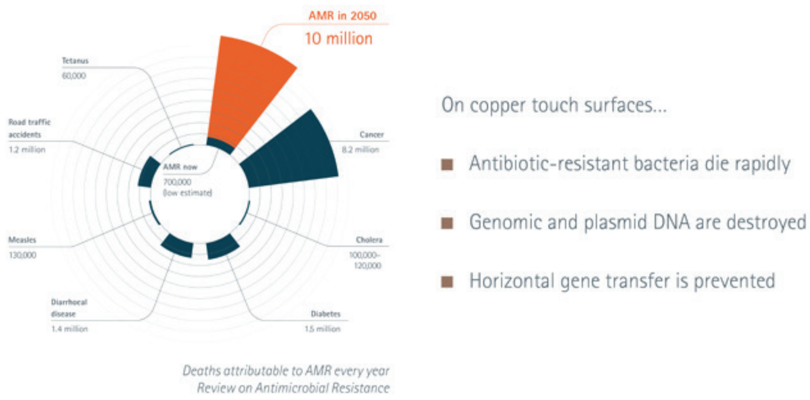
Antimicrobial Copper vs Antimicrobial Resistance

The antimicrobial properties of copper have become widely known, harnessed by hospitals around the world in the form of touch surfaces that continuously reduce bioburden. Now, a potential role in combatting antimicrobial resistance is being proposed by researchers. This article describes some of the latest developments in antimicrobial copper, looking at new science, its growing inclusion in guidelines and ratings systems, and a high-profile installation at a leading London research facility.



Infographic presenting the threat of AMR and antimicrobial copper's potential to combat it

First, a quick recap: copper is a powerful antimicrobial with broad-spectrum efficacy against bacteria and viruses, and has been shown to rapidly destroy pathogens, including influenza A, *E. coli* and norovirus, and resistant bacteria such as MRSA. It shares this benefit with a range of copper alloys – including brasses and bronzes – forming a family of materials called 'antimicrobial copper'.

These familiar engineering materials perform their primary function – delivering hard-wearing surfaces that meet the demands of a busy clinical environment – with the additional benefit of continuously reducing bioburden and thus reducing the risk of infections spreading.

An Additional Weapon in the Fight Against Antimicrobial Resistance

Antimicrobial resistance (AMR) threatens the effective prevention and treatment of an ever-increasing range of infections caused by bacteria, parasites, viruses and fungi. Of these, antibiotic-resistant bacteria have the most serious implications for health.

At the World Health Organization's 68th World Health Assembly in May 2015, a global action plan[1] was endorsed for tackling antimicrobial resistance, including antibiotic resistance. It includes the prevention of infection as one of five strategies to tackle the global rise of AMR. If not stemmed, the WHO advises AMR could result in one death every three seconds by 2050.

In September 2016, all 193 UN member states agreed to combat the proliferation of drug-resistant infections and reaffirmed their commitment to develop national action plans on AMR, based on the WHO's Global Action Plan on Antimicrobial Resistance.

According to Dr Beth Bell, CDC Deputy Director for Infectious Diseases and Director of the Office of Infectious Diseases, infection prevention is the foundation of preventing antimicrobial resistance.

Pathogenic bacteria can survive on standard environmental surfaces in healthcare facilities, leading to the risk of patients acquiring an infection. Reducing healthcare-associated infections reduces the need for antibiotics, which is another of the WHO's five strategies.

It is accepted that hand hygiene, and surface cleaning and disinfection, are standard measures to prevent and control healthcare-associated infections, but more needs to be done to prevent the spread of pathogens by staff, visitors and patients touching contaminated surfaces. What is not always appreciated is that bacteria deposited and surviving on a surface can exchange genes – including those for antibiotic resistance – which can result in new, resistant strains. This process is called horizontal gene transfer.

Professor Bill Keevil, Chair of Environmental Healthcare at the University of Southampton and member of the Network for Anti-Microbial Resistance and Infection Prevention (NAMRIP), is a leading expert on the hygienic properties of copper, and believes replacing frequently-touched surfaces with antimicrobial copper equivalents – teamed with good hygiene practices – could help address both the environmental spread of pathogens and the rise of antibiotic resistance.

He explains: 'Our work[2] has shown that antibiotic resistance genes are rapidly transferred from one superbug to another species on touch surfaces such as stainless steel, meaning that an infected traveller with poor hand hygiene can fly into an airport, touch various surfaces leaving his superbug behind and then another person from another part of the world can add their bacteria to the same surface to create an even greater superbug threat.

Professor Bill Keevil stands by the efficacy of antimicrobial copper to reduce the spread of infection

'Cleaning these touch surfaces every hour is impracticable. This is where measures affording 24/7 protection become an important adjunct to regular cleaning. Indeed, our work has shown that copper alloys used for touch surfaces quickly kill bacteria, viruses and fungi, and just as importantly prevent antibiotic resistance gene transfer on touch surfaces.

'The bacteria include the superbugs MRSA, *C. difficile, Acinetobacter baumanii,* extended spectrum beta-lactamase (ESBL) producing *E. coli* and carbapenamase producing *Klebsiella pneumonia* (KPC), which are now causing many outbreaks worldwide. The viruses include influenza, adenovirus, human coronavirus (a close relative of SARS and MERS) and the highly robust norovirus, which suggests that antimicrobial copper surfaces should be efficacious against Ebola and more.'

Although cleaning and disinfection are more frequent and robust in healthcare settings than other areas, such as airports, the fact remains that they cannot happen often enough to completely eliminate the spread of bacteria, and the potential for horizontal gene transfer to occur.

A different approach is needed to boost regular cleaning and hand hygiene, round the clock, and in hospital trials, antimicrobial copper surfaces have been found to harbour >80% less contamination than non-copper surfaces.[3] A multi-centre ICU trial in the US further found the bioburden reduction was associated with a 58% reduction in infections.[4]

Researchers have concluded that the strategic deployment of antimicrobial copper touch surfaces can significantly and continuously reduce the number of microbes on surfaces, reduce the risk of transmission of infection and prevent the transfer of antibiotic resistance between bacterial species, providing an additional tool in infection control and the war on antimicrobial resistance.

Maintaining 'Terminal Clean' Hygiene Levels

New research that builds on the existing US trial data – published at the end of 2016 in the *American Journal of Infection Control* – reports antimicrobial copper touch surfaces installed in hospital patient rooms not only significantly reduced concentrations of bacteria, but sustained them at levels prescribed on completion of terminal cleaning. Grinnell College's Associate Professor of Biology, Shannon Hinsa-Leasure, PhD, and her team conducted research over 18 months at Grinnell College and Grinnell Regional Medical Center (GRMC) in Iowa, with more than 1500 samples. The study found significantly fewer bacteria on copper alloy products – such as grab bars, toilet flushes, IV poles, switches, keyboards, sinks and dispensers – than on traditional, non-copper hospital room surfaces.[5]

The study notes more than half of all healthcare-associated infections are acquired outside ICUs. Here, 20 frequently-touched surfaces – in medical and surgical suite patient rooms, en-suite bathrooms and areas external to patient rooms 0150 – were replaced with antimicrobial copper equivalents. Both occupied and unoccupied rooms were studied to determine background bacterial concentrations.

'Even the most conscientious cleaning will not remove all bacteria cells from a surface, allowing for recolonisation,' says Hinsa-Leasure. 'To reduce the risk of patients acquiring an infection while in the hospital, we need to reduce the number of bacteria surrounding them. This is what makes copper so important: it is always working to destroy micro-organisms and will maintain a clean environment for patients.'

With weekly sampling over the course of 12 months, 88% of the samples collected from copper components in occupied areas were below the recommended terminal clean level (250 CFU/100 cm^2). During the same period, 55% of control surfaces had burdens above this threshold.

More surprisingly, in unoccupied rooms (given a terminal clean after the patient vacated), 51% of control samples were above the threshold. The observation that microbial populations are re-established on hospital surfaces subsequent to cleaning supported observations made in previous research.[6] 93% of the copper samples from unoccupied rooms were below the threshold.

The researchers further noted most of the copper surfaces went unnoticed by patients, and concluded antimicrobial copper should become an important part of hospital infection control, working in concert with hand hygiene and daily and terminal cleaning.

Copper in Guidelines and Ratings Systems

As the evidence base for antimicrobial copper has grown and awareness becomes more widespread, it is being included in infection prevention and control guidance, healthcare accreditation schemes and green, hygienic and well building schemes. Some of these reach beyond the healthcare environment, highlighting where and how antimicrobial copper can be of benefit in many different building types. A few recent developments follow.

Centrum Monitorowania Jakości w Ochronie Zdrowia (CMJ) is a government agency of Poland, responsible for encouraging healthcare facilities to improve the quality and efficacy of services and patient safety standards. It runs a national hospital accreditation programme.

In late 2015, it was the first European health agency to recognise the use of antimicrobial copper touch surfaces as an infection prevention and control measure, awarding a higher accreditation score for hospitals that installed antimicrobial copper surfaces.

On a global level, the WELL Building Standard™ is a new evidence-based system for measuring, certifying and monitoring the performance of building features that impact health and wellbeing – the first of its kind. High-touch surfaces made from 'an abrasion-resistant, non-leaching material that meets EPA testing requirements for antimicrobial activity' are an optimisation option for the two highest levels of the standard. Copper and more than 500 'antimicrobial copper' alloys fulfil this requirement.

Most recently, in February 2017, Finland's Building Information Foundation (RTS) issued its first guidelines on indoor environmental hygiene for new build and renovation projects across all building types.

These establish four levels of hygiene, and various measures to deliver the required standard.

Antimicrobial materials for high-touch surfaces are included in the three most stringent categories, and copper is singled out as the most recognised and effective antimicrobial material in the accompanying guidance.

Preventing Cross-contamination in Laboratory Settings

The prestigious Francis Crick Institute research facility, in the heart of London's Knowledge Quarter, has antimicrobial copper door furniture throughout its laboratory and high-traffic areas, including auditorium doors in the visitor area. In addition, antimicrobial copper handles and bathroom turns have been used for WC doors and storage cupboards throughout the building.

Antimicrobial copper door furniture installed at Francis Crick Institute. Courtesy of Allgood.

David King, Senior Vice President at HOK – the architects that jointly designed the facility with PLP Architecture – observes, 'The Francis Crick Institute is the largest and most advanced research facility of its kind in Europe, but science is constantly evolving and therefore requires a highly collaborative environment to facilitate scientific research. We are delighted that our holistic design solutions will aid the Crick's aspiration of "discovery without boundaries", helping to keep London and the UK at the forefront of innovative medical research.'

Conclusion

With copper's antimicrobial efficacy confirmed and now widely known, companies around the world offer a wide range of antimicrobial copper touch surface products, for use in hospitals and in the communities beyond, anywhere hygiene is of concern. Available in a range of colours – from the red of copper, through the gold of brasses and the brown of bronzes, right up to a silver colour resembling stainless steel – these products are seeing more extensive use than ever, and offer some exciting benefits over other engineering materials.

With research suggesting copper could play a role in curbing the rise of antimicrobial resistance, and increasing numbers of recommendations in building guidelines and rating systems, its myriad colours and forms look set to become a familiar sight, boosting other hygiene measures and providing continuous protection against pathogens.

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