Here, There, and Everywhere: How Antibiotic Resistance is Now the Norm

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As antibiotic resistance becomes an increasingly urgent global problem, it is important to address how resistance occurs and how it is propagated throughout the general population. Our arsenal of antibiotics that has been routinely used to treat bacterial infections for the past seventy years is no longer effective in an alarming number of clinical cases. Over fifty percent of our antibiotics are no longer acceptable for use as first-line treatments due to the development of resistance against them (CDC, 2015). This rise in resistant pathogenic bacteria can be heavily attributed to our overuse, and misuse, of antibiotics.

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In the event of a bacterial infection, a population of bacteria has multiplied to a level at which an immune response is generated in the human body – this is the point at which we start to feel unwell and display the multitude of symptoms associated with an infection. If an antibiotic is prescribed and administered, the bacterial cells which are highly sensitive to that specific antibiotic are effectively eradicated; however those which are not highly sensitive are not immediately wiped out. It is usually near this point when we start to feel better, and our immune response begins to decrease in response to a reduced population of bacterial invaders. Eventually over the course of the antibiotic treatment, the population of bacteria will be completely wiped out, assuming that the correct antibiotic is prescribed. Therein lies the problem; when the course of antibiotic treatment is not finished in its entirety, the bacterial population is not completely eradicated. The highly sensitive subset of the population is wiped out, but the less susceptible (and therefore more resistant), subset of the population remains. This is only the beginning of how resistance occurs.

Although they are considered to be relatively simple and primitive organisms, bacteria are incredibly resourceful and have acquired ways to adapt against selective pressures. In addition to being opportunistic, they also possess the ability to share their DNA within their species, as well as between different species (e.g. *E. coli* and MRSA). Bacteria, which were once susceptible to a certain antibiotic can acquire segments of DNA encoding for resistance - essentially the blueprints for building the machinery needed to effectively block, deactivate, or secrete, the threatening antibiotic.

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The misuse of antibiotics is a major factor in the development of resistance. In addition to selecting for resistant bacteria, which allows resistant populations to persist and share their resistance-enabling genetics, we also provide them with a welcoming and low-stress environment to live in by removing competing bacteria. Prescribing and administering antibiotics in cases where the illness is caused by a virus, such as the common cold, lends more benefit to resistant bacteria present in the human host while providing no benefit to the human host. Antibiotics have absolutely no efficacy in treating viral infections, but what they can do is wipe out susceptible, beneficial bacteria that are essential to our health. This creates a less competitive environment for resistant bacteria, where they can thrive and repopulate, which in turn harms the human host. In addition to being used to treat bacterial pathogens in humans, antibiotics are also used for treating and preventing infections in agriculture and are often used as growth promoters. The presence of antibiotics in agriculture and food production is to the same effect – enabling and encouraging populations of resistant bacteria to populate organisms, and propagate throughout communities.

In efforts to raise awareness, the World Health Organization (WHO) has officially announced Nov. 16 - Nov. 22, 2015 to be the first World Antibiotic Awareness Week (WAAW). Here I have expanded on one of the seven key messages they are emphasizing:

Antibiotic Resistance Occurs When Bacteria Change In Response To The Use Of Antibiotics. While This Happens Naturally, The Over-Use And Misuse Of Antibiotics Has Accelerated The Process, Leading To Record High Levels Of Antibiotic Resistance.

It is absolutely crucial that we heed the warnings of the WHO, and other experts in the medical and research communities, in order to protect ourselves from a future where widespread bacterial disease and devastation is the norm, and where antibiotics are a mere echo of what once was, and what was once taken for granted.

Additional Resources:

Center for Disease Control (2015)

http://www.cdc.gov/drugresistance/

Pan-American Health Organization (2015)

http://www1.paho.org/english/hcp/hct/eer/antimicrob.htm

Public Health Agency of Canada (2015)

http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/15vol41/dr-rm41s-4/overview-apercu_04-eng.php

U.S. Food and Drug Administration (FDA) (2015)

http://www.fda.gov/AnimalVeterinary/SafetyHealth/AntimicrobialResistance/NationalAntimicrobialResistanceMonitoringSystem/default.htm

World Antibiotic Awareness Week (2015)

http://www.who.int/mediacentre/events/2015/world-antibiotic-awareness-week/en/

World Health Organization (WHO) - Global Action Plan on Antimicrobial Resistance (2015)

http://apps.who.int/iris/bitstream/10665/193736/1/9789241509763_eng.pdf