Novel copper-based biocides: efficacy against multiresistant Acinetobacter in an ICU environment

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The problem with routine disinfectants

Hospital-acquired infections (HAIs) have never been healthier and the environment contributes to some of them. Products in current use for disinfecting hospital environments are far from ideal.

Chlorine, quaternary ammonium, peroxide and alcohol-based products damage the fabric of hospitals, and present varying degrees of health risks. Phenolics such as triclosan as well as quaternary-ammonium-based products are also suspected of driving bacterial resistance [1].

Copper-based products - what the research shows

Copper's biocidal properties are well established, and two examples are the Bordeaux mixture and anti-fouling paint. Copper-containing surfaces [2] and fabrics [3] have been shown to be effective against the bacteria responsible for HAIs. Recently, our group was contracted to assess the antibacterial activity of three novel copper-based biocides (proprietary to, and patented, by Remedy Research Ltd). These products are in liquid form, giving them the distinct advantage of being potentially applicable to a wide range of hospital and topical disinfection needs.

Extensive testing of these products over the past 18 months has shown their remarkable biocidal activity against methicillin-resistant *Staphylococcus aureus* (MRSA), *Acinetobacter*, glycopeptide-resistant *Enterococcus*, *Legionella pneumophila* and even Clostridium difficile organisms and spores [4]. All three compounds effectively inhibited colony formation in all of the 185 antibiotic-resistant clinical isolates referred to the Health Protection Agency (HPA; Dr Tyrone Pitt, personal communication, 2007).

All three copper compounds were highly effective at decontaminating ultramicrofibre (UMF) cloths [5] and disinfecting contaminated laundry in conjunction with commercially available detergents [6]. An *Aloe vera*-based alcohol-free hand gel (Xgel) containing one of these copper-based formulations (CuAL42) was much more effective than Purell against MRSA, *Acinetobacter* and spores of *C. difficile* using the standardised EN12054 suspension test protocol (Hall TJ, et al. submitted for publication, 2007).

Furthermore, our recent studies have shown that the dried residue of Xgel on hospital surfaces inhibits bacterial survival much more effectively than that of Purell.

A surgical patient, *Acinetobacter* and a copper biocidal

We had an opportunity to test one of these copper-based formulations in the field at the National Hospital for Neurology and Neurosurgery, London. Following an operation, a patient became colonised and infected with highly antibiotic-resistant *Acinetobacter* calcoaceticus *baumannii.* He was admitted to the intensive care unit (ICU), but we didn't have the option of an ICU side room.

We assessed the degree of environmental *Acinetobacter* contamination in the patient's bay using sterile cloth sampling wipes (Medical Wire and Equipment, Bath, UK), contact plates, or both. Contact plates and eluents of UMF cloth wipes used for cleaning were plated onto agar. These were examined by traditional methods for presence and density of *Acinetobacter* species.

The patient's bay and other areas in the ICU were comprehensively swabbed and/or contacted plated on three separate occasions. At the same time, routine cleaning continued with chlorine-based disinfectants. Despite regular cleaning and adherence to best practice by the nursing staff, viable *Acinetobacter* was consistently identified in numerous sites: curtain grips, under the patient's bed, on bed panels and rails, on the patient's chair, on flat surfaces such as shelves, as well as tilt table straps, ventilator tubes and fascia.

Even more worrying was the identification of *Acinetobacter* on the central ICU work station PC keyboard. This was well away from the patient and despite the excellent barrier nursing infection control practice by all the ITU staff, which included consistent and frequent use of alcohol-based hand gel.

We then cleaned these areas once with UMF cloths impregnated with one of the copper-based formulations (CuAL42) and then swabbed and/or contact plated within the hour. The results showed that cleaning with the CuAL42-impregnated UMF cloths either substantially reduced or more often eliminated *Acinetobacter* contamination in all areas.

A case for further testing

We have found that setting performance and monitoring standards and protocols for cleaning and decontaminating the ICU near-patient environment has always been a challenge. But our encouraging results have prompted us to engage in a feasibility exercise with the Trust. We aimed to study the effect and effectiveness of training and supporting domestic staff to undertake this role to our new standards.

Conclusion

The ICU clinical environment is highly dynamic, containing equipment with highly complex physical shapes and very sick patients. This environment is also notorious for high rates of

transmission of HAI organisms, among which multidrug-resistant *Acinetobacter* is one of the most difficult to eradicate [7].

The area around the patient is typically cleaned by domestic staff. Although rarely defined, cleaning of equipment designed to operate close to patients is generally considered to be the responsibility of the nursing staff. We discovered viable *Acinetobacter* in this environment, despite a team of motivated and informed domestic and nursing staff and use of chlorine-based disinfectants. Our preliminary study suggests that changes in cleaning practices, protocols and materials resulted in a far less contaminated environment.

We believe that our interventions had a remarkable impact on Acinetobacter's ability to survive and transmit to patients in this ICU; no subsequent cases ensued despite the lack of side room availability for this patient.

Learning points

- Current disinfectants used in hospitals have several disadvantages, including health risks and increased bacterial resistance.
- Copper-based biocidal products may be more effective at reducing HAIs in high-risk environments such as the ICU.
- Stringent cleaning practices, motivated domestic and nursing staff, and appropriate protocols and materials can have a positive impact on infection control in ICUs.

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Online link:
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