Press Release

Fighting hospital infections requires an integrated approach to hygiene systems and materials

Chemically and mechanically resistant stainless steel surfaces are best for ensuring long-term hygiene

According to the European Centre for Disease Prevention and Control (ECDC), hospital-acquired infections are among the greatest medical and economic challenges facing today's healthcare system. One in ten patients undergoing hospital treatment in the European Union becomes infected. Of the three million people suffering nosocomial (hospital-acquired) infections, 37,000 die of them. Germany is a case in point: according to research by the German Society of Hospital Hygiene (DGKH), over 500,000 patients become infected with one of the highly-resistant germs every year. All over the world, researchers and manufacturers of hospital equipment are making great efforts to find preventive measures against dangerous microbes. Currently, the oligo-dynamic (antimicrobial) effect of copper is being put forward as a universal weapon against difficult-to-fight germs on contact surfaces. However, stainless steel, the classic material, with its proven hygiene properties in medical environments, remains "state-of-the-art". According to a recent study by the Institute for Hygiene and Public Health (IHPH), at Bonn University, copper's antimicrobial properties do not justify an unrestricted, generalised recommendation of copper as a material for infection prevention.

Surface properties are the key factor

The dreaded phenomenon of hospital infection is caused by highly-resistant germs, which are becoming increasingly difficult to fight with conventional antibiotics. For antibiotics to have

an effect, they must penetrate the bacteria, to prevent the formation and proliferation of new cells. If frequently exposed to antibiotics, bacteria react by mutating into resistant variants. Five such germs are known to be among the most widespread causes of hospital infections: MRSA (Methicillin-resistant Staphylococcus aureus), ORSA (Oxacillin-resistant Staphylococcus aureus), VRSA (Vancomycin-resistant Staphylococcus aureus), VRE (Vancomycin-resistant enterococcus) and ESBL (Extended-spectrum beta-lactamase). The usual complications caused by MRSA infections are toxaemia, pneumonia and urinary-tract infections. Germs are mainly transferred by direct hand contact and there is a particularly high risk of contamination in hospitals and medical practices from door handles, light switches, bedposts, bedside tables and taps – on all of which germs can survive for quite some time. There has been extensive research not only into the systematic use of various cleansers and disinfectants but also into the nature of the surfaces on which bacteria can settle and by which they can be transferred. Man has been aware of the hygienic properties of copper since antiquity and today copper is recommended as a groundbreaking solution for the fight against hospital germs. However, this argument neglects certain factors. There are good reasons why stainless steel has become a preferred option wherever the utmost hygiene must be permanently and reliably ensured.

Long-term neutrality vs. the risk of resistance developing

A characteristic feature of stainless steel is its particularly smooth and inert surface, which does not release ions. In contrast, the undisputed biocidal effect of copper depends on its ability to release ions which, like antibiotics, can penetrate the bacteria and destroy the cells. However, it is not yet entirely clear if bacteria permanently exposed to copper can become resistant to this metal, in the same way as they can become resistant to antibiotics. It is consequently not certain that the biocidal effect of copper surfaces provides a suitable long-term solution in the race against the development of mutation-related resistance.

Smooth surfaces prevent dirt films

Stainless steel surfaces are scratch-resistant and abrasion-resistant. It is difficult for bacteria to adhere to them, even after many years of use. The antimicrobial effect of copper's ion release, however, can suffer in a number of ways. A first series of practical tests shows that the oligo-dynamic effects of the material decrease significantly over time. Sweat and dirt can form an impenetrable layer between the ion-releasing surface and the unwanted bacteria, preventing the ions from migrating into the bacteria. Surfaces frequently contacted by hands, such as doorknobs or light switches, are particularly prone to developing such films, which may block ion transfer. If, under long-term exposure, the ion-release is proved to decrease and the antibacterial effect to diminish, claims for the oligo-dynamic advantages of copper would lose their basis.

Mechanical resistance keeps surface roughness low

The hard and homogeneous nature of stainless steel surfaces makes it possible to maintain the highest standards of hygiene. In the case of copper, on the other hand, a soft alloy is usually needed to ensure a sufficiently high level of ion-release. The harder the coppery alloy, the lower its ion-release and the less its antibacterial effects. Compared with stainless steel, soft copper surfaces are significantly more prone to scratching. In the case of copper, it is difficult to avoid damage during the use and mechanical cleaning of frequently-touched surfaces, such as switches, handles and bedposts. Not only do the resulting dents and scratches make possible the adhesion of bacteria, they can even accelerate the phenomenon and make hygienic and regular cleaning difficult. In a typical hospital environment, this means a continually increasing level of surface roughness and risk of soiling, which again reduces the

efficiency of ion transfer. In contrast, the smooth surface of stainless steel resists high levels of mechanical stress over an extended period of time.

Germ-free and with no risk of patina formation
The passive layer of stainless steel is neither attacked by acids or alkali nor is there any chemical reaction between the metal surface and the cleaning agents. As a result, even after frequent cleaning of stainless steel, using disinfectants or cleansers, no bio-film containing residual germs is observed. Additionally, the inert stainless steel surface minimises interaction of the material with the environment, preventing unwanted reactions with oxygen from the air or the formation of rust. With copper, regular cleaning can lead to changes in the surface, which can be seen in the form of discoloration and the formation of a greenish patina. The oxidising and acidic cleansers typically used in hospital environments accelerate the formation of such a patina. This not only gives an impression of lack of hygiene but also actually reduces the cleanability of the surfaces and makes them less permeable for ions, causing a loss of their antibacterial effect.

Long-term cleanability better than fading ion release
The economic argument that the use of biocidal copper-containing surfaces makes it possible to reduce the use of disinfectants involves considerable risks. The factors discussed above make it clear that there is a possibility of the initial ion-release decreasing over time, for a number of reasons. This calls into question the consistently high antibacterial property claimed for copper surfaces. Decreasing efficiency of the disinfection process can lead to gaps in the disinfection chain. As the surviving germs can become resistant, this would even worsen the bacterial load.

Protective coatings are not a solution
As an alternative solution, the coating of stainless steel with copper or silver nanoparticles has been considered. This solution is not to be recommended. While the biocidal properties are initially good, they eventually diminish, as a consequence of a loss of thickness caused by cleaning and mechanical stress. The original antibacterial effect is progressively reduced. Copper-coated stainless steel is also less corrosion-resistant and coated stainless steel surfaces are neither a durable nor an economical approach.

Conclusion
The recent study shows that antimicrobial material properties alone are not a durable solution to multi-resistant hospital germs. Only the long-term mechanical and chemical stability of a material like stainless steel, however, can be the basis of consistently high levels of hygiene and aesthetic appeal. In combination with efficient cleaning and disinfection systems, the smooth and inert surfaces of stainless steel are so far the safest and most economical solution to ensure optimal protection against nosocomial germs.

The complete research report (in German) can be downloaded from the “Werkstoff/Info” section of the website http://www.edelstahl-rostfrei.de/

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