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### The Advertiser Review

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# CAN YOU Believe it?

WITH JAMES BYRNE

## Superbug wars

An arms race is being played out in our bodies.

**B**ACTERIA and antibiotics are battling it out for supremacy in our bodies, in our hospitals and in our research labs. And antibiotics are losing. For centuries, the world yearned for a super drug, one that could cure almost any disease, could be taken by almost anyone and had few side effects.

We found that drug.

The war-ravaged world of the 1940s was made dramatically safer by the mass distribution of the new wonder drug, penicillin. It was considered the holy grail of medicine even though it was available in only tiny quantities at the time.

But the more it began to be used, the more strange, new, resistant "superbugs" such as golden staph began to appear.

Now, penicillin's effectiveness has waned, causing major problems in public health management around the world.

Why has this happened?

Penicillin interferes with the maintenance proteins that preserve a major defensive structure of bacterial cells together. This structure, called peptidoglycan, when not maintained will dissolve – causing the bacteria cell to absorb water and continue to do so until it bursts.

Over the decades, some bacteria evolved ways to resist penicillin and other antibiotics.

In the case of penicillin, some bacteria have evolved a protein called beta-lactamase, an enzyme that turns the tables and attacks penicillin itself.

Other bacteria have found ways to camouflage the maintenance proteins in their cell walls so that penicillin is no longer able to attack it.

If bacteria keep their new techniques to themselves, it should not be a great problem.

Within a population of bacteria, those with antibiotic resistance have an advantage. In a classic example of Charles Darwin's theory of natural selection, the resistant bacteria can reproduce and spread into areas where the older vulnerable bacteria have been killed off.

In the same way humans pass on their genetic information, bacteria pass on their information to the next generation – mutations and all.

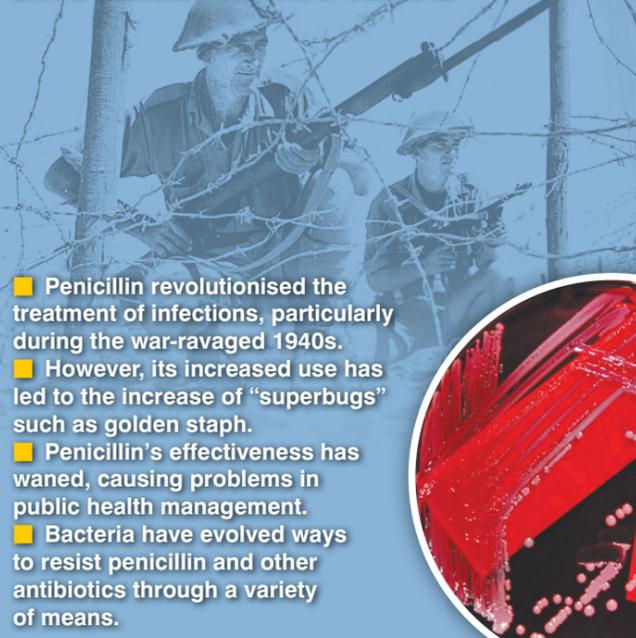
But this alone cannot explain the rapid rise of antibiotic-resistant superbugs.

Statistically, the chance of spontaneously developing antibiotic resistance is very small. But the prevalence of resistance is widespread.

This is because bacteria have another trick up their sleeve. Bacteria can share their secrets, as they can actually share their genes.

There are a number of ways in which bacteria can share genes but the most common and probably most important way is transformation. When cells die, they break up and the insides

### BACTERIA ARMS RACE



- Penicillin revolutionised the treatment of infections, particularly during the war-ravaged 1940s.
- However, its increased use has led to the increase of "superbugs" such as golden staph.
- Penicillin's effectiveness has waned, causing problems in public health management.
- Bacteria have evolved ways to resist penicillin and other antibiotics through a variety of means.

leak out. Bacterial transformation is where other bacteria sort through the scattered DNA debris in their environment, attempting to find pieces of coding which may be useful for its new host.

Most of the stuff they take up is junk. But occasionally a piece of DNA results in the bacterium being able to do something better – such as use a new food source, make a toxin or escape the activity of antibiotics. The bacterium then promptly integrates this DNA into its chromosome.

The real problems arise when some bacteria acquire resistance to multiple families of antibiotics, resulting in superbugs.

One of the most well known of these is MRSA (methicillin resistant staphylococcus aureus) or "golden staph".

Golden staph is resistant to the penicillin family of antibiotics as well as members of other families, such as the cephalosporins.

It has been reported to show resistance to vancomycin, one of the medical world's most potent antibiotics. Golden staph can now be treated only by using multiple high-potency antibiotics in a combined attack.

The arms race between antibiotics and bacteria continues to escalate.

Resistance levels in human pathogens continue to rise, highlighting the importance of preventive measures such as high levels of personal hygiene and community vaccination.

James Byrne is a PhD student of microbiology at the University of Adelaide.



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