



Sir Alexander Fleming was curious. A blue-green mould was killing **bacteria** he'd been growing in his London lab in 1928. He named the **antibiotic** penicillin.

A decade later, doctors began using penicillin to treat patients with bacterial **infections** – and when they did, medicine changed forever. Antibiotics were the greatest medical advance of the 20<sup>th</sup> century. These miracle drugs saved millions of lives.

### **SUPERBUGS**

But the miracle didn't last. Bacteria are highly adaptable. These single-cell **microorganisms** reproduce and **mutate** rapidly. That allows

them to fight off threats to their survival. They eventually became **resistant** to penicillin.

So medicine developed new and more powerful antibiotics. Yet over time bacteria have become resistant to these drugs, too. Now, some bacteria – ‘superbugs’ – can fend off any antibiotics thrown at them.

“A crisis looms,” said a recent article in a medical journal. “In the... rapidly approaching future, the wonder drugs of the 20<sup>th</sup> century, antibiotics, may cease to be useful.”

### **BACTERIAL CULTURE**

Bacteria are found everywhere on Earth: in soil, in water, in air, and in people's bodies. The

human gut contains many good forms that help us digest food. But other forms cause infections that lead to diseases such as pneumonia, tuberculosis and diarrhea.

### **DID YOU KNOW?**

Before antibiotics, three out of 10 people with pneumonia died. So did one out of nine with a skin infection – even from something as simple as a scrape.

Healthy people usually fight off these infections. However, the very young, the very old, and those with weakened immune systems, like cancer patients, are more at risk.

### **DEFINITIONS**

**ANTIBIOTIC:** a drug that stops the growth of microorganisms

**BACTERIA:** microorganisms that consist of a single cell and that can cause disease

**INFECTIONS:** illnesses caused by harmful bacteria

**MICROORGANISMS:** life forms too small for the eye to see

**MUTATE:** to become physically different from other plants or animals of the same type as a result of a genetic change

**RESISTANT:** not harmed or affected by something

**BACTERIA: GETTING THE UPPER HAND**

Hospitals, unfortunately, are breeding grounds for antibiotic-resistant infections. Overcrowding, poor hygiene, and patients with lowered defenses all cause bacteria to spread. In fact, about one in nine patients develops infections each year. Of those, 8,000 die.

**USE, MISUSE AND OVERUSE**

The misuse and overuse of antibiotics can speed up the development of drug-resistant bacteria. Why? Because not using the drugs properly gives bacteria more opportunities to develop defense strategies.

For instance, many patients stop taking antibiotics when they feel better. Not all the bad bacteria may have died, however. So bugs with some resistance become stronger. Then they multiply, mutate and spread.

As well, these drugs only cure infections. Yet some doctors prescribe them anyway for **viruses** like the flu. This increases the risk that disease-causing bacteria will take hold.

Another problem? Some 80 percent of the 100,000 to 200,000 tonnes of antibiotics produced each year are used in agriculture and **aquaculture**.

Giving antibiotics to healthy animals boosts growth. The drugs also allow farmers to raise animals in crowded conditions. That way, they make more money. However, this practice also creates antibiotic-resistant bacteria that are spread to humans who eat the animals.

**PHARMACEUTICAL FIX**

In the past, if an antibiotic stopped working, another took its place. Today, drug companies aren't developing many new antibiotics because there's little reward in it.

It can take up to 10 years and a lot of money to make a new antibiotic. That means that if companies want to make a profit, they have to be able to sell the drug for a long time. That can't happen if bacteria adapt, because then the drug becomes useless. So not a lot of new drugs are waiting in the wings to be used when current drugs no longer work against bacterial infections.

**A POST-ANTIBIOTIC WORLD**

It's rare today for people living normal lives to die of an infection. Yet, that could happen again. Doctors are already seeing

**MEET THE SUPERBUGS**

About five percent of hospital patients on antibiotics become infected by the most common superbug, *C. difficile*, which causes severe diarrhea.

Another two percent of hospital patients get the skin infection MRSA. A further 0.5 experience VRE – resistant bacteria in the intestine and the urinary tract.

The latest and scariest superbug? CRE, a class of bacteria that resists all standard antibiotics. These bugs transfer their resistance to other bacteria, making them impossible to treat. CRE was first seen in Canada in January 2014, when 41 cases were reported.

antibiotic-resistant cases of pneumonia and tuberculosis.

The problem of antibiotic resistance needs immediate global commitment, leadership, and funding, observers say.

For their part, Canadian officials want to monitor hospital routines, learn more about outbreaks and identify the most common bugs.

“This is a huge problem,” says one health officer. “So much more needs to be done.” ★

**DEFINITIONS**

**AQUACULTURE:** the rearing of aquatic life for food

**VIRUSES:** simple living parasites that are smaller than bacteria and that can enter your body and make you sick



# BACTERIA: GETTING THE UPPER HAND

## ON THE LINES

Answer the following in complete sentences:

1. Explain what **bacteria** are.

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2. What drugs are used to destroy bacteria?

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3. Who discovered the first bacteria-killing drug and when did this discovery occur?

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4. What was the name of this new drug and why was it important?

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5. Why did some bacteria become resistant to these new drugs?

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6. Explain what a **superbug** is.

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7. List at least two ways that misusing or overusing antibiotics speeds up the development of drug-resistant bacteria.

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8. Why are drug companies not developing many new antibiotics?

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# BACTERIA: GETTING THE UPPER HAND

## BETWEEN THE LINES

An inference is a conclusion drawn from evidence. *A plausible inference is supported by evidence in the article and is consistent with known facts outside of the article.*

What inference(s) can you draw from the fact that drug companies and North American food producers are not taking the necessary steps to solve the problem of superbugs?

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## JUST TALK ABOUT IT

1. Of all the examples of misuse and overuse of antibiotics, which do you think is the most difficult to solve? Explain your choice and brainstorm a list of possible solutions.
2. Do you think that drug companies should be allowed to profit from life-saving medicines? Give reasons to support your response.

## ONLINE

Visit our student website at [www.news4youth.com](http://www.news4youth.com) and click on the *What in the World?* tab to:

1. See [Ninjas vs. Superbugs!](http://www.wired.com/insights/2013/12/ninjas-nanotech/) and learn about a whole new way of fighting bacteria (or visit <http://www.wired.com/insights/2013/12/ninjas-nanotech/>). Watch the action video and read the infographic.
2. Learn about Sir Alexander Fleming and his Nobel Prize from “[A Science Odyssey](http://www.pbs.org/wgbh/aso/databank/entries/bmflem.html)” on the PBS website (or visit <http://www.pbs.org/wgbh/aso/databank/entries/bmflem.html>).
3. Read “[Arms Race with a Superbug](http://www.pbs.org/wgbh/nova/evolution/arms-race-superbug.html),” follow the interactive timeline, and find out how bacteria can be good for you (or visit <http://www.pbs.org/wgbh/nova/evolution/arms-race-superbug.html>).
4. Watch a two minute trailer for the documentary, “[Rise of the Superbugs](https://www.youtube.com/watch?v=zKjzRagzzlA)” (or visit <https://www.youtube.com/watch?v=zKjzRagzzlA>).
5. Watch a video about [the dangers of giving antibiotics to livestock](https://www.youtube.com/watch?v=C_priT33-EM) (or visit [https://www.youtube.com/watch?v=C\\_priT33-EM](https://www.youtube.com/watch?v=C_priT33-EM)).
6. Read about [efforts in the U.S. to curb antibiotic use in livestock](http://www.theglobeandmail.com/news/british-columbia/us-move-ramps-up-pressure-for-canadian-farmers-to-curb-antibiotics/article17785295/) (or visit <http://www.theglobeandmail.com/news/british-columbia/us-move-ramps-up-pressure-for-canadian-farmers-to-curb-antibiotics/article17785295/>). ★