# 3 essential questions on antibiotic resistance

August 4 2021, by Michael Greenwood


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Melinda Pettigrew, Ph.D., the Anna M.R. Lauder Professor of Epidemiology, researches the growing public health threat posed by antibiotic resistance. She uses microbiology and infectious disease epidemiology to identify factors that influence whether pathobionts colonize or cause diseases such as pneumonia. Additionally, she is

studying whether shorter regimens of antibiotics may be effective in some cases.

**In the race between antibiotics and bacteria, who is winning?**

MP: Bacteria have the upper hand. Globally, over 700,000 people die each year from antibiotic resistant infections—and this number is expected to rise.

Antibiotic resistance is an inevitable evolutionary process: Bacteria replicate quickly, they mutate, and they can transfer resistance genes to other bacteria. Each time we introduce a new antibiotic, bacteria evolve so that they are resistant. This creates a unique challenge in the antibiotics market, leading to fewer new antibiotics in the pipeline. When new antibiotics are introduced, the potential for sales is low because old antibiotics are preferentially used to delay the emergence of resistance. Moreover, pricing and reimbursement for antibiotics is typically low. Patients want low prices on medications, but the low reimbursement rates are a disincentive for companies to invest in developing new antibiotics.

Still, there are reasons to be optimistic. One of the most straightforward ways to prevent antibiotic resistance is to use fewer antibiotics. Many hospitals, including Yale New Haven Hospital, have antibiotic stewardship programs in place to promote the judicious use of antibiotics. There is proposed legislation, the Pioneering Antimicrobial Subscriptions to End Up surging Resistance (PASTEUR) Act, which would create market incentives for the development of new antibiotics and also promote their appropriate use. Antibiotic resistance isn't a battle that we can "win." It is a public health challenge that has to be managed.

**What is one of the most underappreciated strategies to prevent antibiotic resistance?**

MP: Vaccines! Vaccines are one of the most useful, safe, and cost-effective tools for preventing infectious diseases.

They directly impact antibiotic resistance by preventing infection in the first place. If you prevent an infection, then you don't have to treat it—which helps reduce antibiotic use overall.

Antibiotics are not effective for treating viral infections, but antiviral vaccines can still help prevent the emergence of antibiotic resistance, too. Several viral infections present with symptoms that are similar to bacterial infections. If you vaccinate against these viruses, you can prevent the use of antibiotics that might be prescribed inappropriately for a viral infection. Viral infections can also result in secondary bacterial infections. If you vaccinate against a virus like influenza then you also reduce the number of antibiotics prescribed for secondary bacterial infections related to influenza. Vaccines are also great in the long term because antibiotic resistance emerges much more readily than vaccine resistance.

**Do I really need to finish all of my antibiotics?**

MP: The short answer: Yes, it is very important to take your antibiotics as prescribed by your doctor.

However, some antibiotic treatment regimens are not evidence-based and may be too long. For decades, doctors and public-health officials have been telling us that it is really important to finish the entire bottle of antibiotics, even when we are feeling better. The argument behind this was that you increase the chances of killing all of the bacteria responsible for causing your illness if you finish your antibiotics.

Conversely, if you do not finish taking your antibiotics then some of the bacteria may survive and develop resistance. Researchers are learning

that taking antibiotics for longer than necessary may actually increase the risk of resistance. Antibiotics don't just affect the targeted pathogen that is causing the infection. They can also affect the other "good" bacteria that live in your body, which we refer to as the microbiome.

I am working with the Antibiotic Resistance Leadership Group on a study to determine whether shorter durations of therapy are safe and effective for treating pneumonia in children. Our data indicates that shorter treatment may be effective in treating pneumonia and may also reduce the abundance of resistant bacteria in our microbiomes.

Provided by Yale University

Citation: 3 essential questions on antibiotic resistance (2021, August 4) retrieved 27 January 2023 from https://medicalxpress.com/news/2021-08-essential-antibiotic-resistance.html