

We may think we have outfoxed bacteria with the invention of antibiotics, but some strains have evolved defenses that render antibiotics useless. And experts worry that it won't be long before doctors will have nothing left in their black bags to treat bacterial disease.

It is inconceivable to most of us that anyone would die from an infected tooth or wound, not to mention the Bubonic plague. But those days may be back soon if, as a society, we don't stop taking antibiotics for granted. We may think we have outfoxed bacteria infections with the invention of antibiotics, but the tides are now shifting. Many types of disease-causing bacteria have become resistant to the effects of currently available drugs. And infectious disease experts say if we don't act fast, we may need to take the word plague out of retirement.

Drug-resistant "superbugs" are becoming more common and the ability to fight diseases caused by them is being severely threatened. If we don't stop indiscriminate use of antibiotics it won't be long before doctors don't have anything in their black bag to offer patients when they need it most.

Gaining a better understanding about antibiotics is a good first step because the public's health is at stake, and we are all responsible parties.

### **How Antibiotics Work**

It is unlikely that anyone alive today can remember what life was like before antibiotics. It was a pivotal point in the history of medicine and probably the whole of mankind. If it weren't for the ingenious speculation of men like Alexander Fleming that not all bacteria live in harmony with other bacteria, we may never have discovered penicillin, the first antibiotic to treat bacterial disease in humans. The *Penicillium* fungus, a type of mold often seen growing on bread, exudes a chemical that causes the cell wall of certain bacteria to rupture and die. Since then researchers have studied the various ways bacteria are antagonized to develop new antibiotic.

Each type of antibiotic targets a specific aspect of a bacteria's life by interfering with either the structure of the cell wall, membranes, genetic material (DNA), enzymes, or proteins; virtually anything that it needs to divide and grow.

### **How Bacteria Become Drug-Resistant**

Since bacteria have been repeatedly bombarded with the same antibiotics for the last few decades, they have evolved a way to protect themselves. These Darwinian-style, survival-of-the-fittest adaptations benefit the survival of all organisms. So if a bacteria cell has evolved a feature that somehow pumps out or deactivates the antibiotic, or changes the characteristics of the attack site that prevents the antibiotic from getting in at all, it can endure. Bacteria can also pass along antibiotic

resistance to an "unprotected" cell by transferring their beneficial antibiotic-resistant genes to non-resistant cells.

Since antibiotics are only able to kill sensitive bacteria, resistant bacteria will flourish until a new antibiotic is designed to attack the resistant cells in a different way.

## **Vulnerability of Bacteria**

Some bacteria are more virulent and resistant to antibiotics than others and much depends on the specific strain. Antibiotics can lay aim to a broad or narrow spectrum of bacteria types.

One way to identify the type of bacteria causing the infection is to check their ability to absorb or resist a colored stain in a laboratory setting. Gram-positive bacteria possess certain unique characteristics in their membranes that cause them to take up a purple stain, while Gram-negative bacteria don't, but they do turn pink when a counterstain is applied.

Gram-negative bacteria - typically found in hospital environments but is now breaching those walls to the outside community - have an extra protective layer that makes it harder for antibiotics to kill them off. So when this type of bacteria no longer responds to therapy, it can have deadly consequences. The most notable gram-negative "superbug" is the methicillin-resistant *Staphylococcus aureus* (MRSA) infection. And many others are also emerging.

If someone is infected with a resistant strain doctors are forced to resort to using antibiotics previously reserved for the most stubborn and deadly of infections; these often come with serious side effects as a result of their potency. And experts say they are running out of options because it won't be long before resistant bacteria wise up to those antibiotics as well.

What Can Be Done About Antibiotic Resistance?

Now that the medical community has a better understanding about the causes of antibiotic resistance, there seems to be a role for everyone in its prevention. Doctors need to be more selective in prescribing them, patients need to question using them, pharmaceutical companies need to develop new ones and the government needs to provide incentives.

Here's what you can do to preserve the effectiveness of antibiotics and protect your loved ones from a "superbug" attack.

## **Learn the difference between a bacterial and viral infection**

Antibiotics only work on bacteria. Period. They do not work on viruses. Ever. So if you have a cold, flu, bronchitis, a runny nose or a sore throat (unless it is strep throat), taking antibiotics will not make you feel better, cure the disease or prevent others from catching it.

## **Do not insist your doctor give you a prescription for an antibiotic**

Patients have come to expect that if they go to the doctor, they should leave with a prescription. Believe it or not, doctors feel pressured by patients into writing antibiotic prescriptions whenever a patient asks for one. Avoid the temptation to ask for a prescription if it is not medically indicated. Instead, ask what you can do to feel better without taking antibiotics. Conversely, if your healthcare provider offers you an antibiotic, ask if it absolutely necessary.

## **Take antibiotics properly as prescribed**

Only take antibiotics prescribed to you specifically and follow the directions carefully. Do not skip any doses and take the full course even if you start feeling better. Stopping prematurely can cause the infection to roar back, which will require more antibiotics that might not work as well. Throw out left over antibiotics and do not save them for the next time you are sick. And never share antibiotics with anyone else.

## **Prevent infections from spreading**

Wash your hands frequently and correctly with soap and water for at least 20 seconds or use a hand sanitizer if water is not available. If you are in the hospital, make sure anyone entering your room washes his or her hands, and speak up to remind them if they don't, even if it is your doctor! If you must be in the hospital, get out as soon as you are able.

## **Demand better legislation to avoid a public health crisis**

Since there is little incentive for pharmaceutical companies to engage in new antibiotic discovery, it is imperative that the government enact stronger legislation to keep antibiotic development robust. You can become an advocate for better antibiotic legislation by writing to your local and state representatives and senators. Visit the Infectious Diseases Society to take action now.