

# The threat from superbugs

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“We’re not coming to the end of the antibiotic era, but we’re in danger of not being able to save lives we should save. We should be able to cure bacterial infections and viruses,” said Stuart Levy (right), a physician at Tufts University School of Medicine and president of the Alliance for the Prudent Use of Antibiotics. Levy was joined at the HSPH forum by Aaron Kesselheim (left), director of the Program on Regulation, Therapeutics, and Law at Brigham and Women’s Hospital, and HSPH epidemiology Professor Marc Lipsitch. Credit: Mike Mazzanti/HSPH

As government and health officials voice growing alarm over the spread of drug-resistant bacteria around the world, a panel of experts on

Wednesday recommended steps to address the problem in hospitals, in communities, and across businesses.

Experts appearing at the Forum at Harvard School of Public Health recommended a mix of hospital-stewardship programs and community education to fight antibiotic misuse, as well as legal changes that allow pharmaceutical companies to profit longer from [new antibiotics](#) to provide economic incentives to develop new drugs.

"We're not coming to the end of the antibiotic era, but we're in danger of not being able to save lives we should save. We should be able to cure bacterial infections and viruses," said Stuart Levy, a physician at Tufts University School of Medicine and president of the Alliance for the Prudent Use of Antibiotics.

Levy took part in a forum discussion called "Battling Drug-Resistant Superbugs: Can We Win?" in the Harvard School of Public Health's (HSPH) leadership studio in Kresge Hall; it was webcast live. It also featured HSPH epidemiology Professor Marc Lipsitch, director of the HSPH Center for Communicable Disease Dynamics; Aaron Kesselheim, director of the Program on Regulation, Therapeutics, and Law at Harvard-affiliated Brigham and Women's Hospital; and Beth Bell, director of the Centers for Disease Control and Prevention's (CDC) National Center for Emerging and Zoonotic Infectious Diseases.

The event, produced by the forum in collaboration with WGBH broadcasting and the Public Radio International program "The World," was moderated by David Baron, health and science editor of "The World."

Since the first alarms were sounded over rising [drug resistance](#) in the 1970s, the problem has grown more deadly. Two million people are infected with drug-resistant bacteria each year, and 23,000 die,

according to CDC statistics.

The problem has a significant economic impact as well, with an estimated \$20 billion in excess medical costs and perhaps \$30 billion in lost productivity from ailments caused by drug-resistant bugs.

It wasn't always this way. Penicillin, the first antibiotic, revolutionized medical care when it was introduced in the early 1940s, giving physicians a powerful tool to fight infections and ailments caused by bacteria. Other antibiotics arrived, ushering in an era when infection control was seen as routine.

But with reproduction times as short as 30 minutes, bacteria are resilient, Lipsitch said. Survivors from an [antibiotic treatment](#) rapidly reproduce, passing their resistant genetic makeup to future generations and spreading it in the population. Bacteria also can take up DNA from dead relatives and swap DNA with other living bacteria, giving them an ability to acquire resistance that they didn't have before.

"This is evolution in action," Lipsitch said.

As this process has taken place, economic considerations have caused several major drug companies to stop research into new antibiotics, panelists said. Compared with cancer drugs or health-maintenance drugs like statins, which either have high costs or are taken for long periods of time, antibiotics are inexpensive and typically used for just days or weeks. That means they don't provide similar financial returns.

"It was a rational business decision, but it left a lot of investment and innovation in antibiotic development to smaller companies and academics working in the field," Kesselheim said.

The result is today's stagnant arsenal of [antibiotic drugs](#), even as more

organisms develop resistance to them. Organisms have emerged that are resistant to not just one drug but several, forcing physicians to resort to treatments that are toxic to the bug but also can hurt the patient.

Last spring, the CDC sounded the alarm over drug resistance, highlighting three organisms whose threat was urgent: *Clostridium difficile*, which causes intestinal infections and kills 14,000 people annually; *Neisseria gonorrhoeae*, which causes gonorrhea, strains of which are resistant to any antibiotic; and carbapenem-resistant Enterobacteriaceae, which causes bloodstream infections and kills 600 annually. The CDC report also highlighted a dozen other resistant bugs that it termed serious, and others of concern.

Resistant bacteria are often found in settings where both bacteria and the drugs to fight them are abundant, such as hospitals. But they are increasingly common in the community, with instances of heartbreaking cases of seemingly routine infections growing to life-threatening proportions.

The panelists agreed that over-prescribing antibiotics has to stop. Antibiotics are often improperly prescribed, sometimes for infections caused by viruses, which don't respond to antibiotics. This over-prescription exposes populations of bacteria to antibiotics unnecessarily, fostering drug resistance. Over-prescription occurs even in hospital settings, and Bell said that as much as 50 percent of antibiotic prescriptions in hospitals are unnecessary.

Another problem is lack of adherence to prescriptions. When a patient doesn't complete the entire course of antibiotics, it leaves a small population of hardier bacteria alive to reproduce, which also fosters drug resistance.

Antibiotic overuse also extends to agriculture. The drugs are routinely

given to livestock, even when healthy, so they grow more quickly. Some 65 percent of chickens and 44 percent of ground beef tested had bacteria resistant to tetracycline, Levy said.

To fight problems in usage, panelists suggested establishing stewardship programs at hospitals to raise awareness and foster proper handling and prescribing of antibiotics. In the community, the panelists suggested enhanced monitoring for drug-resistant infections and more education so consumers are aware of the dangers from drug resistance, and also that the solutions are in their hands.

Levy said he considers antibiotics "societal drugs" because one person's improperly taken antibiotic can create another person's drug-resistant bacterial infection.

Consumers can help by not pestering physicians for unnecessary [antibiotic prescriptions](#), panelists said, by completing the drug regimens they do receive, and by taking simple steps, such as washing their hands, to stay healthy in the first place.

The other half of the solution, panelists said, is to increase the supply of antibiotic drugs. Because financial incentives to develop [antibiotics](#) are poor, the pipeline of new medications to fight bacteria resistant to existing drugs is drying up. Kesselheim suggested extending the time that a pharmaceutical company has exclusive rights to profit from a discovery. This would let them make money on a new drug longer so they can recoup the research and development dollars that go into creating a new antibiotic.

"This is a complicated problem, and we need to attack it at different levels," Bell said.

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