

Data Analysis

Antibiotic-Resistant Bacteria

Antibiotics are medicines used to kill disease-causing bacteria. Studies have shown that certain species of disease-causing bacteria evolved to be resistant to antibiotics. The Centers for Disease Control and Prevention (CDC) found that doctors were prescribing antibiotics when they weren't necessary. Additionally, patients were not taking their full antibiotic doses. Both practices have led to bacteria developing resistance against various antibiotics.

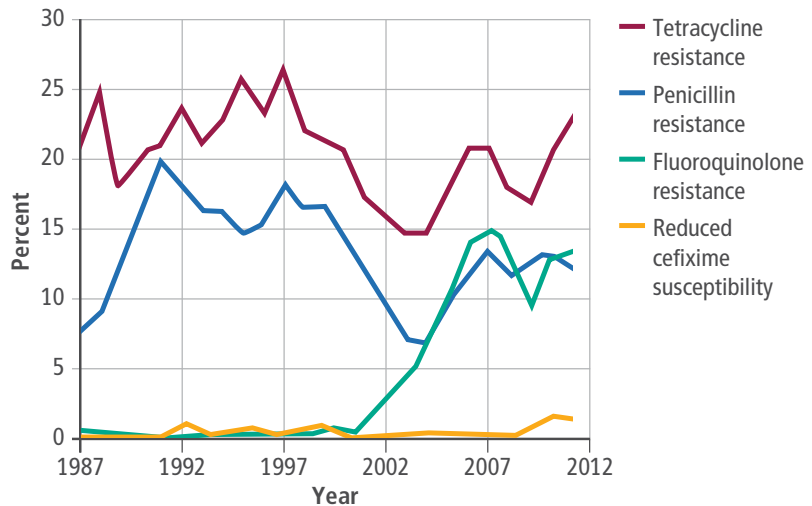
Consider a population of bacteria. In the population, most bacteria have genes that make them susceptible to antibiotics, but a very small percentage of the population do not have these genes. These bacteria are antibiotic resistant. When exposed to antibiotics, the bacteria population experiences the bottleneck effect. The bacteria in the population that are susceptible to antibiotics are killed. The remaining resistant individuals reproduce, passing on the resistance genes to their offspring. Eventually, the population consists of more antibiotic-resistant bacteria.

The bacterium *N. gonorrhoeae* causes the disease gonorrhea. This disease affects organs of the reproductive system, as well as parts of the urinary tract. If not treated, an affected person may lose the ability to produce offspring. The bacteria are transferred from one person to another through sexual activity.

N. gonorrhoeae has now developed varying levels of resistance to most antibiotics, including penicillin.

N. gonorrhoeae Resistance, United States, 1987-2011

FIGURE 17: *N. gonorrhoeae* shows some level of resistance to many types of antibiotics.



Source: The Gonococcal Isolate Surveillance Project (GISP), quoted in "Antibiotic Resistance Threats in the United States, 2013" (CDC)

N. gonorrhoeae is also developing resistance to the drug cefixime. It is recommended that cefixime be used with other antibiotics, or not at all, so the bacteria do not become fully resistant to it.

Figure 17 shows resistance patterns of *N. gonorrhoeae*. This graph shows an increased resistance to

fluoroquinolones around 2000. This can be attributed to the increased use of this antibiotic during this time. It also shows that the bacteria has been resistant to penicillin since the 1980s and continues to be resistant. For this reason, scientists need to continuously develop new antibiotics to treat gonorrhea. However, new antibiotics can lead to new resistances.



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Answer the following questions in your Evidence Notebook:

1. What happened to penicillin resistance from 1987 to 1990?
2. What type of natural selection is observed in antibiotic-resistant bacteria?
3. Make a model to show the changes in the population of bacteria over time as they were exposed to antibiotics.

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