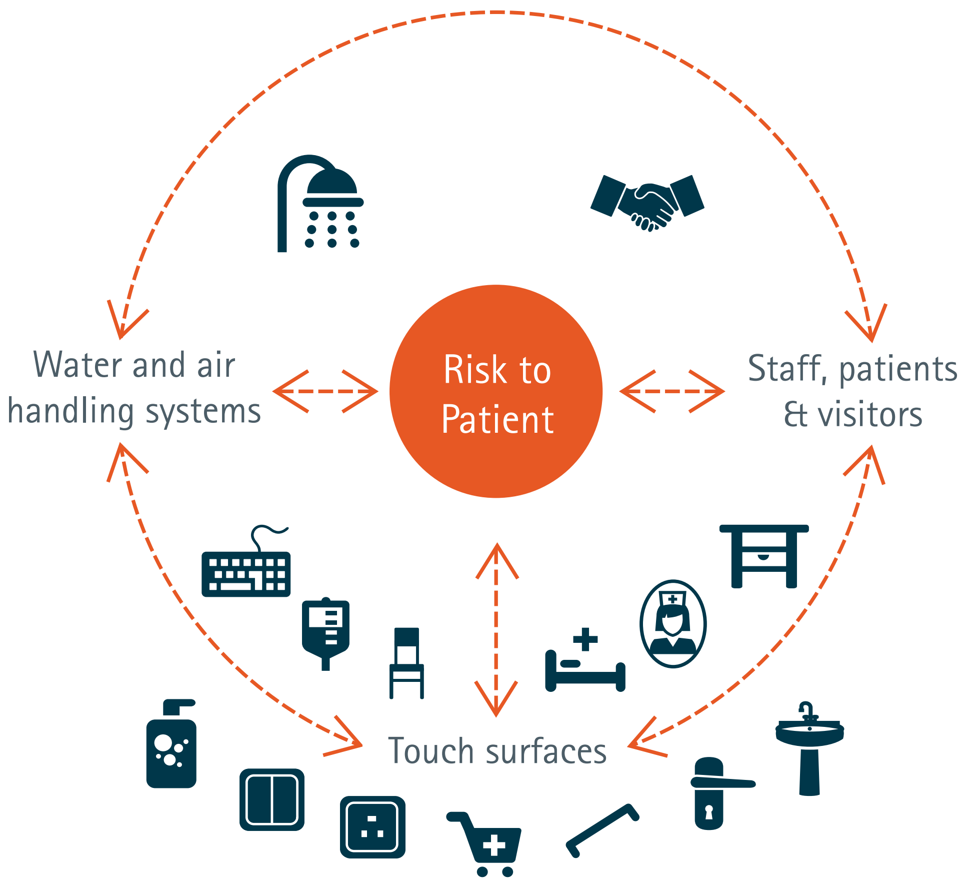
Copper - a Tool for Tackling Antimicrobial Resistance:
Breaking the Chain of Infection

CDA Publication 227

Antimicrobial Copper



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Introduction

Antimicrobial resistance (AMR) is a threat to modern medicine, reducing our clinical options for the prevention and treatment of infections caused by bacteria, parasites, viruses and fungi. Of these, antibiotic-resistant bacteria have the most serious implications for health.

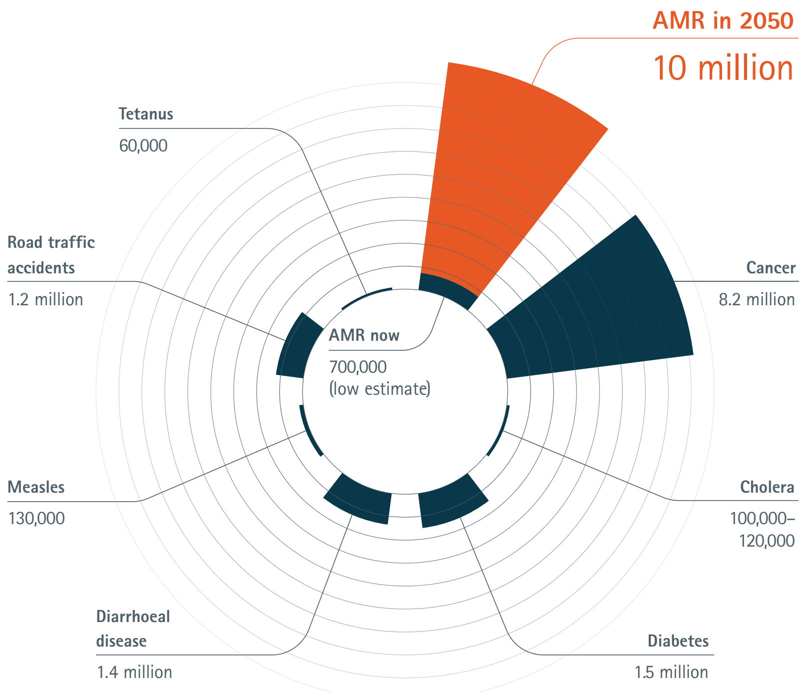
Resistance arises when bacteria that cause infections survive exposure to the antibiotics that would normally kill them. This is a natural biological phenomenon stemming from bacteria evolving to survive, but the process is accelerated by various factors such as misuse of antibiotics, poor infection control practices and global trade and travel.

Many of the medical advances in recent years—including organ transplantation and cancer chemotherapy—need antibiotics to prevent and treat the bacterial infections that can occur during treatment. Without effective antibiotics, even minor surgery and routine operations could become high-risk procedures.

As the speed at which bacteria develop resistance to existing antibiotics is increasing, the antibiotics pipeline is drying up, with few new drugs being developed, threatening to plunge us back into the dark ages of the pre-antibiotic era.

Health and Economic Impact of AMR

According to a joint UK Government/Wellcome Trust review on the potential impact of AMR[1], 10 million people a year could die across the world by 2050—more than the number of people lost to cancer every year—if no radical action is taken regarding antimicrobial resistance. The associated economic costs have been estimated at $100 trillion due to a forecast reduction in GDP of between 2 and 3.5%. So, AMR presents not just a health problem, but also an economic one. The review concludes that the cost of doing nothing, both in terms of lives lost and money wasted, is too great, and the world needs to work together and agree on a common approach.



Source: Antimicrobial Resistance: Tackling a crisis for the health and wealth of nations. The Review on Antimicrobial Resistance. Chaired by Jim O'Neill, December 2014.

UN Declaration to Tackle AMR

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. The high-level meeting was convened by the President of the 71st session of the UN General Assembly, HE Peter Thomson, who declared *"Antimicrobial resistance threatens the achievement of the Sustainable Development Goals and requires a global response. Member States have today agreed upon a strong political declaration that provides a good basis for the international community to move forward. No one country, sector or organisation can address this issue alone."*

WHO Global Action Plan on Antimicrobial Resistance

At the 68th World Health Assembly in May 2015, a global action plan[2] was endorsed for tackling antimicrobial resistance, including antibiotic resistance: the most urgent drug resistance trend.

It states: *"The goal of the draft global action plan is to ensure, for as long as possible, continuity of successful treatment and prevention of infectious diseases with effective and safe medicines that are quality-assured, used in a responsible way and are accessible to all who need them."*

The global action plan sets out five strategic objectives:

- Improve awareness and understanding of antimicrobial resistance
- Strengthen knowledge through surveillance and research
- Reduce the incidence of infection
- Optimise the use of antimicrobial agents
- Develop the economic case for sustainable investment that takes account of the needs of all countries, and increase investment in new medicines, diagnostic tools, vaccines and other interventions.

> *"Infection prevention is the foundation of preventing antimicrobial resistance."*
>
> Dr Beth Bell, CDC Director, National Center for Emerging and Zoonotic Infectious Diseases

Infection Control

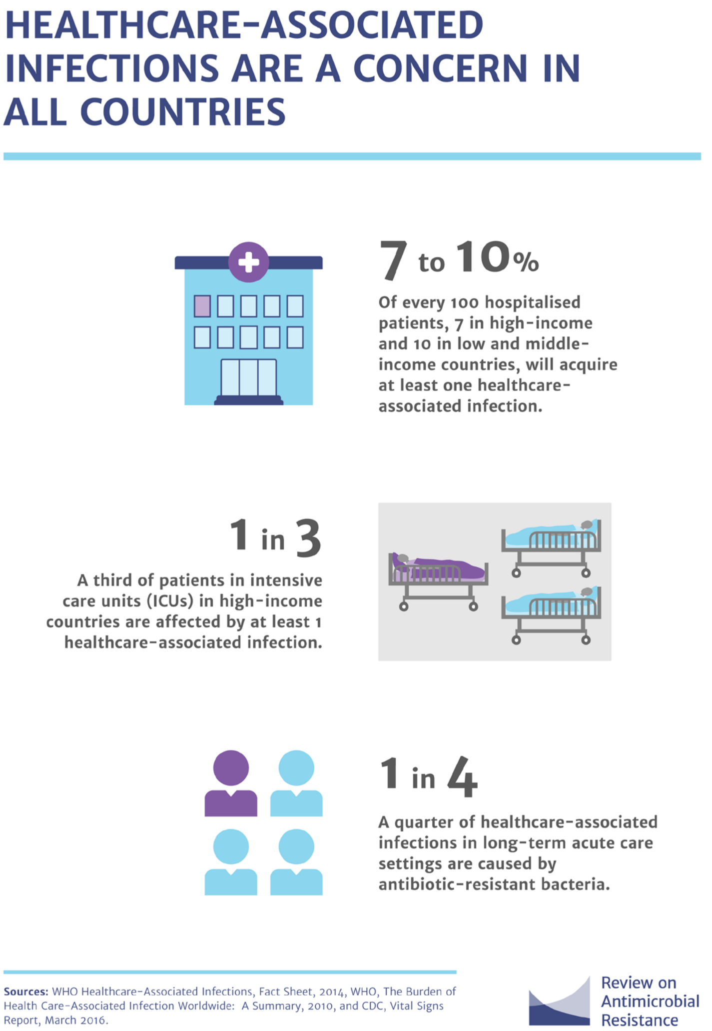
In all parts of the world, hospitals and other care settings—such as residential care homes for the elderly—represent high-risk areas for the development and spread of bacterial infections, including drug-resistant strains. Interventions that reduce the opportunities for infections to spread within health and care facilities therefore have significant potential not just to lower the burden of associated mortality and morbidity, but also to limit opportunities for drug-resistant strains to emerge.

A high percentage of healthcare-associated infections are caused by highly-resistant bacteria such as Methicillin-resistant *Staphylococcus aureus* (MRSA) or multidrug-resistant Gram-negative bacteria such as *Pseudomonas aeruginosa* and *Klebsiella pneumoniae*.

Antimicrobial-resistant infections currently claim at least 50,000 lives each year across Europe and the US alone, with many hundreds of thousands more dying in other areas of the world.

Patients with infections caused by drug-resistant bacteria are generally at increased risk of worse clinical outcomes and death, and consume more healthcare resources than patients infected with the same bacteria that are not resistant.

Infection prevention and control is a priority for preventing health systems from being amplifiers of antimicrobial-resistant infections.



Source: Antimicrobial Resistance: Tackling a crisis for the health and wealth of nations. The Review on Antimicrobial Resistance. Chaired by Jim O'Neill, December 2014.

The Role of Touch Surfaces in Transmission of Infection and Spread of Antimicrobial Resistance

Until recently, the environment was widely considered by healthcare practitioners to be a minor component of infection prevention and control, but published studies have now shown the efficacy of good regular cleaning, as well as terminal deep cleaning of vacated rooms, to reduce microbial bioburden in hospitals with a concomitant reporting of reduced infection rates.

The environment not only serves as a reservoir of infection to be transferred by touch, but also as a pool of bacterial species between which genetic material can be transferred, including the genes for antibiotic resistance. The process by which this occurs is called horizontal gene transfer (HGT).

Imagine the scenario of an airport where an infected traveller with poor hand hygiene may arrive, touch various surfaces and deposit their resistant bacteria, and then someone from another part of the world adds their bacteria to the same surface. The resistance genes can be transferred on that surface to create a new, resistant strain.

Just as in the healthcare setting, cleaning these touch surfaces every hour is impractical. This is where a different approach is needed to boost regular cleaning and hand hygiene, round the clock. By employing an effective and durable antimicrobial material for high-touch surfaces, the chain of infection can be broken.

The Role of Copper in Reducing Transmission of Infection and Spread of Antimicrobial Resistance

Research has shown copper to be a powerful antimicrobial with rapid, broad-spectrum efficacy against bacteria, viruses and fungi. It shares this benefit with a range of copper alloys—such as brasses and bronzes—forming a family of materials collectively called 'antimicrobial copper'. In hospital trials, antimicrobial copper surfaces have been found to harbour >80% less contamination than non-copper surfaces[3].

In laboratory tests carried out under typical indoor conditions, copper alloys have been shown to be effective against many pathogens, including those with antibiotic-resistance:

- Methicillin-resistant *Staphylococcus aureus* (MRSA)[4,5]
- Multi drug-resistant *Tubercle bacillus*[6]
- Multi drug-resistant *Acinetobacter baumannii*[6]
- Vancomycin-resistant enterococcus (VRE)[7]
- Carbapenem-resistant Enterobacteriaceae (CRE)[8]
- ESBL-producing *Klebsiella pneumoniae*[9]
- ESBL-producing *E. coli*[9].

This efficacy translates into the clinical environment, as demonstrated in a multi-centre ICU trial[10] in the US. Six near-patient surfaces were upgraded to copper and sampling was undertaken weekly over a period of 23 months. Copper surfaces were approximately six times less likely to harbour MRSA or VRE than control surfaces. Based on the summative microbial burden measured for each of the surfaces sampled over the intervention period, the combined MRSA and VRE burdens were 96.8% lower on copper surfaces than on comparable plastic, wood, metal, and painted surfaces and were 98.8% lower on the bed rails, the most heavily burdened object.

In this US trial, the bioburden reduction was associated with a 58% reduction in infections[11].

Horizontal gene transfer in bacteria plays an important role in the evolution of antibiotic resistance, which has led to an increasing number of difficult-to-treat healthcare-associated infections. Research shows that, while HGT can take place in the environment—on frequently touched surfaces such as door handles, trolleys and tables made from stainless steel—copper prevents this process from occurring by rapidly killing bacteria on contact and destruction of plasmid and genomic nucleic acid[9].

Strategic deployment of antimicrobial copper touch surfaces significantly and continuously reduces the number of microbes on surfaces, reduces the risk of transmission of infection and prevents the transfer of antibiotic resistance between bacterial species on those surfaces, providing an additional tool for infection control and for tackling antimicrobial resistance.

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Further Information

Visit www.antimicrobialcopper.org to access scientific references, the York Health Economics Consortium business case model, copper in guidelines and ratings schemes, case studies, presentations and brochures. The key publications, shown below, are available to download from the website.

Publication 196: Reducing the Risk of HCAIs - The Role of Copper Touch Surfaces (a summary of the science with key references)
Publication 201: Antimicrobial Copper FAQs
Publication 212: Near-patient Antimicrobial Copper Touch Surfaces for Infection Control - The Business Case
Publication 213: Guidance on Cleaning and Disinfection
Publication 214: Antimicrobial Copper Alloys: Guidance on Selection (background engineering information)
Publication 219: Antimicrobial Copper: A Hospital Manager's Guide
Publication 220: Antimicrobial Copper: A Specifier's Guide
Publication 228: Antimicrobial Copper in Guidelines and Rating Systems.

Copper and copper alloys are engineering materials that are durable, colourful and recyclable and are widely available in various product forms suitable for a range of manufacturing purposes. Copper and its alloys offer a suite of materials for designers of functional, sustainable and cost-effective products.

Copper and certain copper alloys have intrinsic antimicrobial properties (so-called 'Antimicrobial Copper') and products made from these materials have an additional secondary benefit of contributing to hygienic design. Products made from Antimicrobial Copper are a supplement to, not a substitute for standard infection control practices. It is essential that current hygiene practices are continued, including those related to the cleaning and disinfection of environmental surfaces.

Notes

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