Published on *American Council on Science and Health* (https://www.acsh.org)

Copper-Lined Surfaces Hope to Stem Infections Spread

By Nicholas Staropoli — September 21, 2015

Hospital-acquired infections have received much attention in recent years, and with good reason: they are a significant contributor to morbidity and mortality. In 2011, over 700,000 people had a hospital-acquired infection, with 75,000 fatalities resulting from these nosocomial illnesses.

Alarmingly, many of these deaths stem from drug-resistant bacteria like Methicillin Resistant *Staphylococcus aureus* (MRSA) and Vancomycin-resistant *Enterococcus* (VRE). More needs to be done to combat this issue, and one solution outlined in the *Washington Post* [1] is to line medical surfaces with copper. Does this actually work? Let's just say the jury is still out.

Interestingly, *The Post* notes, that for thousands of years humans have used copper for its perceived antimicrobial properties. Copper (generally in the form of copper sulfate) has also long been considered an important fungicidal and bactericidal compound used in agriculture [2].

The Egyptians used it to sterilize water and chest wounds. The Greeks and Romans used it to treat burns and ear infections. Contemporary evidence has seemingly backed-up the practices of these ancient civilizations, particularly one double-blind study [3] from 2013 published in *Infection Control and Hospital Epidemiology*.

The study, performed at Medical University of South Carolina, Memorial Sloan Kettering Cancer Center and the Veterans Affairs hospital in Charleston, found that ICU rooms equipped with copper alloy surfaces had about 60 percent fewer colonies of MRSA and VRE.

The Post also reported that at least 15 hospitals, as well as airports, gyms -- and even some Chick-fil-A restaurants -- have installed some form of copper based antimicrobial equipment, in some cases spending tens of thousands of dollars to do so despite clear and compelling evidence of its effectiveness.

Copper does appear to have some antimicrobial powers. Some evidence suggests that the reaction of the metal with water creates free radicals, which can be damaging to carbohydrates,

proteins and lipids involved with the bacteria's structural integrity and normal metabolism. Other evidence points to a similar process, but instead copper reactions lead to the creation of the equally destructive hydrogen peroxide. Copper may also displace iron atoms, or compete with zinc for binding sites on vital bacterial proteins, leaving the proteins inactive or denatured. It is also known to deplete important amino acids like cysteine.

However, there's one question that remains unanswered: will resistance evolve to copper in the same way it has to most antibiotics?

Anytime the goal is killing a living organism, resistance is a possibility. This is simple natural selection: changing an environment forces organisms to adapt or die. Predicting if this will happen for copper, though, is difficult.

Some common bacteria already have mechanisms to live in areas of high-copper content: pumps on their outer membranes to remove copper ions before interior-cell damage can occur (a similar mechanism takes place with resistance to some antibiotics). Further, some bacteria can form spores in the presence of high copper that protect them from this environment, which allow them to later regerminate when conditions are more favorable.

Despite these mechanisms [4], some still scientists believe that copper surfaces will still be an effective antimicrobial agent. The bacteria that contain pumps do not thrive in the presence of copper, but merely survive longer in its presence than ones without the pump. Also, plasmids (small pieces of DNA that bacteria pass around that often contain antibiotic resistance genes) degrade in the presence of copper. This is important because often when a bacteria dies from an antibiotic, these plasmids can still be picked up by another bacteria.

In these cases the bacteria dies but resistance is still spread. Copper degrades both the bacteria and the plasmid, so even if a bacteria had a plasmid with copper resistance genes on it, it would degrade before spreading. Therefore, even if some get resistance, it's unlikely to spread in the way antibiotic resistance has.

On the other hand, we naively once thought that we found a silver bullet for bacterial infections, and were gravely wrong. Check back on this issue, because as we all know, life finds a way.
