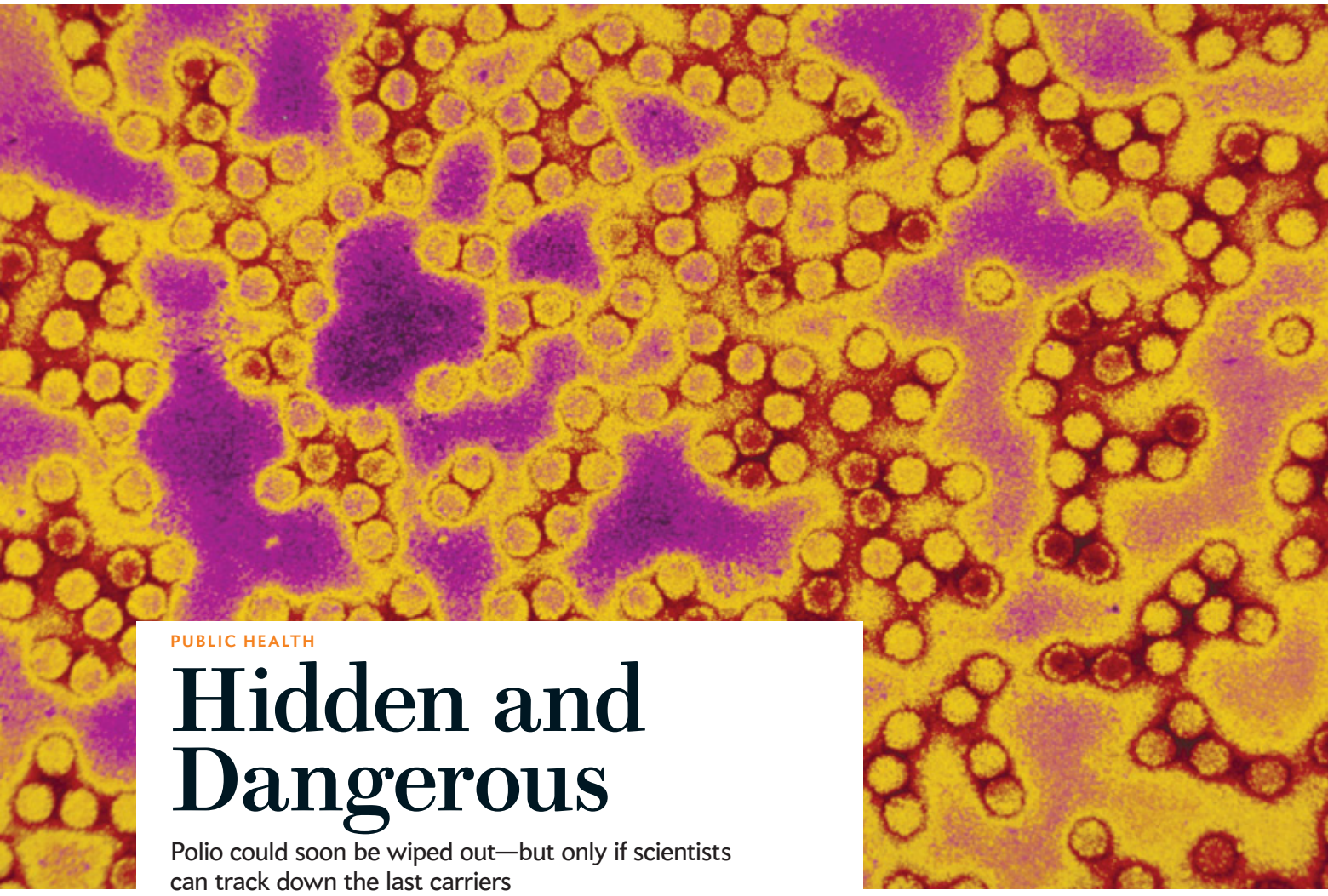

PUBLIC HEALTH

Hidden and Dangerous

Polio could soon be wiped out—but only if scientists can track down the last carriers

Global eradication of polio has been the ultimate game of Whack-a-Mole for the past decade; when it seems the virus has been beaten into submission in a final refuge, up it pops in a new region. Now, as vanquishing polio worldwide appears again within reach, another insidious threat may be in store from infection sources hidden in plain view.

Polio's latest redoubts are "chronic excreters," people with compromised immune systems who, having swallowed weakened polioviruses in an oral vaccine as children, generate and shed live viruses from their intestines and upper respiratory tracts for years. Healthy children react to the vaccine by developing antibodies that shut down viral replication, thus gaining immunity to infection. But chronic excreters cannot quite complete that process and instead churn out a steady supply of viruses. The oral vaccine's weakened viruses can mutate and regain wild polio's hallmark ability to paralyze the people it infects. After coming into wider awareness in the mid-1990s, the condition shocked researchers.

Philip Minor, deputy director of the U.K.'s National Institute for Biological Standards and Control, describes the biomedical nightmare: Wild polioviruses stop circulating. Countries cut back on vaccination efforts. A chronic excreter kisses an unvaccinated baby, and the baby goes to day care. "And zappo," he adds, "it's all over the place, with babies drooling all over each other. So you could see a scenario where polio would come back from a developed country." It could happen in the developing world as well. Although it was once thought that immunocompromised individuals could not survive for long in lower-income countries, circumstances are changing as those countries improve their health care systems. In 2009 an immunodeficient 11-year-old Indian boy was paralyzed by polio, five years after swallowing a dose of oral vaccine. It was only then that researchers recognized him as a chronic excreter.

Chronic excreters are generally only discovered when they develop polio after years of surreptitiously spreading the virus. Thankfully, such cases are rare. According to Roland W. Sutter, the World Health Organization scientist who heads research policy for the Global Polio Eradication Initiative, the initiative is pushing for the development of drugs that could turn off vaccine virus shedding. A few

GETTY IMAGES

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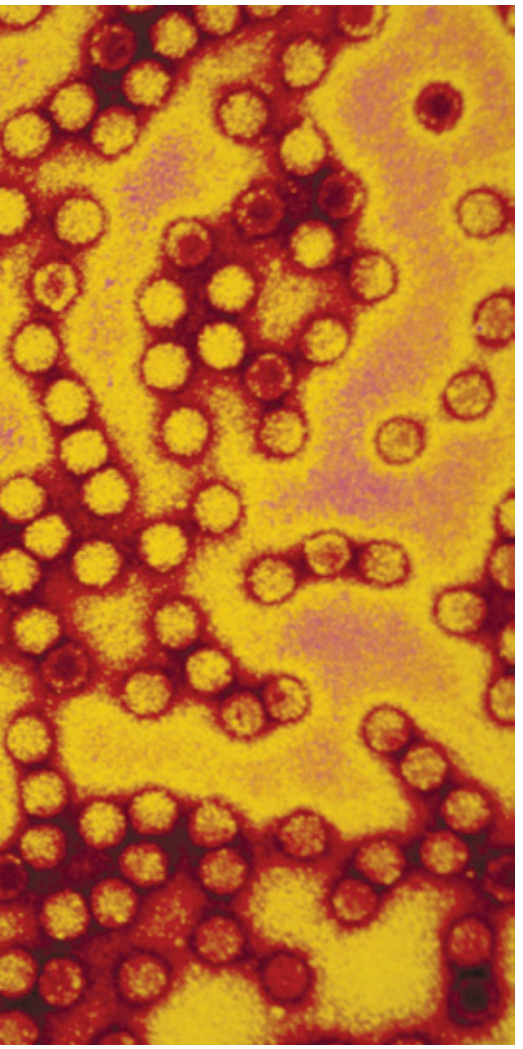


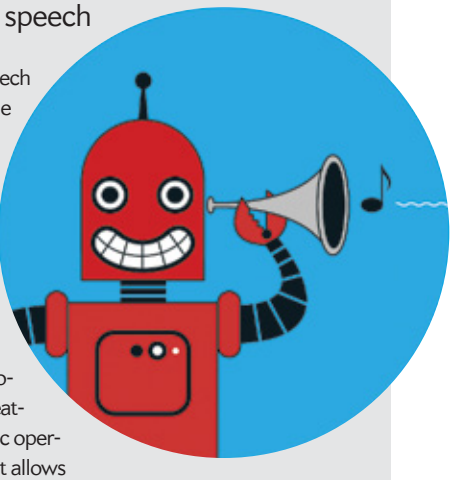
promising options are in the pipeline.

Drugs can only solve the problem if chronic excreters are identified, and that's no easy task. For years scientists in Finland, Estonia and Israel monitored city sewers, watching for signs of shedders' presence. In many samples, they have found the telltale viruses from chronic excreters, but they have failed to locate any of the individuals. These stealthy shedders may not be classic immunodeficient patients traceable through visits to immunologists. Instead they may be people who do not know they have an immunity problem at all and are under no specialized medical care. "We know that there's really a Damocles sword hanging over them," Sutter says. It hangs over the rest of us as well. —*Helen Branswell*

TECHNOLOGY

Lending Robots an Ear

A new approach allows "smart" machines to understand sounds other than speech



Robots can already discern and react to speech thanks to voice-recognition software such as the iPhone's Siri. But "smart" machines still struggle with most other sounds. "In some sense, it's almost a simpler problem, but there hasn't been a lot of work on noise in the environment," says roboticist Joseph Romano of Rethink Robotics in Boston. "It hasn't been in the loop for robotic feedback."

Now Romano is letting robots listen in on more than our conversations. He and his collaborators at the University of Pennsylvania have created a software tool called ROAR (short for *r*obotic *o*perating system *o*pen-source *a*udio *r*ecognizer) that allows roboticists to train machines to respond to a much wider range of sounds. As described in a recent issue of *Autonomous Robots*, the tool's chief requirement is a microphone.

To begin training, the robot's microphone first captures ambient sounds, which ROAR scrubs of noisy static. Next the operator teaches ROAR to recognize key sounds by repeatedly performing a specific action—such as shutting a door or setting off a smartphone alarm—and tagging the unique audio signature while the robot listens. Finally, the program creates a general model of the sound of each action from that set of training clips.

The group tested ROAR on a one-armed robot, improving the machine's ability to complete specific tasks. In one scenario, the robot attempted to autonomously grasp and activate an electric drill. Without any sonic feedback, the robot only succeeded in nine out of 20 attempts, but its success rate doubled while using ROAR. If after grasping, the robot did not hear the whir of the electric motor, it adjusted its grip and tried again.

The next step is to ensure the system works in loud environments. Integrating audio into a robot's feedback loop alongside visual and tactile cues could someday allow robotic nurses to rapidly respond to cries for help or enable factory robots to react when something breaks. Although the technology is in early stages, Romano thinks the potential is enormous. "We haven't even begun to explore what we can do," he says. —*Gregory Mone*

BY THE NUMBERS

658

The average number of annual deaths in the U.S. attributed to extreme heat between 1999 and 2009—"more than tornadoes, hurricanes, floods, and lightning combined," according to the U.S. Centers for Disease Control and Prevention.

14,802: The number of people in France who died from an extreme heat wave in 2003, which took place during the hottest European summer since 1540.

Illustrations by Thomas Fuchs