New reagents can fight MRSA and other hospital-acquired infections, study shows

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Researchers in the UK have designed reagents that are well suited to fight MRSA (Methicillin-resistant Staphylococcus aureus) and other pathogens associated with antibiotic-resistant infections. They showed how a class of ionic fluids can wipe out colonies of dangerous microbes growing on biofilms. Their discovery, published in the journal Green Chemistry, has implications for both medicine and industry.

The researchers, led by Dr Brendan Gilmore and Dr Martyn Earle of Queen's University Belfast, looked at the antimicrobial properties of ionic liquids, which have been the subject of intensive study in the chemical industry as a potential replacement for volatile organic compounds, among other things.

Previous studies of the antimicrobial effects of ionic fluids focused on microbes growing independent of biofilms, protective matrices that protect a microbial colony from antiseptics, disinfectants, and antibiotics. This non-biofilm mode of growth is referred to as 'planktonic'. However, an estimated 80% of all chronic human infections are caused by pathogens growing on biofilms. These matrices are behind a wide range of medical and industrial complications, from chronic infection to the biocorrosion of industrial pipes.

This latest research examined, for the first time, the effects of ionic fluids on biofilms, which are known to persist even in antimicrobial concentrations 1,000 times stronger than would be needed to kill off their planktonic counterparts.

The scientists looked at the antibiofilm activity of a class of ionic liquids (specifically, 1-alkyl-3-methylimidazolium chlorides) using a device designed specifically to screen for the susceptibility of biofilms to antimicrobials. The device also measured the minimum concentration of antimicrobial reagent required to 'kill' the biofilm.

According to Dr Earle, the goal of the study was 'to design ionic liquids with the lowest possible toxicity to humans while wiping out colonies of bacteria that cause hospital-acquired infections.' Ionic liquids (picture a glass of table salt dissolved in water) offer an attractive flexibility: because it is possible to modify the properties of the positively and negatively charged ions, the physical, chemical and biological properties of the fluid can effectively be tailored.

The ionic liquids developed by the researchers were indeed effective against biofilms. 'We have shown that when pitted against the ionic liquids we developed and tested, biofilms offer little or no protection to MRSA, or to seven other infectious microorganisms,' said Dr Earle.

Dr Gilmore added: 'Ionic liquid based antibiofilm agents could potentially be used for a multitude of medical and industrial applications. For example, they could be used to improve infection control and reduce patient morbidity in hospitals and therefore lighten the financial burden to healthcare providers. They could also be harnessed to improve industrial productivity by reducing biofouling and microbial-induced corrosion of processing systems.'
The toxicity of the group of ionic liquids the researchers studied is a desirable property in terms of developing new antiseptics and disinfectants, but the researchers acknowledge that the environmental impact of these compounds merits close investigation.

'The design of novel classes of ionic liquids with improved antibiofilm activities, reduced environmental impact, and improved toxicity profile should be possible through rational design,' the study concludes. The flexibility of the reagents should, the authors say, make it possible to improve their biodegradative properties whilst retaining their potent antimicrobial and antibiofilm activity.

Source: Queen's University Belfast; Green Chemistry

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