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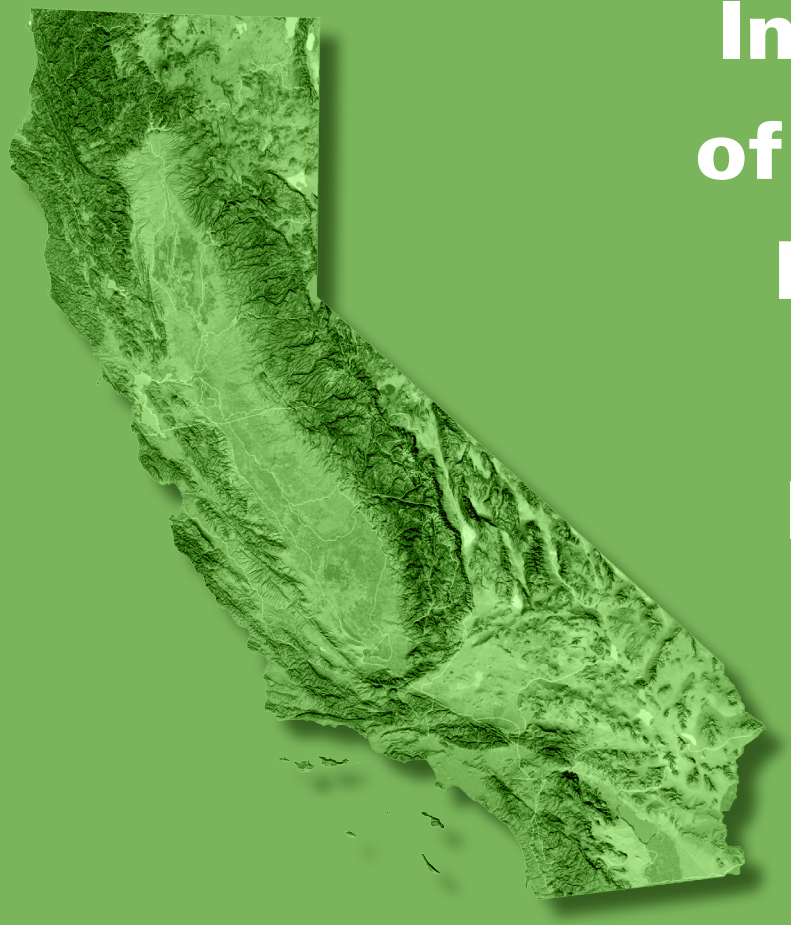

Implementation of the California Environmental Contaminant Biomonitoring Program

2012-2013

BIOMONITORING CALIFORNIA
MEASURING CHEMICALS IN CALIFORNIANS

Implementation of the California Environmental Contaminant Biomonitoring Program: 2012-2013

Third Report to the California Legislature

California Department of Public Health

In collaboration with
California Environmental Protection Agency's
Office of Environmental Health Hazard Assessment and
Department of Toxic Substances Control

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Governor, State of California

CDPH California Department of PublicHealth

Office of Environmental Health Hazard Assessment OEHHA State of California

Department of Toxic Substances Control

The Great Seal of the State of California

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This report is available online at *www.biomonitoring.ca.gov/biomonitoring-california-reports*.

Copies may also be requested from the
Environmental Health Investigations Branch, California Department of Public Health
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Environmental Health Investigations Branch
850 Marina Bay Parkway, Building P-3, Richmond, CA 94804

Executive Summary

Biomonitoring — the measurement of chemicals or their metabolites in a person's body — can provide an overall measure of human exposure to certain chemicals found in air, water, food, soil, dust, and consumer products. Biomonitoring helps us track the amounts and types of chemicals that get into people from all sources.

Background

The California Environmental Contaminant Biomonitoring Program (the Program) was established through legislation in 2006 by Senate Bill 1379 (Perata) and codified in Health & Safety Code Sections 105440 et seq. Also known as Biomonitoring California, the Program is a collaborative effort involving the California Department of Public Health (CDPH) as the lead, with the Office of Environmental Health Hazard Assessment and the Department of Toxic Substances Control. It receives technical advice and peer review from a Scientific Guidance Panel and input from the public.

The Program is required to submit progress reports every two years to the Legislature. This document is the third such report. The first two reports can be accessed at: *www.biomonitoring.ca.gov/biomonitoring-california-reports*. For more information about Biomonitoring California, visit the Program website at: *www.biomonitoring.ca.gov/*.

This report includes information on program deliverables for the time period between January 1, 2012 and December 31, 2013. The report also includes current financial information.

Biomonitoring will play a key role in assessing the effectiveness of recent measures to reduce specific chemical exposures, and in helping to inform the state's efforts to identify and regulate chemicals of concern in consumer products.

New Biomonitoring California Results and Other Program Highlights

In establishing the Biomonitoring California program, the Legislature found that biomonitoring can "provide data that will help California scientists, researchers, public health personnel, and community members explore linkages between chemical exposures and health." The Legislature envisioned that the data would be collected in scientifically-based statewide surveys, as well as community-based surveys, contingent on resources. As described in the following sections, Biomonitoring California is undertaking a number of smaller-scale projects that in themselves will provide valuable information and will also establish a strong foundation for statewide surveys in the future. Biomonitoring California has focused to date on building laboratory capabilities, developing techniques to appropriately communicate results of individual tests to participants (as required by the statute), and engaging in a series of scientifically-based targeted studies of vulnerable subpopulations. We have been able to compare the results from our targeted studies with data from national surveys, providing valuable information about exposures in some California subpopulations. By leveraging available state and federal funding and building partnerships with university researchers and other expert scientists, Biomonitoring California has succeeded in building a robust program with the ability to measure nearly 140 priority chemicals in Californians.

To date, we have pursued three full project collaborations and eight laboratory collaborations, including participants from a wide range of California populations. The Program has completed two of the three full collaborative projects:

- The Maternal and Infant Environmental Exposure Project (MIEEP), a study of 92 pregnant mothers and their infants in San Francisco, is complete.
- The Firefighter Occupational Exposures Project (FOX), a study of 101 firefighters in Southern California, is complete.
- The Biomonitoring Exposure Study (BEST), a study of more than 500 adult residents of the Central Valley, has completed recruitment, and sample analyses are partially complete.

Biomonitoring California's key findings to date are:

- Infants in MIEEP had higher levels of certain chemicals as compared with their mothers, including PBDE flame retardants that have been banned in California due to health concerns. Of the 59 chemicals analyzed both in pregnant mothers and their infants, 50 were detected.
- High levels of PBDE flame retardants were found in Southern California firefighters, compared with the general U.S. population and with other subgroups in California. Levels were especially high in those who worked on front-line activities. The use of personal protective gear and regular cleaning of the gear were associated with lower flame retardant levels.
- Higher levels of benzophenone-3 (BP-3), a chemical used in sunscreens and as a stabilizer in plastics, were measured in Southern California firefighters, compared with the general U.S. population. BP-3 is suspected of interfering with hormone action.
- Higher levels of the toxic metal arsenic were found in the Central Valley BEST population compared with the general U.S. population, based on preliminary results.
- A family with significantly elevated mercury levels had been using foreign-made skin-lightening creams adulterated with mercury. This led to a public health alert to medical providers in 2011 and a subsequent follow-up study within CDPH to analyze skin-lightening products for mercury and other harmful contaminants.

Biomonitoring California is continuing to analyze information from these three major studies and will release additional findings as they become available. Preliminary results are available at *www.biomonitoring.ca.gov/results*.

Biomonitoring California's laboratories are also collaborating with university researchers and other expert scientists to analyze samples collected for other studies. For example, serum samples from thousands of female educators for the California Teachers Study (CTS) are being analyzed for persistent organic pollutants, including flame retardants and persistent pesticides. The Program's analyses for CTS led to the key finding that race (non-white), lower socioeconomic status, and higher body weight were correlated with higher levels of some flame retardants.

Over the past two years, Biomonitoring California has continued to expand its laboratory capability to analyze environmental chemicals in blood and urine samples and its capacity to look for these chemicals in a growing number of Californians. As of the beginning of 2014, Biomonitoring California:

- Is capable of measuring nearly 140 distinct chemicals or their breakdown products in urine, serum, and whole blood. Many of these chemicals have the potential to adversely impact public health.
- Obtained specimens from more than 3,700 Californians.
- Built the capacity to conduct more than 4,000 analyses per year.
- Is able to serve as an early warning system for new chemical exposures and support the state's environmental and occupational health policies.

During the two-year period covered by this report (2012-2013), Biomonitoring California conducted more than 7,000 biomonitoring analyses for toxic chemicals or their breakdown products, including heavy metals, flame retardants, phthalates, and pesticides. Results of these analyses have been returned to participants who requested them and aggregate results for individual studies have been made public on the Program's website.

Informing Participants and the Public

The Program returns detailed results to participants recruited by Biomonitoring California upon their request, as required by the establishing legislation.

- To date, the vast majority of participants (96 percent) recruited by Biomonitoring California have asked to receive their results. Informational packets contain test results, fact sheets, and suggestions on ways to reduce exposures. Participants whose samples were collected by other researchers and analyzed by Biomonitoring California laboratories do not receive their results directly from the Program; such results may be returned to participants by the collaborating investigators.
- The redesigned Biomonitoring California website, *http://www.biomonitoring.ca.gov/*, was launched in July 2013. The improved design includes new features and content, including biomonitoring study descriptions and initial results, fact sheets on chemicals measured, links to Program reports and publications, and a user-friendly guide to biomonitoring. An interactive database of biomonitoring study results was launched in May 2014, which allows the public and researchers to search for data on chemical exposures in Californians.

Program Priorities and Opportunities

Biomonitoring California has identified the following priorities and opportunities for maintaining and improving the Program:

1. **Chemicals of Emerging Concern**
   Through years of key legislative action, California has become a leader in identifying chemicals of emerging concern in the environment and consumer products. To contribute to this effort, and specifically to provide information to the Safer Consumer Products program, Biomonitoring California has prioritized the development of methods to identify new chemicals that present potential risk to Californians. For example, Biomonitoring California is working on new methods to efficiently detect and measure chemicals of emerging concern to the state, including substitutes for bisphenol A, some fragrance compounds, and newer flame retardants.

2. **Focused Biomonitoring Studies**
   The Program places a high priority on identifying opportunities to monitor chemical exposures in subpopulations, including: disadvantaged communities with specific exposure concerns, employees in workplaces where levels of chemicals of concern exceed ambient environmental levels, and sensitive populations such as pregnant women and infants. These studies provide important data that will help inform public health practice and chemical regulation policy to reduce harmful chemical exposures in California.

3. **Program Funding**
   Biomonitoring California continues to seek resources to support its complex laboratory infrastructure and its other programmatic elements. In 2009, the Program was awarded a five-year cooperative agreement (for $2.65 million annually) by the U.S. Centers for Disease Control and Prevention. This grant allowed Biomonitoring California to launch each of the collaborations described in this report. When the first CDC grant ended in August 2014, Biomonitoring California lost approximately 60 percent of its funding. This decrease was alleviated by a second round of CDC grant awards and state funding. The second round of federal grant funding provides $1 million annually for five years (the grant began September 1, 2014). The 2014 Budget Act included state funds ($700,000 per year for two

years, which includes support for four limited-term positions) to support Biomonitoring California. Furthering the support for Biomonitoring in California, the Governor's 2015-16 budget proposes an additional $900,000 and six 2-year limited-term positions for CDPH, and $600,000 and two 2-year limited-term positions for the Department of Toxic Substances Control. This funding will be used by the Program to support ongoing identification and measurement of toxic chemicals in Californians, thereby helping to assess the effectiveness of public health and environmental programs in reducing chemical exposures and preventing disease. The funding also will be used to investigate the feasibility of detecting and measuring emerging chemical threats to California.

Introduction

"Biomonitoring" refers to measuring chemicals in human biological samples such as blood and urine. It can provide an overall measure of human exposure to certain chemicals found in air, water, food, soil, and consumer products.

Californians experience widespread exposures to a multitude of chemicals such as flame retardants, pesticides, heavy metals like mercury and arsenic, and substances used in manufacturing and consumer products (e.g., cosmetics and plastics), many of which pose health concerns. Recognizing that Californians' health can be improved by reducing exposures to harmful chemicals, the Legislature established the California Environmental Contaminant Biomonitoring Program (also known as Biomonitoring California), which is the first legislatively mandated, ongoing state biomonitoring program in the country.

Biomonitoring can help assess the extent of chemical exposures from all sources, including consumer products, diet, and occupation. Results from biomonitoring studies play a key role in assessing the efficacy of measures to reduce specific chemical exposures, and in helping to inform the state's efforts to identify and regulate chemicals of concern.

Biomonitoring California was established by Senate Bill (SB) 1379 (Perata, 2006 Session, chaptered as California Health & Safety Code [H&SC] sections 105440 et seq.). The Legislature found that:

> ***"... the establishment of a statewide biomonitoring program will assist in the evaluation of the presence of toxic chemicals in a representative sample of Californians, establish trends in the levels of these chemicals in Californians' bodies over time, and assess effectiveness of public health efforts and regulatory programs to decrease exposures of Californians to specific chemical contaminants. A statewide and community-based biomonitoring program will expand biomedical, epidemiological, and behavioral public health research."***

The long-term goals of Biomonitoring California are to monitor, analyze, and report on specific environmental chemicals detected in blood, urine, and other biological specimens from a representative statewide sample of Californians, and to assess the effectiveness of existing public health programs in reducing these chemical exposures. Measuring environmental chemicals in California residents will help scientists and policymakers answer such questions as:

Which chemicals are in people's bodies, and how high are the levels?

- Are the levels of chemicals increasing or decreasing over time?
- Are there groups or subpopulations in California that have higher exposures to specific toxic chemicals?
- Do regulatory efforts, including bans or phase-outs of chemicals, actually reduce exposures?
- Do certain chemicals contribute to the development of chronic diseases or conditions?

Biomonitoring California's enabling legislation requires biennial reports to the Legislature. This report is intended to inform the Legislature and the public of the current status of Biomonitoring California and includes information about its activities and findings during calendar years 2012 and 2013.

Biomonitoring California was envisioned in SB 1379 to include a statewide survey in which the Program would measure levels of environmental chemicals in a representative sample of Californians. A statewide survey has so far been beyond the capacity of the Program for a number of reasons, including the need to develop laboratory capabilities to accurately and rapidly test for a large number of high-priority chemicals in biological specimens, and the need to pioneer approaches for appropriately communicating individual test results to participants, as required in the statute. The Program, advised by the Scientific Guidance Panel, chose to focus initially on conducting a series of community-based studies designed to gather data on exposures to vulnerable subpopulations in California. This strategy successfully leveraged state resources both by collaborating with other researchers and by acquiring supplemental extramural support through a cooperative agreement with the U.S. Centers for Disease Control and Prevention (CDC). The community-based strategy has also allowed the Program to acquire essential laboratory equipment (funded by state and federal funds), develop methods to measure more chemicals, including emerging contaminants, and successfully pilot methods to communicate results to participants and the California public.

Biomonitoring California Studies

The enabling legislation directs the Program to conduct community-based biomonitoring studies "contingent on funding" (H&SC section 105441). To undertake such studies, Biomonitoring California has pursued external funding and collaborations with other researchers and has investigated the feasibility of analyzing archived biological samples collected by other public health programs statewide or in large areas of California.

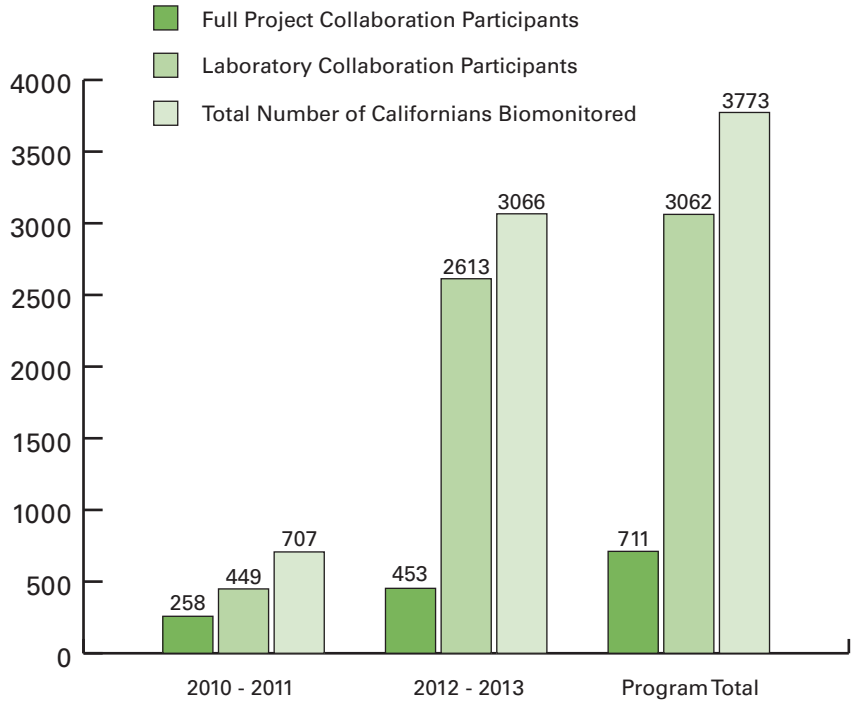
The Program's collaborations thus far include varied sets of California residents and workers with a focus on subpopulations that may be especially vulnerable or exposed to priority chemicals. Communities tested include pregnant women receiving prenatal care at San Francisco General Hospital, Southern California firefighters, teachers throughout California, and residents of agricultural communities in the Central Valley. We are comparing the results from our studies with national data collected by the CDC to evaluate whether the levels of contaminants are higher or lower in these California groups compared to national surveys. In some cases, our collaborating researchers are also planning to follow these people over time to assess potential associations between biomonitoring results and health outcomes. The Program's ongoing studies and collaborations will lay the groundwork for better characterizing chemical exposures in California's diverse population, including racial and ethnic groups underrepresented in other biomonitoring studies.

The Program has engaged in biomonitoring studies in two ways:

1. **Full project collaborations:** These collaborations are community-based studies designed and carried out by Biomonitoring California staff in partnership with other organizations. The Program returns detailed information on biomonitoring results to all participants from these collaborations who request to receive their results.
2. **Laboratory collaborations:** Biomonitoring California works with researchers to analyze blood and urine samples collected in previous or ongoing studies. The Program is responsible for biomonitoring analyses, but does not give input to study design or communicate with participants about their biomonitoring results.

Since the second report to the Legislature, dated January 2013, the Program has greatly expanded the number of participants in Biomonitoring California projects, as described in Figure 1. All collaborations are supported in part by the U.S. Centers for Disease Control and Prevention (CDC) Cooperative Agreement 5U38EH000481.

Figure 1: Participants in Biomonitoring California Projects



Full Project Collaborations

Full project collaborations are community-based studies designed and carried out by Biomonitoring California in partnership with other organizations. The Program is involved in choosing the population, recruiting participants, collecting survey information and blood and urine samples, conducting laboratory analyses, and reporting results to participants. Three full project collaborations are discussed below. Results are posted on the Program's website at *www.biomonitoring.ca.gov/results* as they become available.

Maternal and Infant Environmental Exposure Project

The Maternal and Infant Environmental Exposure Project (MIEEP), also known as the Chemicals in our Bodies Project, is a collaborative study involving Biomonitoring California, the University of California San Francisco (UCSF) Program on Reproductive Health and the Environment (PRHE), and the University of California Berkeley (UCB) School of Public Health. This study is partially supported by the CDC Cooperative Agreement. The Scientific Guidance Panel (SGP) had previously identified pregnant women and infants as susceptible populations of particular interest for biomonitoring.

Biomonitoring California measured environmental chemical exposures in 65 mother-infant pairs and an additional 27 pregnant women. English- and Spanish-speaking pregnant women were recruited at San Francisco General Hospital (SFGH) in 2010-2011. Urine samples and questionnaire information were collected in the third trimester of pregnancy, and maternal and umbilical cord blood samples were collected at delivery. This study was completed in 2013. For more information on this study, visit: *www.biomonitoring.ca.gov/projects/maternal-and-infant-environmental-exposure-project-mieep*.

Among the study's major accomplishments were the following:

- Blood and urine samples from mothers were analyzed for 92 chemicals. Samples from infant cord blood were tested for 59 chemicals.
- Mothers received their results in 2012 and 2013, and were offered suggestions in English and Spanish on how to reduce exposures.
- Infant cord blood was found to contain up to 50 of the 59 chemicals that were biomonitored. Certain chemicals, including flame retardants, were found at higher levels in infants than in their mothers.
- Results from MIEEP suggest that levels of certain flame retardants banned in California in 2006 (Assembly Bill [AB] 302, Chan, 2003 & AB 2587, Chan, 2004) are declining in the population, providing support for California's public health policies.
- The Program identified a family with significantly elevated mercury levels in 2011. This family had been using foreign-made skin-lightening creams adulterated with mercury. This led to a public health alert to medical providers and a subsequent follow-up study within the California Department of Public Health (CDPH) to analyze skin-lightening products for mercury and other harmful contaminants.
- Biomonitoring California, along with UCSF and UCB collaborators, will continue to evaluate the results for associations between chemical exposures and future health outcomes.

Firefighter Occupational Exposures Project

Firefighters are exposed to toxic chemicals in their work environment more frequently and in higher levels than the general population. The SGP had also identified firefighters as a susceptible population of particular interest for biomonitoring. The Firefighter Occupational Exposures (FOX) Project was conducted in partnership with the University of California (UC) Irvine's Center for Occupational and Environmental Health and a Southern California Fire Authority. The FOX Project was partially supported by the CDC Cooperative Agreement. During the course of this study, completed in 2013, Biomonitoring California collected questionnaire information from 101 firefighters in Southern California, and tested their blood and urine samples. The protocols and procedures developed in this pilot study will serve as a basis for subsequent biomonitoring efforts in occupational groups. For more information on the FOX Project, visit: *www.biomonitoring.ca.gov/projects/firefighter-occupational-exposures-fox-project*.

Among the study's major accomplishments were the following:

- Blood and urine samples were analyzed for more than 80 distinct chemicals. All participants who requested their individual results received them in 2012 and 2013.
- Firefighters' urine levels of benzophenone-3 (BP-3) were significantly higher than the levels reported for the general population. Research indicates that BP-3, a chemical used as a sunblock in lotions and cosmetics and as an ultraviolet-light stabilizer in plastic surface coatings, may interfere with the activity of essential hormones (estrogen and testosterone). Further analysis of these results is underway.
- Very high levels of polybrominated diphenyl ether (PBDE) flame retardants were measured in all firefighters, particularly those with classifications consistent with front-line firefighting activities. Use of personal protection (such as a self-contained breathing apparatus) during firefighting and salvage operations and proper cleaning and maintenance of firefighting gear were associated with lower serum PBDE levels, pointing to the efficacy of health and safety procedures.
- As part of a larger study on contaminants in house dust, dust samples were collected from several fire stations. Dust was analyzed for some of the same chemicals biomonitored in firefighters. Levels of PBDEs (and in particular, decaBDE) in fire station dust were much higher than in dust similarly collected from hundreds of California homes.

Biomonitoring Exposures Study

Biomonitoring California is collaborating with the Kaiser Permanente Division of Research, Research Program on Genes, Environment & Health to conduct the two-phase project known as the Biomonitoring Exposures Study (BEST). KPNC membership in California's Central Valley is demographically similar to the entire population of northern California with respect to characteristics such as educational attainment and race/ethnicity.

In Phase 1, or "Pilot BEST," Biomonitoring California measured environmental chemical exposures in 112 adult KPNC members living in the Central Valley. Recruitment was based on achieving balanced distributions across characteristics of race/ethnicity, gender, and age. Laboratory analyses were completed in 2013, and data are currently in review by the Program. In Phase 2, also known as "Expanded BEST," environmental chemical exposures are being measured in an additional 339 adult KPNC members in the Central Valley. Expanded BEST focused on recruiting Hispanics, Asians, and Pacific Islanders and included provisions that enabled participation by those who speak only Spanish. Questionnaires (in English and Spanish), medical information, and blood and urine samples have been collected; analyses began in 2014. For more information on Pilot and Expanded BEST, visit: *www.biomonitoring.ca.gov/projects/biomonitoring-exposures-study-best-1pilot* and *www.biomonitoring.ca.gov/projects/biomonitoring-exposures-study-best-2expanded*.

Among the study's major accomplishments were the following:

- The Program recruited 451 adult KPNC members and obtained exposure questionnaire data and biological samples from them.
- The Program will analyze samples for up to 80 distinct chemicals. Laboratory analyses are partially complete and continued into 2014. Preliminary averaged results from Pilot BEST show higher levels of urinary arsenic in this population compared with the general population.

Laboratory Collaborations

Biomonitoring California laboratories often collaborate with other entities and analyze blood and urine samples collected by these outside partners as part of their research projects. In these collaborations, the Program does not design the study or return results to participants. Aggregate biomonitoring results from laboratory collaborations are posted to the Program's website with the permission of the outside partners.

UCSF Studies of Second-Trimester Pregnant Women

The UCSF Studies of Second-Trimester Pregnant Women collected samples from 25 pregnant women seeking care at SFGH in 2008-09 and 36 pregnant women in 2011-12. The study population consisted of ethnically diverse and predominantly low-income women in their second trimesters of pregnancy. These studies were the result of a collaboration between Biomonitoring California laboratories and UCSF PRHE. The Program laboratories analyzed blood samples for perfluorinated compounds (PFCs) and other persistent organic pollutants, including polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs), PBDEs, and their metabolites (hydroxy-PCBs and hydroxy-PBDEs). For more information on this study, visit: *http://biomonitoring.ca.gov/projects/ucsf-studies-second-trimester-pregnant-women*.

Among the study's major accomplishments were the following:

- The first UCSF study of 25 women, sampled in 2008-09, found the highest PBDE levels ever reported among pregnant women worldwide. The second UCSF study of 36 women, sampled three years later, showed a 39% decrease in PBDE levels, while the levels of hydroxy-metabolites of PBDEs decreased even more (by 86%).
  In contrast, levels of legacy chemicals such as PCBs and hydroxy-metabolites of PCBs declined only slightly over the same time period.

- Although PBDE levels appear to be dropping, Californians still have the highest measured levels in the world because of extensive past use of these flame-retardant chemicals in consumer products. California was the first state in the nation to legislate a ban on the commercial mixtures pentaBDE and octaBDE (AB 302 [2003] and AB 2587 [2004]; H&SC Section 108921 et seq.). U.S. production of these two mixtures ended in 2005. In 2009, the two U.S. producers, and the largest U.S. importer, announced commitments to phase out decaBDE in the United States by the end of 2013. Because of the PBDE bans and phase-outs, a further decline in PBDE levels is expected. However, PBDEs still exist in furniture manufactured before the phase-out, are persistent in the environment, and have entered the food supply, so exposures will continue.

California Teachers Study

The California Teachers Study (CTS) is a large, multi-institutional, statewide cohort study conducted by the Cancer Prevention Institute of California, the City of Hope, the University of Southern California, and UC Irvine to study factors influencing women's health among active and retired female school teachers and administrators in California. In a sub-study focusing on links between chemical exposures and breast cancer, Biomonitoring California laboratories are analyzing PFCs, PBDEs, and other persistent organic pollutants (PCBs and OCPs) in serum samples from approximately 1,000 women with breast cancer and 1,500 women without breast cancer. Recruitment was completed in 2014. For more information about this study, visit *http://biomonitoring.ca.gov/projects/california-teachers-study-cts*.

Among the study's major accomplishments were the following:

- Approximately 2,500 samples have been transferred to the laboratory at the Department of Toxic Substances Control (DTSC), of which nearly half have been analyzed for PFCs and one-fourth have been analyzed for other persistent organic pollutants (PCBs, PBDEs, and OCPs).
- The Program has posted PFC and PBDE results for a subset of CTS participants. More results will be added as they become available.
- As a part of CTS, investigators examined predictors of flame-retardant exposures. Certain characteristics were correlated with higher exposures for some flame retardants. Race (non-white), lower socioeconomic status, and heavier individuals were likely to have higher levels.

Preliminary data are available on the Program website: *http://www.biomonitoring.ca.gov/results*.

UC Berkeley Leukemia Study

The Program has analyzed 50 blood samples from mothers living in households with high levels of flame retardants (PBDEs) in dust. The purpose of the collaboration is to examine a possible link between flame retardant exposure in the environment and leukemia. Data analysis is ongoing, and information will be released as it becomes available (*http://www.biomonitoring.ca.gov/projects/california-childhood-leukemia-study-ccls*).

UC Irvine Study of Environmental Contaminants and Fertility

The Program has analyzed 99 urine samples for creatinine and hydroxy polycyclic aromatic hydrocarbon (PAH) analytes. The purpose of this collaboration is to examine a possible link between environmental contaminants and ovarian dysfunction, which is a major cause of infertility. Data analysis is ongoing, and information will be released as it becomes available.

Future Laboratory Collaboration with Genetic Disease Screening Program

The Program continues to pursue collaboration with CDPH's Genetic Disease Screening Program (GDSP). GDSP collects and stores dried blood spots from more than 99 percent of the nearly 500,000 infants born each year in California as part of the Newborn Screening Program. In addition, 70 to 80 percent of pregnant women in California participate in the State's Prenatal Screening Program, which results in 400,000 maternal serum samples per year. These archived samples could provide a representative sample of neonates and pregnant women in California, or they could be pooled to track trends over time or among specific groups.

Completed Laboratory Collaborations

The following four laboratory collaborations have been completed. For more information and description of these collaborations, visit the links to the Program's website for the specific projects below:

1. Center for the Health Assessment of Mothers and Children of Salinas. The Program analyzed phthalates in urine samples from 5-year-old children living in an agricultural community in the Salinas Valley (*http://biomonitoring.ca.gov/projects/center-health-assessment-mothers-and-children-salinas-chamacos*).
2. Cohort of Young Girls' Nutrition, Environment, and Transitions. The Program analyzed 500 blood samples for metals for a study of teenagers and young girls in the San Francisco Bay Area (*http://biomonitoring.ca.gov/projects/cohort-young-girls-nutrition-environment-and-transitions-cygnet*).
3. Markers of Autism Risk in Babies – Learning Early Signs. The Program analyzed phthalates in urine samples from pregnant women who already have an autistic child (*www.biomonitoring.ca.gov/projects/markers-autism-risk-babies-learning-early-signs-marbles*).
4. Pesticide Drift 2 Study. The Program analyzed urine samples from adults and children for pesticides for a study of individuals living in a rural agricultural community in Tulare County (*http://biomonitoring.ca.gov/projects/pesticide-drift-2-study*).

Identifying Chemical Exposures

Biomonitoring California includes two laboratories nationally recognized for their leadership and expertise in biomonitoring analytical methods.

The Environmental Health Laboratory (EHL), a branch of CDPH, has primary responsibility within Biomonitoring California for developing analytical methods and measuring inorganic chemicals in blood and non-persistent organic chemicals, such as phthalates, phenols, and some pesticides, in urine. EHL also oversees sample management and laboratory quality assurance for the Program.

The Environmental Chemistry Laboratory (ECL), a division of DTSC, has primary responsibility for developing analytical methods and measuring persistent organic chemicals such as flame retardants, PCBs, PFCs, and OCPs in serum. ECL will be leading the effort to identify new "unknown" chemicals for the Program.

The Program has rapidly expanded its capability to analyze additional chemicals and their breakdown products (Figure 2). In the first report to the Legislature, laboratory capability included measurement of three metals in blood and one pesticide in urine. By the second report, Biomonitoring California laboratories had the capability to measure more than 60 chemicals or their breakdown products in blood, urine, and serum. At the close of 2013, the Program was able to analyze nearly 140 chemicals across 12 chemical groups, including metals, pesticides, flame retardants, chemicals from personal care products and plastics, and other persistent pollutants such as PCBs. Chemicals that Biomonitoring California labs can measure are listed in Table 1.

Figure 2: Chemicals Biomonitoring California Labs Can Measure

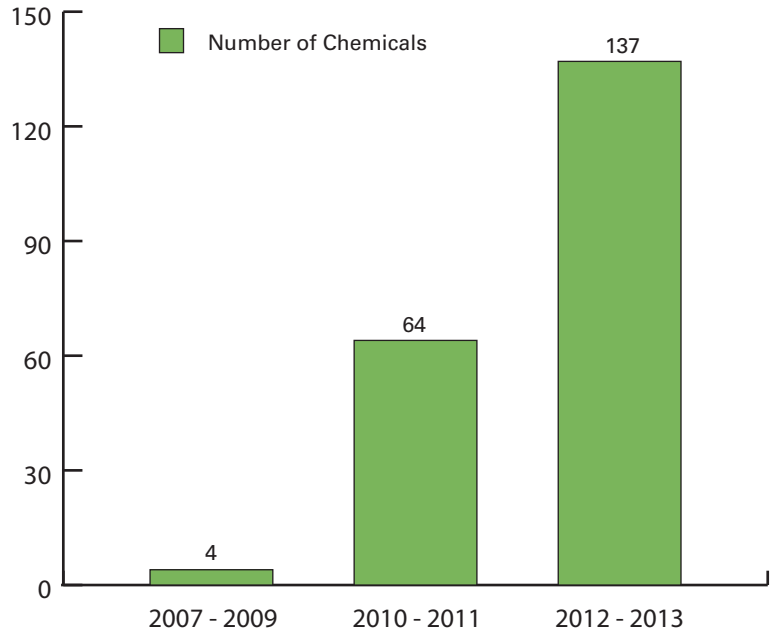


Table 1. Chemicals that Biomonitoring California Labs Can Measure

Chemical Group	Description of chemicals in the lab panel
Environmental phenols	Environmental phenols have a wide variety of uses, such as in personal care and other consumer products. These chemicals share a common chemical structure. Some examples of environmental phenols are bisphenol A, triclosan, benzophenone-3, and parabens. This group of chemicals may interfere with the body's natural hormones. Biomonitoring California measures environmental phenols in urine.
Polybrominated diphenyl ethers (PBDEs) and hydroxy-PBDEs (metabolites of PBDEs)	PBDE flame retardants were commonly added to polyurethane foam used in upholstered furniture and in some infant products. PBDEs were also used in electronics and insulation for cables and wires. U.S. production of penta- and octa-PBDEs ended by 2006. PBDEs have spread through the environment and break down slowly. Research studies have measured the world's highest levels of PBDEs in California residents. PBDEs may interfere with the body's natural hormones, may harm the developing fetus, and may decrease fertility. Biomonitoring California measures PBDEs and hydroxy-PBDEs in serum.
Metals	Metals are used in many industries and found in a variety of products. Biomonitoring California measures arsenic (total and specific forms), cadmium, lead, mercury, and manganese. Cadmium, lead, and mercury are toxic metals that can cause a range of health effects, including cancer and toxicity to the developing infant and child. Some forms of arsenic may harm the developing fetus and contribute to cardiovascular disease, and can increase cancer risk, while other forms found in seafood are not considered to be a health concern. Manganese is an essential nutrient that can be toxic to the nervous system at higher exposure levels. Biomonitoring California measures metals in urine and/or blood.
Perfluorinated compounds (PFCs)	PFCs are used to make various products resistant to oil, stains, grease, and water. Some example products that use PFCs include non-stick cookware, stain-repellent carpets and clothing, and grease-repellent food containers. There is concern that PFCs may affect the developing fetus and child, decrease fertility, interfere with the body's natural hormones and the immune system, and increase cancer risk. Biomonitoring California measures PFCs in serum.
Organochlorine pesticides (OCPs)	The OCPs measured by Biomonitoring California are no longer used in the United States. Because OCPs last a long time in the environment, they can still be found in high-fat fish, meat, and dairy products. Examples of OCPs are DDT, which is still used in some other countries, and chlordane. OCPs may affect the developing fetus and interfere with the body's natural hormones, and may increase cancer risk. Biomonitoring California measures OCPs in serum.
Organophosphate (OP) pesticides	OP pesticides are used in commercial agriculture to control pests on fruit and vegetable crops. OP pesticides are also used in home gardens, for flea control on pets, and in some no-pest strips. OP pesticides may affect the nervous system and may harm the developing fetus, possibly affecting later learning and behavior. Biomonitoring California measures OP pesticide metabolites in urine.

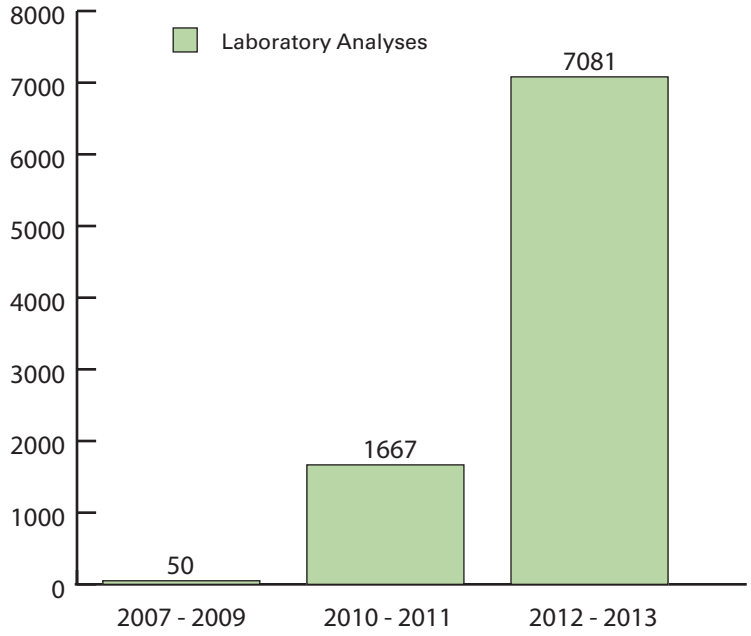
Chemical Group	Description of chemicals in the lab panel
Pyrethroid pesticides	Pyrethroid pesticides are common ingredients in pest control products for the home and garden. They are also used to control insects on commercial agricultural crops and livestock. Some pyrethroid pesticides may affect the developing fetus and interfere with the body's natural hormones, and may increase cancer risk. Biomonitoring California measures pyrethroid pesticide metabolites in urine.
Herbicides	Herbicides measured by Biomonitoring California include 2,4-D and 2,4,5-T. 2,4-D is found in some home lawn products designed to kill weeds. There is concern that 2,4-D may interfere with the body's natural hormones and affect the developing fetus, and may increase cancer risk. 2,4,5-T was used in the past to control weeds but is no longer used due to toxicity concerns. Biomonitoring California measures these herbicides in urine.
Polychlorinated biphenyls (PCBs)	PCBs were widely used to insulate electrical equipment and as plasticizers. PCBs were banned in the late 1970s but are still in some old equipment and products. They have spread through the environment and take a long time to break down. They are found in some high-fat fish and high-fat animal products and also in old caulk and old fluorescent light fixtures. Exposure to PCBs can affect the developing fetus and interfere with the body's natural hormones, and may increase cancer risk. Biomonitoring California measures PCBs in serum.
Phthalates	Phthalates are added to vinyl to make it soft and flexible. Vinyl products include shower curtains, flooring, and plastic tubing. Phthalates are also used in scented products, coatings like nail polish and paint, and a variety of other consumer products. Phthalates can interfere with the body's natural hormones and affect development and fertility, and some phthalates may increase cancer risk. The male reproductive system is especially sensitive to phthalate exposure during development. Biomonitoring California measures phthalate metabolites in urine.
Perchlorate	Perchlorate is an ingredient in rocket fuel and explosives. It also occurs naturally in dry regions, such as in the Southwestern United States. Industrial uses of perchlorate have led to contamination of soil, groundwater, and drinking water in some areas of California. Perchlorate lasts a long time in the environment and can accumulate in various crops. Perchlorate can interfere with the thyroid gland's ability to use iodide, which can decrease the production of thyroid hormones. Perchlorate may affect the developing fetus and child and may increase risk factors for heart disease. Biomonitoring California measures perchlorate in urine.
Polycyclic aromatic hydrocarbons (PAHs)	PAHs occur naturally in petroleum products, such as gasoline and diesel, and are formed when these products are burned. PAHs are found in tobacco and wood smoke. They also form when foods are grilled, barbecued, or roasted. PAHs may contribute to respiratory problems, affect the developing fetus and the body's natural hormones, and may increase cancer risk. Biomonitoring California measures PAH metabolites in urine.

Biomonitoring analytical capacity has also dramatically increased (Figure 3). Analytical capacity refers to the number of specimens the lab can analyze during a given time period. A single blood or urine sample may yield several specimens for analysis for different chemical classes.

In the first report to the Legislature, the Program had only begun to analyze specimens as part of the process of validating newly developed methods. In the second report to the Legislature, spanning 2010-2011, the Program had rapidly expanded to conduct more than 1,500 analyses.

In the past two years, the Program's analytical capabilities have seen unprecedented growth. In 2013 alone, laboratory analytical capacity exceeded 4,000 per year. With expected technological advances in sample throughput, this number could increase further.

Figure 3. Number of Specimens the Labs Can Analyze



Chemicals of Emerging Concern

The Program is also developing additional methods to measure chemicals of emerging concern, including:

1. **Fragrances, including synthetic musks.** These chemicals are ubiquitous in personal care products, and exposure is likely to be widespread in Californians. Synthetic musks are biologically active, potentially affecting the body's natural hormones.
2. **Bisphenol A (BPA) analogs and substitutes.** BPA is being voluntarily phased out of a number of consumer products because of its potential effects on hormones. However, chemicals with similar structures, such as bisphenol S (BPS) and bisphenol A diglycidyl ether, are still used in products. BPS shows similar biological activity as BPA, including potential hormonal effects.
3. **Phosphate flame retardants.** Because high levels of flame retardants have previously been found in Californians, the Program has made it a priority to measure recently banned flame retardants and their substitutes. As brominated flame retardants are phased out, phosphate-based flame retardants have been entering the market in larger quantities.
4. **Identifying unknown chemicals present in Californians.** The Program is developing methodologies to screen biological samples for previously unknown and otherwise undetected chemicals of potential concern.

Public Participation Activities

H&SC Section 105451 directs Biomonitoring California to "provide opportunities for public participation and community capacity building" to allow for "meaningful stakeholder input" and to "develop a strategy and plan … to establish the framework for integrating public participation in this program." Opportunities for public involvement and the Program's Public Involvement Plan, which provides an overview of the range of public involvement efforts being carried out by Biomonitoring California, can be found online at *http://biomonitoring.ca.gov/public-involvement*.

Public Website

The Program's redesigned website, launched in July 2013 and available at *www.biomonitoring.ca.gov*, was a focus of public-oriented activities during 2012-2013. With a web designer, staff worked to improve navigation, ease of use, accessibility, and relevance of the site for a general audience, while also increasing site content. The new site is designed to appeal to a broad audience, including the lay public, scientists, legislators, industry, and advocacy groups. New content includes information about Biomonitoring California laboratories, details of our projects, study results, and fact sheets on the chemicals being measured. A "Biomonitoring Guide" provides an easy-to-understand introduction to the Program and broader issues, such as chemical exposures in everyday life and why biomonitoring is important. Information is available in both English and Spanish.

Results from biomonitoring studies are released to the public on the website. Aggregate results are also posted for all the studies that have data available on the chemicals measured. Reporting includes features intended to aid understanding, such as a glossary of terms.

Other ongoing public involvement activities include maintenance of a listserv with more than 900 active subscribers. Notes are sent to subscribers approximately twice per month informing them of Program activities and new materials, such as results, posted on the website.

Communicating Biomonitoring Results

A distinctive feature of the Program is the statutory requirement to return biomonitoring results to study participants who request them (H&SC Section 105443), even if the health implications of these results are scientifically uncertain.

This poses a challenge for the Program to interpret biomonitoring results and convey their potential health implications to individuals, particularly when a particular chemical's toxicity in humans has not been well studied.

Results return packets include informational fact sheets (available in English and Spanish), which detail the sources of chemicals in the environment, possible health concerns, and ways to reduce exposure.

Collaboration

The Program's partners and collaborators include community groups, scientists, and other State of California departments. Collaborators include:

- Cancer Prevention Institute of California (Dr. Peggy Reynolds)
- California Conference of Local Health Officers
- California's Green Chemistry Initiative
- CDC
- CDPH, California Environmental Health Tracking Program
- CDPH, Childhood Lead Poisoning Prevention Branch
- CDPH, GDSP
- CDPH, Occupational Health Branch
- Child Health and Development Studies (Dr. Barbara Cohn)
- Kaiser Permanente Division of Research (Dr. Stephen Van Den Eeden)
- UC Berkeley (Drs. Asa Bradman, Catherine Metayer, and Rachel Morello-Frosch)
- UC Davis (Drs. Deborah Bennett, Oliver Fiehn, and Irva Hertz-Picciotto)
- UC Irvine (Drs. Leslie Israel and Ulrike Luderer)
- UCSF (Drs. Roy Gerona and Tracey Woodruff)
- Zero Breast Cancer

Program Priorities

Biomonitoring California has established a reputation for developing and using cutting-edge analytical methodology and for setting high standards in reporting results to participants and the general public. In order to continue to provide unsurpassed leadership and quality as a state biomonitoring program, it is important to examine and evolve our direction and priorities in order to better meet the needs of Californians. To achieve this, we summarize below three key priorities for maintaining and improving Biomonitoring California:

Priority 1: Investigate Chemicals of Emerging Concern

Through years of key legislative action, California has become a leader in identifying chemicals of emerging concern in the environment and consumer products. To contribute to this effort, and to support the Safer Consumer Products program, Biomonitoring California has prioritized the development of methods to identify new chemicals that present potential risk to Californians by:

Expanding and automating existing methods to measure more chemicals, more quickly and accurately.

1. Screening blood and urine samples to start to identify previously unknown and potentially toxic chemicals.
2. Pioneering new laboratory methods to efficiently measure previously unknown chemicals with significant exposures in California.

Proportionate to available resources, the Program will continue to conduct activities to measure additional chemicals by its current methods, and expedite analytical throughput using enhanced automation, where possible. Using CDC funds, the Program has begun exploring the development of methodologies for analyzing specimens for previously unknown chemicals of concern.

Priority 2: Illustrate Statewide Exposures through Community Studies

Biomonitoring a representative set of California's population would provide important information about levels of environmental chemical exposures throughout the state. The Program places a high priority on identifying opportunities to analyze chemical exposures using samples collected by other organizations in subpopulations around the state such as disadvantaged communities with specific exposure concerns, workers with potential exposures to chemicals not typically monitored in the workplace, and sensitive populations like pregnant women and infants. Continuing to carry out such studies that can provide important data to help inform public health practice and chemical policy in California is a priority. These types of studies add value by highlighting exposures in groups at particularly high risk to possible harmful effects from exposure to environmental chemicals. The Program will also continue to seek collaborations that allow access to samples that may provide a more representative cross-section of the California population, including using samples archived by the State's Prenatal and Newborn Screening Programs.

Priority 3: Program Funding

Most of the recent accomplishments in building laboratory biomonitoring capacity and capability listed above were made possible by the augmentation of the Program's budget by the five-year Cooperative Agreement with CDC, which has provided $2.65 million annually.

These additional resources have played a critical role in allowing the Program to acquire several highly sophisticated laboratory instruments, initiate multiple community studies, and obtain blood and urine samples. While the Cooperative Agreement funding ended on August 31, 2014, Biomonitoring California was awarded a second round of CDC funding that provides $1 million annually for 5 years (the grant began September 1, 2014.)

The 2014 Budget Act included additional state funds to support Biomonitoring California; specifically, an additional $700,000 per year for two years, which includes support for four limited-term positions.

To address the decrease in federal funding, the 2015-16 Governor's Budget proposes an increase of $900,000 and six 2-year limited-term positions for CDPH, and $600,000 and two 2-year limited-term positions for the Department of Toxic Substances Control. This funding will be used by the Program to support ongoing identification and measurement of toxic chemicals in Californians, thereby helping to assess the effectiveness of public health and environmental programs in reducing chemical exposures and preventing disease. The funding will additionally be used to investigate the feasibility of detecting and measuring emerging chemical threats to California.

In addition, Biomonitoring California staff will continue to leverage existing resources by securing cooperative agreements and other external funding whenever possible to support and expand community-based and regionally representative biomonitoring studies.

Conclusions

Biomonitoring California has been building laboratory capabilities and capacity and other elements of a robust state biomonitoring program since the Program's inception. This effort has begun to generate data that is informing public health and chemical policy in California. Examples of important findings made possible by Biomonitoring California's efforts include:

- Infants in MIEEP had higher levels of certain chemicals as compared with their mothers, including PBDE flame retardants that have been banned in California due to health concerns. Of the 59 chemicals analyzed in both pregnant mothers seen for prenatal care at SFGH and their infants' cord blood, 50 were detected.
- High levels of PBDE flame retardants were found in Southern California firefighters, particularly those who worked on front-line activities. The use of personal protective gear and regular cleaning of the gear were associated with lower flame retardant levels.
- Higher levels of BP-3, a chemical used in sunscreens and as a stabilizer in plastics, were measured in Southern California firefighters, compared with the general U.S. population. BP-3 is suspected of interfering with hormone action.
- Higher levels of the toxic metal arsenic were found in the Central Valley BEST population compared with other California populations and the general US population, based on preliminary results.
- A family with significantly elevated mercury levels had been using foreign-made skin-lightening creams adulterated with mercury. This led to a public health alert to medical providers in 2011 and a subsequent follow-up study within CDPH to analyze skin-lightening products for mercury and other harmful contaminants.

These discoveries have been made possible by the continued progress of Biomonitoring California's development. Since the Program's inception, Biomonitoring California has:

- Completed two biomonitoring studies and made significant progress toward completion of a third.
- Obtained specimens from more than 3,700 Californians.
- Developed the capability to measure nearly 140 distinct chemicals or their breakdown products in urine, serum, and whole blood. Many of these chemicals have the potential to adversely impact public health.
- Built the capacity to conduct more than 4,000 analyses per year.
- During the two-year period covered by this report (2012-2013), Biomonitoring California conducted more than 7,000 biomonitoring analyses for toxic chemicals or their breakdown products, including heavy metals, flame retardants, phthalates, and pesticides. Results of these analyses have been returned to participants who requested them, and aggregate results for individual studies have been made public on the Program's website.

Biomonitoring California has achieved its status as a recognized leader in state biomonitoring programs nationally by leveraging state and federal resources and building key partnerships around the state. As California's future policy and regulations attempt to reduce toxic chemical exposures to Californians, the Program must be prepared to provide essential information regarding the effectiveness of these new policies.

Appendix A: Program Structure and Resources

Program Structure

Biomonitoring California is a complex, multidisciplinary program developed and implemented collaboratively by the California Department of Public Health (CDPH), Office of Environmental Health Hazard Assessment (OEHHA), and the Department of Toxic Substances Control (DTSC). This multidisciplinary approach contributes to the success of the program by bringing together expertise in analytical chemistry, toxicology, and epidemiology. General roles and staff responsibilities for Biomonitoring California are listed below and shown in Figure A1.

Figure A1. Biomonitoring California Departmental Roles and Lead Responsibilities

Biomonitoring California			
DTSC	**CDPH**		**OEHHA**
Environmental Chemistry Laboratory Laboratory analyses of blood samples for biologically persistent chemicals Quality assurance and interpretation of laboratory data Identification of unknown chemicals	**Environmental Health Laboratory** Laboratory analyses of blood samples for metals and urine samples for metals and non-persistent chemicals Quality assurance and interpretation of laboratory data Processing and storage of blood and urine samples	**Environmental Health Investigations Branch** Design of statewide and community surveys Participant recruitment and sample collection Results communication to participants Management and analysis of epidemiologic data Generation of reports to the Legislature Dissemination of information to the public Overall coordination of program components and partners	**Reproductive and Cancer Hazard Assessment Branch** Administration and support of the SGP Evaluation of scientific information for chemical selection, chemical analyses, and results return Outreach to the public, including maintenance of the Program website

CDPH is the lead entity, with primary responsibility for: (1) overall design of the biomonitoring program, including both statewide and community surveys; (2) participant recruitment and sample collection; (3) receipt, storage, and analysis of blood and urine samples for metals and chemicals that are not biologically persistent; (4) quality assurance and interpretation of laboratory test results; (5) communication of test results to participants; (6) data analysis; (7) generation of reports to the Legislature; and (8) dissemination of information to the public.

OEHHA has primary responsibility for: (1) administering and supporting the SGP; (2) evaluating and summarizing scientific information for the SGP's deliberations on chemicals for biomonitoring; (3) evaluating and summarizing scientific information used in returning test results to study participants; (4) collaborating with CDPH on study design and data analysis; and (5) conducting public outreach efforts, including maintaining the Program's website: *www.biomonitoring.ca.gov/*.

DTSC has primary responsibility for: (1) analysis of blood samples for biologically persistent chemicals, (2) quality assurance and interpretation of the laboratory's test results, and (3) exploring methodologies to identify new and emerging chemicals of concern, including those not yet identified.

Staff members in all three departments collaborate on multiple activities, including program design, SGP meetings, and data analysis. For instance, OEHHA and DTSC staff members contribute to the program design, for which CDPH is the lead. Similarly, OEHHA convenes the SGP and provides scientific support, while representatives from DTSC and CDPH provide scientific and other programmatic input to meeting content, as well as making presentations and responding to questions from the Panel. The three departments share responsibility for analyzing data collected by Biomonitoring California, focusing on different scientific issues so that analyses are not duplicative. Selected managers and senior scientists from the three departments also meet regularly during the "Leads" meetings to coordinate activities. Staff members from the three departments also constitute the Biomonitoring Interagency Group, which meets twice per month to share information.

Scientific Guidance Panel and Chemical Selection

As mandated in SB 1379 (H&SC Sections 105448 and 105449), scientific peer review of Biomonitoring California is provided by a Scientific Guidance Panel (SGP). The SGP's rigorous technical input provides a robust scientific underpinning for Biomonitoring California. OEHHA is responsible for convening and staffing the Panel and providing scientific materials to support the SGP's deliberations. The Panel consists of nine members appointed by the Governor and the Legislature. The panelists' biographies, meeting agendas, presentations, background materials, transcripts, and recordings (when available) are posted on the Biomonitoring California website at *www.biomonitoring.ca.gov/scientific-guidance-panel*. Meeting materials are also available on the Biomonitoring California website at *www.biomonitoring.ca.gov*meetings. The meetings are open to the public, and stakeholder comments are encouraged. The Panel met six times during 2012-2013, as required by law.

The SGP performs many functions that are critical to the success of Biomonitoring California. The SGP's major role is to provide recommendations on chemicals or groups of chemicals that should be measured by Biomonitoring California. The Panel also provides feedback on the design and implementation of Program projects, and advice to the laboratories. The SGP gives input on results return materials for participants and website development, and provides suggestions for future Program activities.

The SGP has emphasized the importance of including emerging chemicals and chemicals of specific concern in California. Emerging chemicals are often known or suspected substitutes for chemicals that are being phased out due to safety and other concerns. In 2012, the Panel recommended two classes of chemicals that are structurally related to BPA, some of which are known substitutes for BPA, and a class of phosphate flame retardants that are substitutes for PBDE flame retardants as priorities for measurement by Biomonitoring California. Method

development is currently underway for these classes of chemicals. To access the complete list of chemicals that can be considered for inclusion in Biomonitoring California projects ("designated chemicals"), visit: *www.biomonitoring.ca.gov/chemicals/designated-chemicals*.

Program Resources

Baseline state funding for Biomonitoring California since 2008-09 has been stable at approximately $2.2 million. This baseline state funding supports 13 core staff (eight in CDPH, three in OEHHA, and two in DTSC). The Program's budget has been augmented over the past five years by a five-year (FFY 2009-14) Cooperative Agreement with the U.S. Centers for Disease Control and Prevention (CDC). The CDC Cooperative Agreement provided $2.65 million annually through August 31, 2014. These additional resources have played a critical role in allowing the Program to acquire several highly sophisticated laboratory instruments, initiate multiple community studies, and obtain blood and urine samples. The CDC Cooperative Agreement, which was awarded to the nonprofit Sequoia Foundation serving as a designated "bona fide" agent of CDPH, has also enabled the hiring of grant personnel (15 positions) who provided vital support for Program activities, and the purchase of highly specialized laboratory analytical instruments.

The 2014 Budget Act included additional state funds to support Biomonitoring California: specifically, an additional $700,000 per year for two years, which includes support for four limited-term positions.

Furthering the support for Biomonitoring in California, the Governor's 2015-16 budget proposes an additional $900,000 and six 2-year limited-term positions for CDPH, and $600,000 and two 2-year limited-term positions for the Department of Toxic Substances Control. This funding will be used by the Biomonitoring Program to continue to support ongoing identification and measurement of toxic chemicals in Californians, and thereby to help assess the effectiveness of public health and environmental programs in reducing chemical exposures and preventing disease. The funding also will be used to investigate the feasibility of detecting and measuring emerging chemical threats to California.

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This report is available online at
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