

# Briefing for House of Commons Westminster Hall general debate on World Antibiotics Awareness Week November 2017

The British Society for Immunology is the largest immunology society in Europe. Our mission is to promote excellence in immunological research, scholarship and clinical practice in order to improve human and animal health. We represent the interests of more than 3,000 immunologists working in academia, clinical medicine, and industry. We have strong international links and collaborate with our European, American and Asian partner societies in order to achieve our aims.

The UK is a world leader in infection and immunology research, ranking first in the G7 for the quality of our research in this area. The aim is to also be a world driver in the fight against antimicrobial resistance (AMR), and immunology can play a key role in achieving this goal.

## Introduction

The increasing threat of antimicrobial resistance (AMR) to antibiotics is a global problem. Bacteria are evolving to resist treatment with many (even most) of the antibiotic classes while maintaining or even increasing their human virulence. Exploiting our natural immune defences as an alternative to antimicrobial drugs and the development of new and improved bacterial vaccines will play a vital part in addressing these problems.

An estimated 700,000 deaths occur every year as a result of AMR infections<sup>i</sup>. The AMR report, chaired by Lord Jim O'Neill, estimates that by 2050, AMR could result in an estimated 10 million deaths every year and cost the global economy approximately £66trillion<sup>i</sup>. Infection with antibiotic resistant bacteria will have much more severe consequences than infection with antibiotic susceptible bacteria. Such consequences include treatment failure, increased or longer hospitalisation and prolonged illness, and as a result increased economic burden. AMR is therefore not only a serious threat to human and animal health but also to the national and global economy.

Inappropriate and over-use of antibiotics in human and food-producing animals are considered the main contributors to AMR, in addition to poor infection prevention and intervention programmes. As highlighted by the reports' sixth recommendation 'promote development and use of vaccines and alternatives', immunological research has the potential to find alternative infectious disease interventions, both preventative and therapeutic, such as novel vaccines and immunotherapy.

## Immunological tools

### *Vaccines*

Vaccines are one of the most cost-effective infection prevention methods that we have. In cases when bacterial infections can be prevented by vaccination, antibiotic use can be reduced or avoided.

There are several bacterial vaccines in routine clinical use, for example those against diphtheria, tetanus, pertussis, meningococcus, H. influenzae type b and pneumococcus. Many of these vaccines are now part of the routine childhood vaccination programme and introduction of each has drastically reduced the number of cases of infection. For example, the number of cases of diphtheria fell from 50,804 per year in England and Wales before the vaccine, to today an average of one case per year today<sup>ii</sup>.

Infection with pneumococcus is estimated to cause 14.5 million cases of serious infection and 500,000 deaths in young children each year<sup>iii</sup>, but the pneumococcal vaccine (PCV) can reduce the incidence of pneumococcal infection among children by 64%<sup>i</sup>. Universal coverage by the vaccine could avert 11.4 million days of antibiotic use per year in children under 5, reducing the amount of antibiotics used for *S. pneumoniae* infections by 47%<sup>i</sup>. However, on average in England, uptake of both the recommended doses of the PCV vaccine in children 24 months of age currently fails to meet the WHO's 95% uptake target<sup>iv</sup>. Average uptake in England was 91.5% but some local authorities have rates as low as 68%.

Today, TB kills around 1.5 million people every year making it the deadliest infectious disease<sup>i</sup>. Multi-drug resistant (MDR) and extremely drug resistant (XDR) TB strains are becoming increasingly prevalent, with 490,000 cases documented in 2016<sup>v</sup>. The BCG vaccine, introduced in 1921, is approved for the prevention of TB, but only seems effective against some severe forms of disease. Improved TB vaccines are being developed by UK immunologists, but insufficient funding continues to limit vital progress in this area. The need for effective vaccines is an urgent global priority.

Veterinary immunology is also an important field for which alternatives must be found for antibiotic use. A major contributor to AMR is the overuse and misuse of antibiotics in farm animals. New and improved veterinary vaccines would assist in prevention of infection, resulting in a reduced need for antibiotics and assist

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with prevention of AMR. This has been demonstrated successfully in the fish farming industry, where a switch from antibiotic use to vaccination in Norwegian fish farms in the early 1990s reduced antibiotic use by 99.8%<sup>vi</sup>. Six infectious diseases in chickens, 12 in pigs and 11 in fish, were highlighted in 2015 as priority diseases for which vaccine development would dramatically reduce the need for antibiotics in the industry<sup>vii</sup>.

## *Novel treatment alternatives to antibiotics*

In addition to developing vaccines, immunologists can investigate the mechanisms by which the immune system fights off bacteria. Identification of natural antimicrobial defence mechanisms is enabling novel medicines that could be used in place of conventional antibiotics. Reflecting this potential, the AMR report highlights a number of different biological agents that could be used in prevention or therapy. These include antimicrobial peptides, antibodies, immune stimulation and probiotics.

## **Funding and support**

For immunology to help tackle AMR, further funding and support is required. Historically, poor commercial return on investment for AMR research has driven attention away from the antibiotic pipeline. Less than 5% of venture capital investment into pharmaceutical R&D between 2003 and 2013, went towards antimicrobial development. Even though AMR is predicted to cause more fatalities than cancer by 2050, approximately 800 new oncology products entered the development pipeline in 2014 compared to a total of just under 50 in the antibiotics pipeline two years on<sup>i</sup>.

MRC and BBSRC joint GCRF Networks, Vaccines Research & Development initiative with its initial £8 million in funding is a welcomed initiative to accelerate vaccine development. One of the five networks within the initiative is BactiVac which aims to 'save lives through accelerating the development and use of vaccines against bacterial infections relevant to low and middle-income countries (LMIC)'. This is a major step forward for the UK in the battle against AMR.

- <sup>i</sup>[O'Neil 2016 The review on antimicrobial resistance](#)
- <sup>ii</sup>[British Society for Immunology 2016 A guide to childhood immunisation](#)
- <sup>iii</sup>[Tashani et al 2016 Carrier priming to improve pneumococcal disease control and reduce the international program's cost in children](#)
- <sup>iv</sup>[NHS Digital 2017 Childhood Vaccination Coverage Statistics, England, 2016-17](#)
- <sup>v</sup>[WHO 2017 Tuberculosis](#)
- <sup>vi</sup>[Pharmaq 2016 Antibiotic History in Norway](#)
- <sup>vii</sup>[OEI 2015 Report of the meeting of the OEI ad hoc group on prioritisation of diseases for which vaccines could reduce antimicrobial use in animals](#)