1.2	12
	Adult (male)				0	1.0	10

^aATSDR MRL = Agency for Toxic Substances and Disease Registry minimal risk level; ppb = parts per billion.
^{*}Maximum mean inorganic arsenic content in ppb, based on data in Table 1.
^{**}Maximum mean total arsenic (where most species are inorganic), based on Table 1.

tion patterns for high-risk foods and beverages. This approach is considered next.

Consumption Patterns

Consumption patterns can vary widely among children and adults, ethnicity, culture, and preferences of U.S. consumers. To understand arsenic exposure and potential health risk in terms of total dietary intake, Tables 3 and 4 use the ATSDR MRL of 0.3 μg inorganic As/kg body weight per day as a point of comparison for multiple foods and beverages consumed by individuals of various ages. The data in Tables 3 and 4 are estimated based on the following:

1. **Average weight** for children and adults is estimated based on Centers for Disease Control and Prevention (CDC) anthropometric data (n.d.) for the U.S.: eight-year-old boy (31.3 kg) or girl (31.9 kg); 15-year-old boy (70.1 kg) or girl (63.3 kg); and average male (88.9 kg) or female (75.5 kg) adult.
2. **Consumption patterns** are based on available data in market research and scientific literature and are broken down into three levels: minimum, typical or mid-range, and maximum.
3. **Inorganic arsenic consumption per day** in μg (As/day) is calculated as the amount of food or beverage ingested for a particular consumption pattern (e.g., min, typical, max) multiplied by the mean inorganic arsenic contamination level for a particular food or beverage, based on recent studies from the peer-reviewed literature. In cases where multiple studies considered the same food or beverage, the maximum mean contamination level among all studies is used.
4. **Percentage of ATSDR MRL** is computed as arsenic exposure (in μg As/kg of body weight per day) due to a particular food or beverage divided by the ATSDR MRL for inorganic arsenic of 0.3 μg inorganic As/kg body weight per day. Arsenic exposure

is calculated as the inorganic arsenic consumption per day divided by average body weight for a particular type of individual.

Juice consumption: juice consumption patterns were estimated using data based on the National Health and Nutrition Examination Survey (NHANES) as analyzed by Storey and co-authors (2006). Six categories of consumption patterns from the Storey study were used as follows: (a) girls and boys between 6 and 11 years of age; (b) emerging adolescents and adolescents between 12 and 19 years of age; and (c) men and women (adults) between 20 and 39 years old. Fruit juice consumption was broken down by three ethnicity groups: white, African-American, and Mexican-American. In most cases, fruit juice consumption by African-American children and adults is highest (max) and consumption by whites the lowest (min). Boys and girls between 6 and 11 years old consume between 78.6 and 128.4 g (0.08–0.13 L) of fruit juice a day; adolescents between 96.2 and 136.1 g (0.10–0.14 L); and adults between 71.8 and 174.5 g (0.07–0.17 L) of juice per day. These numbers are consistent with the 42.8 L of juice consumed per year on average by individuals in the U.S. (Euromonitor, 2002).

Milk consumption: milk consumption patterns are estimated using similar data based on the NHANES survey as analyzed by Storey and co-authors (2006). Boys and girls between 6 and 11 years old consume between 165 and 298 g (0.16–0.29 L) of milk a day; adolescents between 72 and 241 g (0.07–0.23 L) of milk per day; and adults between 83 and 208 g (0.08–0.20 L) of milk per day.

Bottled water consumption: bottled water consumption patterns were estimated using data from the NHANES survey as analyzed by Drewnowski and co-authors (2013a, 2013b). Bottled water consumption is very similar among children, so only a single category of children's exposure (an eight-year-old child) was estimated. Bottled water consumption ranged from 160 to 231 mL per day for children and from 413 and 758 mL per day for adults (Drewnowski et al., 2013a, 2013b).

Wine consumption: in 2012, the Wine Market Council reported that approximately 44% (100 million) of the 228 million adults in the U.S. consumed wine. Of these wine drinkers, 43% (43 million or 19% of all adults) were considered marginal drinkers, consuming 7% of the total volume of

295 million cases of wine. The remaining 57% of wine drinkers (57 million or 25% of all adults) were considered core drinkers, consuming 93% of the total volume of wine consumed in the U.S. Core wine drinkers consume wine anywhere from daily to once a week while marginal drinkers consume wine less often than weekly (Wine Market Council, 2012). Thus, the core (max) wine drinker consumes about 11.5 gallons (43.3 L) of wine per year (max) while the marginal drinker (typical) consumes about 1.13 gallons (4.3 L) of wine per year.

Cereal bar consumption: cereal bars weigh between 28 g and 100 g and are consumed by an unknown percentage of the 30% of Americans who are heavy consumers of morning goods (*Wall Street Journal*, 2014). Total inorganic arsenic consumption from a typical cereal bar as estimated in Table 4 is based on a mean inorganic arsenic level of 71 µg/g (ppb) as identified by Jackson and co-authors (2012b), an average consumption of one cereal bar per day, and on three different sizes: small (28g), medium (55 g), and large (100 g).

Infant formula consumption: data from the Infant Feeding Practices Study II indicate that a large number of infants consume formula during the first 12 months of life. Fifty-two percent of infants receive formula while still in the hospital. By two months, 61% of infants are receiving formula in their daily diets. This number stays relatively stable until one year of age, when formula consumption drops off to 36.4% of infants (Grummer-Strawn, Scanlon, & Fein, 2014). Data for infant formula in Table 4 are based on a maximum formula consumption of 2.5 ounces per pound of body weight per day; typical formula consumption is estimated at half this amount; and minimum formula consumption is estimated at zero corresponding to babies less than six months of age who are 100% breastfed.

Rice consumption: approximately 18.2% of adults surveyed in the NHANES survey consume some white or brown rice during a randomly chosen day of observation data. The average rice consumed was 61.2 g (dry weight) or just over one cup of cooked rice. Many Americans consume no rice at all on any given day while some consume up to 126.5 g in a single day (Batres-Marquez, Jensen, & Upton, 2009).

Seafood consumption: the average American consumes approximately 2.7 pounds of tuna per year and 2.0 pounds of salmon per

TABLE 4

Total Inorganic Arsenic Dietary Intake Estimated by Food and Consumption Patterns

Food (Inorganic Arsenic)*	Individual	Estimated Arsenic/Day (µg)			% of ATSDR MRL ^a		
		Min	Mid	Max	Min	Mid	Max
Cereal bars (71 ppb ^b)	Adult (female)	2.0	3.9	7.1	8.8	17	31
	Adult (male)				7.5	15	27
Formula 1 ^{**} (0.98 ppb)	Infants (6 kg)	0	0.46	0.92	0	26	51
	Infants (9 kg)	0	0.69	1.4	0	26	51
Formula 2 ^{**} (8.5 ppb)	Infants (6 kg)	0	4.0	8.0	0	221	442
	Infants (9 kg)	0	6.0	12	0	221	442
Formula 3 ^{**} (20 ppb)	Infants (6 kg)	0	9.4	19	0	520	1040
	Infants (9 kg)	0	14	28	0	520	1040
Rice (180 ppb)	Adult (female)	0	11	23	0	49	101
	Adult (male)				0	41	85
Salmon (92 ppb) ^{***}	Adult (female)	0	0.23	0.52	0	1.0	2.3
	Adult (male)				0	0.9	2.0
Tuna (180 ppb) ^{***}	Adult (female)	0	0.6	1.4	0	2.7	6.1
	Adult (male)				0	2.3	5.2

^aATSDR MRL = Agency for Toxic Substances and Disease Registry minimal risk level; ppb = parts per billion.

^bMaximum mean inorganic arsenic content in ppb, based on data in Table 2.

^{**}Refer to Table 2 for content of these foods.

^{***}Based on assumption that approximately 10% of arsenic in seafood is inorganic.

year, second only to shrimp at 4 pounds per year and relative to a total of 15.8 pounds of seafood overall (Seafood Health Facts, 2010). Of the seafood tested recently by Morgano and co-authors (2014), tuna and salmon are consumed far more than amberjack and octopus in the U.S. and are therefore used as benchmark estimates of arsenic exposure through seafood consumption. Americans consume about 3.5 ounces of seafood a week compared to the recommended dietary intake of approximately twice that amount (*USA Today*, 2011). Thus, seafood consumption is estimated at a minimum of 0 pounds per year, a typical level corresponding to what Americans do eat (2.7 pounds of tuna and 2.0 pounds of salmon per year), and a maximum level corresponding to what American should eat (slightly over twice that amount). All total intake estimates assume that only 10% of the arsenic ingested is inorganic, which is typical for most seafood (Duxbury & Zavala, 2005).

Chicken and beef broth were not included in Table 4 because consumption rates in the

U.S. are low. A heavy soup consumer in the U.S. has approximately four cans of soup per month, or approximately 1.4 ounces on average per day (Business Insider, 2011). Even if all soup contained heavily contaminated broth (12.5 ppb from Table 1), a heavy soup consumer would consume only 0.52 µg of inorganic arsenic per day, or 2.3% of the ATSDR MRL for a typical American female weighing 75.5 kg and 1.9% of the ATSDR MRL for a typical American male weighing 88.9 kg. By similar reasoning, arsenic content in 1st, 2nd, and 3rd stage foods for infants was not included in Table 4. Arsenic levels in these foods are much lower than in infant formulas, and consumption of these foods is significantly lower than infant formula.

Discussion

The issue of arsenic contamination in the food and beverage supply has been presented in two different ways. In comparing arsenic levels in beverages to the U.S. EPA drinking water safety standard or MCL (Table 1), sev-

eral beverages raise some concern as to their health risk. Grape juice and wine, in particular, demonstrate mean arsenic levels over twice the U.S. EPA MCL and maximum levels at 5 and over 7.5 times the MCL, respectively. While fewer brands are contaminated at levels above the MCL in apple ciders and juice, many brands of apple juice still contain arsenic contamination over the MCL. On the other end of the spectrum, milk and bottled water are relatively safe, with inorganic arsenic levels averaging below 1 ppb. With regard to liquid food, only infant formula sweetened with OBRs demonstrates arsenic contamination above the U.S. EPA MCL (Table 2). While the usefulness of comparing inorganic arsenic contamination in solid food to the U.S. EPA MCL may be limited, arsenic levels in cereal bars, rice, and seafood are nevertheless well above the 10 ppb exposure limit (Table 2).

The human body does not differentiate inorganic arsenic consumed from different foods and beverages, which makes total dietary in-

take a more useful measure of the total risk of adverse health effects from chronic arsenic poisoning. When put into the context of total dietary intake by body weight (Tables 3 and 4), it is evident that heavy consumers of contaminated rice and OBRs-containing foods (e.g., some cereal bars and infant formulas) are at most risk of adverse health effects when a single source of arsenic contamination is considered. Even moderate consumers of multiple contaminated foods or heavy consumers of mildly contaminated foods can be at risk for adverse health effects from total dietary arsenic intake. Consumption of apple and grape juice, wine, and certain seafood in combination can pose just as much risk as highly contaminated rice products.

Conclusion

The ubiquitous presence of arsenic in the environment and subsequent frequency of contamination in both foods and beverages underscores the need for individuals to un-

derstand their total arsenic exposure based on consideration of the whole diet. While this review has highlighted a diverse range of food and beverages that are contaminated with inorganic arsenic, a much wider range of food and beverages remains to be tested. Because full disclosure of arsenic contamination in the food, water, and beverage supply is at best a distant possibility, it has become more and more important for individuals even in developed countries like the U.S. to be tested periodically for arsenic exposure. Since urine and hair tests are readily available to assess exposure, such individual testing may be far more feasible than widespread testing of all potential dietary sources of arsenic. 🐼

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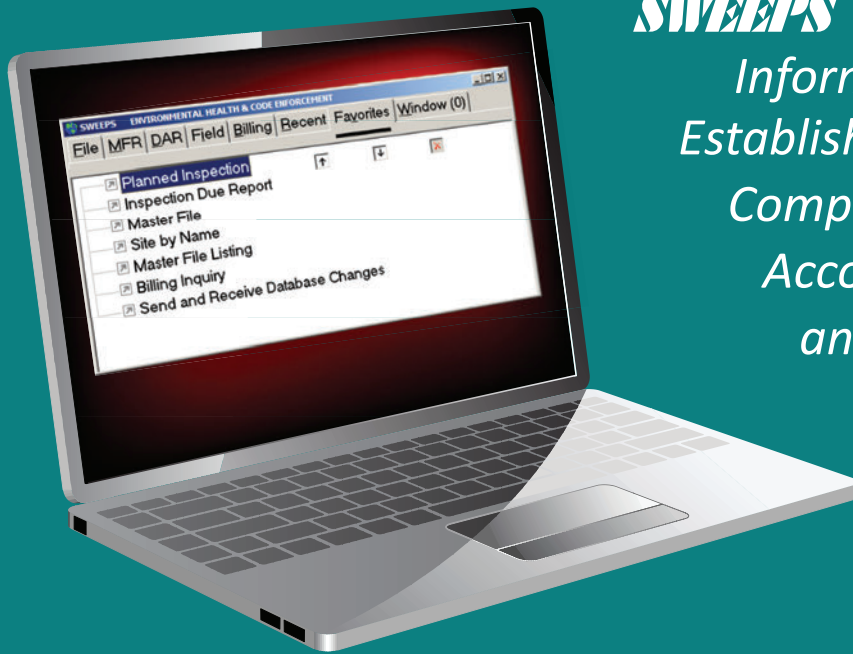
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Arsenic Content in American Wine

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Abstract Recent studies that have investigated arsenic content in juice, rice, milk, broth (beef and chicken), and other foods have stimulated an interest in understanding how prevalent arsenic contamination is in the U.S. food and beverage supply. The study described here focused on quantifying arsenic levels in wine. A total of 65 representative wines from the top four wine-producing states in the U.S. were analyzed for arsenic content. All samples contained arsenic levels that exceeded the U.S. Environmental Protection Agency (U.S. EPA) exposure limit for drinking water of 10 parts per billion (ppb) and all samples contained inorganic arsenic. The average arsenic detected among all samples studied was 23.3 ppb. Lead, a common co-contaminant to arsenic, was detected in 58% of samples tested, but only 5% exceeded the U.S. EPA exposure limit for drinking water of 15 ppb. Arsenic levels in American wines exceeded those found in other studies involving water, bottled water, apple juice, apple juice blend, milk, rice syrup, and other beverages. When taken in the context of consumption patterns in the U.S., the pervasive presence of arsenic in wine can pose a potential health risk to regular adult wine drinkers.

Introduction

Arsenic is ubiquitous in air, water, and living things (Azcue, 1995). Although present in both elemental and compound forms, arsenic poses the most serious threat to humans in its inorganic forms, as pentavalent As^{5+} and trivalent As^{3+} compounds. Organic forms of arsenic are predominantly arsenobetaine and are considerably less toxic than inorganic forms. Herein, the term arsenic is used to describe composition that is dominated by inorganic compounds in either pentavalent or trivalent states.

Arsenic in groundwater typically comes from minerals that have dissolved from

weathered rocks and soils rather than from human influences (Azcue, 1995). For hundreds of years, however, arsenic has also been introduced into the environment through the use of pesticides and insecticides on a wide range of crops. Grape vines absorb arsenic from the soil as pentavalent As^{5+} , 60% of which is further reduced during fermentation to trivalent As^{3+} , the most toxic form of arsenic. Despite the fact that arsenic-containing pesticides are now prohibited in all major wine-producing countries, grapes can continue to uptake large amounts of arsenic from residue in the soil for very long peri-

ods of time. Soil composition, background arsenic in irrigation water, and possible corrosion of metal caps (Galani-Nikolakaki & Kallithrakas-Kontos, 2006) have also been implicated in arsenic contamination of wine.

Arsenic has been studied in wine around the world. For example, Galani-Nikolakaki and co-authors (2002) found no arsenic above the 0.5 parts per billion (ppb) detection limit in any of 30 Cretan wine samples analyzed. Similarly, a study of wines originating from 10 vineyards in Italy (Bertoldi, Villegas, Larcher, & Santato, 2013) yielded concentrations less than 1.62 ppb in all wine samples, with red wines yielding higher concentrations than white wines from the same vineyards. A study of 80 wine samples in central Europe (Huang, Hu, Ilgen, & Ilgen, 2012), both red and white, also showed that most contained total arsenic concentrations less than the 10 ppb drinking water limit of the U.S. Environmental Protection Agency (U.S. EPA, 2010). Spanish wines (Herce-Pagliai, Moreno, Gonzalez, Repetto, & Caméan, 2002) showed slightly higher arsenic concentrations ranging from 2.10 to 14.6 ppb but with a mean level remaining below the drinking water limit of 10 ppb. These arsenic levels are low compared to the maximum 110 ppb and 420 ppb of pentavalent As^{5+} and trivalent As^{3+} species, respectively, found in U.S. table wines (Crecelius, 1977) in the 1970s.

The study described here sought to complement recent studies by looking at arsenic contamination in American wines. This study also examined lead in wine, since lead is a common co-contaminant to arsenic (Per-

yea, 1998) due to the extensive historical use of lead-arsenate pesticides in agriculture.

Methods

Sample Procurement

Wines were selected for testing according to the following guidelines: (1) samples in each state represented at least four diverse wine-growing regions (American Viticultural Areas or AVAs) within that state; (2) red wines were chosen over white wines because grape skins contain more heavy metal than pulp (Teissedre, Cabanis, Champagnol, & Cabanis, 1994); and (3) the same red wine grape was sampled wherever possible within a state to reduce any confounding impacts of grape variety. Most wines were procured from local grocery stores, wine shops, or online wine merchants, while some small production wines were procured directly from the producing winery. All but two wines tested contained grapes grown in a single AVA; two wines used grapes that were grown in multiple AVAs but within the same state (California). Origin of grapes was confirmed through information contained on the label or sell sheet for each wine or by personal communication with the producing winery.

Sample Selection

California is the largest wine-producing state in the U.S., producing 667.6 million gallons in 2012, accounting for 90% of wine produced in the U.S. (Tornow, 2013) and 58% of all wines sold in the U.S. (Wine Institute, 2012). California is home to over 110 AVAs (Wine Institute, 2010). A representative sampling of all AVAs in California was not possible because of limited resources. Instead, four counties in California (Lake, Mendocino, Napa, and Sonoma) were chosen for testing because they represent the full range of underlying groundwater arsenic contamination data in California. Lake County had the highest groundwater concentration among the four counties considered with at least 25% of groundwater samples containing arsenic at levels of 10 $\mu\text{g/L}$ or more. In Napa County, 25% of groundwater samples contained arsenic at levels greater than 5 $\mu\text{g/L}$, and in Mendocino County, 25% of groundwater samples contained arsenic at levels greater than 3 $\mu\text{g/L}$. Sonoma County had insufficient data to identify baseline arsenic contamina-

tion (U.S. Geological Survey [USGS], 2011, 2014). Each of these four counties also has a revenue share at least twice their share of grape crush in the state of California (Goodhue, Green, Heien, & Martin, 2008), indicating a tendency to produce more premium wines where the vineyards of origin and hence the source of arsenic contamination can be readily identified.

New York is the second largest wine-producing state in the U.S., producing 26.4 million gallons of wine or roughly 3.6% of U.S. capacity in 2012 (Tornow, 2013). New York is home to nine AVAs (Wine Institute, 2010). This study emphasizes the Finger Lakes region, consisting of Finger Lakes, Cayuga Lake, and Seneca Lake AVAs, which produce over 85% of the state's wine (Bates, 2010). Of the four states considered, New York had the lowest known underlying groundwater contamination with 25% of samples containing only 1 $\mu\text{g/L}$ or less in groundwater (USGS, 2011, 2014).

Washington State is the third largest wine-producing state in the U.S., producing 24.5 million gallons of wine or roughly 3.3% of U.S. capacity in 2012 (Tornow, 2013). Washington is home to 13 AVAs (Washington State Wine, n.d.). Ten AVAs were sampled in this study. Underlying groundwater arsenic contamination in Washington State AVAs tends to be low, with 25% of groundwater samples exceeding 5 $\mu\text{g/L}$ only in parts of the Puget Sound AVA, Walla Walla AVA, and the Yakima Valley AVA. Remaining AVAs in the state have groundwater arsenic contamination that is even lower (USGS, 2011, 2014) than these three AVAs.

Oregon is the fourth largest wine-producing state in the U.S., producing 6.5 million gallons of wine or roughly 0.88% of U.S. capacity in 2012 (Tornow, 2013). Oregon is home to 16 AVAs (Wine Institute, 2010). Eight of these AVAs were sampled from Oregon wineries, and three AVAs were sampled from Washington wineries that produced wine in AVAs in distinct geographic regions that cover areas in both Washington and Oregon. Half of the wine samples originated from the larger Willamette Valley AVA, which is located in northwestern Oregon and contains underlying arsenic groundwater contamination ranging from 3 $\mu\text{g/L}$ to 10 $\mu\text{g/L}$ or greater in 25% of samples by region. Arsenic tends to be more concentrated further west (USGS, 2011, 2014) toward the Oregon coast.

Sample Preparation

A total of four samples of each of the 65 wines, for a total of 260 samples, were prepared for analysis. One hundred mL of each sample were poured directly from the original wine bottle into glass bottles and analyzed by environmental laboratories for total arsenic content. Two hundred mL of wine were also analyzed for arsenic content using field tests made by Sensafe. Two additional samples each containing 50 mL of wine were analyzed for arsenic content using field tests made by Hach. This process resulted in identical samples (batch and composition) analyzed for all 65 wines. All sample bottles were given a random number that was recorded along with winery, type of wine, winery location, grape source, date of bottling, and other relevant information. All bottles were thoroughly cleaned after foil removal and before uncorking to reduce potential contamination from foil and other sources.

Analytical

Each wine sample was analyzed in two different ways: (a) for total arsenic (including both inorganic and organic compounds) and lead content using laboratory tests and (b) for inorganic arsenic species using low concentration field tests made by Hach and Sensafe.

Laboratory tests were conducted according to U.S. EPA Methods 200.8, ICP-MS (U.S. EPA, 1994). Interference in the wine samples required using multiple standard additions to analyze each laboratory sample. Field tests were conducted using Hach and Sensafe low range arsenic field test kits. For the Hach tests, 50 mL of undiluted sample and 50 mL of 10:1 diluted (with purified water) sample were used to measure arsenic content in increments of 0, 10, 30, 50, and 70 ppb. In the Hach method, hydrogen sulfide is first oxidized to sulfate by the addition of three reagents to prevent interference with the measurement of arsine gas. These three reagents are (a) sodium phosphate dibasic and potassium monopersulfate to force sulfides to be oxidized to sulfate; (b) disodium and tetrasodium EDTA to remove residual potassium monopersulfate. After the oxidation of hydrogen sulfide, sulfamic acid and powdered zinc are used to generate strong reducing conditions where inorganic arsenic is reduced to arsine gas. The arsine gas then reacts with mercuric bromide tests

strips to form arsenic/mercury halogenides that discolor the test strip and provide a semiquantitative indication of arsenic content (Kroll, n.d.). In the Sensafe tests (U.S. EPA, 2003), the sample is first mixed with tartaric acid and rate enhancers to acidify the sample. A potassium peroxymonosulfate is then added to oxidize the sample to remove hydrogen sulfide interferences followed by zinc powder to convert inorganic arsenic compounds to arsine gas that then reacts with mercuric bromide tests strips similar to the Hach tests.

Comparison Criteria

Detected concentrations of arsenic and lead were evaluated in comparison to three exposure criteria for arsenic and two exposure criteria for lead in drinking water. These comparison criteria are summarized in Table 1 along with the method detection limit (MDL) for U.S. EPA 200.8 (1994). As of this writing, wine contaminant levels are not required to meet these exposure standards.

Results

Arsenic was detected in 100% of 65 wines studied, ranging from a minimum of 10.0 ppb to a maximum of 75.9 ppb. Lead was detected in 58% of the 43 wines studied, ranging from 2.63 ppb to 54.2 ppb. The average arsenic level in all wines tested was 23.3 ppb (*SD* = 11.3) while the average lead level was 9.27 ppb (*SD* = 11.0).

California Wines (Table 2)

Most wines tested from California were Cabernet Sauvignon, produced from grapes grown in a single AVA. Three wines (two red, one white) sourcing grapes from multiple, unspecified AVAs in California were also tested. The single white wine tested (Chardonnay) contained arsenic at 24.3 ppb. Results for the remaining 16 red wines are summarized in Table 2. Field tests confirmed that inorganic arsenic dominated total arsenic content.

Arsenic was detected in all 16 red wines (100%) tested from California. All wines tested above the U.S. EPA drinking water limit of 10 ppb. Lead was detected in 11 of 15 wines tested (73%), although at much lower levels than arsenic (mean = 7.29 ppb; *SD* = 2.95 ppb). No samples (0%) indicated lead content greater than the U.S. EPA drinking water limit of 15 ppb.

TABLE 1

Comparison Criteria and Experimental Detection Limits for Chronic Arsenic Exposure

Comparison Values	Agency	Media	Total Arsenic	Lead
MCL (maximum contaminant level in ppb ^a)	U.S. EPA ^a (2010, 2011), WHO ^a (2010)	Drinking water	10	15
MDL (maximum detection limit in ppb) after multiple standard additions	AmTest	Water and beverages	0.1	2.5

^appb= parts per billion; U.S. EPA = U.S. Environmental Protection Agency; WHO = World Health Organization.

TABLE 2

Arsenic Levels in Red Wines Grown and Produced in California

AVA*	Type of Wine	Arsenic (ppb ^a)	Lead (ppb)**
Alexander Valley	Cabernet Sauvignon	17.2	5.96
Guenoc Valley	Petit Syrah	29.5	8.39
Lake County	Cabernet Sauvignon	24.8	ND
Lake County	Cabernet Sauvignon	22.6	2.63
Mendocino	Cabernet Sauvignon	21.6	ND
Napa Valley	Cabernet Sauvignon	19.4	ND
Napa Valley	Cabernet Sauvignon	17.2	ND
Rutherford	Cabernet Sauvignon	27.3	8.22
Sonoma Valley	Cabernet Sauvignon	20.3	ND
Sonoma Valley	Zinfandel	28.7	5.10
Sonoma Valley	Pinot Noir	24.0	7.17
Sonoma Valley	Pinot Noir	27.0	11.2
Spring Mountain District	Cabernet Sauvignon	15.1	5.96
Stags Leap District	Cabernet Sauvignon	18.4	13.3
Multiple, unspecified	Cabernet Sauvignon	34.2	6.70
Multiple, unspecified	Cabernet Sauvignon	29.1	5.50
Mean (<i>SD</i>)***	Arsenic in red wine (<i>n</i> = 16) Lead in red wine (<i>n</i> = 15)	23.5 (5.45)	7.29 (2.95)

^appb = parts per billion.

*AVA (American Viticultural Area) or county refers to the region in which the grapes used to produce the wine were grown (origin) and not necessarily where the grapes were processed into wine.

**ND = not detected at 2.5 ppb or greater.

***Mean and standard deviation (*SD*) calculated only for wines in which a contaminant was detected.

New York Wines (Table 3)

All wine samples from New York State were red and most were Pinot Noir. Arsenic was detected in all eight wines (100%) tested although at lower levels than in California wines. Field tests confirmed that inorganic arsenic dominated total arsenic content.

Lead was detected in five (63%) of the wines tested. Variations in lead content were substantial (*SD* = 21.1 ppb). Three wines contained no detectable levels of lead. Of the remaining five wines, lead content varied from 5.8 ppb to 54.2 ppb. Two samples (31.6 ppb, 54.2 ppb) tested higher than the drinking water limit of 15 ppb.

TABLE 3

Arsenic Levels in Red Wines Grown and Produced in New York State

AVA*	Type of Wine	Arsenic (ppb) ^a	Lead (ppb)**
Cayuga Lake	Gamay Noir	18.7	ND
Finger Lakes	Pinot Noir	15.4	ND
	Pinot Noir	19.4	ND
	Red blend: 43% Cabernet Franc, 41% Merlot, 16% Cabernet Sauvignon	17.0	5.80
Seneca Lake	Cabernet Franc	18.6	31.6
	Pinot Noir	21.5	54.2
	Pinot Noir	17.1	6.37
	Pinot Noir	18.3	10.2
Mean (SD)***	Arsenic in red wine (<i>n</i> = 8) Lead in red wine (<i>n</i> = 8)	18.3 (1.8)	21.6 (21.1)

^appb = parts per billion.
^{*}AVA (American Viticultural Area) or county refers to the region in which the grapes used to produce the wine were grown (origin) and not necessarily where the grapes were processed into wine.
^{**}ND = not detected at 2.5 ppb or greater.
^{***}Mean and standard deviation (SD) calculated only for wines in which a contaminant was detected.

Washington Wines (Table 4)

Arsenic was detected in all 30 wines tested. Of these 30 wines, 28 were red and two were white. The two white wines were chosen because a suitable red wine made from grapes grown in two of the AVAs considered in Washington State was not available: (a) a Madeleine Angevine wine from Puget Sound (arsenic = 19.1 ppb; lead = not detected); and (b) a Pinot Gris wine from Natches Heights (arsenic = 17.7 ppb; lead = not detected). Field tests confirmed that inorganic arsenic dominated total arsenic content.

Arsenic was found in all of the red wines tested in Washington State (mean = 27.4 ppb) above the U.S. EPA drinking water limit of 10 ppb. Of the 12 AVAs sampled, two had unusually high levels of arsenic in grapes cultivated in these regions. Walla Walla, in southeastern Washington, had an average arsenic content of 46.0 ppb (*SD* = 28.6) and the Red Mountain AVA had an arsenic level of 55.1 ppb, although only a single wine was tested from this region.

Lead was detected in only five of the nine wines (55%) tested in Washington State with a mean level of 4.97 ppb. No samples contained lead over the U.S. EPA drinking water limit of 15 ppb.

Oregon Wines (Table 5)

Arsenic was detected in all eight red wines (mean = 12.6 ppb) tested. All samples tested above the U.S. EPA drinking water limit of 10 ppb, but no wine contained lead over the U.S. EPA drinking water limit of 15 ppb. Only two of eight (25%) wines tested contained lead (mean = 5.26 ppb). Field tests again confirmed that inorganic arsenic dominated total arsenic content.

Discussion**Comparison Between Arsenic and Lead Contamination**

By a wide margin, arsenic was present in more samples and in greater quantities across all types of wines tested in this study than lead. Lead was not detected in 42% of samples. Although both metals would be expected from soils previously treated with or exposed to lead-arsenate pesticides, arsenic can also derive from a wide range of other sources, both natural and man-made (Azcue, 1995).

Evaluation by State (Figure 1)

State of origin played a minor role in arsenic and lead contamination among wines tested. Analysis of variance (ANOVA) showed only that arsenic levels in wines produced in

Washington were significantly higher than those in Oregon ($p < .01$), but all other differences in arsenic content were not statistically significant. Differences in lead levels among the four states tested were also not statistically significant, although this result is likely due to small sample size. Lead contamination seemed to be lower in more rural vineyards in Oregon and Washington. In more densely populated wine-growing regions in California and New York, lead appeared to be more prevalent. In particular, Finger Lakes (New York) has historically been home to a wide range of industries and agriculture including apple orchards, which may contribute lead-arsenate residue to modern day vineyard soil. In addition, the use of leaded gasoline is known to contribute to lead levels in sediment cores and water samples taken from the Finger Lakes region that, while declining rapidly in the last few decades, continue to test above tolerable exposure limits for lead (New York State Department of Environmental Conservation, 2001).

Evaluation by Agricultural History

The agricultural histories of most vineyards in this study were not known. In some AVAs, however, it was possible to clearly identify one wine produced from grapes grown on "new" agricultural land and one produced from grapes grown on old agricultural land. These case studies are discussed here.

New York

Two of the wines sampled from the Finger Lakes region are known to have agricultural histories dating back before 1950, one in Finger Lakes AVA and one in Seneca Lake AVA. Both arsenic and lead content in these two wines was not exceptionally high for the region. In fact, arsenic (15.4 ppb, 18.3 ppb, respectively) for these historical vineyards was at or below average for the wines sampled while lead content (not detected, 10.2 ppb, respectively) was well below average. Thus, it seems that another source of contamination aside from lead-arsenate pesticide residue is likely at play in these vineyards and wineries.

Washington

Yakima Valley has a rich and long history of cultivating and producing apples that are likely to have been treated with lead-arsenate pesticides prior to their ban in the

1940s in Washington. One wine tested in the Yakima Valley AVA had a known history of growing apples prior to the planting of grapes, dating back to 1908. Arsenic in this wine produced from grapes in old agricultural land was found to be 38.7 ppb while other samples from Yakima Valley AVA were 38.0 ppb, 15.5 ppb, 23.8 ppb, 22.8 ppb, and 17.2 ppb. It is important to note here that the 38.0 ppb result, while guaranteed to be from old apple orchard land, was nevertheless grown and produced in close proximity to the 38.7 ppb sample. Along this same line of reasoning, a winery in the Columbia Gorge AVA with a known history of peach and pear tree cultivation also demonstrated arsenic levels well above average (32.2 ppb). Thus, some evidence exists that higher levels of arsenic in red wines in Washington may be a result of lead-arsenate pesticide residue in the soil.

Summary

Chronic arsenic exposure is known to lower IQ in children and in the long term to cause skin, lung, liver, and bladder cancers (Rahman, Ng, & Naidu, 2009; Wang et al., 2007). Chronic arsenic poisoning is a possible risk for heavy drinkers of highly contaminated wines. The health impacts of lead, even when present below existing exposure levels, are still mixed and controversial; thus, the risk imposed by lead contamination in some wines may also be significant. While information regarding arsenic and lead in drinking water is required in public water quality reports and must be disclosed on request for bottled water (California), no such requirements exist for wine. Thus, consumers have little information that can be used to direct which wines and how much wine to drink. Since arsenic is ubiquitous, becoming ever more prevalent in the environment, its presence in wine should be carefully considered in the context of other dietary sources of arsenic.

This study has several limitations that correspondingly limit its application to understanding the public health risk posed by arsenic and lead in wines. First, a limited number of wines were sampled and generalizability may be limited for this reason. Second, resource limitations did not allow for speciation during laboratory testing. Field tests and underlying knowledge about

TABLE 4

Arsenic Levels in Red Wines Grown and Produced in Washington State

AVA*	Type of Wine	Arsenic (ppb) ^a	Lead (ppb)**
Ancient Lakes	Red blend: 55% Cabernet Sauvignon, 45% Merlot	14.0	ND
Columbia River Gorge	Grenache	32.2	8.90
Columbia Valley	Cabernet Sauvignon	47.0	ND
	Cabernet Sauvignon	32.3	ND
	Cabernet Sauvignon	23.4	ND
	Cabernet Sauvignon	15.5	ND
	Cabernet Sauvignon	23.4	ND
	Malbec	16.4	ND
	Red blend: 57% Merlot, 34% Cabernet Sauvignon	13.4	ND
Horse Heaven Hills	Red blend: 33% Cabernet Sauvignon, 26% Sangiovese, 21% Carmenere, 13% Syrah	20.1	ND
	Tempranillo	16.1	ND
Lake Chelan	Cabernet Sauvignon	18.1	ND
	Cabernet Sauvignon	29.5	ND
Rattlesnake Hills	Cabernet Sauvignon	28.6	ND
	Cabernet Sauvignon	38.7	3.35
Red Mountain	Cabernet Sauvignon	38.0	6.41
	Red blend: 44% Cabernet Sauvignon, 40% Merlot, 10% Sangiovese	55.1	3.38
Wahluke Slope	Cabernet Sauvignon	27.0	ND
	Cabernet Sauvignon	29.8	ND
Walla Walla	Cabernet Sauvignon	75.9	ND
	Cabernet Sauvignon	45.4	2.80
	Syrah	17.8	ND
Yakima Valley	Cabernet Sauvignon	17.2	ND
	Lemberger	11.3	ND
	Red blend: unknown grapes	15.5	ND
	Red blend: 55% Syrah, 45% Cabernet Franc	22.8	ND
	Red blend: 38% Cabernet Sauvignon, 32% Cabernet Franc, 16% Malbec	21.0	ND
Mean (SD)**	Tempranillo	23.8	ND
	Arsenic in red wine (n = 28) Lead in red wine (n = 9)	27.4 (14.5)	4.97 (2.62)

^appb = parts per billion.

*AVA (American Viticultural Area) or county refers to the region in which the grapes used to produce the wine were grown (origin) and not necessarily where the grapes were processed into wine.

**ND = not detected at 2.5 ppb or greater.

***Mean and standard deviation (SD) calculated only for wines in which a contaminant was detected.

conversion of arsenic species during fermentation support the conclusion that most arsenic detected in this study was likely inorganic, but further resource-intensive testing would be required to make this conclusion

fully quantitative. Third, this study investigated a very limited number of low-end wineries that source grapes from multiple and often unspecified vineyards. Although this limitation makes our conclusions more di-

TABLE 5

Arsenic Levels in Red Wines Grown and Produced in Oregon State

AVA*	Type of Wine	Arsenic (ppb) [†]	Lead (ppb)**
Applegate Valley	Tempranillo	12.3	6.94
Chehalem Mountains	Pinot Noir	10.5	ND
Dundee Hills	Pinot Noir	14.3	ND
Eola-Amity Hills	Pinot Noir	10.0	ND
Rogue Valley	Pinot Noir	15.5	ND
Umpqua Valley	Pinot Noir	11.7	ND
Willamette Valley	Pinot Noir	11.0	3.57
Yamhill-Carlton	Pinot Noir	15.0	ND
Mean (SD)***	Arsenic in red wine (n = 8); Lead in red wine (n = 8)	12.6 (2.13)	5.26 (2.38)

[†]ppb = parts per billion.

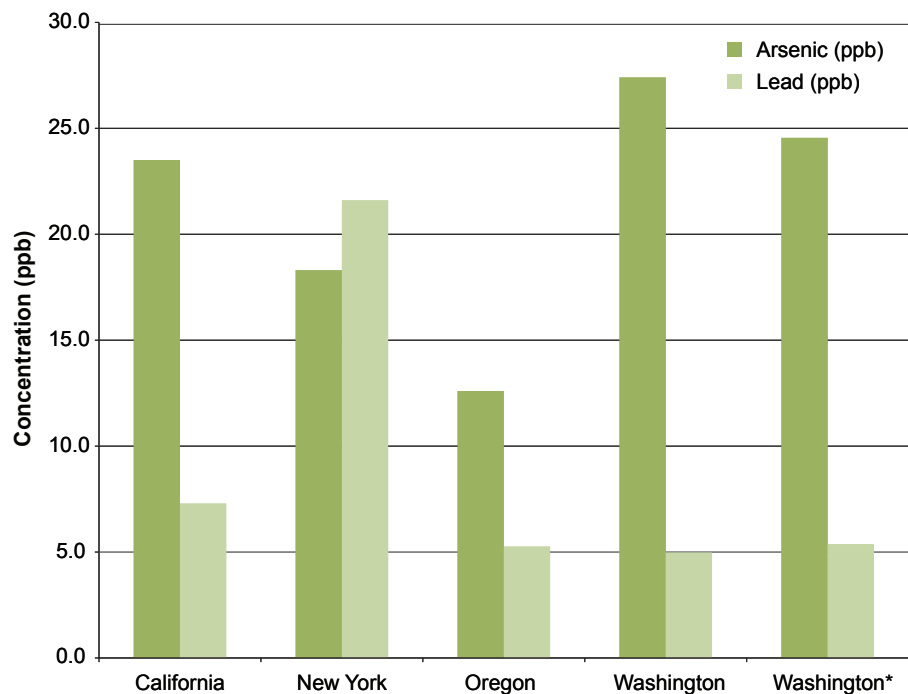
*AVA (American Viticultural Area) or county refers to the region in which the grapes used to produce the wine were grown (origin) and not necessarily where the grapes were processed into wine.

**ND = not detected at 2.5 ppb or greater.

***Mean and standard deviation (SD) calculated only for wines in which a contaminant was detected.

FIGURE 1

Arsenic and Lead Content in Red Wine by State



ppb = parts per billion. Washington* indicates levels with outliers (two) removed.

rectly relevant to premium wines than low-end wines, low-end wines are nevertheless implicated by our general conclusions that show arsenic to be a frequent and significant contaminant in wine.

Despite these limitations, the fact that all wines tested in this study contained arsenic at levels above the 10 ppb exposure limit set by the U.S. EPA for drinking water is cause for concern. These results add to the increasing concern about total arsenic consumption in American diets. The fact that many wines contained lead is also of concern. As with any ubiquitous pollutant, individual consumers and local communities must play an active and integral role in understanding dietary intake of arsenic and lead and subsequently reducing it to safe levels. Wineries also can and should play a role in testing and identifying arsenic and lead in wines, mitigating the risk to the public, and publishing data that support the healthfulness of their products.

Conclusion

The study described here raises cause for concern about arsenic and lead content in wine. In order to fully understand this risk, arsenic in wine must be put into the context of other dietary sources of arsenic. While the health benefits of wine, especially red varieties, are well published and well known, the risk that wine may pose to those who drink wine frequently is not as well understood. This study does not recommend against the consumption of red wine but instead advises careful consideration of total dietary intake of arsenic and lead in consideration of dietary choices. 🍷

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Did You Know?

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Presence of Pathogenic Bacteria and Viruses in the Daycare Environment

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Abstract The number of children in daycare centers (DCCs) is rising. This increases exposure to microorganisms and infectious diseases. Little is known about which bacteria and viruses are present in the DCC environment and where they are located. In the study described in this article, the authors set out to determine the prevalence of pathogenic bacteria and viruses and to find the most contaminated fomites in DCCs. Fifteen locations in each DCC were sampled for bacteria, respiratory viruses, and gastrointestinal viruses. The locations were in the toilet, kitchen, and playroom areas and included nursery pillows, toys, and tables, among other things. Coliform bacteria were primarily found in the toilet and kitchen areas whereas nasopharyngeal bacteria were found mostly on toys and fabric surfaces in the playroom. Respiratory viruses were omnipresent in the DCC environment, especially on the toys.

Introduction

Children, especially young children aged 0–3 years, have a high frequency of infectious disease episodes (Denny, Collier, & Henderson, 1986). Daycare centers (DCCs) worldwide are ideal places for infections to spread because of the density of small children and their constant interaction. Moreover, the number of children attending DCCs is increasing. In Denmark, the vast majority of small children are cared for in center-based institutions, and in the U.S., center-based care is now the dominant form of care for young children (ChildStats.gov, 2013). Thus, it is not surprising that young children attending DCCs have more sick days than children cared for elsewhere (Bartlett et al., 1985; Fleming, Cochi, Hightower, & Broome, 1987; Uldall, 1990). This is in part due to the spread of infectious microorganisms from child to child. Other pathways of pathogen transmission may play a role, but this has not been well investigated.

Every day, the daycare environment is exposed to thousands of different microorganisms from the children, staff, and parents, but whether these fomites play a role in disease transmission is not well known. The focus in research within this field has previously been on presence of nonpathogenic bacteria or low-pathogenic bacteria in the DCC environment (Cosby et al., 2008; Laborde, Weigle, Weber, & Kotch, 1993; Staskel, Briley, Field, & Barth, 2007). Studies using culture samples have found that 10%–60% of the samples are positive for coliform bacteria depending on location. Studies using molecular methods such as quantitative polymerase chain reaction (qPCR) have determined the diversity of bacteria in DCCs and found that the main bacteria flora in the DCC environment consisted of coagulase-negative staphylococci (CoNS), *Bacillus* spp., and *Pseudomonas*-like bacteria, all of which rarely cause disease in healthy humans (Lee, Tin, & Kelley, 2007).

The majority of infections in DCCs are respiratory infections, which are mainly caused by viruses such as rhinovirus, bocavirus, adenovirus, and respiratory syncytial virus (RSV) (Fairchok et al., 2010; Martin, Fairchok, Stednick, Kuypers, & Englund, 2013; Pitkaranta et al., 2006). The presence and amount of these viruses in the DCC environment is unclear (Denny et al., 1986). A few studies have looked at influenza virus and rotavirus in the environment but these viruses are only two of the viral pathogens (Boone & Gerba, 2005; Butz, Fosarelli, Dick, Cusack, & Yolken, 1993; Keswick, Pickering, DuPont, & Woodward, 1983). Viruses causing a common cold, which is by far the most prevalent disease among young children, have not yet been the subject of thorough investigations in the DCC environment.

The aim of our study was to determine the presence and quantity of bacteria and viruses in the DCC environment and to locate the fomites with the highest prevalence of pathogens.

TABLE 1

Sampling Locations

Room	Location	Bacteria	Gastrointestinal Virus	Respiratory Virus
Kitchen	Kitchen table	X		
	Kitchen sink	X		
	Refrigerator door	X		
Playroom	Table upper side	X	X	X
	Table underside	X		
	Plastic toys	X		
	Wooden toys	X		
	Food toys	X	X	X
	Pillows	X	X	X
	Sofa	X		
Toilet	Toilet seat	X	X	
	Nursery pillow	X	X	
	Toilet floor	X		
	Water faucet	X		
	Sink	X	X	

Materials and Methods

Recruitment of Institutions

Twenty-three institutions were recruited in the fall of 2011. They were randomly selected among all the public daycare centers in the municipalities of Copenhagen and Nyborg because these two municipalities had agreed to be a part of the project. Recruited institutions were all “integrated institutions” with both nursery and kindergarten divisions. The number of divisions in each institution ranged from two to seven and the number of children per institution ranged from 24 to 149. The total number of children was 1,820.

Virus Sampling and Processing

Gastrointestinal viruses were sampled from six locations and respiratory viruses were sampled from three (Table 1). A location of 10x10 cm was sampled using a 15x25 mm polyester foam swab. The swab was immersed in sterile, RNase-free water before sampling. After sampling, the swab was put into a 15-mL sterile plastic container with 5 mL Nuclisens lysis buffer. Upon arrival to the lab, the tubes were placed on a shaking table for 20 minutes and the lysis buffer was transferred to a 3.6-mL cryotube and stored at -20°C until analysis.

Nucleic Acid Extraction and qPCR

Virus DNA and RNA from the sample were extracted using a MiniMag apparatus and Nuclisens extraction reagents. The purified DNA/RNA, eluted in 100 µL of elution buffer, was stored at -80°C until qPCR amplification and analysis.

Selected samples were analyzed for the presence of 10 respiratory and 4 gastrointestinal viruses, all of which are pathogenic to healthy children. The respiratory viruses were influenza A and B, coronavirus, parainfluenzavirus, rhinovirus, RSV A and B, adenovirus, enterovirus, parechovirus, and bocavirus. The gastrointestinal viruses were norovirus genogroup G1 and G2, astrovirus, and rotavirus. qPCR was done using 10 µL of extracted nucleic acids and the following commercial multiplex PCR kits: FTD Viral Gastroenteritis and FTD Respiratory Pathogens 21 Plus using the recommended enzyme kit AgPath-ID One-Step RT-PCR Reagents. The PCR amplification and reading was done using a RotorGene Q and analysis was done using Rotorgene Software.

Bacterial Sampling and Processing

Sampling was done in February and March 2012 because a previous pilot study had shown that the winter period is the period with the

highest prevalence of infectious diseases (data not shown). Fifteen predefined locations were sampled in each of the 23 DCCs (Table 1). Based on a study evaluating different sampling methods, the following sampling techniques were chosen for each location: an area of 100 cm² (10x10 cm) was sampled using 1) a sterile, cotton-tipped swab, dipped in ox broth after sampling and 2) a TV dipslide (Ibfelt, Foged, & Andersen, 2013). The TV dipslide has two sides: a nonselective side with tryptic soy agar (TSA) for total count and a violet red bile glucose agar on the other side for the isolation of Enterobacteriaceae. Moreover, the dipslide contains a neutralizer in order to neutralize traits of disinfectants and detergents. As for bacterial species presence, the results from the dipslides and the ox broth were pooled for each sample location and given as binary results depending on whether the specific bacteria were present or not.

Incubation and Identification

The dipslides were incubated for 48 hours and the ox broth for seven days at 35°C–37°C. Following incubation, the ox broth was plated onto a blood agar plate and a gram-negative selective lactose agar plate with bromothymol blue and incubated for 24 hours at 35°C–37°C. The bacteria from both the dipslide and the ox broth were identified using conventional identification and matrix-assisted laser desorption/ionization-time of flight (Maldi-Tof). Maldi-Tof was only used for potential pathogens. Total bacteria count was determined using the TSA side of the dipslide and the supplied key from the manufacturer and given as CFU/cm².

Bacteria Classification

The bacteria were divided into four groups: skin bacteria (CoNS, *Micrococcus* spp., *Propionibacterium* spp., and *S. aureus*), water and soil bacteria (*Acinetobacter* spp., *Pseudomonas*-like spp., *Aeromonas* spp., *Comamonas* spp., *Bacillus* spp., and mold), nasopharyngeal bacteria (*S. pneumoniae*, *Moraxella* spp., and nonhemolytic streptococci), and intestinal bacteria (all Enterobacteriaceae and *Enterococcus* spp.). *E. coli* and *Enterococcus* spp. were used as fecal indicators. Furthermore, all potential pathogens (all fecal bacteria, *S. aureus*, and nasopharyngeal bacteria) were identified using Maldi-Tof and susceptibility testing was performed against cefpodoxime, ciprofloxacin, and meropenem for all gram-negative rods using a disc diffusion test.

Results

Viruses

Respiratory virus presence was widespread in the daycare environment but the prevalence of the different virus species was very different. The prevalence of the 10 different respiratory viruses is depicted in Figure 1. The most prevalent virus was bocavirus (present on 81% of the sites), followed by coronavirus (77%), adenovirus (46%), and rhinovirus (29%). Other respiratory viruses such as parainfluenza, parechovirus, and influenza B were rarely found, if found at all. The presence of respiratory viruses was examined at three locations in the playroom area; the toys were the fomite with the highest general prevalence of respiratory viruses, followed by the pillows and the playroom table. Gastrointestinal viruses were less prevalent. The virus with the highest prevalence was astrovirus (12%), followed by rotavirus (2%), norovirus G1 (1.5%), and G2 (0.7%). The nursery pillow was the fomite with the highest prevalence of gastrointestinal viruses, followed by the playroom pillows and the toilet seat. The detailed information is shown in Figure 2.

Bacteria

The predominant findings were nonpathogenic bacteria, especially CoNS (333 positive locations, 97%), and various water bacteria such as *Pseudomonas*-like bacteria (159 positive spots, 46%) and *Acinetobacter* spp. (61 positive spots, 18%). We did not find any *S. aureus*. As for fecal indicator bacteria, only 2 out of 345 (0.2%) locations tested positive for *E. coli* and one location (0.1%) tested positive for Enterococci. Those locations were a toilet seat, a kitchen sink, and a nursery pillow, but not all in the same institution. When counting all coliform bacteria, 40 locations (11.6%) were found positive. Of these, 15 locations were in kitchen areas, 15 locations were in toilet areas, and 10 locations were in playroom areas. A more detailed outline of the coliform-positive locations is shown in Figure 3.

Nasopharyngeal bacteria were present on 58 locations (16.8%). Species were dominated by nonhemolytic streptococci (40 locations, 12%) and *Aerococcus* sp. (15 locations, 4%) while one location was found positive for *S. pneumoniae* and two locations for *Moraxella* sp. In contrast to the coliform bac-

FIGURE 1

Prevalence and Location of Selected Respiratory Viruses in Samples From the Daycare Environment (n = 69)

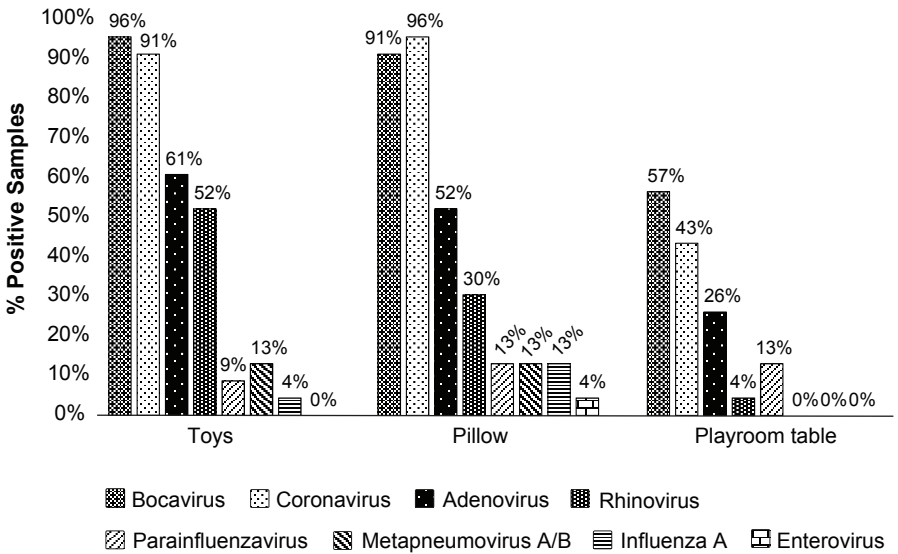


FIGURE 2

Prevalence and Location of Gastrointestinal Viruses in Samples From the Daycare Environment (n = 138)

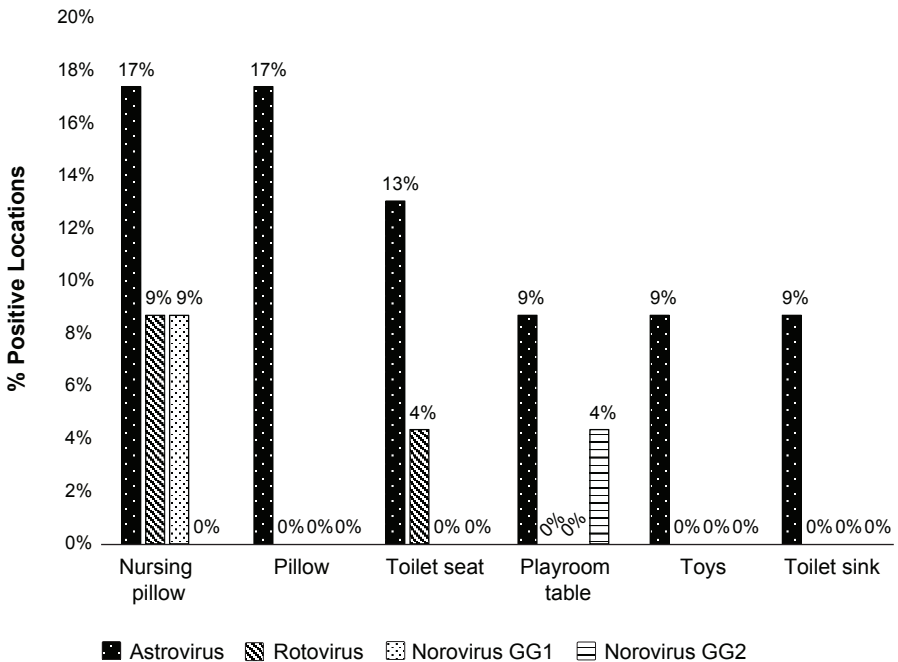


FIGURE 3

Location of Coliform Bacteria in Samples From the Daycare Environment (n = 345)

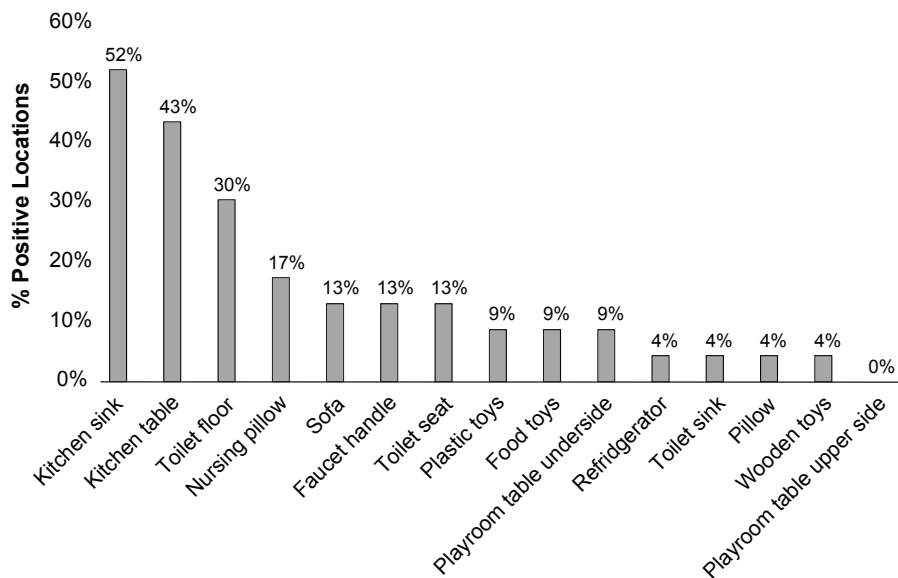
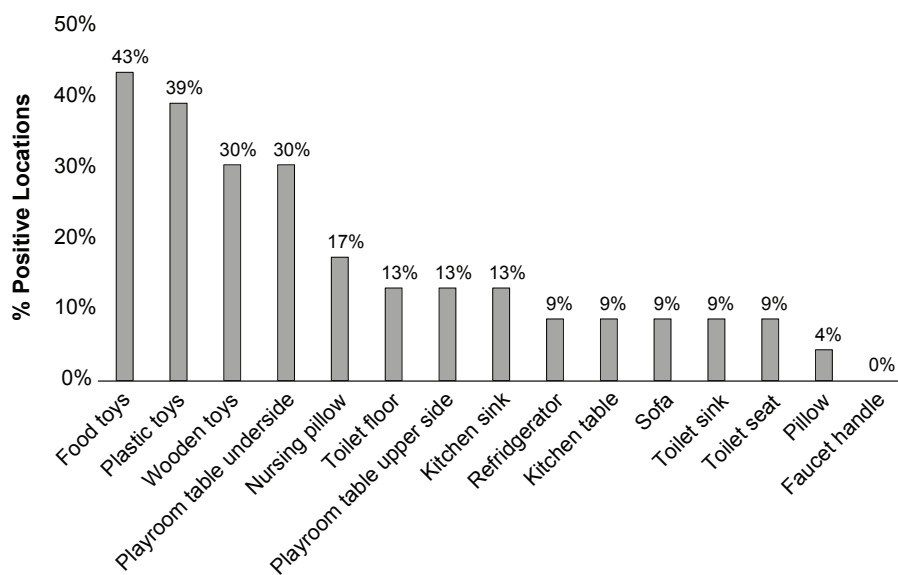


FIGURE 4

Location of Nasopharyngeal Bacteria in Samples From the Daycare Environment (n = 345)



teria, most positive locations were found in the playroom area, especially on the toys. A more detailed outline of the positive fomites is shown in Figure 4.

We found no multiresistant (extended-spectrum beta-lactamase or Carbapenem-resistant) *E. coli* or *K. pneumoniae* in the DCC environment.

Discussion

The bacteria found in the DCC environment were mainly nonpathogenic and we only found a few fecal bacteria and nasopharyngeal pathogen bacteria. A study done in 2007 by Lee and co-authors investigated the bacterial diversity in a DCC through a combination of cultures and 16S rRNA sequencing. They found that the most prevalent bacteria from culture plates were *Bacillus* spp., *Staphylococcus* sp., and *Pseudomonas* sp. while 16S sequencing analysis was dominated by *Pseudomonas* sp. and *Oxalobacteria* sp. In our study, the goal was to locate viable bacteria using culture methods and our results are quite similar to those by Lee and co-authors. We observed a very low prevalence of fecal indicators compared to many other studies, e.g., by Laborde and co-authors, who found frequencies of 20%–50% positive samples for fecal coliforms on toys, sinks, and tables in toddler classrooms (Laborde, Weigle, Weber, Sobsey, & Kotch, 1994). Ekanem and co-authors (1983) found rates of isolation of fecal coliforms of 13% from classroom objects. If looking solely at the fecal indicators *E. coli* and *Enterococcus* spp., the prevalence in our study was very low. But if we include all coliforms, the prevalence was 11.6%, similar to that found by Ekanem and co-authors. The sampling locations and methods were not similar, however, which complicates the comparison.

We found more respiratory viruses than bacteria in the environment. The respiratory virus diversity and the prevalence rates on the surfaces correspond well to the rates found in child airways in other studies (Bonfim et al., 2011; Fairchok et al., 2010; Martin et al., 2013). These studies found rhinovirus, RSV, coronavirus, and adenovirus to be the most prevalent type of virus in children with respiratory tract infections. This corresponds well with our results, although bocavirus was the most prevalent virus, followed by coronavirus, adenovirus, and rhinovirus. RSV detection was low, probably because the children suffering from RSV pneumonia are often severely ill and are therefore not sent to daycare. Bocavirus is a rather newly discovered virus and its causal role in respiratory tract infections is still unclear (Allander et al., 2005; Schildgen et al., 2008). The high prevalence of bocavirus is in accordance with other studies but the number may be high due to

asymptomatic shredding of the virus and not actual infections (Schildgen et al., 2008).

Gastrointestinal virus presence in the environment ranged from a positivity rate of approximately 15% for astrovirus to only a few positive samples for rota- and norovirus. As for rota- and norovirus, their presence is highly outbreak-related and samples were taken when no outbreaks occurred in the DCCs. It is therefore not surprising to find low viral numbers and this is in accordance with other studies finding low rates of rotavirus in the daycare environment and significantly higher rates during outbreaks (Boxman et al., 2011; Butz et al., 1993; Wilde, Van, Pickering, Eiden, & Yolken, 1992). Had our samples been taken during an outbreak period, the rates may have been higher.

Viruses can be difficult to show in environmental samples because the amount of virus is low. In this study we used a sampling method that was developed and tested by our group prior to sampling (data not yet published), combined with a commercial, real-time PCR kit that covered the most

prevalent respiratory and gastrointestinal viruses in children. The sensitivity had been tested in our prior study using norovirus as a model virus and we found the detection limit to be approximately 100 virus copies/cm². This may differ with other types of virus than norovirus but generally the method is sensitive enough to show a virus amount in the environment that is pathogenic. In contrast, the method may overestimate the virus amount because it also detects inactivated viruses and virus RNA/DNA fragments, which are not pathogenic. Thus, we may have either overestimated or underestimated the amount of pathogenic virus in the environment, but the method we used is, in our opinion, the best method available today.

Conclusion

In conclusion, our study showed that bacteria and viruses, especially respiratory viruses, are omnipresent in the daycare environment. Toys were particularly contaminated with respiratory viruses whereas fecal bacteria and viruses

were mainly found in the toilet and kitchen areas. Toys may be one of the most contaminated fomites and may contribute to indirect pathogen transmission. Our group is currently conducting a study to examine the effect of toy washing on microorganism presence and infectious diseases in DCCs, the results of which will be published when that study is finished. 🐼

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EHSB's Free Resources for Environmental Health Practitioners

Editor's Note: NEHA strives to provide up-to-date and relevant information on environmental health and to build partnerships in the profession. In pursuit of these goals, we feature a column from the Environmental Health Services Branch (EHSB) of the Centers for Disease Control and Prevention (CDC) in every issue of the *Journal*.

In these columns, EHSB and guest authors share insights and information about environmental health programs, trends, issues, and resources. The conclusions in this article are those of the author(s) and do not necessarily represent the views of CDC.

Elaine Curtiss is a contract public health analyst working on communications projects within EHSB.

In today's fast-paced, budget-driven world, environmental health practitioners need all the help they can get keeping up-to-date with the latest research and best practices for their diverse field. The environmental health workforce needs to be strong, sustained, and prepared to meet today's challenges and improve the health and safety of all.

To help the environmental health workforce meet these challenges, the Centers for Disease Control and Prevention's Environmental Health Services Branch (EHSB) provides free tools and guidance, training, and research to prevent foodborne illnesses and outbreaks, protect recreational and drinking water sources, and improve the performance of environmental health programs and practitioners. Our resources are specifically intended for practitioners and programs

serving states, tribes, localities, and territories. This column highlights a sampling of the free resources available on the EHSB Web site (www.cdc.gov/nceh/ehs).

Food Safety Resources

Around 68% of foodborne illness outbreaks occur at restaurants (Centers for Disease Control and Prevention, 2013). And each year, 48 million Americans contract a foodborne illness, causing 128,000 hospitalizations and 3,000 deaths (Scallan, Griffin, Angulo, Tauxe, & Hoekstra, 2011; Scallan et al., 2011). Furthermore, acute foodborne illnesses cost the U.S. an estimated \$78 billion each year in health care, workplace, and other economic losses for these preventable diseases (Scharff, 2012). These food safety resources can help you prevent foodborne illness outbreaks and

improve your investigation process when they do occur.

- **e-Learning on Environmental Assessment of Foodborne Illness Outbreaks:** Practice skills in an interactive virtual environment and learn to conduct environmental assessments during outbreak investigations (Figure 1).
- **Environmental Health Specialists Network (EHS-Net):** Explore our practice-based research on environmental causes of foodborne illness outbreaks.
- **National Environmental Assessment Reporting System (NEARS):** Participate in our system to capture environmental assessment data from foodborne illness outbreaks. (This system was formerly known as National Voluntary Environmental Assessment Information System [NVEAIS].)

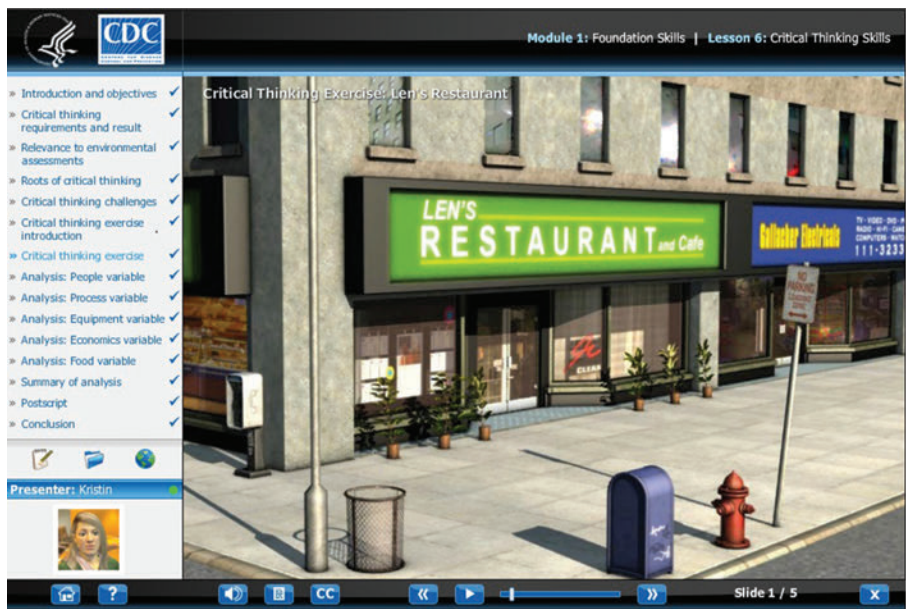
Water Protection Resources

Healthy water is key to a healthy population, and illnesses caused by contaminated well and spring water have continually grown over the past 35 years due to inadequate water treatment (Craun et al., 2010). Environmental health practitioners are crucial to protecting drinking water supplies; inspecting public swimming pools; and working to protect water during emergencies caused by drought, water outages, or outbreaks. These resources can help you prevent and respond to water-related threats to health before they start.

- **Drinking Water Advisory Communication Toolbox:** Access resources to help communities with all phases of water advisories including guidance, recommendations, instructions, templates, and other tools.

FIGURE 1

Screenshot From CDC’s e-Learning on Environmental Assessment of Foodborne Illness Outbreaks Showing a Simulated Environmental Assessment of a Restaurant



- **Emergency Water Supply Planning Guide for Hospitals and Health Care Facilities:** Develop an Emergency Water Supply Plan to prepare for, respond to, and recover from a total or partial interruption of health facilities’ normal water supply.
- **Model Aquatic Health Code (MAHC):** Reduce risk for waterborne illness outbreaks, drowning, and chemical poisoning at public pools and other aquatic venues with these free science-based guidelines.
- **Improving Drinking Water Programs:** Strengthen the performance of your drinking water program to ensure access to safe drinking water.
- **When Every Drop Counts: Protecting Public Health during Drought Conditions—a Guide for Public Health Professionals:** Understand and prepare for drought in your community.

Performance Improvement Resources

Environmental health programs can contribute to and benefit from collaborations to improve public health efforts throughout their department. These tools help you iden-

tify programmatic gaps in service and offer suggestions on how to improve them.

- **Environmental Public Health Performance Standards (EnvPHPS):** Use these standards to improve delivery of the 10 Essential Environmental Public Health Services in your community.
- **EnvPHPS Assessment Toolkit:** Prepare for, conduct, and act upon your EnvPHPS assessment with tools such as a facilitator guide, response analysis tool, report templates, and more.
- **Improving Environmental Public Health Services Performance to Meet Community Needs:** Explore resources to improve and align your program with broader public health department initiatives.
- **Protocol for Assessing Community Excellence in Environmental Health (PACE EH):** Partner with your community to identify and address local environmental health issues using this guidebook.

Cross-Cutting Training Resources

The National Association of County and City Health Officials (NACCHO) notes that “the

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changing practice of public health requires local health department staff... to use skills in areas that were probably not part of their formal education, [making] on-the-job training critical (NACCHO, 2007).” The following online trainings can help you improve your knowledge.

- **Environmental Health Training in Emergency Response (EHTER):** Improve your knowledge, skills, and resources to address environmental health impacts of emergencies and disasters.
- **Environmental Public Health Online Courses (EPHOC):** Access comprehensive environmental health workforce development resources with this package of 15 e-learning courses.
- **Biology and Control of Vectors and Public Health Pests: The Importance of Integrated Pest Management:** Learn to control bed bugs and rodents through pest management approaches. Available for continuing education credits through NEHA.

Our nation’s public health depends on proactive approaches to issues before they become widespread problems. With these resources, you can help improve your community’s ability to prevent and investigate environmental health issues. These and other resources are freely available on CDC’s Environmental Health Services Web site at www.cdc.gov/nceh/ehs.

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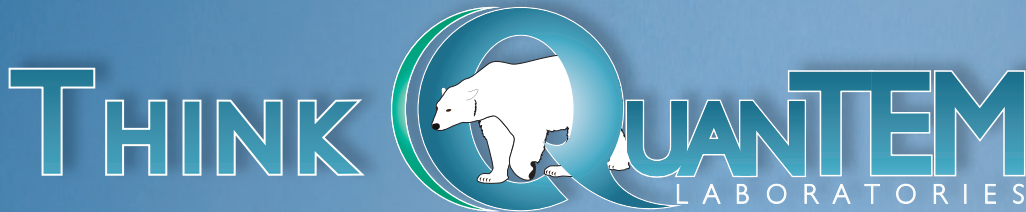
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Scharff, R. (2012). Economic burden from health losses due to foodborne illness in the United States. *Journal of Food Protection*, 75(1), 123–131.

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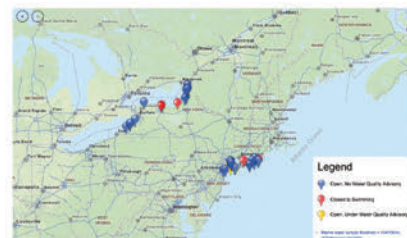
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Patrick A. Wall

Together at Last: Exploring Health and Environmental Information on the National Environmental Health Tracking Network

Editor's Note: As part of our continuing effort to highlight innovative approaches and tools to improve the health and environment of communities, the *Journal* is pleased to publish a bimonthly column from the Centers for Disease Control and Prevention's (CDC's) Environmental Public Health Tracking Network (Tracking Network). The Tracking Network is a system of integrated health, exposure, and hazard information and data from a variety of national, state, and city sources. The Tracking Network brings together data concerning health and environmental problems with the goal of providing information to help improve where we live, work, and play.

Environmental causes of chronic diseases are hard to identify. Measuring amounts of hazardous substances in our environment in a standard way, tracing the spread of these over time and area, seeing how they show up in human tissues, and understanding how they may cause illness is critical. The Tracking Network is a tool that can help connect these efforts. Through these columns, readers will learn about the program and the resources, tools, and information available from CDC's Tracking Network.

The conclusions of this article are those of the author(s) and do not necessarily represent the views of CDC.

Patrick Wall joined the CDC's Environmental Health Tracking Branch in 2002 and currently works on informatics activities related to the development of the Tracking Network.

“The National Tracking Web site really looks nice, but I thought the whole idea behind Environmental Health Tracking was to be able to look at health and environmental information *together*. Why can't the system do that?”

It was a question that hung in the air like a thick fog nearly every time I gave briefings to management officials on the National Environmental Health Tracking Network Web site

since it was launched in 2009. The question was easy to answer, but I still hated having to answer it.

For those readers not familiar with Environmental Health Tracking, allow me to explain some history. The Centers for Disease Control and Prevention (CDC) established the Environmental Health Tracking Program in response to a September 2000 report by the Pew Environmental Health Commission,

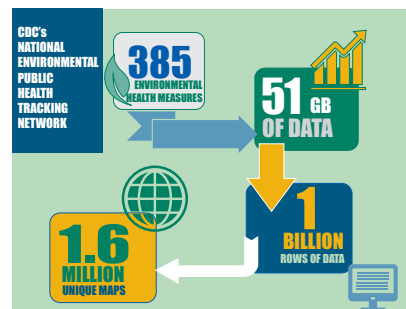
“America's Environmental Health Gap: Why the Country Needs a Nationwide Health Tracking Network.” The report stated that public health agencies lacked capacity to evaluate and conduct key investigations into the status of the health of their environment. The Pew Commission's report called for the establishment of an Environmental Public Health Tracking Network (Tracking Network) that would monitor the level of burden for environmentally related disease.

The vision for the Tracking Network called for federal, state, and local agencies and others to monitor and distribute information about environmental hazards and disease trends, as well as advance research on the possible linkages between environmental hazards and disease. After several years of planning and implementing with partners from around the country, CDC launched the National Tracking Network in 2009. Since that time, the system has grown not only in the functionality it provides but in the amount of data it contains. Currently, 385 (Figure 1) environment and health measures are accessible by a user-friendly query panel that returns query results in a customizable series of maps, charts, and tables (see <http://ephtracking.cdc.gov/showHome.action>).

Because of the way government organizations obligate funds, it is common for public health surveillance systems to be designed to focus on a single disease or category of health conditions. The result is a collection of independent surveillance systems that provide detailed material for their respective areas yet leaves users unable to access information for related topics. Requiring users to access

FIGURE 1

Data Facts About the National Environmental Health Tracking Network



multiple single-category surveillance systems hinders data discovery and access. The Tracking Network, however, provides standardized environmental data and public health data together in a central location that are formatted consistently for easy comparison.

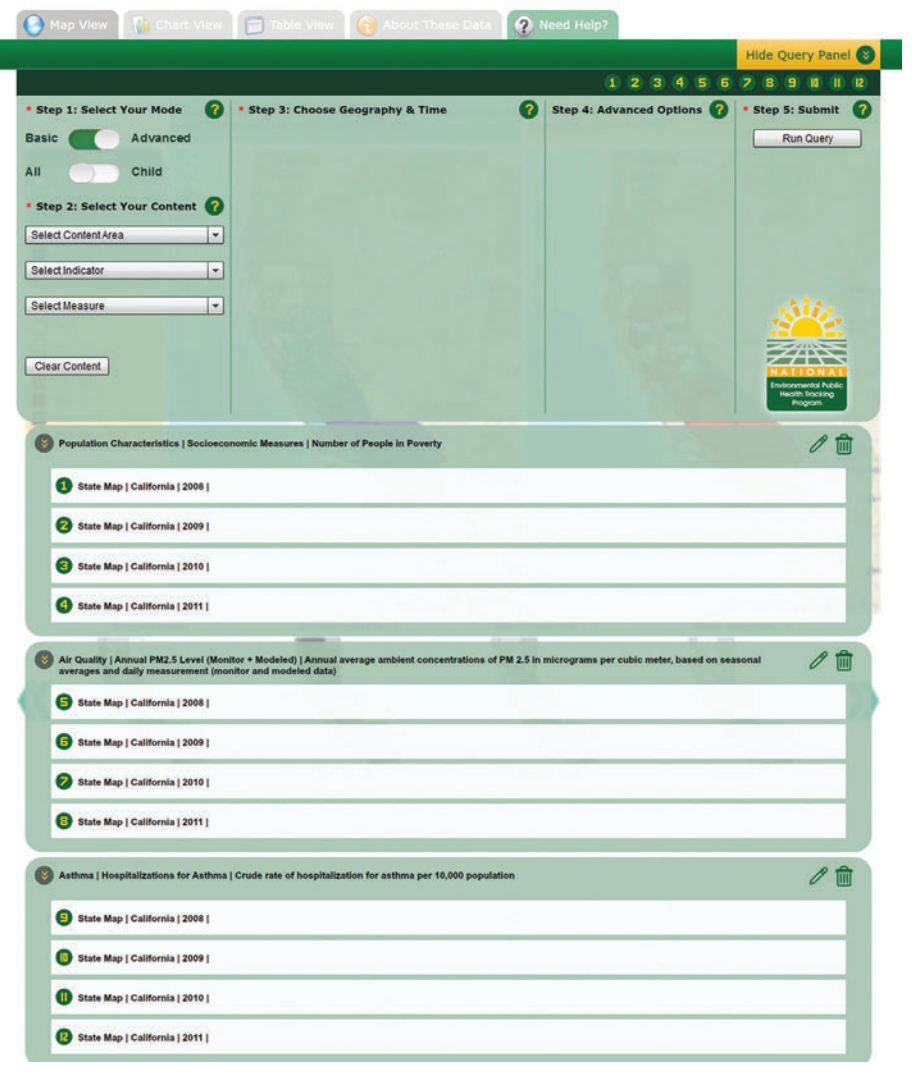
Initially, the Tracking Network users could perform separate queries and data downloads of available environmental and health measures. Data queries could include multiple years and multiple states or counties, but only for a single measure. Which brings us back to the question asked in so many of my Tracking Network briefings and demos: “Why can’t users see different environmental and health measures at the same time?”

Ideally, a user will be able to query data on, for example, air quality, hospitalizations, and socioeconomic and view outputs of all three measures on the same display. Before 2015, obstacles such as limited resources and concerns about generating inaccurate associations between environmental exposure and health outcomes hindered the Environmental Health Tracking Program’s progress in fulfilling our plans to show multiple measures at the same time on the Tracking Network. As of this year, however, the query and display of multiple measures are a reality.

Users can query and display multiple measures on the National Tracking Network by selecting the “Advanced” mode on the query panel. Turning on the “Advanced” mode toggle opens up a series of powerful features for data exploration. The “Advanced” mode is modeled after something we are all familiar

FIGURE 2

Building a Query With Multiple Types of Data



with in the online world: the virtual shopping cart. To put it simply, the user picks from any of the environmental health measures across time and location, and then adds them to their shopping cart—or as we call it, a “query queue.” For example, users can fill their shopping carts with four years of their state’s annual county data for each of the following categories: air quality, asthma hospitalization, and poverty status (Figure 2).

Sticking with the shopping cart model, the next step is to “check out” by clicking the “Run Query” button. The system fetches the data and returns it as a series of thematic

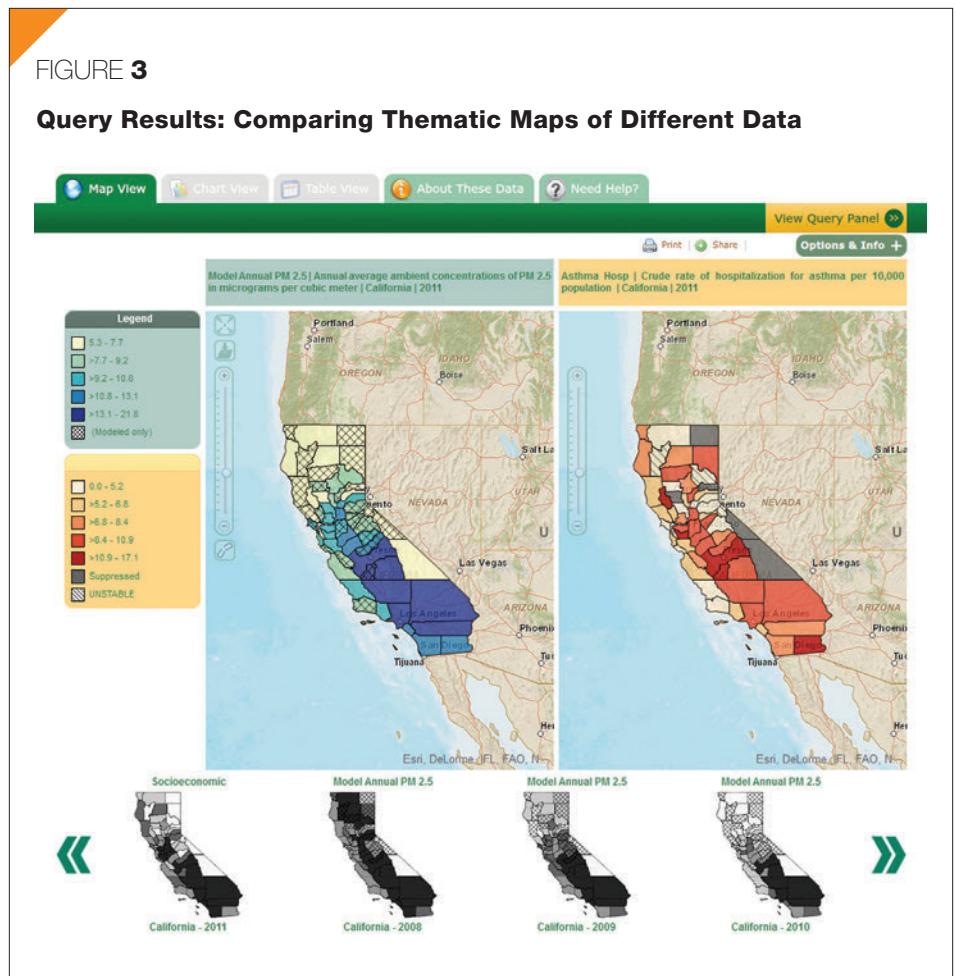
maps. The maps are presented in a dual-map interface that consists of interactive map panes and a series of thumbnail maps representing each of the queries that the user placed in the queue. Users can drag and drop any of the thumbnails to either one of the map panes, allowing an easy comparison of any two of the system’s environmental and health measures at the same time (Figure 3).

The decision to create a system where multiple measures are viewed in side-by-side maps rather than a combined single map was primarily due to (1) the complexities of reengineering the map display portion of

the original single measure system (it already contained the functionality for side-by-side maps), (2) displaying more than two variables as overlays on a single map results in busy and distracting visualizations, and (3) CDC partners, grantees, and stakeholders expressed concerns that the implementation of multiple measures enhances the risk of users creating invalid associations among environmental quality data, exposure data, and health conditions.

Understandably, Tracking Network data stewards have an obligation and interest in knowing that the data in their scope are not misused or misinterpreted. Even without having a multiple measures display option, however, system designers can do little to prevent data misuse on any publicly accessible health information system given the increased accessibility to both data and the tools to combine them. We have helped address this concern by adding a prominent pop-up message after a user hits the “Run Query” button. The statement warns users that valid scientific associations cannot be assumed by combining disparate data.

The addition of multiple measure query and display functionality provides an exciting new capability in the Tracking Network that increases a user’s ability to freely explore and analyze data on the Network. Now more than ever, public health practitioners and other users can formulate hypotheses, analyze trends, and explore possible relationships across a wide variety of health and environmental information. For example, users can now visually explore the relationships among air quality, asthma hospitalizations, and pov-



erty. Moving forward, this functionality will continue to be expanded and refined.

As a bonus for me, those demos and briefings to management officials about the National Tracking Network Web site just got a lot more fun! 🚗

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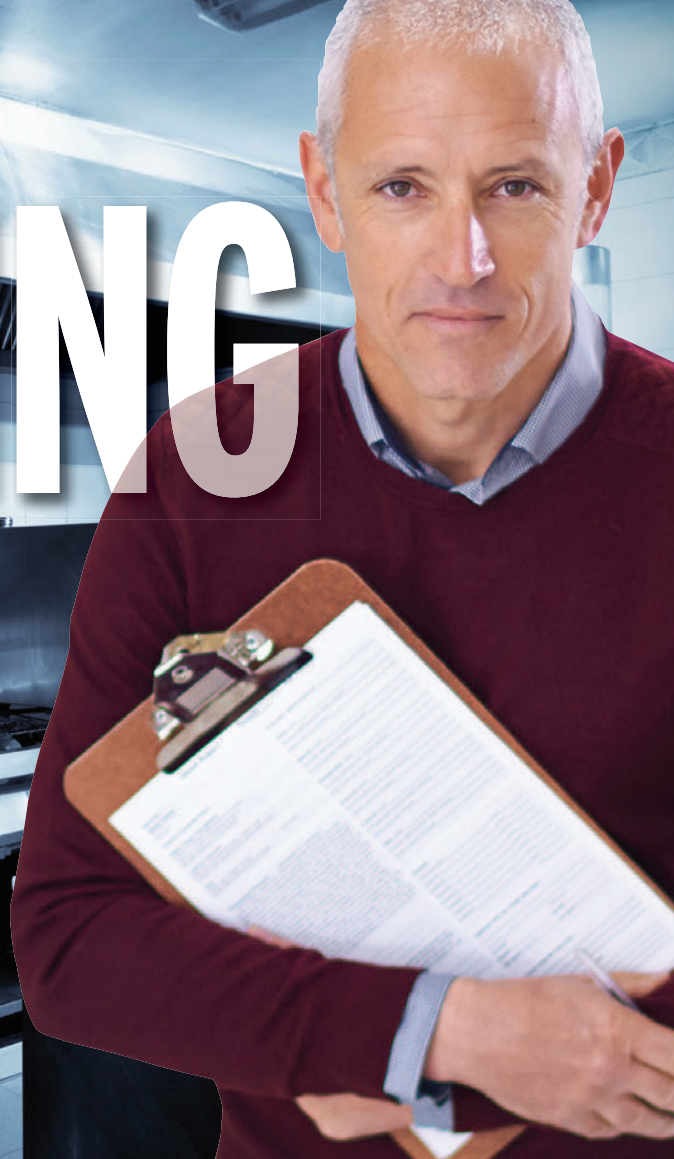
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NEHA AFFILIATE AND REGIONAL LISTINGS

Alaska

October 7–9, 2015: Annual Educational Conference, hosted by the Alaska Environmental Health Association, Anchorage, AK. For more information, visit <https://sites.google.com/site/aehatest/>.

Iowa

October 7–8, 2015: NEHA Region 4 Environmental Health Conference, hosted by the Iowa Environmental Health Association, Waterloo, IA. For more information, visit www.ieha.net.

Kansas

September 30–October 2, 2015: Fall Conference, hosted by the Kansas Environmental Health Association, Topeka, KS. For more information, visit www.keha.us.

National Capitol Area

October 29, 2015: Fall Educational Conference, hosted by the National Capitol Area Environmental Health Association, College Park, MD. For more information, visit www.ncaeha.com.

Nebraska

October 21, 2015: Fall Education Conference, hosted by the Nebraska Environmental Health Association, Ashland, NE. For more information, visit www.nebraskaneha.com.

North Dakota

October 20–22, 2015: Fall Education Conference, hosted by the North Dakota Environmental Health Association, Jamestown, ND. For more information, visit <http://ndeha.org/wp/conferences>.

Texas

October 12–16, 2015: 60th Annual Education Conference, hosted by the Texas Environmental Health Association, Austin, TX. For more information, visit www.myteha.org.

Virginia

October 2, 2015: Fall Educational Conference, hosted by the Virginia Environmental Health Association, Henrico, VA. For more information, visit <http://viriniaeha.org/educational-sessions>.

Wyoming

October 6–8, 2015: Annual Education Conference, hosted by the Wyoming Environmental Health Association and the Wyoming Food Safety Coalition, Saratoga, WY. For more information, visit www.wehaonline.net/events.asp.

TOPICAL LISTINGS

Aquatic Venues/Recreational Health

October 6–7, 2015: Conference for the Model Aquatic Health Code (CMAHC) Biennial Conference, "Bringing the Voice of Aquatics to Updating the MAHC," Scottsdale, AZ. For more information, visit http://cmahc.org/biennial_conference.php.

October 7–9, 2015: 12th Annual World Aquatic Health Conference, "Shaping the Future Through Aquatics," hosted by the National Swimming Pool Foundation, Scottsdale, AZ. For more information, visit www.thewahc.org.

Food Safety

November 17–20, 2015: Integrated Foodborne Outbreak Response and Management (InFORM) Conference, sponsored by the Centers for Disease Control and Prevention, Enteric Diseases Laboratory Branch and Outbreak Response and Prevention Branch; Association of Public Health Laboratories; U.S. Department of Agriculture, Food Safety and Inspection Service; and the Food and Drug Administration, Phoenix, AZ. For more information, visit www.aplh.org/conferences/Pages/InFORM.aspx. 🐞

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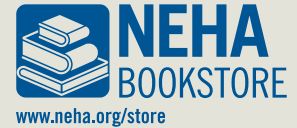
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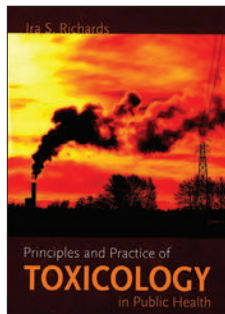
RESOURCE CORNER

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Principles and Practice of Toxicology in Public Health

Ira S. Richards (2008)



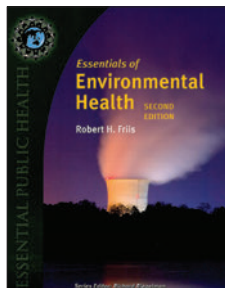
In four sections, this book offers an introduction to the field of toxicology, as well as the basics of toxicology principles, systemic toxicity, and toxicology practice. It offers thorough coverage of the basic principles of toxicology without being too technical or specialized. The text uses reader-friendly language making it accessible to professions from a variety of backgrounds including environmental health, industrial hygiene, engineering, and more. Finally, it includes a section on the application of toxicology in the field.

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Essentials of Environmental Health (Second Edition)

Robert H. Friis (2010)



This book provides a clear and comprehensive study of the major topics in environmental health including 1) background on the field and tools of the trade (environmental epidemiology, environmental toxicology, and environmental policy and regulation); 2) environmental diseases (microbial agents and ionizing and nonionizing radiation); and 3) applications and domains of environmental

health (water and air quality, food safety, waste disposal, and occupational health). The second edition is a thorough revision that includes new material such as a chapter on injuries, an expanded discussion of the history of environmental health, a case study on pandemic influenza (H1N1) 2009, and coverage of environmental controversies.

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Control of Communicable Diseases Manual (20th Edition)

Edited by David L. Heymann, MD (2015)



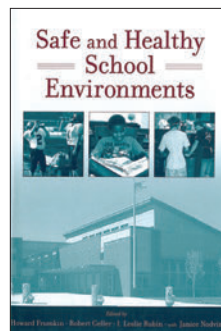
NEW! The *Control of Communicable Diseases Manual (CCDM)* is revised and republished every several years to provide the most current information and recommendations for communicable-disease prevention. The CCDM is designed to be an authoritative reference for public health workers in official and voluntary health agencies. The 20th edition sticks to the tried and tested structure of previous editions. Chapters have been updated by international experts. New disease variants have been included and some chapters have been fundamentally reworked. This edition is a timely update to a milestone reference work that ensures the relevance and usefulness to every public health professional around the world. The CCDM is a study reference for NEHA's REHS/RS, CP-FS, and CEHT exams.

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Safe and Healthy School Environments

Edited by Howard Frumkin, Robert J. Geller, I. Leslie Rubin, and Janice Nodvin (2006)



Millions of children and adults across the nation spend their days in school buildings, and they need safe, healthy environments to thrive, learn, and succeed. This book explores the school environment using the methods and perspectives of environmental health science. Though environmental health has long been understood to be an important factor in workplaces, homes, and communities, this is the first book to address the same

basic concerns in schools. Each section of this book addresses a different environmental health concern facing schools today. The entire book is evidence-based, readable, generously illustrated, and practical—an indispensable resource for parents, school staff, administrators, government officials, and health professionals.

480 pages / Hardback / Catalog #631

Member: \$49 / Nonmember: \$54

DirecTalk

continued from page 62

them, irrespective of how unscientific it sounds on the surface. The energy industry has no qualms about bending the rules. Think about “Clean Coal” campaign. People, the last time I checked there was no such thing as clean coal.

In the breast-feeding example, we could express our commitment to universally held maternal values, such as infant-mother bonding through the act of breast-feeding. Let’s be associated with loving and nurturing acts, the values shared by all humans. Let’s get into the intimacy business. What is more intimate than the food we prepare and place in our children’s mouths? How about the universal recognition of the value of clean water? Let’s



The intimacy of the parent-child bond. The intimacy of our relationship with the environment.

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align ourselves and our messages with society’s values and beliefs.

The environmental health profession believes that mothers who choose to breast-feed should confidently nourish their child free from worry. As parents, we too value wholesome food and clean water. As citizens we desire our families to recreate in parks free from things that might harm us. You can count on us as predictably as the morning sun, and be confident that we will shine sunlight on things you need to know about to keep your family safe. We work every day to protect your families and ours.

Complacency kills careers. It’s time to rethink ours. 🐞

Dave

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JEH QUIZ

FEATURED ARTICLE QUIZ #2

Arsenic Consumption in the United States

Available to those holding an Individual NEHA membership only, the *JEH* Quiz, offered six times per calendar year through the *Journal of Environmental Health*, is a convenient tool for self-assessment and an easily accessible means to accumulate continuing-education (CE) credits toward maintaining your NEHA credentials.

1. Read the featured article carefully.
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b) Fax the quiz to (303) 691-9490, or
c) Mail the completed quiz to
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JEH Quiz #6 Answers May 2015

- | | | | |
|------|------|------|-------|
| 1. b | 4. c | 7. b | 10. b |
| 2. a | 5. b | 8. c | 11. a |
| 3. d | 6. c | 9. d | 12. c |

→ Quiz deadline: January 1, 2016

1. Humans can be exposed to arsenic in both inorganic and organic forms.
 - a. True.
 - b. False.
2. Recent studies have shown ___ to contain significant amounts of inorganic arsenic.
 - a. certain grains
 - b. milk
 - c. certain fruits
 - d. beef
 - e. all of the above
3. The U.S. Environmental Protection Agency (U.S. EPA) has established a maximum contaminant level (MCL) for total arsenic of ___.
 - a. 1 part per billion (ppb).
 - b. 5 ppb.
 - c. 10 ppb.
 - d. 20 ppb.
4. The MCL ___ apply to private well water, bottled water, or other sources outside public water systems under the Safe Drinking Water Act of 1974.
 - a. does
 - b. does not
5. The World Health Organization provides a provisional guideline value for arsenic in drinking water that is ___ U.S. EPA's exposure limit.
 - a. less than
 - b. the same as
 - c. greater than
6. For chronic exposures, the Agency for Toxic Substances and Disease Registry's (ATSDR's) estimated minimal risk level for total dietary intake of inorganic arsenic is ___.
 - a. 0.1 µg/kg body weight per day.
 - b. 0.2 µg/kg body weight per day.
 - c. 0.3 µg/kg body weight per day.
 - d. 0.4 µg/kg body weight per day.
7. Arsenic is well known to cause
 - a. skin lesions.
 - b. cardiovascular disease.
 - c. skin, lung, and bladder cancers.
 - d. all of the above.
8. Total arsenic content in rice grown in the U.S. has been found to be as high as 753 ppb, with a majority being ___ in nature.
 - a. inorganic
 - b. organic
9. The infant formula with the highest maximum level of inorganic arsenic contained the following:
 - a. no organic brown rice syrup.
 - b. dairy with organic brown rice syrup.
 - c. soy with organic brown rice syrup.
10. Which seafood had the lowest maximum contamination level of total arsenic?
 - a. Amberjack.
 - b. Octopus.
 - c. Salmon.
 - d. Tuna.
11. ___ had the lowest typical estimated arsenic consumption per day for milk.
 - a. Adolescent girls
 - b. Adolescent boys
 - c. Adult women
 - d. Adult men
12. Using the maximum level, wine consumption in adult men can equate to ___ of ATSDR's minimal risk level.
 - a. 1%
 - b. 2%
 - c. 5%
 - d. 10%

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CALL FOR ABSTRACTS

Deadline for abstract submissions is November 4!

neha.org/aec

80th
AEC



NEHA

**ANNUAL EDUCATIONAL
CONFERENCE & EXHIBITION**

SAN ANTONIO, TX ★ JUNE 13-16, 2016

IN PARTNERSHIP
WITH HUD



AEC Format

NEHA is seeking abstracts that bring the latest advances in environmental health, as well as unique responses to environmental health and protection problems. Practical applications in both the public and private sectors should be emphasized along with the latest in proven emerging technologies.

Types of training and educational sessions at the AEC:

Lectures

- Interactive presentations
- Single or multiple speaker presentations in traditional lecture or panel formats

Learning Labs

- Hands-on demonstrations
- Tabletop exercises
- Drop-in learning labs
- Roundtable discussions
- Poster presentations
- Other interactive and innovative presentation formats

**Be a Leader in
Environmental
Health!**

Inspire.



Influence.



The NEHA AEC is designed to train, educate, and advance people who have an interest or career in environmental health and protection, as well as to bring people together to build a professional network of environmental health colleagues, exchange information, and discover new and practical solutions to environmental health issues.

Track Subjects Include:

Food Safety, Climate Change, Sustainability, Onsite Wastewater, Vector Control & Zoonotic Diseases, Risk Assessment, Emergency Preparedness & Response, Healthy Homes, Emerging Environmental Health Issues



SAVE-THE-DATES

JUNE 13-16, 2016 ★ SAN ANTONIO, TEXAS



PREPAREDNESS

 FOOD SAFETY

 CLIMATE CHANGE



HEALTH TRACKING



 VECTORS & PESTS



 AIR QUALITY



HEALTHY HOMES

 WATER QUALITY



AEC 80th

NEHA
ANNUAL EDUCATIONAL
CONFERENCE & EXHIBITION

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NEHA 2015 AEC WRAP-UP

IMAGINING THE NEW NEHA

Vanessa DeArman
Laura Gallaher
Kristen Ruby-Cisneros
Clare Sinacori
*National Environmental
Health Association*

ORLANDO, FLORIDA!

Almost 1,000 environmental health professionals flocked to this hot and sunny location to attend NEHA's 2015 Annual Educational Conference (AEC) & Exhibition, July 13–15. This year's theme, "Imagine the New NEHA: Tools for Success Today and Making a Difference Tomorrow," played out in numerous ways throughout the conference. And what was palpable to all in attendance was the heightened level of excitement and energy as NEHA was launched into a new era.

The usual suspects formed the backbone of the conference: the multitude of environmental health sessions, the interactive Exhibition, and the networking events full of comradery and pure fun. New components to the conference—the meeting app, the use of social media, a different opening session, and a unique keynote—infused a fresh twist on the solid core of the conference. Tie it all together and attendees were treated to a multifaceted experience that provided education, training, networking, advancement, motivation, inspiration, policy involvement, and sheer enjoyment!

We thank all of our fantastic attendees, presenters, and exhibitors for making the 2015 AEC such a success. We truly hope that every one of you who made the trip to Orlando found it to be a rewarding and informative experience that will help you perform your duties and advance your career.

Check out the amazing AEC video (<https://youtu.be/SQF5evW8lo>) to relive the memories and get psyched for the 2016 AEC. Flip back to pages 50 and 51 for information about the exciting 2016 AEC taking place in San Antonio, Texas, and the Call for Abstracts.



NEHA 2015 AEC photos courtesy of Joe Deats Photography, Michele Samaryya-Timm, Colleen Mattoza, and Kristen Ruby-Cisneros.

KEYNOTE PRESENTATION



Imagine this scene. A packed ballroom. A black table-clothed table with two wine glasses and bottle of red wine are on stage. A lone man sits on a stool and addresses the audience in an honest and intimate manner. This man is NEHA's newly appointed executive director, Dr. David Dyjack, and he provided a unique keynote to AEC attendees.

Dr. Dyjack shared with the audience three basic principles that he promises to operate under as follows: 1) environmental health is a contact sport, 2) we need to remove the invisibility cloak from the profession, and 3) we need a more disciplined effort toward going global. He went on to share stories and thoughts that tie into these principles. Rather than provide a written record of the presentation, we encourage you to go to www.neha2015aec.org/keynote-presentation and view it yourself! This is one presentation that should not be missed by anyone!

OPENING WELCOME

Conference attendees were brought together on the first day of the conference with a brief opening session. The room exploded and attendees came to their feet as NEHA President Dr. Carolyn Harvey opened the session and introduced Dr. David Dyjack as NEHA's new executive director. The standing ovation reflected the tone felt throughout the conference and the tremendous amount of optimism for NEHA's future under his leadership.

The opening went on to include a live singing of the national anthem by NEHA staff member Kristen Ruby-Cisneros and a welcoming statement from Dr. Pat Breyse, director of the National Center for Environmental Health/Agency for Toxic Substances and Disease Registry. A brief awards ceremony ended the session. A second awards ceremony took place after the Keynote Presentation and a list of award winners can be found on page 60.



In his welcome, Dr. Breyse reaffirmed the importance of the profession, described the major initiatives of his agency, and charged attendees to continue to innovate.

“The environmental health workforce works tirelessly to ensure the health and safety of everyone and at the AEC we have an opportunity to reaffirm and re-energize ourselves and our missions.”
– AEC attendee



On behalf of the Lincoln-Lancaster County Health Department, Joyce Jensen and Scott Holmes (left) accepted the Samuel J. Crumbine Consumer Protection Award presented to them by Dr. Carolyn Harvey (right).



NEHA's very own Kristen Ruby-Cisneros belted out the National Anthem acappella.



The educational program at the AEC continued to go above and beyond, covering relevant and current topics throughout many avenues of environmental health. This year featured 150 exciting sessions and over 30 posters with 285 speakers extending over 22 tracks. Always on the cutting edge of current environmental health issues, this year's AEC did not disappoint. Session topics included the effects of legalizing marijuana, goals for reducing emissions and conserving water at the Disney World Resort in Florida, and emergency preparedness at the Kennedy Space Center. As one attendee put it, "Choosing which educational session to go to is akin to a child trying to decide which sweet to buy in a candy shop." The Food Safety track was on the top of its game again at the 2015 AEC, kicking off the conference with the Food Safety Focus Series, which included talk-show panel discussions and conversations about the Partnership for Food Protection. Attendees were later given the exciting opportunity to participate in a food safety training discussion, while a cartoonist conveyed their ideas and suggestions onto paper.

The AEC included three preconference workshops built around the most popular credentials offered through NEHA. The courses spanned over two and a half days and included the opportunity to take the exam on site. The three courses offered were Registered Environmental Health Specialist/Registered Sanitarian, Certified Professional—Food Safety, and the Certified in Comprehensive Food Safety. Over 50 environmental health professionals participated in the preconference workshops and exams.

Field trips are always an exciting and unique way to experience the educational value of the AEC host city. This year, attendees had the opportunity to do a "behind the scenes" tour of Aquatica, SeaWorld's Waterpark. Participants were able to learn integrated approaches to recreational water illness and injury prevention as well as the building process for a waterpark and the training and education involved. AEC attendees were also able to tour the Florida Onsite Wastewater Association's (FOWA's) training center. This field trip provided a number of hands-on workstations, featuring above-ground low-pressure distribution, various tanks and their components,

"The NEHA presenters gave inspiring presentations that encourage me to keep developing my professional abilities so that I may have greater career opportunities in the future."

— AEC attendee

numerous aerobic treatment units, media filters, and performance-based treatment systems. We extend our gratitude to FOWA's Executive Director Roxanne Groover for hosting this special event!

The AEC would not be successful without the help of our incredible team of technical advisors who volunteer their time and energy into making sure we are offering the best education for attendees. The full listing of the 2014–2015 technical advisors is on page 49.

We also want to acknowledge our appreciation to our partners who assist in the education of the conference: the Association of Environmental Health Academic Programs, the Association of Pool and Spa Professionals, the U.S. Department of Housing and Urban Development, the Uniformed Services Environmental Health Association, the Centers for Disease Control and Prevention, and the Food and Drug Administration.



Alan Tart, Adam London, and Roy Kroeger (left to right) made up one of the Food Safety Focus Series panels and presented on bringing an integrated food safety system into reality.



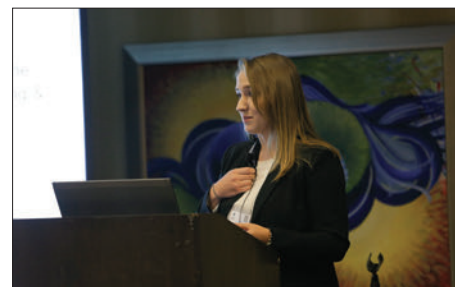
With so many excellent sessions to choose from attendees took a few moments to map out their schedule for the day.



In one of the more unique sessions, attendees helped to create a food defense cartoon and got to see their suggestions drawn out live by the artist.



A packed session room with engaged attendees!



Student Abigail Tompkins presented her research on the characterization of fog machine aerosols and its potential health hazards.

2015 AEC Session Tracks

- Children's Environmental Health
- Climate Change
- Emergency Preparedness & Response
- Emerging Environmental Health Issues
- Environmental Health Impact Assessment
- Environmental Health Tracking & Informatics
- Environmental Justice
- Food Safety
- International Environmental Health
- Leadership/Management
- Onsite Wastewater
- Pathogens & Outbreaks
- Recreational Waters
- Risk Assessment
- Schools
- Student Research Presentations
- Sustainability
- Sustainable Solid Waste
- Technology & Environmental Health
- Uniformed Services
- Vector Control & Zoonotic Disease
- Water Quality

“We are separated most of the year from our environmental health colleagues and friends across the country ... the AEC provides the opportunity to unite both personally and professionally, which cannot be replicated in any other venue.”

– AEC attendee



Attendees were treated to a wealth of expert speakers on a wide variety of environmental health topics.



The Poster Session in the Exhibition was a hit with attendees and offered an excellent opportunity for interactive learning.



The NEHA staff pitched in to assemble moderator packets for the next day's sessions. Way to go, team!



The tour to Aquatica, SeaWorld's Waterpark, gave attendees a hands-on look at environmental health in action.

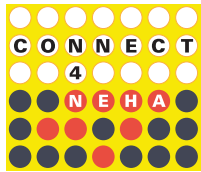
ENVIRONMENTAL HEALTH RECORDED SESSIONS



Not able to attend the AEC? Did you attend but weren't able to sit in on a session that piqued your interest? We've got you covered! You can access more than 30 educational sessions that were recorded at the AEC. This is a **free** benefit for those who attended the conference. For those unable to attend the conference, these sessions can be purchased for \$99/members or \$215/nonmembers. This online archive of sessions enables you to view sessions on demand at your convenience; access speaker presentations, handouts, and other materials; and earn 20–30 NEHA continuing education hours. Details on the recorded session can be found at www.neha2015aec.org/recorded-sessions.



AEC MEETING APP A SUCCESS!



A highlight of the 2015 AEC was the new **Connect4 NEHA** app game, which was evident in the Exhibition and throughout the first two days of the AEC. It was great to

see so many people embrace technology and connect digitally! Close to 70% used the app to add sessions and events to their schedule, create a profile, swap digital business cards, scan QR codes to earn points, and more.

Attendees earned different amounts of points for a variety of conference activities including attending sessions and events, meeting and scanning other attendees' badges, sending a tweet, visiting an exhibitor, and meeting an award winner. Two drawings were held based on total points earned in three different point categories, one on Monday and one on Tuesday. We were pleasantly surprised to find quite a few of you made it to the Master of the Universe level, with 1,000 or more points! We always knew our environmental health professionals would rise to any challenge!

Monday App Contest Winners

- \$100 Amazon gift card for Master of the AEC Universe (1,000+ points): Stephen Gilman
- \$50 Amazon gift card for AEC Leader (500–1,000 points): Andrew Roszak
- \$25 Amazon gift card for AEC Champion (250–499 points): Stacie Duitsman



NEHA RVPs Ned Therien (left) and Keith Johnson (right) get into the app spirit and help each other scan their QR codes!



Scanning an event QR code.



Monday's Master of the AEC Universe Stephen Gilman (left) is awarded his prize by NEHA staff member Clare Sinacori (right).

Tuesday App Contest Winners

- \$100 Amazon gift card for Master of the AEC Universe (1,000+ points): Janie Cambron
- \$50 Amazon gift card for AEC Leader (500–1,000 points): David Ruhl
- \$25 Amazon gift card for AEC Champion (250–499 points): Sherry Glick

The following are the overall top app scores for the 2015 AEC:

- Stephen Gilman: 1,536 points
- Sara Coly: 1,459 points
- Lavone Lee: 1,295 points
- Janie Cambron: 1,252 points
- Andrew Roszak: 1,206 points
- Roy Kroeger: 1,181 points
- Sheila Pressley: 1,156 points
- Ernesta Hickman: 1,063 points
- Dawn Helms: 1,001 points

Beyond the winners and the points earned, use of the AEC meeting app greatly contributes toward our efforts to green our conference and reduce paper consumption while encouraging more interactions and use of technology to get the most out of the conference. Thank you to all for participating!

A sample of quotes from the AEC meeting app's Chatter page:

RPS/RPES Sara Coly

I never tweeted before the conference, but the words of knowledge and wisdom from presenters are worth a tweet #nehaaec

Janie Cambron

great facilitated group discussion on health literacy in environmental justice session #nehaaec

Abigail Tompkins

"Environmental Health is a contact sport" I'll be #teamNEHA from now on... #nehaaec. Thank you to @DTDyjack for the conversational twist on EH

Jenifer George

I'm excited for tomorrow! For the first time attending it has been very educational and I have enjoyed all the networking! There are so many great people attending!

Erin Cavin

so excited to be attending such great classes right out the gate at the NEHA AEC!

Jennifer Osorio

@DTDyjack great motivational talk!!! let's see where NEHA can go #nehaaec



EVENTS GALORE AT THE AEC

There were so many ways to network at the AEC and attendees took full advantage of the opportunities. The annual UL Event started the conference off with a trip to Universal's City Walk and cocktails and appetizers in the Hard Rock Café's hip and swanky John Lennon Room. Other events such as the Networking Luncheon, Exhibition, and Presidents Banquet brought attendees together and were hugely successful. Planned and impromptu, there were numerous meetings, dinners, and happy hours where attendees shared insights and knowledge and were able to kick back and just enjoy the company of each other.

P.S. You missed out if you didn't get a chance to stop by the Florida Environmental Health Association's silent auction and social event—the room was hopping with energy and fun!



Attendees networked on the private John Lennon Room patio during the UL Event.



The UL Event sparked many fascinating conversations. We can only imagine what Dr. Dyjack was discussing here!



A birds-eye view of the Networking Luncheon.



A Presidents Banquet tradition—the passing of the gavel from NEHA's immediate past president to incoming president.

THE AEC INVADES TWITTER



Social media played a heightened role at this year's AEC. Along with the meeting app, Twitter was a popular way to instantly share conference thoughts, images, and information. Using #nehaaec, 125 people tweeted about the AEC with 1,132 tweets and 872,514 impressions (for the time period of July 1–31). Tweets covered a broad range of topics from newly formed friendships and reconnections with old ones to the keynote and a wide variety of sessions, plus all the different conference events.

Andy Roszak (@andyroszak) led the way in tweeting about the AEC and you definitely need to check out the video he put together and posted via Twitter:

@andyroszak: My great week at #nehaaec—video featuring @DTDyjack @ushahmd @LisaBrownMPH @kristen_e_ruby @abigailvonne_ & more! <https://youtu.be/1BhezJsvtKo>

Not on Twitter? If you plan to attend next year, consider creating an account so you don't miss out! Start by following NEHA at @nehaorg.

A shout out to those who made the leader boards for tweets and mentions (and people you might want to consider following!).

Top Five by Mentions

1. @dtdyjack
2. @andyroszak
3. @nehaorg
4. @kristen_e_ruby
5. @michelesamaryat

Top Five by Tweets

1. @andyroszak
2. @michelesamaryat
3. @swallingford82
4. @kristen_e_ruby
5. @mononacoenviron

FIFTH ANNUAL COMMUNITY VOLUNTEER EVENT

NEHAs 2015 AEC Community Volunteer Event was fun, inspirational, and educational! NEHA continues this event as part of its sustainability initiatives to help offset the energy expenditures from hosting a conference. This year we had 14 volunteers and many of them are “regulars” who return each year. That’s commitment and loyalty!

Clean the World Foundation

The event was held again this year at the Clean the World Foundation (CTW) recycling operation center, but this time in Orlando. CTW only has two U.S. facilities—one in Las Vegas and one in Orlando. Lucky us!

CTW’s mission is to collect and recycle soap and shampoo products and distribute to those in need. CTW helps prevent millions of deaths caused by hygiene-related illnesses. It’s a great partnership for NEHA! Learn more about CTW’s activities including its safe recycling process at <https://cleantheworld.org/>.

Continuing Education Offered

New for this year: volunteers received 0.5 continuing education units! In addition to



Our dedicated gang of volunteers!

sorting 11,000 bottles and 4,000 soaps, and boxing up 20 boxes of product, volunteers listened to a presentation on CTW’s mission and activities as well as took a tour to learn about their soap rebatching, melting, and sterilization processes. It inspired many of us to make this event bigger and better!

Sponsorship

A big THANK YOU goes to Starbucks who sponsored the bus to/from the event and pro-



Volunteers worked hard to sort a table full of different amenities.

vided snacks and reusable cups. NEHA again provided water and collapsible water bottles.

Thank you!

Volunteers and NEHA staff also donated about four pounds of travel-size amenities. Thank you to all of the volunteers for their continued dedication and participation! If you missed out this year, please volunteer next year in San Antonio. Your ideas are welcome!

Sponsors

(listed in order of highest contribution to lowest)

- | | |
|--|----------------------------|
| UL | Mitchell Humphrey & Co. |
| Abila | Orkin |
| American Public University | Anua |
| Accela
(formerly Decade Software Company) | ITW Pro Brands |
| NSF | Micro Essential Laboratory |
| Digital Health Department | Presby Environmental, Inc. |
| National Restaurant Association | Starbucks Coffee Company |
| Prometric | Sweeps Software, Inc. |
| Skillsoft | YUM! Brands |
| XTIVIA | |

Partners & Grants

- Association of Environmental Health Academic Programs
- Association of Pool and Spa Professionals
- Centers for Disease Control and Prevention/ National Center for Environmental Health Food and Drug Administration*
- Indian Health Service
- NEHA Technical Advisors
- Uniformed Services Environmental Health Association
- U.S. Environmental Protection Agency
- U.S. Department of Housing and Urban Development
- USDA Food and Nutrition Service

**Funding for this conference was made possible, in part, by the Food and Drug Administration through grant 1 R13 FD 005363-01; views expressed in written conference materials or publications and by speakers and moderators do not necessarily reflect the official policies of the Department of Health and Human Services; nor does any mention of trade names, commercial practices, or organization imply endorsement by the U.S. government.*

EXHIBITION

Monday night July 13 kicked off the 2015 Exhibition Grand Opening & Party with great energy and enthusiasm from attendees! NEHA got to show off its new exhibit booth but best of all was seeing the friendly faces of our members in person and welcoming them side-by-side with our faithful exhibitors. The conference would not be a success without the help of many partners, and we owe our deep gratitude to those who exhibited with us in Orlando. Also new this year, we hosted Tuesday's coffee break and lunch in the Exhibition, which offered additional networking time to meet with exhibitors and each other. In keeping with our efforts to be greener this year, door prizes were randomly selected electronically from the AEC attendee list and more than a dozen door prizes were given on both Monday and Tuesday.

Thank You for Door Prize Donations!

- Chartered Institute of Environmental Health/Peter Wright
- Georgia Affiliate
- Indiana Affiliate
- Kansas Affiliate
- Massachusetts Affiliate
- Missouri Affiliate
- Montana Affiliate
- NEHA
- NSF
- Terry Osner
- The University of Findlay



Attendees were able to get valuable one-on-one interactions with exhibitors.



The exhibitors loved being at the AEC!



Networking with exhibitors enabled attendees to learn more about new products and invaluable services.



There was a great turnout on the opening night of the Exhibition.

2015 AEC Exhibitors

- AEHAP
- American Academy of Sanitarians
- American Chemistry Council
- American Public Health Association
- American Public University
- Anua
- Association of Food and Drug Officials
- Association of Professional Piercers
- CDC—National Center for Environmental Health/Agency for Toxic Substances and Disease Registry
- Columbia Southern University
- Custom Data Processing, Inc.
- Decade Software, an Accela Company
- Digital Health Department, Inc.
- Eljen Corporation
- Environmental Hazards Services
- Environmental Information Association
- Food and Drug Administration
- Florida Environmental Health Association
- Florida Environmental Public Health Tracking Program
- GLO GERM
- HealthSpace USA Inc.
- Hedgerow Software Ltd
- HUD Office of Lead Hazard Control and Healthy Homes
- IAPMO R&T
- Industrial Test Systems, Inc.
- ITW PRO Brands
- IVS—Integrated Veteran Services
- LaMotte Company
- Mattress Safe, Inc.
- Micro Essential Laboratory
- Mitchell Humphrey
- MSU Online MS in Food Safety Program
- Mycometer
- National Library of Medicine
- National Restaurant Association
- National Swimming Pool Foundation
- NCBRT
- NSF
- Ozark River Portable Sinks
- Paster Training Inc.
- Polylok Inc.
- Presby Environmental, Inc.
- Prometric
- QuantEM Laboratories
- San Jamar
- Shat-R-Shield Inc.
- Skillssoft
- StateFoodSafety.com
- Sweeps Software
- The University of Findlay
- ThermoWorks
- Underwriters Laboratories
- USDA Food Safety and Inspection Service
- XTIVIA



AWARDS AND HONORS

Numerous notable individuals and organizations were recognized at the AEC. For more information about each award, please go to www.neha.org/about-neha/awards.

A. Harry Bliss Editor's Award

Peter Thornton

Excellence in Sustainability Award

City of Columbus, Mayor Michael B. Coleman

Joe Beck Educational Contribution Award

James English

Past Presidents Award

Sheila Pressley

Sabbatical Exchange Award

Michael A. Pascucilla

Dr. R. Neil Lowry Grant

Columbus Public Health,
Environmental Health Division (OH)

Samuel J. Crumbine Consumer Protection Award

Lincoln-Lancaster County Health Department
(NE)

U.S. Department of Housing and Urban Development Secretary's Award for Healthy Homes

Cross Program Coordination

Alaska Native Tribal Health Consortium
Children's Mercy Hospitals and Clinics

Public Housing/Multifamily Supported Housing

Wisconsin Housing and Economic
Development Authority

Public Policy

Breathe Easy Coalition of Maine

NEHA/AAS Scholarship Awards

Christopher Conrad

Elizabeth Pirtle

Jennie Wong

Shanta Zietz

NSF International Scholarship

Natasha Borgen

Student Research Presentations

Amanda Bewley

Adam Mannarino

Linzi Thompson

Abigail Tompkins

Decade Scholarship Awards

Michelle Bilodeau

Lynn Bremby

Charles Daniel

Cindy Goocher

Claudia Herrera

Michele Howard

Eric Maday

Nikolay Ostrovskiy

Scott Reynolds

Michelle Rhone

Teresa Sherrod

Gregory Thomas

Aftan Vargas

Dawn Wair

Stewart Whitney

Outgoing Regional Vice President Award

Marcy Barnett

Outgoing President Award

Carolyn Harvey

Presidential Citations

Marcy Barnett

Darryl Booth

Edward Briggs

Gary Brown

Norbert Campbell

Alicia Collins

Brian Collins

Bob Custard

Tim Hatch

Keith Johnson

Roy Kroeger

Adam London

Sandra Long

Lynne Madison

Priscilla Oliver

Sheila Pressley

Vince Radke

David Riggs

Kristen Ruby-Cisneros

Henroy Scarlett

LCDR James Speckhart

Ned Therien

Certificates of Merit

Individual

Sandra R. Baniaga-Brown (NV)

Kimberley Carlton (MN)

CAPT Keith Cook (AK)

Thomas Dominick (AZ)

Scott Holmes (NE)

Michele Howard (Nat'l Capitol Area)

Danica M. Lee (CO)

Kathleen MacVarish (MA)

Colleen Maitoza (CA)

Noel Coleman Reid (Jamaica)

Team

AZ—Cheri Dale and David Morales

CO—Colorado Directors of Environmental
Health

MA—The Massachusetts Healthy
Cosmetology Committee

MN—Jeff Brown, Jesse Harmon, Sarah
Hogan, Caleb Johnson, Kyle Johnsen, Kris
Keller, Diane Olson, and Amy Zagar

Nat'l Capitol Area—Ronald Campbell,
Shannon McKeon, Nicole Biala, Jeanelle
Rogers, and Diana Rodriguez

VA—Daniel Blasche, Keith Ayotte, Tiffany
Johnson-Wiggins, and Corey Dixon



Richard Hicks and Keith Krinn (center) accepted the Excellence in Sustainability Award on behalf of the City of Columbus from UL's Joshua Jacobs (left) and NEHA's Dr. Carolyn Harvey (right).



Professor James English addressed the audience after receiving the Joe Beck Educational Contribution Award.



The Student Research Presentation and NSF International Scholarship winners.



The Decade Scholarship Award winners.



HUD's Peter Ashley and Michelle Miller (from left) and Matt Ammon (right) posed with representatives from the Wisconsin Housing and Economic Development Authority, Brenda Marquardt and Carol Keen (center).



Dr. Sheila Pressley accepted the NEHA Past Presidents Award on the last night of the AEC.

Walter F. Snyder Award

Ron Grimes, RS, MPH, DAAS

NSF International and NEHA presented this distinguished award to Ron Grimes, RS, MPH, DAAS. The Snyder Award, given in honor of NSF International's cofounder and first executive director Walter F. Snyder, is presented annually in recognition of outstanding contributions to the advancement of environmental health. Grimes was honored for more than 40 years of significant and lasting contributions to environmental public health through his work on consensus national standards, education, leadership, and public service.

"Ron Grimes' achievements reflect the principles expressed by Walter F. Snyder and the public health mission of NSF International," said NSF International President and CEO Kevan Lawlor. "His extensive knowledge of environmental health and his commitment to educating regulators and environmental health professionals demonstrate his strong commitment to the promotion of environmental health."

"Ron's leadership at the two health departments he directed, as well as his NEHA leadership and his role at NSF International,



Snyder Award winner Ron Grimes (center) is all smiles with Kevan Lawlor (left) and Dr. David Dyjack (right).

establish him as a highly regarded and respected leader in the environmental health community," said NEHA Executive Director Dr. David Dyjack.

To read more about Grimes' career, please visit www.nsf.com/newsroom/ron-grimes-earns-walter-f-snyder-environmental-health-award-from-nsf-inter.

Breaking News at the AEC

On Sunday, July 12, NEHA's board of directors voted to create the new Industry Affiliate! The mission of the affiliate is to provide an open forum where industry and service providers can work collaboratively on environmental health initiatives and to coordinate unified positions that help NEHA carry out its mandate. The Industry Affiliate later held a meeting at the AEC where interested attendees discussed the bylaws and the purpose of the group, as well as membership fees. Meeting attendees approved the affiliate bylaws and elected an interim board. It was an enthusiastic first meeting and the board is now working hard to put the infrastructure in place and to recruit members. Anyone interested in the new Industry Affiliate should contact Shelly Wallingford at swalling@starbucks.com.

► **DirectTalk** MUSINGS FROM THE 10TH FLOOR



David Dyjack, DrPH, CIH

Of Similes, Metaphors, & Intimacy

Environmental health is the sun around which the health, safety, and security of our communities orbit. The presence of the sun is warm and reassuring on a frigid, blustery morning. Lengthening daylight is harbinger of pleasant spring weather. The sun's ultraviolet light fuels photosynthesis, the very foundation of life on earth. The reliable presence of sunlight in many parts of the world. It is always darkest just before the dawn, when the sun breaks through in the east, welcoming the possibilities of a new day. Our profession is like the sun.

Yes, I believe I know what you are thinking. "I'm not going to waste my time reading this." I ask you to hang with me for a moment. As I lay down these thoughts, the Centers for Disease Control and Prevention National Center for Environmental Health's FY 16 budget is under assault. Yet again. This agency is the intellectual and financial foundation around which much of our professional work is grounded. While I won't dive into the details and tales of woe, the evidence is all around us that society values our work and what we represent, but does not understand us. Our usual and customary response? Evidence. Data. Statistics. If we could only repackage our report, get the public information officer's attention, or get the press on our side, then the evidence will sway the public's opinion. Sound familiar? My inner voice tells me we are wrong.

People, including elected officials, generally do not act on data; they act on their values and beliefs. The recent measles outbreak in the U.S. is an illustration. Evidently there is

*People generally
do not act on data;
they act on their
values and beliefs.*

no amount of data on the safety and efficacy of the MMR (measles, mumps, and rubella) vaccine that will dilute the autism conspiracy theory. Furthermore, I am acquainted with many people who are ardent objectors to the fluoridation of drinking water because of some perceived government plot, and there is no pile of health benefit data or return on investment reports that can convince them otherwise. The data analysis you mastered in statistics may help you get published and perhaps earn you fame, but it will not guarantee your success as a practitioner.

The educational processes that provided you and me the scientific basis of our professional identity are deeply flawed in some crucial features. Think about it. A vast majority of our preparation is laser focused on basic science. My crude estimate is 90%. Now reflect on how decisions are made in your company, association, or agency. Almost every decision and opinion program is grounded in social science. My crude estimate is 90%. Therein lies the conundrum. We are in many ways uniquely ill prepared, academically speak-

ing, to promote environmental health with the general world around us in a manner that predisposes us to success, and more importantly, understanding.

There have been recent efforts to address this issue. Our friends at the American Public Health Association have provided leadership with their shepherding of the National Environmental Health Partnership Council. The council has been working in collaboration with Frameworks, an organization that makes complicated issues accessible to the general public. You can learn more about Framework's efforts on behalf of our profession on their Web site: www.frameworksinstitute.org/environmental-health.html. I encourage you to explore their findings and test their proposed frames (metaphors).

I also believe we have something that almost no other public health profession has—the power of intimacy and image. Again, think about it. There are few things more intimate than the act of breast-feeding. Are there risks associated with breast-feeding? Of course; most of these are related to maternal environmental exposure, to organic pollutants, pesticides, and metals. In such unfortunate cases, we engage in the "lather-rinse-repeat" cycle, of being the experts where we identify the sources, describe the exposure pathways, and present the implications. Then we come to a full STOP. This is the problem. I am tired of being the bearer of bad news—or as I like to call it, "the prince of darkness."

We need to do a much better job of relating to society in a manner that resonates with

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