The Ribbon

BCERF

An excerpt from the newsletter of the Cornell University Program on Breast Cancer and Environmental Risk Factors (BCERF)

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Tracking Chemical Exposures with Biomonitoring

Changes in Monitoring Chemicals in Humans

While scientists have monitored levels of chemicals in exposed workers to assess the cancer risk of many chemicals, little data have been available on actual exposures in the general population. Until recently relatively large blood samples were needed to conduct laborious tests for even one chemical.

This is changing. Over the past decade, there have been rapid advances in the analytical techniques used to measure levels of chemicals in people. Now, researchers can quickly determine low levels of a variety of environmental chemicals in small samples of blood, urine or other tissues. The rapid advances in techniques have also lowered the cost of many tests, making the possibility of monitoring levels of chemicals in the general public more feasible.

Biomonitoring is the direct measurement of a chemical in human tissues or fluids

While human tissues monitored most often are blood and urine, researchers have also used fat, hair, nails, breast milk, and even expired air samples to monitor chemicals of interest. Chemicals monitored may be "natural" (e.g. phytoestrogens from food, metals like cadmium or arsenic contained in the earth's crust), or "synthetic" chemicals (e.g. polychlorinated biphenyls, dioxins, and pesticides).

It is important to consider the strengths and limitations of biomonitoring. While the technology to detect low levels of chemicals has rapidly advanced, our ability to interpret the data is still in its infancy (Stokstad, 2004). Detection of a chemical in blood or urine does not necessarily mean it will cause a harmful health effect. For most chemicals, we lack data on what ranges may affect health endpoints, whether it be asthma, cancer, or reproduction.

Call for the Creation of a National Public Health Tracking System

Scientists increasingly realized that while the US had excellent systems to track infectious diseases, and monitor blood lead levels in children, our ability to track a variety of illnesses resulting from other types of environmental exposures was sorely lacking. In 1995, Dr. Lynn Goldman, an EPA administrator, noted that our environmental surveillance systems were fragmentary. We lacked basic information on the magnitude and range of chemical exposures in the general population. She called for the development of human tissue banks that would be integrated with information from vital statistics, cancer and birth defect registries, and other health-based databases. She stated that an integrated system could form the basis for setting priorities to be addressed by both public health and regulatory programs (Goldman, 1995).

Dr. Goldman's recommendations were mirrored in a later assessment made in 2000 by the Pew Environmental Health Commission. The commission also found the current environmental public health tracking system to be "fragmented, neglected, and ineffective." (McGeenhin, 2004)

> *As a result of decades of neglect, we have a public health system that is working without the most basic information about chronic disease and potential environmental factors. The Commission found information on trends in health conditions potentially related to the environment is largely unavailable. (Pew Commission, Technical Report, 2000)*

The Pew Commission called for the creation of a national environmental public health tracking network. This network would link information on human exposures (from biomonitoring), and environmental hazards, to environmentally related diseases (McGeenhin, 2004; Litt, 2004; Ritz and Balmes, 2005).

In response, Congress provided funding to the Centers for Disease Control (CDC) to both initiate a national human biomonitoring program, and build the infrastructure needed to link monitoring programs with disease tracking and chemical hazard programs. The first step was to use an existing survey, called the National Health and Nutrition Examination Survey (NHANES), to monitor chemicals in blood and urine samples in the general population. The NHANES survey collects blood and urine samples, and nutritional and health information on persons across the US. In the first biomonitoring report released in 2001, 27 chemicals were monitored. In the second report released in 2003, 116 chemicals were monitored over a two year period (1999 to 2000), and in the third report released in July 2005, biomonitoring was

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expanded to include 148 chemicals. Chemicals monitored include metals, pesticides, phthalates (used in plastics and cosmetics), phytoestrogens, polyaromatic hydrocarbons (PAHs), dioxins, furans, polychlorinated biphenyls (PCBs), and cotinine (as index of tobacco smoke exposure). The third report includes blood and urine levels of chemicals monitored during 2001 to 2002 in males and females of different ages, as well as for different ethnic groups. (See **References and Resources** for links to the *3rd National Report on Human Exposure to Environmental Chemicals* and the *3rd Report chemical list.*)

Building on Current Biomonitoring Efforts

Currently, the CDC biomonitoring program is largely limited to surveillance, because the crucial infrastructure and information networks still need to be developed to interpret the data. But, this biomonitoring program is already yielding important information. For instance, baseline levels of chlorpyrifos, a commonly used insecticide that was recently phased out of household use were established in the second report. Future studies will determine if levels of chlorpyrifos, a known neurotoxin, are staying the same or are declining. The number of young children with elevated blood lead levels is declining. Exposure to the persistent pesticide DDT and its metabolite DDE was found to be several fold higher among Mexican Americans than whites and blacks. In the third report, ranges of exposures called "reference levels" were available for the first time for over 38 chemicals. In addition, more sensitive methods were available for the detection of dioxins, furans and the plasticizers called phthalates. The third report also documents possible widespread exposure to commonly used pesticides call pyrethroid insecticides.

The CDC is partnering with other federal and state programs to establish the Environmental Public Health Tracking Network (see links in **References and Resources** for further information). This includes state departments of health, the US Geological Survey (monitoring emerging contaminants in the water supply), NASA, and the EPA.

Ultimately, it is hoped that a biomonitoring system can be used in the prevention of human disease due to environmental exposures. Dr. William Suk and colleagues at the National Institute of Environmental Health Sciences (NIEHS) wrote:

> *…biomonitoring … may lead to identification of potentially hazardous exposures before adverse health effects appear and to establish exposure limits for minimizing the likelihood of significant health effects. (Suk, 1996)*

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References and Resources

CDC National Biomonitoring Program

Overview: http://www.cdc.gov/biomonitoring/overview.htm

3rd National Report: http://www.cdc.gov/exposurereport/
(Note: summary is 18 pages; full report is almost 500 pages)

3rd Report, chemical list
http://www.cdc.gov/exposurereport/pdf/third_report_chemicals.pdf

3rd Report, fact sheets: http://www.cdc.gov/exposurereport/factsheets.htm

CDC National Environmental Public Health Tracking Program

General: http://www.cdc.gov/nceh/tracking/

Background-Needs: http://www.cdc.gov/nceh/tracking/background.htm

Accomplishments: http://www.cdc.gov/nceh/tracking/pib.htm#accomplish

Other References:

Stokstad, E. (2004) Pollution gets personal, *Science*, 304:1892-1894.

Goldman, L.R. et al. (1995), Banking of human tissue for biomonitoring and exposure assessment: utility for environmental epidemiology and surveillance, *Environmental Health Perspectives*, 103 (Suppl. 3):31-34, 1995. (for HTML of article, go to http://ehp.niehs.nih.gov/docs/1995/Suppl-3/goldman-abs.html)

Pew Commission (2000), links to the Pew Environmental Health Commission's report, *American's Environmental Health Gap: Why the Country Needs a Nationwide Health Tracking Network*, John Hopkins School of Hygiene and Public Health, can be found at http://www.cdc.gov/nceh/tracking/publications.htm#pew. (note: the Companion Report is 21 pages long; the Technical Report is 92 pages long)

For on-line access to archive articles published in *Environmental Health Perspectives* (EHP) go to:
General: http://ehp.niehs.nih.gov/docs/admin/openaccess.html
EHP: http://ehp.niehs.nih.gov/docs/montharch.html
EHP Supplements: http://ehp.niehs.nih.gov/docs/suparch.html

McGeehin, M.A. et al. (2004) National environmental public health tracking program: bridging the information gap, *Environmental Health Perspectives*, 112:1409-1413.(for HTML of article, go to http://ehp.niehs.nih.gov/members/2004/7144/7144.html)

Litt, J. et al. (2004) Identifying priority health conditions, environmental data, and infrastructure needs: a synopsis of the Pew Environmental Health Tracking report, *Environmental Health Perspectives*, 112:1414-1418. (for HTML of article, go to http://ehp.niehs.nih.gov/members/2004/7147/7147.html)

Ritz, B. and Balmes, J. (2005) Can lessons from public health disease surveillance be applied to environmental public health tracking? *Environmental Health Perspectives*, 113:243-249. (for HTML of article, go to http://ehp.niehs.nih.gov/members/2004/7450/7450.html)

Suk, W.A. et al. (1996) Human biomonitoring: research goals and needs, *Environmental Health Perspectives* 104 (Suppl 3): 479-483. (for HTML of article, go to http://ehp.niehs.nih.gov/members/1996/Suppl-3/479-483suk/suk-full.html)

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