On the farm in Africa

The wristbands have caught the attention of researchers around the world. Projects are under way in Africa, Asia, Europe, and the U.S. to evaluate the bands for use in monitoring farm and worker-related chemical exposures, Anderson says.

Paul Jepson, director of the Integrated Plant Protection Center at Oregon State, and scientists in Anderson's group are collaborating to help residents of a rural farming community in Senegal learn about their chemical exposures.

"We've been working with the community for about a decade or more with stationary air monitors," Anderson says. "They had heard about the wristband and asked us if they could wear them as part of a study."

The Oregon State researchers recruited 35 men and women from the community to each wear a band for five days. Afterward, they were given a second band to wear for another five days. The researchers then analyzed the bands quantitatively for 63 pesticides. Each person's band had two to 10 pesticides, but no two individuals had the same profile. The amounts of pesticides

in the bands within the same individual were consistent from the first week to the second.

Differences such as this in pesticide exposure from one individual to the next are not captured by stationary air monitors, which are often used to calculate exposures, Anderson stresses. On the basis of the information provided by the wristbands, she says it may be important to customize advice to individual farmers about how to reduce their exposure to pesticides.

Although this was a small study, it demonstrates the eagerness of people to use this technology, Anderson says. The researchers observed 100% compliance—participants wore the bands as they were instructed. That's not been the case with conventional personal-backpack monitors, she says.

High-throughput exposure modeling

Scientists at the U.S. Environmental Protection Agency are excited about the flurry of research under way using silicone wristbands for monitoring everyday exposures to chemicals. EPA and the world's other regulatory agencies need both exposure and toxicity information to assess the risk of a chemical. But there are many chemicals for which exposure data simply don't exist.

"If we can identify hundreds or thousands of chemicals in a wristband that we didn't know people were being exposed to, that is a treasure trove," says John Wambaugh, a physical scientist with EPA's Office of Research & Development.

Wambaugh sees one limitation to the wristbands: They provide only a record of a person's cumulative exposure over time. "You lose some of the notion: Did they get one big exposure at one point, or have they been gradually getting exposure?" he says.



Still, he is excited to examine how the wristbands could complement an ongoing EPA effort to develop computer models that generate high-throughput exposure predictions for thousands of chemicals. Initially, the models were based on data about how chemicals are used, says Kristin Isaacs, an EPA scientist who works with Wambaugh.

"We needed information about what chemicals are in consumer products and at what concentrations," Isaacs says. So a few years ago, the EPA scientists began collecting data for about

2,000 chemicals that are listed on product material safety data sheets made publicly available by retail giant Walmart. They then merged that information with what they could find in scientific literature about how people use consumer products.

EPA has entered into collaborations to get more data on consumer product use. For example, EPA scientists have access to product-use questionnaires for 50,000 women enrolled in the National Institutes of Health's Sister Study—a study following the health of women whose sister had breast cancer.

EPA also has an agreement with Nielsen, a company that provides information on what television shows consumers watch and what they buy. The company provided EPA with a year's worth of data from 60,000 households involved in a project in which people record every product they bring into their homes. "We are analyzing those data to see if we can predict what people are buying based on demographics," Wambaugh adds.

Although EPA now has more data than ever on chemicals in consumer products, the agency still lacks information about thousands of substances. In a recent test, EPA scientists ground up 100 consumer products, including upholstery, breakfast cereals, and baby toys, and tried to extract every chemical they could.

The researchers found 3,800 different chemicals, and only 2,000 of those were ones that they already knew were in consumer products, Wambaugh says. The unidentified substances might not raise concerns, however. "Unless you are grinding your baby toy up in a blender and extracting it with dichloromethane, you are not necessarily being exposed," he says. "But the potential is there." The wristbands could help EPA identify whether people are actually being exposed to any of the chemicals.

> **"It is much easier to analyze a wristband for a wide range of chemicals than it is to analyze a blood sample for a wide range of chemicals."**
>
> **-Heather Stapleton,** Duke University

Identifying chemicals in pulverized consumer products, house dust, silicone wristbands, or any other matrix can be challenging if researchers don't know what they are looking for. Advances in high-resolution mass spectrometry, coupled with more data on how people use various consumer products, however, are facilitating the process.

High-resolution MS has been a boon to exposure science over the past few years, Wambaugh says. "It allows you to try to identify everything in the sample," he notes. In the past,

scientists would analyze a sample, such as blood, urine, or dust, for a specific chemical. That work was predicated on researchers knowing which substance they were looking for.

But even with high-resolution MS, identifying specific chemicals can be tricky. That's because different molecules can consist of the same atoms combined in disparate arrangements.

EPA scientists recently ran into that situation when trying to identify chemicals in house dust from dozens of homes across the U.S. The researchers detected a compound with the molecular formula $C_{17}H_{19}NO_3$ in 75% of the dust samples. Initially, they thought they had uncovered a huge heroin problem because the molecular formula matches that of morphine, a component of heroin. But the formula also matches piperine, the alkaloid that gives black pepper its pungency.

The EPA scientists then examined information about how each of these two chemicals is used and combined those data with exposure predictions from high-throughput models. "We decided that most of those matches were actually the black pepper ingredient rather than the heroin component," Wambaugh says, because many more people use black pepper than heroin.

EPA scientists are currently working with university researchers and technology companies to develop methods for screening blood samples for new chemical signatures using nontargeted

high-resolution MS. Silicone wristbands could simplify the analysis.

"It is much easier to analyze a wristband for a wide range of chemicals than it is to analyze a blood sample for a wide range of chemicals," Stapleton says. "The matrix isn't as complicated."

Wambaugh sees great potential in people using silicone wristbands to record their chemical exposure. He acknowledges that the bands are an imperfect tool, but he says they have fewer limitations than other methods routinely used to evaluate risk, such as toxicity tests on laboratory rats.

Consumers who want to learn about their everyday exposures to chemicals can try out the wristbands by joining projects such as those conducted by EDF. MyExposome eventually hopes to market the bands directly to the public. But for now, the company only offers them to groups of 20 people or more, at a cost of about $1,000 per person.

Anderson is hoping to get funding for a citizen science project using the wristbands. "You don't have to wait for a disaster like a Flint" for people to get interested about their chemical exposures and want to wear the band, she says, referring to the lead-in-drinking-water crisis in Flint, Mich. "We have developed a technology that inspires people to think about science and their environment and hopefully even act about their environment."

Chemical & Engineering News
ISSN 0009-2347
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Comments

Kathleen Podzimek (Mon Apr 18 12:27:29 EDT 2016)
Can I purchase a wristband?
» **Reply**

Aaron Griffith (Mon Apr 18 14:59:29 EDT 2016)
This was very interesting. I can see a lot of potential in this. Sort of like the time I ask High School students for a dollar bill and analyzed it for cocaine.
» **Reply**

Susan (Mon Apr 18 19:38:51 EDT 2016)
Thank you for posting!
» **Reply**

Angela DeLia-King (Tue Apr 19 14:04:13 EDT 2016)
Would love to know and get my hands on a wrist band as well.
» **Reply**

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