Towards an integrated approach to the problem of antimicrobial resistance in Australia

“The threat is real, the science is in, the time for action is now!”

A familiar refrain that for most of us is associated with the debate surrounding global warming, but surely equally applicable to the situation surrounding its microbiological equivalent – antimicrobial resistance (AMR). We are all well aware of AMR and the consequences of its emergence and spread, following the recognition of this phenomenon when the ‘antibiotic era’ began only a few decades ago. Perhaps we have been somewhat complacent about AMR, in that we have relied overmuch on the continuing development of new and better antimicrobial agents. As the efficacy of older antimicrobials wanes and the supply of new agents declines in the face of increasing AMR, some have suggested that we may be facing a ‘post-antibiotic era’.

This edition of Microbiology Australia provides an overview of the current situation and effects of AMR, especially with regard to Australia. The topic is extensive and the ramifications wide, so the contributions in this edition are aimed to provide only a flavour of the intricacies of the overall problem of AMR, the mechanisms involved, and the known and possible means by which AMR may be contained.

Enormous benefits have accrued in terms of individual wellbeing and, at a public health level, control of infectious disease following the discovery, clinical application and manipulation of naturally occurring compounds (antibiotics) and synthetic agents (chemotherapeutic agents) active against microbial pathogens. However, AMR is also a natural phenomenon and its effects, amplified by continuing exposure and over-exposure to antimicrobials, have seen the progressive and now accelerating erosion of these benefits for the treatment of bacterial, viral, parasitic and fungal infections. A precise definition of AMR is surprisingly difficult, as some forms of interest to microbiologists are not necessarily of clinical relevance and phenotypic expression does not always mirror all underlying genetic alterations. One

World Health Organization (WHO) source suggests the following definition:

AMR is the expression of the ability of microbes to resist the actions of naturally occurring or synthetically produced compounds inimical to their survival. In a clinical context, AMR refers to a reduction in clinical efficacy so that either the benefits for the individual of treatment with an antimicrobial drug or the benefits to general public health are compromised.

While most attention surrounding AMR has focused on issues affecting human health – predictably most of this on bacterial resistance – this edition of Microbiology Australia attempts to take a wider view. It is perhaps pertinent to remember that of the three infectious diseases – tuberculosis (TB), malaria and HIV/AIDS – regarded by the United Nations as the most significant for human health worldwide, the control of all three is materially affected by AMR, but only one has a bacterial cause. In this edition, a summary of WHO efforts aimed at containment of antimicrobial resistance in general follows, taking the broader ‘antimicrobial’ as opposed to the narrower ‘antibiotic’ view, and an overview of bacterial antibiotic resistance is provided in the contribution by Robert Moellering.

Resistance mechanisms to antibacterial agents are reviewed by Jon Iredell and John Merlino in a timely summary of the current status of these phenomena. It is important to remember that although AMR may impact adversely on an individual infected with a resistant organism, there are also significant public health issues that emerge as a result of AMR. We are reminded that the public health issues surrounding antibacterial resistance are two-fold. David Jordan discusses issues arising from interaction between animal and human AMR from a public health perspective. Keryn Christensen points out that AMR is an important public health issue in its own right, being responsible for significant mortality
and morbidity with major economic implications. Further, while the very real problems of AMR in animal health and husbandry impinge on human health, sometimes significantly, they are often used to excuse poor practice with regard to the use of antibiotics in human health. Mary Barton presents data on AMR in veterinary practice in Australia while reminding us that antibiotic treatment is also necessary for animal wellbeing.

Examples of problems resulting from increasing AMR are provided in a number of articles. Chris Coulter addresses the specific topic of the global threat of MDR and extensively drug-resistant TB and describes national and international efforts directed at TB control. The real and seemingly inexorable increase in AMR in hospitals and the wider community leads to repeated attention in the popular press. Contributions by Lyn Gilbert and Tom Gottlieb and Elaine Cheong illustrate continuing, new and emerging problems of AMR in other pathogens of local and global significance. Consequences of antibiotic misuse in the form of *Clostridium difficile* infection and the emergence and spread of virulent subtypes of this organism are reported by Tom Riley. The broader implications of AMR in parasitic infections less commonly encountered in Australia, but nonetheless very relevant, are described by Harsha Sheory, while David Smith and David Speers provide a picture of antiviral resistance and its consequences in diseases of major importance. The origins and impact of resistance to antifungal agents is discussed by David Ellis, Sharon Chen and Tanya Sorrell.

Finally a series of papers describes Australian attempts to date for the containment of AMR. The broader picture of principles of AMR containment is set out in Figure 1 of the WHO article. Local efforts at AMR containment by means of government regulatory and other control measures and at a practical level through activities of the National Prescribing Service, are set out by John Turnidge and Lyn Weekes respectively. One aspect not covered here – deliberately, because of space limitations – is that of surveillance of AMR regarded by the WHO in its Global Strategy as one of the two ‘fundamental requirements’ for any attempt at control of AMR. Of course, surveillance should not be limited to assessment of resistance itself, but optimised by also monitoring how much antimicrobial is used and how well this use is applied.

No one would suggest that in Australia we are anywhere near addressing the issue of AMR containment in the coordinated and comprehensive manner suggested by world experts and a number of authors imply that management of AMR in Australia is hampered by lack of critical data.

Thus, AMR is an important, systemic, chronic and worsening problem in Australia, as it is elsewhere. The means by which AMR can be contained are well established and proven. However, this requires an integrated approach with the political will, resources and long-term commitment to make success feasible – a little bit like global warming and in its own way just as important.