Do some people have genetic variants that make them more susceptible to the harmful effects of air pollution? Are there some sources of air pollution—such as particulates from vehicles, power plants, or factories—that are worse than others? What are the long-term chronic effects of air pollution on the cardiovascular health of local residents?

These are some of the tough questions that U.S. Environmental Protection Agency (EPA) scientists in collaboration with Duke University School of Medicine physicians are hoping to answer with an ambitious new study called CATHGEN. The study is supported by health records derived from nearly 10,000 people living in North Carolina from 2001 to 2011 and who had a cardiac catheterization done at Duke.

This vast database of patients—most of whom have some indication of cardiovascular disease—will allow EPA researchers to tease apart many questions that otherwise would be impossible to
answer. It’s the largest, most comprehensive database ever used to attempt to explain how exposure to air pollution can affect the progression of cardiovascular disease, explains Robert Devlin, senior scientist at the EPA’s Environmental Public Health Division.

“It’s a unique cohort because it’s so big,” Devlin says. “That’s where the power of 10,000 people comes into play. For example, genetic polymorphisms (changes) make some people more susceptible to air pollution, but those events may only occur in 10 to 20 percent of the population. With 10,000 people, you have the ability to divide the population into subgroups to find out what’s going on.”

The database includes detailed clinical information, genomics and epigenetic markers, and various blood biomarkers, including those involved in inflammation. It was collected from patients in the North Carolina Raleigh-Durham area from 2001 to 2011 by the Duke University Medical Center. Researchers will compare this patient health data to regional air pollution readings collected by both ground sensors and satellites. Scientists from EPA, Duke University, Harvard University, and the Helmholtz Institute in Germany will spend the next five years poring over the information.

The CATHGEN study is also examining what kinds of air pollution particles may be responsible for what kinds of health problems. It’s also looking at their sources, from local roadways for example or far-away power plants.

By using the CATHGEN database, Devlin says EPA researchers are drilling down into the physiological and cellular changes that happen when people breathe polluted air for several years.

“We have access to the (patient’s) blood that seems to change with particulate matter (exposure),” Devlin says. “Are they likely to have long-term changes, like chronic inflammation, or higher cholesterol levels, for example? By looking at blood over a period of time, we can ask: Does chronic exposure to air pollution cause changes in blood that lead to cardiac events.”

EPA cardiologist Wayne Cascio says the CATHGEN study will fill in big gaps in current scientific knowledge. Epidemiological data has shown the link between air pollution and heart attacks and strokes and air modeling research has shown how air pollution impacts people near roadways and other near source air pollutants. The CATHGEN data gives researchers the ability to get a closer look at the health impacts air pollution have had on people in the real world.

So far, two analyses have been completed and are being prepared for publication from CATHGEN: one that concludes that people who live closer to busy roads are likely to have worse coronary artery disease than those who don’t. Another study shows that people who live in areas with higher particulate matter are prone to have more heart attacks and worse coronary artery disease.

Finding the genetic markers that make some people more susceptible to heart disease when exposed to air pollution could also help save lives. In the future, people may have the ability to determine if their genetic make-up makes them more susceptible to air pollution and take action to reduce exposures. This kind of rigorous scientific data also can be used by policymakers to decide on how better to control sources of air pollution in the first place.

You can learn more about the links between air pollution and heart disease at www.epa.gov/healthyheart.

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