Antibiotic Resistance

Emergence of resistance

The first step in the emergence of resistance is a genetic change in a bacterium. There are two ways that can happen.

1. Spontaneous mutation in the bacterium's DNA.

Many antibiotics work by inactivating an essential bacterial protein. Genetic change can **remove** that protein. Also, **mutations** in the target protein can prevent the antibiotic from binding or it if does bind, prevent it from inactivating the target protein.

Genetic change can also lead to **increased production** of the antibiotic's target enzyme so that there are too many of them and the antibiotics cannot inactivate them all. Alternatively, the bacterium may produce an **antibiotic-inactivating enzyme**. As well, the bacterium may **alter the permeability** of its cell membrane, or wall to the antibiotic.

2. Transfer of antibiotic-resistant genes

The second way for a bacterium to gain resistance is for an existing **antibiotic-resistant gene to transfer** from one bacterium to another bacterium. Microbiologist, Doctor John Turnidge, says they literally borrow their resistance genes from neighbouring bugs. "They're the original life forms almost, so for thousands of millions of years they've had a chance to work out ways to survive and one of those is to borrow genes from other bacteria to survive."

How does resistance spread?

"Antibiotic resistance is an inevitable consequence of [antibiotic] use, the more you use them the more resistance you will get." Says Associate Professor Collignon.

As well as the transfer of antibiotic resistance genes directly from one bacterium to another, resistance also spreads through the **movement** of bacteria from one host to another either directly or indirectly, for example, through food, water or even contact between animals - including humans.

Antibiotics, like herbicides or pesticides, **select** for antibiotic resistant bacteria. When an antibiotic attacks a particular bacterial infection there is always the chance that, within a population of bacteria, there will be some members with resistance. Those not killed are now free to multiply without any competition from the sensitive strains. Antibiotics can also wipe out friendly bacteria, which would otherwise compete with the resistant strain for resources.

And to make matters worse, antibiotics can also **increase resistance** emerging in harmless bacteria which can, under certain conditions such as in an immune suppressed patient, become aggressive and cause infection. Just the existence of antibiotic resistant bacteria, harmful or not, increases the likelihood of resistance being passed on to other bacteria.

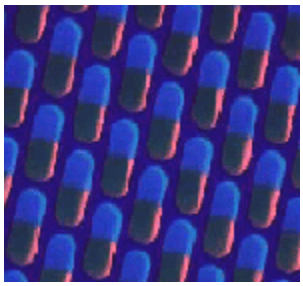
Resistance is a natural phenomenon perhaps as old as bacterium themselves. However, we have contributed to an increase in the rate of antibiotic resistance through the increased transmission of infection and the misuse and abuse of antibiotics.

Misuse and abuse of antibiotics

Australia is one of the highest users of antibiotics in the world. There are just over 22 doses of antibiotics prescribed per thousand people, every day. Unlike other developed countries, Australia's usage has declined since 1994 when doctors wrote 26.1 million antibiotic prescriptions. By 1998 that had declined to 24 million prescriptions for Australia's 16 million people.

In the US it's estimated that 50 million of the 250 million prescriptions issued for antibiotics each year are unnecessary. Doctor John Turnidge, Chairman of Australia's Joint Expert Technical Committee on Antibiotic Resistance, says he believes Australian medicine could safely cut its antibiotic usage by half.

What are unnecessary prescriptions?



Antibiotics prescribed for the treatment of either cold or 'flu are the most obvious case. Cold and 'flu are caused by viruses, not bacteria, and therefore are not affected by the administration of antibiotics. Almost 30 percent of Australian prescriptions of the most popular antibiotic amoxycillin, are for upper respiratory tract infections where the cause is likely to be viral. The prescription of antibiotics for either the prevention or treatment of minor bacterial infections is also arguably unnecessary.

The risk of resistance is believed to be enhanced by patients not finishing the full course of antibiotics. All too often patients discontinue treatment when they begin to feel better. By not undertaking a full course of antibiotics the bacterial infection may not be completely wiped out, a situation which can give rise to a resistant strain which may be more difficult to treat in future.

"We tend to look at antibiotics as just another product that needs to be produced and used as cheaply as possible. But antibiotics are different. They're non-renewable resources - the more you use them the less they last," says Associate Professor Collignon.