Biocides in the health industry

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Biocides, whether naturally extracted or chemically engineered, are invaluable compounds that provide the health industry with numerous benefits. They can be used as disinfectants or antiseptics playing an important role in the control of bacteria and viruses. Thus, they are a precious resource that must be managed so as to be protected from loss of activity over time; these compounds are often overlooked in the significance of bacterial persistence and resistance[1].

In order to preserve the role of biocides in infection control and hygiene, it is paramount to prevent the emergence of bacterial resistance and cross-resistance through their appropriate and prudent use. Microorganisms are able to adapt rapidly to new environmental conditions such as the presence of antimicrobial molecules and, as a consequence, resistance may increase with increasing exposure to biocides and other antimicrobials. Serious concerns about bacterial antibiotic resistance from nosocomial and community-acquired pathogens have been growing for a number of years, and have been raised at both national and international levels[1].

Current microbiological, biochemical and genetic scientific evidence indicates that the use of certain active substances in biocidal products in various settings may contribute to the increased occurrence of antibiotic-resistant bacteria. Resistance mechanisms to biocides are often similar or identical to those employed by microbes to antibiotics, for example, efflux pumps, permeability changes, target-site mutations and biofilm production. Indeed, many multidrug efflux systems can export not only antibiotics but also accommodate biocides, giving rise to multiple-resistant strains. Resistance determinants can be encoded on the chromosome of the bacteria or are present on mobile genetic elements that then have the ability to spread through bacterial populations and impact on the evolution of strains resistant to these compounds. Thus, continual exposure to biocides can result in selection of strains resilient to multiple compounds and may favour the expression and dissemination of these mechanisms of resistance[2].

Biocides are also likely to contribute to maintaining selective pressure allowing the presence of mobile genetic elements harbouring specific genes (chromosomal and plasmid-mediated) involved in the resistance to biocides and antibiotics. Further research is urgently required on the role of newer biocidal compounds in selecting for or maintaining bacterial antibiotic resistance. Studies carried out in the environment agree on their limitations in terms of identifying and characterising cross-resistance *in situ* and conclude that more research is needed in this field[1].

The existence of horizontal gene transfer, particularly associated with mobile genetic elements, is the most likely mechanism for selecting and increasing antimicrobial resistance. The dissemination of these mobile genetic elements, their genetic capacity to contain several resistance genes, and the presence of overlapping genetic cascades of regulation responding to selective pressures from chemicals on bacteria represent the highest risk factors. The formation of biofilms could also be considered a potential risk factor for the development of cross-resistance between antibiotics and biocides[1, 2].

As increases in antibiotic resistance continue to reduce our ability to treat infections, then infection prevention through hygiene – not only in hospitals but also in the community – becomes of even greater importance. It is necessary to ensure that the biocides which are used retain their effectiveness for use in situations where they can have real health benefits in reducing infection transmission[2].

In this issue of *Microbiology Australia – Biocides in the health industry* authors from various backgrounds have focused on many of these issues and highlight that biocides, whether natural or chemically engineered, are invaluable compounds that provide society with numerous benefits. In recent years there has been an increase in the number of commercially available products that have biocides included in their formulations for the home-owner. However, has this been a positive or negative impact on health in the community? Articles here address the impact biocides have and are predicted to have in bacterial survival strategies. Biocides play an important role in the management of microorganisms in a variety of applications, but they are a precious resource that must be managed effectively to avoid any loss in activity for as long as possible[1,2].

References

1. Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) (2009). Assessment of the Antibiotic Resistance Effects of Biocides. European Commission Health & Consumer Protection DG, http://ec.europa.eu/health/ph_risk/risk_en.htm
2. A review by the International Scientific Forum on Home Hygiene (IFH) (2000) Microbial resistance and biocides, http://www.ifh-homehygiene.org/2003/2public/antresFINAL.pdf