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Medicine for Managers

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The Changing Face of Disease

In the half century since I qualified medically, the rate of change has been amazing. There has been so much advancement in diagnostic investigation and in drug therapy. The style of medicine has moved from a professionally intimate doctor-patient relationship based on physical examination to a much more diagnostic approach, achieved by testing. Less obvious has been the way in which health allows us to live . . . and die.

The average age of death has risen steadily since the start of the 20th Century. In 1900, the average age of death was 44 for a man and 48 for a woman. Only fifty years later it was 66 for a man and 70 for a woman. The most recent figures state that life expectancy is now 78.6 for a man and 82.6 for a female.

> *Interestingly, those most recent figures reveal a* ***decrease*** *from 2017-2019 when the average life expectancy was 79.3 years for a male and 83 years for a woman.*

This decrease is likely to be the result of the of the increased mortality rates associated with the Covid-19 pandemic.

In fact life expectancy has partially recovered since the pandemic and is expected to continue, although the obesity epidemic may be a problem in waiting and, across the globe, one of the greatest threats of all this century is considered to be the growing resistance to antimicrobial drugs. The latest figures suggest that over 1¼ million patients die each year as a result of antibiotic-resistant organisms failing to respond to the available antibiotics. According to the

World Health Organisation, "if no measures are taken promptly then ***antimicrobial resistance could lead to more deaths than cancer by 2050***".

Of course a host of other factors may have effects on relative death rates and so it is by no means certain that increasing resistance to antibiotics will have such a serious impact, but it is undoubtedly an increasing problem.

The problem stems from the fact that bacteria are an increasing threat as a result of natural changes in the organisms and the increasing use of antibiotics. Bacteria reproduce extremely quickly by ***binary fission*** (they simply divide into two) and have the ability to double in numbers every 10 to 20 minutes. Sometimes even faster.

In ideal conditions a single bacterium can divide into a million cells in five hours, although the speed is influenced by such factors as the available nutrients, the temperature and other variables such as the acidity, oxygen availability and the presence of toxins.

Bacteria, like any cell, can develop random ***mutations*** in their DNA during the replication process. Many mutations damage the bacterium and they simply die.

However, some of the mutations result in changes to the organisms which confer advantages to bacteria such as enabling them to manufacture enzymes which can either inactivate the antibiotic or remove it before it reaches its target, thereby providing an effective defence.

Amazingly, bacteria can also acquire resistance genes from other bacteria by a process called ***horizontal gene transfer***.

The process is complicated but effectively small pieces of genetic material, called ***plasmids***, become added to a bacterium's existing DNA structure to make it resistant.

Antibiotics were once miracle drugs, providing a huge impact on infections, particularly between the 1960s and the end of the millennium. However many have stopped, or almost stopped working against some types of bacteria.

New therapies are being discovered but bacterial infections are increasingly likely to worsen as anti-bacterial resistance worsens.

A further complication is the use of low dose antibiotic which can make the problem worse, because they are not strong enough to kill all the bacteria and some bacteria will develop resistance.

Once resistant, they can reproduce effectively and spread resistance to other bacteria. Such infections are difficult or impossible to treat.

Interestingly, vaccination against ***viral infections*** can play a part because, although viruses are unaffected by antibiotics, when vaccines prevent illness, they reduce the need for antibiotics, either to treat secondary infections or which are given unnecessarily.

Therefore, by vaccination and prevention of viral infection, inappropriate antibiotic prescription is avoided and the risk of antibiotic resistance is reduced.

The role of vaccination will become much more important as antibiotics lose efficacy and treatments inevitably become more complex.

Vaccination provides a preventive solution reducing the spread of resistant bacteria.

Vaccines may prevent antibiotic resistance through various mechanisms:

- ***Directly*** by vaccination which protects against such infections as meningitis and pneumococcal pneumonia, obviating the need for antibiotic to treat such illnesses

- ***Preventing*** inappropriate antibiotic use as above
- ***Reducing*** the risk of over-prescribing antibiotic
- ***Developing*** herd immunity, which slows the circulation of resistant pathogens, limiting spread.

It is essential to try to ensure that vulnerable populations, such as the elderly, those with underlying conditions, the young and pregnant women, and those with immune deficiencies are identified as priority groups.

The problem is also exacerbated by antibiotic usage in veterinary medicine and in animal breeding.

If antibiotic resistant organisms are to be minimised, there will need to be a global approach to the developing problem through all the mechanisms to increase vaccination and reduce antibiotic usage, and to ensure that when used, the dose is appropriate to achieve bacterial destruction.

The bottom line with bacteria is that, if we don't get them, they will be increasingly likely to get us!

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