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Where's Waldo:

How the Lack of Laboratory Detection Methods for Chemicals Leaves the Public in the Dark About Chemical Exposure

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Authored by Jane Williams
California Communities Against Toxics

To act without the facts-whether it be to alarm consumers, or enact restrictive legislation-is irresponsible.

-DuPont's two page magazine ads in 1975 opposing regulaation of CFCs.

Introduction:

When it comes to chemicals, we have a profusion of facts. There are over 85,000 chemicals in commercial production. EPA approves 7 chemicals every day for entry into the market. Yet, we can only detect about 500 of these chemicals with modern laboratory methods, and even then, not in all media (soil, air, water, food, and the human body). In fact, for some of the chemicals that the state of California is charged with regulating, laboratory methods do not exist to find the chemicals in media of concern. (Simmons, 2004)

The state of California has numerous laboratories to assist it in its quest to find chemicals. Each lab specializes in a different type of media. The Hazardous Materiel Lab specializes in finding chemicals in waste, fish, and the human body. The Department of Health Services has three labs that specialize in finding water contaminants, radionuclides, microbes and viruses, genetic material, and chemical warfare agents. The Air Resources Board has a lab that measures chemicals in air. The California Department of Food and Ag Lab measures chemicals in food. Many of these labs have to produce their own methods, or improve on existing methods, to find the chemicals they are concerned about. This is very expensive and time consuming. A recent survey of the state labs found that methods development costs between $20,000 to $200,000 per chemical, per media. This indicates that it could cost the state up to $1 million to develop lab methods for all media, for just one chemical.

Chemical Laboratory Method Development-Expensive and Time Consuming:

To illustrate how intensive lab method development is, here are two examples of lab development at different state labs:

> The Hazardous Materials Laboratory staff became aware that PBDEs were rising exponentially in Swedish women after they attended a conference in Sweden. The scientists reasoned that this was predominately a European problem. However, the lab did have some adipose tissue from women in the Bay Area and one of the scientists decided to test it, on his time off over the weekend. He found very high levels in these women's tissue and thought that he had made a lab error. Other scientists in the lab ran the same samples and also found very high levels. This alarmed the scientists, who then started testing for PBDEs in other media.

Scientist developed methods to find PBDEs in fish, bird eggs, and human milk over the next two years at an estimated cost of over $350,000; the method covered the tetra through hepta congeners of PBDEs. The lab is now working on finding the Deca PBDE in breast milk and estimates that it will costs about $40,000 to establish the methods for Deca PBDE in breast milk. It will cost anywhere from $5,000 to $20,000 to find Deca PBDE in bird eggs. This work entails the commitment of dedicated analytical chemists and hundreds of hours of work in the lab.

A similar story is repeating itself at the Air Resources Board (ARB) Laboratory on pesticides. Rising concern about the impact of pesticide drift has fueled the effort currently underway at the ARB lab to find pesticides in air. Current regulations do not compel the manufacturers of pesticides to supply the methods to find pesticides in ambient air, only in food and in water. The ARB had produced methods for 59 pesticides since 1989.

The Department of Health Services labs rarely do methods development from scratch, but they do alter existing methods to find chemicals in different media or to lower the detection limit for chemicals of concern. For instance,

? DHS has developed a new method to find Methyl Isocyanate in air; an Occupational Safety and Health Administration (OSHA) workplace method was adapted for ambient air testing for this chemical.

? DHS also recently developed new methods for the analysis of Volatile Non-Target Organic Compounds in impaired water sources and recycled water by Method 524.2. The EPA method was modified to expand the list of VOCs measured beyond those listed by regulatory agencies. The method could be used to screen for unknown VOCs in water, following suspected intentional contamination of water.

? DHS developed an improved detection method to measure trichloropropane in water at lower concentrations than standard EPA methods. (Flessel, 2004)

Chemicals in the Human Body:

In May 2000, the Government Accounting office issued a report, Long Term Coordinated Strategy Needed to Measure Exposures in Humans; this report underscored how little information we have on chemicals in the human body. Some key findings in this report are:

? Laboratory methods have not been developed to measure about 88 percent of the 1,456 chemicals in [GOA's] review, according to information provided by EPA and CDC officials. (p.17)

? CDC staff are concerned about the lack of methods to test a single human sample for several related toxins at the same time. (p. 17)

? The chemicals that CDC scientists chose to monitor in the human body are largely chosen on “the availability of analytical methods for measuring the chemical and the laboratory’s capacity to perform the measurements.” (p.20)

? CDCs “current resources will continue to limit progress to develop new methods and include more people and chemicals in federal and state efforts.” (p. 27)

Several public health officials contacted by GAO “indicated that reports on exposures in the national population to toxic chemicals are needed to help inform policymakers, researchers, and the public.” Specifically, such reports can help identify serious human health risks, help officials link exposures to sources, determine appropriate interventions to help reduce these risks, and document the effectiveness of interventions in reducing exposures.” (p. 27)

Case Study: PFOA

In 1976, Dr. Donald Taves of the University of Rochester's School of Medicine and Dentistry reported a surprising finding in a workup of a sample of his own blood. His analyses showed that some of the fluoride in his blood appeared to be organic, and unrelated to the types of fluoride added (controversially) to public drinking water supplies for purposes of dental hygiene. Dr. Taves and his collaborators tentatively identified one of the organic fluorines in human blood samples as one of 3M's perfluorinated organics - PFOA, or perfluorooctanoic acid. The authors speculated that multiple perfluorocarbons (PFCs) appeared be present in human blood, and that some might be branched, or sulfonated (another group of 3M's perfluorochemicals). The authors presciently speculated on the source of these chemicals in blood:

> "These findings suggest that there is widespread contamination of human tissues with trace amounts of organic fluorocompounds derived from commercial products.... A series of compounds having a structure consistent with that found here for the predominant form of organic fluorine in human plasma is widely used commercially for their potent surfactant properties. For example, they are used as water and oil repellants in the treatment of fabrics and leather. Other uses include the production of waxed paper and the formulation of floor waxes...The prevalence of organic fluorine in human plasma is probably quite high since 104 of the 106 plasma samples tested here and all 35 in an earlier study... had measureable quantities.... Computer assisted literature searches using Medline, Toxline and Chemcon developed no information on [metabolism and toxicology of these chemicals]. This was surprising with respect to the widespread commercial use of such compounds."

3M then began testing for, and finding, PFOA in workers' blood. PFOA was found not only in workers' blood, but also in supposedly clean blood samples from U.S. blood banks that were to be used as control samples in the tests. 3M began a series of studies at their environmental laboratory to define the extent to which their chemicals contaminate people and the environment. In March and April 1998 3M's environmental lab finalized ten new studies that confirmed the presence of PFOA in the blood of the general population.

It was only then in May of 2000, 52 years after their initial release into the marketplace, 3M started phasing out the use of PFOA. (EWG, 2003)

Regulated Chemicals: A Case of Looking Under the Street Light.

> "When the original lists of chemicals under regulation (Clean Water Act, Clean Air Act, Resource Conservation and Recovery Act, and the Occupation and Safety and Health Act and Toxic Release Inventory) were created there were many different criteria that landed chemicals on these lists. Some of the criteria were based on human health effects, some on environmental effects. What is not generally known is that "many pollutants did not enter the lists because technical tests to measure their presence or concentration in a particular medium were unavailable or too burdensome."(Dernbach, p.18)

A recent report by the National Academy of Sciences (Air Quality Management Plans in the United States, Feb 2004) noted that the federal Clean Air Act regulates 188 hazardous air pollutants (HAPs). California regulates just over 200 chemicals as toxic air contaminants (TACs), many of these chemicals overlap the HAP list. However, there are thousands of chemicals released into the air each year in the country and in the state, many of them having the same characteristics as HAPs and TACs, yet they are not regulated despite posing a human health risk to those exposed. For most, we don't have laboratory methods that will detect these chemicals in air.

Indeed, Mr. John Dernbach, in his seminal paper on the chemical regulatory system in the U.S., The Unfocused Regulation of Toxic and Hazardous Pollutants, published in the Harvard Environmental Law Review states that:

> "Because the burden on government, technical feasibility, and cost to industry influenced the choice of pollutants, the pollutants on any given list are not necessarily the only pollutants presenting significant risks. Reduction of the 65 chemicals and chemical classes in the original priority water pollutant list to 129 (now 126) specific pollutants, for example, allowed many pollutants in those chemical classes to go unregulated even though they presented significant risks. The General Accounting Office has found that 98% of the pollutants discharged into the nation's waterways are not priority pollutants, and that many of them pose significant health risks. Another study of pollutants released under the Clean Water Act found that priority pollutants comprised only 14 of the 50 most frequently occurring organic compounds. Likewise, a large number of workplace air pollutants for which the [Association of Industrial Hygienists] has adopted threshold limit values are not regulated under OSHA, in all likelihood imposing substantial risks on many workers." (Dernbach, p.18)

Summary:

It is essential for the protection of human health and the environment that we are able to detect the chemicals that are released into our environment each year. We cannot prioritize which chemicals to regulate and target for exposure reductions efforts if we do not know which chemicals people are being exposed to, or which chemicals are finding their way into our food, drinking water, soil, and the air we breathe.

We need the chemical industry to take on the responsibility for producing laboratory methods for the chemicals they are producing, just as we need the chemical industry to produce information on the toxicity of their chemicals.

SB 702 passed in 2001 by the California State Legislature directed the Department of Health Services to produce a report on Environmental Health Surveillance. This report was recently released and recommended that: "Businesses that produce, import, or store chemical, biological, or physical agents in California should be required to develop and provide essential information to the state, including: (1) basic chemical and toxicologic properties to allow evaluation of hazard and environmental persistence; (2) location and quantity of manufacture, use, or storage; and (3) laboratory methods for measuring the chemical, its environmentally degraded products, and metabolites in environmental media and human samples." (SB 702 Report, p.95).

We agree with this recommendation and also note that the fiscal impact to the state, and the necessity of having more information on chemicals, should spur the state to demand that these laboratory methods be produced expeditiously. The state should require that the methods be verified by state certified labs and be produced with economy and efficiency in mind. The state should also impose severe penalties for chemical companies that "game the system" by producing methods that are not accurate or technically feasible to replicate.

No other government body in the world is currently solving this vexing problem of the lack of methods to detect chemicals in our environment and in the human body. Once produced, these methods will be used by other countries to detect chemicals in their environment. Surely, even the chemical industry, which continues to vehemently resist efforts to produce complete and accurate information about the effects of their products on human health and the environment, must admit that, "to act without the facts… is irresponsible".

Sources:

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