

Protecting the Health of Mothers and Babies

SRP researchers discover and mitigate impacts of harmful chemicals in Puerto Rico.

Funded by the National Institute of Environmental Health Sciences (NIEHS) Superfund Research Program (SRP), a team of researchers studies environmental exposures that lead to high rates of preterm birth, and other adverse health outcomes, among mothers and their babies in Puerto Rico. The program is called Puerto Rico Test Site to Explore Contamination Threats (PROTECT).

Puerto Rico has a high density of Superfund sites—higher than most U.S. states—meaning the air, land, and water are especially polluted.²¹ In 2006, they also had the highest preterm birth rate in the U.S., about 20% of all live births in the territory.¹³

The PROTECT team explores the connection between exposure to environmental contaminants and preterm birth in Puerto Rico and hopes to find solutions.

Led by Northeastern University, PROTECT brings together a multi-institution, multidisciplinary team of researchers, including pediatricians, environmental health specialists, social scientists, environmental engineers, data experts, toxicologists, and epidemiologists. They use an effective model of community engagement, relationship building, and sharing results with participants to lower rates of preterm birth and improve babies' health.

In 2010, PROTECT partnered with private clinics and community health centers across Puerto Rico to start enrolling hundreds of pregnant women volunteers annually for their studies. They tested women's blood and urine for exposure to many drinking water contaminants and chemicals found at Superfund sites and in consumer products. Then, the research team collected information about whether the women gave birth preterm or full term.

Between 2010 and 2023, the PROTECT team recruited more than 2,000 women to participate. Some women have participated in the program for multiple pregnancies. The team expanded their work to detect, analyze, and remediate more types of contaminants.



A PROTECT participant brings her baby in for an assessment. The researchers chart babies' birth outcomes and overall health. (Photo courtesy of PROTECT)

"Because of the nature of the study, we are able to collect data about groundwater contamination, as well as lifestyle and behaviors. We can put all that together to get a broader picture of exposures."

– Akram Alshawabkeh, Ph.D.

Impacts of Addressing Health Disparities



Pinpointing

Understanding Exposures and Health Effects

Found sites where the groundwater is contaminated with trichloroethylene (TCE), which is hazardous to human health.^{18, 24} TCE is found in refrigerants, household products like cleaners and spray adhesives, commercial dry-cleaning chemicals, and is used as a degreasing agent for metal equipment.¹⁴



Geology

Realized complex geology was contributing to high levels of water contamination, funneling water too quickly into underground aquifers and not filtering out many contaminants, leading to higher exposures through drinking water.^{8, 16, 20, 24}



Recruiting Participants

Recruited more than 2,000 pregnant volunteers for research studies to understand the link between chemicals measured in the body and adverse birth outcomes.



Health Effects

Found high levels of phthalates in pregnant women, attributed to use of certain personal care products¹⁹ and other sources, and linked with general inflammation in the body, oxidative stress, and increased production of prostaglandin, a hormone that induces labor.⁷ All these conditions can increase the chance of preterm birth.



Digital Tools

Sharing Results and Reducing Exposures

At study participants' request, the team created a smartphone application to report research findings called Mi PROTECT (Spanish for My PROTECT) by collaborating with the Silent Spring Institute and incorporating input from clinic staff and program participants.²



Reporting Results

Community-engagement experts and partners shared research results through community meetings, printed materials, a call center, WhatsApp, YouTube videos, and the social media engagement campaign #ProtectRespond on Facebook and Instagram to reach and educate more pregnant mothers.¹⁷



Reducing Exposures

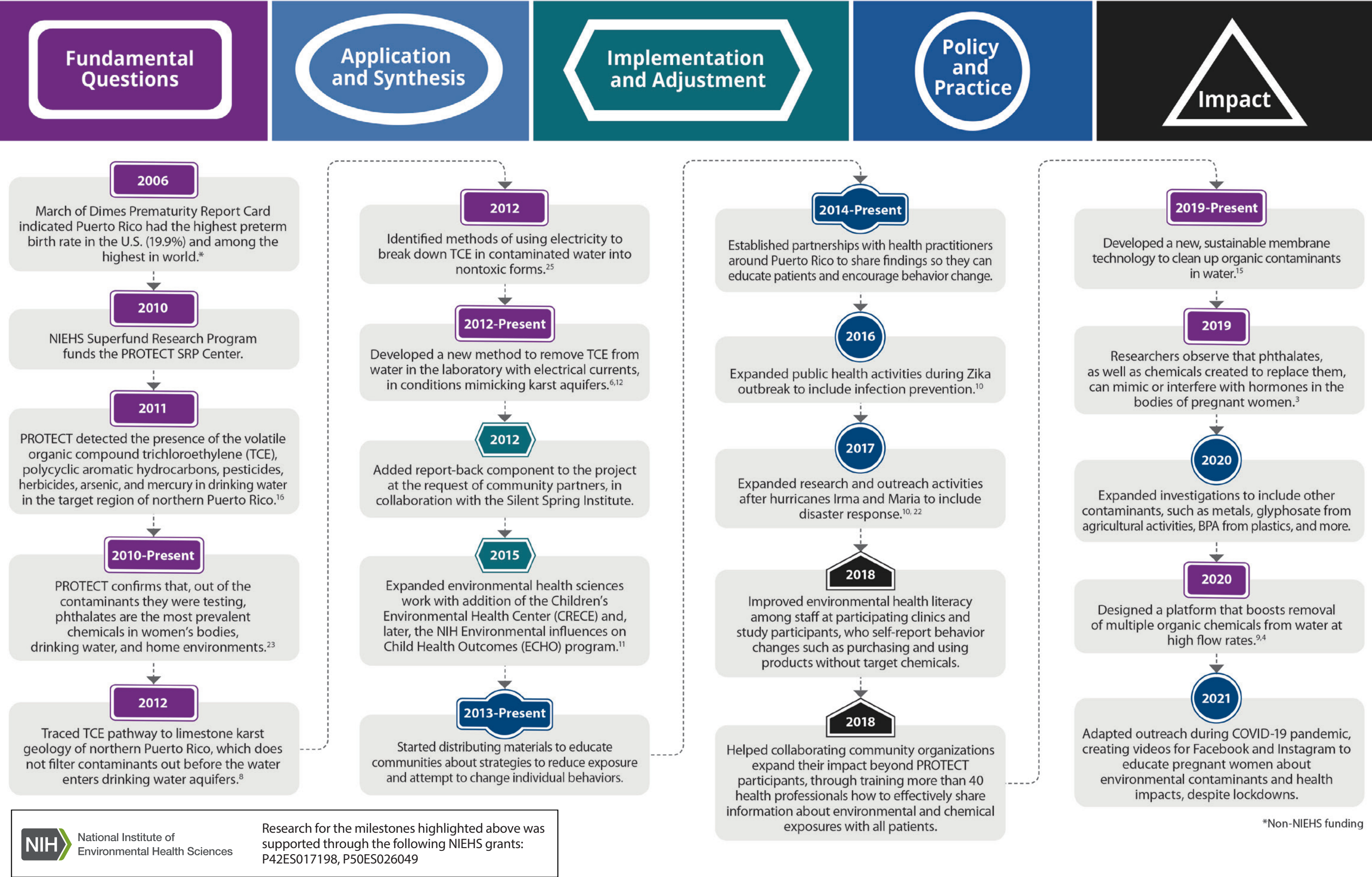
In addition to providing individual results, their resources include practical advice for reducing exposures, such as switching to steel or glass drinking containers, and which ingredients to avoid in personal care products.



Clean Up

To clean up contaminated drinking water sources, researchers developed technologies that use electrical currents to destroy TCE^{6, 12} and a sustainable membrane that absorbs organic contaminants so they can be removed from water.¹⁵

Protecting the Health of Mothers and Babies in Puerto Rico



Creating Personalized Reports

Mi PROTECT was created to report study results back to participants with tailored, culturally relevant information about personal exposure to contaminants and recommendations to reduce exposures.² According to researchers and participants, sharing and interpreting project results increased participants' willingness to continue participating in the project, their motivation to reduce exposures, trust in science, and individual and community empowerment.¹



(Graphic courtesy of PROTECT)

Expanding the Reach

The PROTECT collaboration has grown, evolved, built new partnerships, and produced a spinoff project, the Center for Research on Early Childhood Exposure and Development in Puerto Rico, or CRECE.¹¹ CRECE, which is Spanish for “grow,” uses data about pregnant women’s exposures collected through PROTECT to examine air pollution’s impact on child development.

CRECE, like PROTECT, brings together experts from a variety of fields to study how air pollution from refineries, power plants, and the shipping industry contribute to Puerto Rico’s high rate of childhood asthma. CRECE also provides environmental health knowledge, education, and capacity building to researchers, study volunteers, and the broader Puerto Rican community.



Trainees perform a skit to educate participants and their children about hazards in their environment at a community engagement event. (Photo courtesy of PROTECT)

Research Challenges and Solutions

Challenge: Puerto Rico has many Superfund sites with a wide range of chemicals, making it difficult to untangle which were linked to preterm birth.

Solution: PROTECT researchers use surveys; home water-source samples; and blood, urine, and placenta tissue samples from more than 2,000 pregnant women to gain a holistic idea of all the chemicals they are exposed to in their homes and community environments.⁵

Challenge: Phthalates are common ingredients in a wide range of consumer products, especially low-cost products available in low-income communities.

Solution: The researchers went to local stores where study participants purchased their products and conducted brand-by-brand analyses to determine which contained the most phthalates. Then, they reported back their findings to participants, recommending the safest products that were accessible to them.

“This has been the story of bidirectional relationships, not only between faraway universities, but between our researchers and participants. In a very organic way, we have earned the trust of a lot of people.”

– Carmen Velez-Vega, Ph.D.

A Pioneering Collaboration

PROTECT collaborators include:

- Northeastern University
- University of Puerto Rico, Medical Sciences Campus
- University of Puerto Rico, Mayagüez
- University of Georgia
- University of Michigan
- March of Dimes
- Silent Spring Institute
- EarthSoft Inc.

Then and Now

Then

- The movement of contaminants in karst aquifers—Puerto Rico’s primary drinking water source—was not well understood.
- Sources of exposure and resulting health effects were not well documented.
- PROTECT participants wanted to know how to reduce their exposure to harmful contaminants.
- Public health crises, such as the Zika virus and catastrophic hurricanes, stressed community members.

Now

- PROTECT models groundwater flow and transport of contaminants in karst aquifers, discerning how geological characteristics contribute to drinking water contamination.⁸
- Researchers linked exposure to chemical contaminants in drinking water and personal care products with increased risk for preterm birth.¹⁹
- Community engagement and education specialists explain exposure results simply and provide guidance on how to reduce exposures.
- Because of a robust research infrastructure and partnerships, PROTECT was able to quickly mobilize and provide participants and their families with critical resources, such as mosquito nets and water filters.¹⁰

For references, supplementary information, and more on the impact of NIEHS research, please visit <https://niehs.nih.gov/research/programs/translational/examples>.