Antimicrobial resistance (AMR) is increasingly recognised as one of the major global public health threats, putting at risk the treatment of common infections with antibiotics. Resistant infections currently claim 700,000 lives annually and it has been estimated that 10 million lives each year will be at risk by 2050, with an economic impact of approximately US$100 trillion (O'Neill, 2016). The World Health Organization (WHO) has made it clear that all government sectors and society need to act to reduce this threat. It established a formal tripartite alliance between public health, animal health and food safety under the ‘One Health’ approach. This partnership recognised that addressing health risks across human, animal and ecosystem interfaces requires a collaborative approach with clear roles and responsibilities (WHO, 2014). In tackling AMR, a full range of interventions must be taken across human and animal health.

**The role of vaccination**

Vaccination is an essential tool against AMR, as preventing infections in the first place negates the need for antibiotics. There is a great deal of evidence that vaccination is one of the most successful and cost-effective interventions in healthcare (WHO, 2013). Past successes include:

- The eradication of smallpox;
- A reduction in the incidence of polio;

In the UK in 2012, the Joint Committee on Vaccination and Immunisation proposed extending the national flu immunisation programme to all children aged 2-17 years. A pilot was undertaken and the results from a range of surveillance indicators were encouraging. There were:

- Fewer GP consultations for influenza-like illness;
- Less swab positivity in primary care;
- Fewer hospitalisations;
- A lower percentage of attendances at emergency departments due to respiratory illness (Public Health England, 2014).

**Talking points**

1. Growing resistance to antibiotics is putting their use to treat routine infections at risk across the world
2. Vaccination is one of the most successful and cost-effective interventions in healthcare
3. A high uptake of vaccination helps prevent infections, thereby reducing the need for antimicrobials
4. Health and social care staff need to ask patients about their vaccination history and encourage them to accept appropriate vaccines
Rotavirus vaccination has had a vast impact globally with a 90% reduction in related hospitalisations in resource-poor countries after its implementation (Kollaritsch et al, 2015). England and Wales saw a 77% decline in laboratory-confirmed rotavirus infections and a 26% decline in all-cause acute gastroenteritis hospitalisations (Atchison et al, 2015).

These successful immunisation programmes show that vaccination significantly reduces the burden of infections, including viral infections, therefore reducing the need for antimicrobial use. In the past, many people have been inappropriately prescribed antimicrobials for viral infections such as coughs and colds, or influenza. While antibiotics are of no use in treating these viral infections, vaccination will significantly reduce the risk of acquiring flu, and if there are fewer people with influenza, there will be fewer people seeking to take antibiotics (PHE, 2015a). Reducing the overall use of antimicrobials will reduce the overall burden of AMR.

The immune system
For an infection to develop it requires a number of steps and certain conditions to be met; this is known as the chain of infection. Of central importance in the chain of infection is the susceptible host – someone who is at risk of developing an infection if all the right conditions are met. Several factors make individuals more susceptible to infection depending on their immune system and ability to defend against the invading organism (Zabriskie, 2009).

The immune system provides a complex defence against micro-organisms. The first-line protective measure is a physical barrier, the epithelial system (skin, gastrointestinal tract and respiratory tract), which prevents the entrance of micro-organisms or toxic agents both physically and with some unique additional mechanisms that offer protection against invaders (Delves, 2016).

When micro-organisms do penetrate physical barriers, the body has two immune responses:
- **Innate (natural) immunity**;
- **Adaptive (acquired) immunity**.

### Innate immunity
Innate immunity is when the body provides an immediate response to the invading organism, which is known as an antigen. In innate immunity, the body does not require past exposure to the antigen in the form of an immunologic memory, allowing an immediate response. The innate immune responses include:

- Phagocytic cells (neutrophils, monocytes and macrophages), which ingest and destroy the invading antigen;
- Natural killer cells, which destroy virus-infected cells and some tumour cells;
- Polymorphonuclear leucocytes (neutrophils, eosinophils, basophils, mast cells) and mononuclear cells (monocytes and macrophages), which are phagocytic cells and, together, set up the inflammatory response and produce symptoms such as redness, heat, pain, swelling and loss of function (Delves, 2016).

### Adaptive immunity
Adaptive immunity requires prior exposure to the antigen and can take time to develop following the initial exposure. The immune system remembers the exposure or antigen and responds to subsequent exposures. Adaptive immunity involves the lymphocytes known as T cells and B cells. Cell-mediated immunity is derived from certain T-cell responses and humoral immunity is derived from B-cell responses. The B cells secrete antigen-specific antibodies and together they work to destroy the invaders (Delves, 2016).

Adaptive immunity can be either passive or active.

#### Passive immunity
Passive immunity is provided by the transfer of antibodies from an immune individual to another individual. This happens naturally with cross-placental transfer of a mother’s antibodies to her child, but can also be provided via blood transfusion, blood products or immunoglobulins.

Passive immunity is temporary, only lasting as long as the antibodies maintain their avidity (that is, the strength of their binding with the antigen) and continue to circulate. It is variable in its ability to protect the host from infection.

#### Active immunity
Active immunity is acquired as a result of natural infection or exposure to organisms (for example, measles) or by vaccination (for example, the measles, mumps and rubella vaccination). Whether as a result of exposure to an organism or a vaccination, the host will develop both antibody- and cell-mediated immunity responses, which can provide long-lasting protection against an organism or group of related organisms (Department of Health, 2013).

### Preventing AMR with vaccination
In 2013 the DH and the Department for Environment, Food and Rural Affairs published a five-year antimicrobial resistance strategy for 2013 to 2018 (DH and DEFRA, 2013). In the battle against increasing AMR in the UK and across the world, there is an imperative to implement strategies other than antimicrobial use to prevent and treat infections. The role of vaccines is highlighted numerous times throughout the strategy.

While the majority of AMR is seen in bacteria and their associated antibacterial drugs, there are also issues with emergent resistance among viruses to current antiviral drugs (O’Neill, 2016b; Strasfeld and Chou, 2010).

Vaccines that prevent or reduce the incidence of bacterial, fungal and viral infections will help to reduce reliance on antibiotics and antivirals; since there is a direct correlation between antibiotic use and the emergence of resistance, reducing the amount of antimicrobial drugs used will have an impact on resistance.

Vaccines are also important in the prevention and control of community-acquired infections and healthcare-associated infections (HCAIs). Box 1 lists current immunisation programmes aimed at preventing infections that are associated with transmission, outbreaks, morbidity and mortality in various health and social care settings.

There are many other community-acquired infections and HCAIs for which no vaccines are currently available, but many technological and scientific advances are being made to expand the portfolio of vaccines against viral and bacterial infections (Moxon and Siegrist, 2011). Box 2 lists...
the organisms that have a major impact in healthcare settings or are known to be resistant to antibiotics against which vaccines are currently being developed.

There are numerous major global infections for which vaccines do not yet exist; for example, there are no vaccines against campylobacter, hepatitis C, herpes simplex and rhinovirus. Exciting and challenging developments are likely in the fields of vaccinology, infection prevention and AMR, so this is an area we should all monitor with interest.

**The role of health professionals**

Nurses have a critical role in maximising uptake of vaccination. They are in a unique position to promote health and wellbeing because of the range of roles and settings in which they work (All-Party Parliamentay Group on Global Health, 2016).

Our nursing leadership framework Leading Change, Adding Value (NHS England, 2016) calls on nurses to be positive role models and champions for the prevention of AMR through infection prevention and control messages, so ownership is seen as everybody’s business. In a similar call for action, the Public Health England framework All Our Health calls on health professionals to: “use their knowledge, skills and relationships, working with patients and the population to prevent illness, protect health and promote wellbeing.” (PHE, 2015b)

The section of the PHE framework on AMR calls health and social care workers to support the uptake of all immunisations, vaccination and screening programmes (PHE, 2015c).

Most health professionals are familiar with the infection prevention agenda but fewer may be aware of the UK’s AMR strategy (DH and DEFRA, 2013). However, unless they are directly involved in delivering immunisation services and programmes, many may not appreciate the role their patients’ or clients’ vaccination status can play in the health of those patients and clients, and that of the people around them.

All health and social care staff are urged to ask the people in their care about their vaccination history. While this would seem most pertinent when caring for children, the vaccination status of adolescents and adults should also be checked. If necessary, vaccines should be provided or the individual directed to their GP to discuss missing immunisations. Many individuals will have at-risk conditions and comorbidities that make them more vulnerable to infections. For example, in autumn, older people and those at risk should be asked about their influenza and pneumococcal vaccine history. The full UK Immunisation schedule can be accessed at bit.ly/PHEImmunisationSchedule.

**Conclusion**

Vaccines and knowledge of individuals’ immune status can contribute enormously to infection prevention for those individuals and for health and social care populations. The appropriate use, and high uptake, of vaccines among eligible groups will help to reduce infection and the subsequent need for antimicrobials, thereby helping to combat increasing AMR. Plotkin and Plotkin (2004) reiterated the WHO’s assertion that: “the two public health interventions that have had the greatest impact on the world’s health are clean water and vaccines.”

Nurses are the largest health and social care workforce, and therefore have a real opportunity to make a difference in the prevention of the global threat of AMR by promoting and educating about vaccination.

All health and social care workers should ask their patients and clients about their vaccination history and encourage uptake of missing vaccines for which they are eligible. They should also get involved when possible in promoting vaccination, for example by participating in World Immunisation Week 2017: Vaccines Work (24-30 April; bit.ly/WHOImmunizationWeek2017). NT

**Box 2. Organisms tackled by vaccines under development**

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<thead>
<tr>
<th>Organisms</th>
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<tr>
<td>Group B streptococcus</td>
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<tr>
<td>Staphylococcus aureus</td>
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<tr>
<td>Respiratory syncytial virus</td>
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<tr>
<td>Norovirus</td>
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<tr>
<td>Clostridium difficile</td>
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<td>Tuberculosis</td>
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<td>HIV</td>
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<td>Escherichia coli</td>
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<td>Candida</td>
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<td>Pseudomonas aeruginosa</td>
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*A new TB vaccine is needed because the current Bacillus Calmette-Guérin vaccine is a live vaccine associated with some morbidity. It fails to produce an adequate immune response in some adults. Furthermore, production challenges have resulted in a global shortage of the Statens Serum Institut brand of BCG in recent years. Source: O’Neill (2016b)*

**References**


Bit.ly/APPGTripleimpact


For more on this topic go online

- Prevention by breaking the chain of infection. Bit.ly/NTHChaininfection