Utilizing Antimicrobial Copper for Safer Communities

A review of how copper can reduce the spread of infection in health and public settings

Teck KPMG

Acknowledgements

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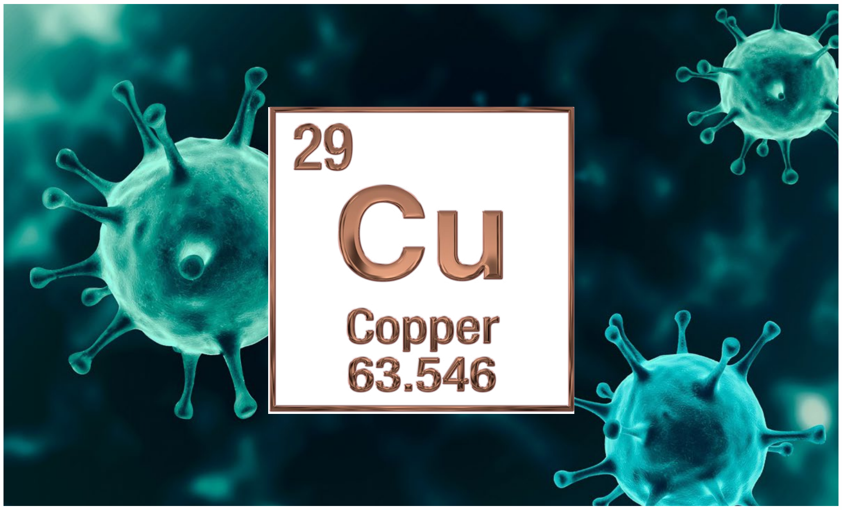
Executive Summary



- **There is ample evidence to support the role of surface contamination in the spread of communicable disease.** Public health and infection prevention and control agencies are now considering a multi-faceted approach preventing infection transmission, which includes additive measures to standard disinfection protocols, such as antimicrobial surfaces.

- **Multiple clinical studies have demonstrated the efficacy of antimicrobial copper** in killing bacteria and viruses, such as Hospital Acquired Infections (HAIs), and laboratory tests have shown that 99.9% of bacteria are killed within two hours or less of contact with antimicrobial copper surfaces.

- **The intrinsic and continuous broad-spectrum antimicrobial qualities of copper remain in effect for the product's lifetime** and do not diminish with tarnishing.

- Health Canada granted full registration for the sale and use of six different groups of antimicrobial copper alloys in July 2014 for infection prevention. **Copper is the only surface that has been approved and registered by Health Canada for its proven antimicrobial properties.**

- For the healthcare system, **antimicrobial copper can be incorporated into a wide variety of surfaces**, providing protection against HAIs for patients, staff, and visitors and generating long-term cost savings.

- **Copper can serve as a visual reassurance** to help restore public confidence and comfort in returning to in-person activities. It can also help protect the workplace from communicable disease transmission and the downstream impacts on employee absenteeism, work satisfaction, and productivity.

- **Antimicrobial copper has been implemented in many types of crowded indoor environments** and places susceptible to the presence of microorganisms, such as hospitals, long-term care, educational institutions, gyms and fitness centres, and transport infrastructure such as railway stations, bus stations, underground trains, and airports around the world.

- **Antimicrobial copper is safe**, does not require any special training for staff or maintenance other than routine cleaning, and is not dependent on electricity, adherence to protocol, or any other human behaviour.

01. Background

Surface contamination has been well-established as a source of communicable disease transmission

The COVID-19 pandemic has highlighted the impacts and risks of communicable disease transmission on a global level and the need for countries to implement more robust public health and infection prevention and control measures. During the pandemic, crowded indoor environments as well as places susceptible to the presence of microorganisms such as healthcare facilities and long-term care homes were some of the primary sites of outbreaks. While COVID-19 has been found to be transmitted mainly through respiratory droplets[1], **there is ample evidence to support the role of surface contamination in the spread of communicable disease**[2,3].

Most high-touch public surfaces have no antimicrobial properties, allowing pathogens to survive and multiply for months

Most high touch surfaces in schools, libraries, malls, public transit, communal residences, and workplaces are made out of plastic, wood, and stainless steel, which allow pathogens, such as *Methicillin-resistant Staphylococcus aureus, Vancomycin-resistant Enterococcus, Clostridioides difficile,* and *norovirus*, to survive and multiply for months[4]. One study found that four hours after planting a benign surrogate virus on the hands of a single employee in an 80-person office building, half of the staff and surfaces sampled tested positive for the virus[5]. **Therefore, public health and infection prevention and control agencies are now considering a multi-faceted approach to prevent infection transmission.** This includes additive measures to standard disinfection protocols such as antimicrobial surfaces.

Antimicrobial surfaces, such as copper, are an additive measure to prevent and control the spread of infections

02.
About Antimicrobial Copper

When bacteria land on copper, ions blast them, rupturing the cell membrane and destroying their DNA and RNA. This rapid killing mechanism prevents cells from replicating on copper surfaces and significantly reduces the amount of bacteria living on the surface, referred to as "microbial burden", which reduces the probability of mutations that lead to the development of drug-resistant superbugs[6,7]. Copper has been found to possess superior antimicrobial properties compared to other metals, such as silver[8].

Historically, copper's antimicrobial properties have been well known among ancient civilizations and copper was often used for skin ailments, wound healing, and water purification. Copper was first clinically investigated for its antimicrobial properties in 1983[9]. **Since then, multiple clinical studies have demonstrated the efficacy of antimicrobial copper in killing bacteria and viruses**[10,11,12].

Copper destroys the genetic material contained within bacteria that allows for replication, preventing the development of drug-resistant superbugs

Copper is one of earth's oldest metals, its use dating back more than 10,000 years

How Copper Kills Bacteria

Enters

Copper ions on the surface are recognized as an essential nutrient and enter the bacteria cell.

Disrupts

Copper ions interfere with normal cell functions and membrane integrity.

Kills

When excess copper binds to the enzymes, the bacteria can no longer breathe, eat, digest or create energy.

Source: CuVerro, Copper Development Association

History of Copper as an Antimicrobial Agent

2600-2200 B.C.

An Egyptian medical text describes the application of copper to sterilize chest wounds and drinking water[i]

1832

Copper workers are noted by scientists to be immune to a large-scale Cholera outbreak[ii]

1932

Continued use of copper in medical applications until the advent of antibiotics[ii]

1932-2008

- The study and use of copper as an antimicrobial agent remains underutilized in the medical setting for a long period of time[ii]
- First clinical investigation of copper as a biocidal surface material - 1983[iv]

2008

The U.S. Environmental Protection Agency recognizes copper as the first antimicrobial metal[iii]

2010

Trials of copper infused surfaces at hospitals in the United Kingdom, Germany and South Africa demonstrated the potent antimicrobial effects when incorporated into high touch surfaces[ii]

2013-2016

- Study showing reduction in HAI in ICU setting by 58%[v,vi]
- Largest clinical trial of antimicrobial copper surfaces in a hospital setting, proving high efficacy in reducing MRDO infections- 2013[vii]

2017-2020

Canadian Standards Association introduces first formal Canadian recommendation to introduce copper surfaces to reduce infection spread in hospitals[viii]

[i] Dollwet HH. Historic uses of copper compounds in medicine. Trace Elem. Med. 1985;2:80-7.

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[viii] https://www.teck.com/responsibility/approach-to-responsibility/global-citizenship/copper-&-health/

Laboratory tests have shown that 99.9% of bacteria are killed within two hours or less of contact with antimicrobial copper surfaces[13]. In fact, one study reported that just having a copper surface nearby reduced the microbial burden of the non-copper surface, referred to as the antimicrobial halo effect[14]. Copper has been found to be effective against several pathogens including *Methicillin-resistant Staphylococcus aureus, Vancomycin-resistant Enterococcus, Legionella pneumophila, Acinetobacter calcoaceticus-baumannii complex, M. tuberculosis* strains*, C. albicans, Clostrioides difficile, E. coli,* and *Enterococcus faecium*[15]. A recent study found that human coronavirus was also rapidly inactivated on a range of copper alloys[16].

99.9% of bacteria are killed within two hours of contact with antimicrobial copper surfaces

Copper has been found to be effective against several pathogens, including COVID-19

Features of Antimicrobial Copper

- **Continuous action:** In real-world settings, copper has been shown to provide continuous action in protecting surfaces, even during intervals in routine cleaning[17].
- **Easy Implementation:** Once installed, antimicrobial copper does not require any special training for staff or maintenance other than routine cleaning. It is not dependent on electricity, adherence to protocol, or any other human behaviour.
- **Safe:** Antimicrobial copper has been shown to be safe, with no documented cases of adverse health events or antibiotic resistance associated with exposure[18].
- **Durable:** The intrinsic and continuous broad-spectrum antimicrobial qualities of copper remain in effect for the product's lifetime[19] and do not diminish with tarnishing.

03.
Benefits of Antimicrobial Copper

Copper can be incorporated in healthcare settings to protect against healthcare acquired infections

Copper is the only metal approved by Health Canada to be used for its antimicrobial properties

The Canadian Standards Association recommends that healthcare facilities introduce copper surfaces as a method of preventing infection transmission

Copper can be incorporated into a wide variety of surfaces in healthcare settings through surface replacement or coating, providing protection against healthcare acquired infections (HAIs) for patients, staff, and visitors and generating long-term cost savings for the healthcare system. This includes door handles, bed rails, overbed tables, IV poles, lavatory components, work surfaces, pens, and stethoscopes. **To date, antimicrobial copper surfaces have been installed in more than 300 healthcare facilities** around the world in order to combat HAIs. Installations have mainly taken place in Intensive care units (ICUs), cancer centres, long-term care homes, and other high-risk settings.

While Canada has been slower than a number of other countries in adopting antimicrobial copper as an infection control measure, Health Canada granted full registration for the sale and use of six different groups of antimicrobial copper alloys in July 2014. In March 2020, the Canadian Standards Association (CSA) published the first national standard in Canada related to the cleaning and disinfection of healthcare facilities. The standard will improve healthcare cleaning procedures and encourage innovative approaches that are being increasingly adopted around the world. **The CSA standards include the first formal recommendation in Canada to introduce copper surfaces as a means to reduce the spread of infection in hospitals**[20].

Reducing Healthcare Associated Infections

In Canadian healthcare organizations, it is estimated that one in nine adults have an HAI at any given time and more than 8,000 die each year as a result[21]. HAIs are caused by a wide variety of bacteria, viruses, and fungi acquired while receiving care or treatment in a healthcare environment. This includes antibiotic-resistant bacteria such as *Methicillin-resistant Staphylococcus aureus, Vancomycin-Resistant Enterococcus, and Escherichia coli,* as well as community pandemic virus outbreaks such as COVID-19[22].

Typical healthcare surfaces have no antimicrobial effects and one study found that at any given time up to 70% of hospital surfaces were contaminated with MRSA or VRE[23]. Surfaces in healthcare environments are often quickly re-contaminated after cleaning[24] and over 50% are inadequately cleaned altogether, even when standard infection control measures are employed[25,26].

One in nine Canadian adults will acquire an infection while receiving care or treatment in a healthcare environment

Surfaces in healthcare environments are often inadequately cleaned and quickly re-contaminated

A large multi-site clinical trial found antimicrobial copper implementation led to 83% fewer *C. difficile* infections and 78% fewer multi-drug resistant organism infections

HAIs led to greater healthcare costs through increased length of hospitalization, readmission rates, and patient morbidity and mortality

Economic analyses and clinical studies have predicted that implementing antimicrobial copper could reduce HAIs by about 20%, which could translate into substantial savings for the healthcare system

Several studies around the world have established the preventative effects of antimicrobial copper on HAIs in real-world settings, including a primary care clinic in South Africa[27], an acute medical ward in the U.K.[28,29], and an ICU in Chile[30]. In 2013, the world's largest known clinical trial was conducted in an American hospital that installed more than 15,000 horizontal square feet of antimicrobial copper in a new wing. Patients in this trial were randomized into either the new wing with copper surfaces or an older wing with standard surfaces, and the rate of HAIs was measured in both groups. The study's results showed that patients in the new wing had 83% fewer *C. difficile* infections and 78% fewer multi-drug resistant organism infections compared to those treated in the standard wing[31].

These findings are further supported by a systematic review and meta-analysis published in 2017, which found that the use of antimicrobial copper had the potential to reduce the incidence rate of HAIs[32]. While all of the studies mentioned above provide substantial evidence for the efficacy of antimicrobial copper for infection prevention in clinical settings, more research is needed to strengthen the evidence base as many confounders are present in real-world healthcare settings that make it difficult to establish causation[33].

Cost savings

HAIs result in greater healthcare costs through prolonged hospitalization and higher readmission rates, as well as significantly increased patient morbidity and mortality[34]. **A Vancouver-based study found that VRE infections increased mean hospital costs by 62% to reach as high as almost $18,000 per patient per hospital stay[35].** With more than 220,000 cases of HAIs seen in Canadian hospitals each year, the resulting costs to the healthcare system are estimated to be up to $4 billion dollars annually[36]. While the exact extent of antimicrobial copper's impact on HAIs has yet to be established, any reduction in infections would translate into substantial savings for the Canadian healthcare system[37]. Reductions in HAIs may lead to "avoidance costs" of long-term morbidity and potential patient mortality. **Moreover, there may be indirect impacts such as improving patient quality of life and economic productivity through reducing time away from work for both health-care providers and staff.** Although cost-savings projections for installing antimicrobial copper in Canadian health -care facilities are currently unavailable, two assessments conducted in other countries found:

- The Copper Development Association carried out an economic assessment in the United States that predicted that installing antimicrobial copper in hospitals would result in about 20% fewer HAIs, which could translate into an annual cost savings of US$7.2 million[38].
- An economic assessment undertaken in the U.K. predicted that installing antimicrobial copper in ICUs would lead to fewer infections and therefore shorter length of stays, allowing the initial costs of installing antimicrobial copper to be recouped in less than two months and an estimated savings of almost £2 million realized over five years[39].
- A clinical study of copper-impregnated linens conducted in a 35-bed long-term care brain injury ward in Israel found a 24% reduction in HAIs, which resulted in saving of approximately 27% through cost reductions in antibiotic use and other treatments, X-rays, disposables, labour, and laundry[40].

Rebuilding Public Confidence

COVID-19 has caused many to fear public spaces, leading to consumer habits and recreation patterns being upended across the globe. Personal safety has emerged as a key decision-making factor among Canadians[41]. **Implementing antimicrobial copper may serve as a visual reassurance that a company, organization, or government is prioritizing safety, helping to restore public confidence and comfort in returning to in-person activites.**

Boosting Productivity

Workplaces are often a source of communicable disease transmission and for many employees, returning to the post-pandemic workplace may induce feelings of anxiety about inadequate cleaning, poor air quality and sharing high-touch surfaces with co-workers. **Implementing antimicrobial copper can help protect the workplace from infection transmission and help employees feel comfortable with returning to in-person work.**

Promoting Sustainability

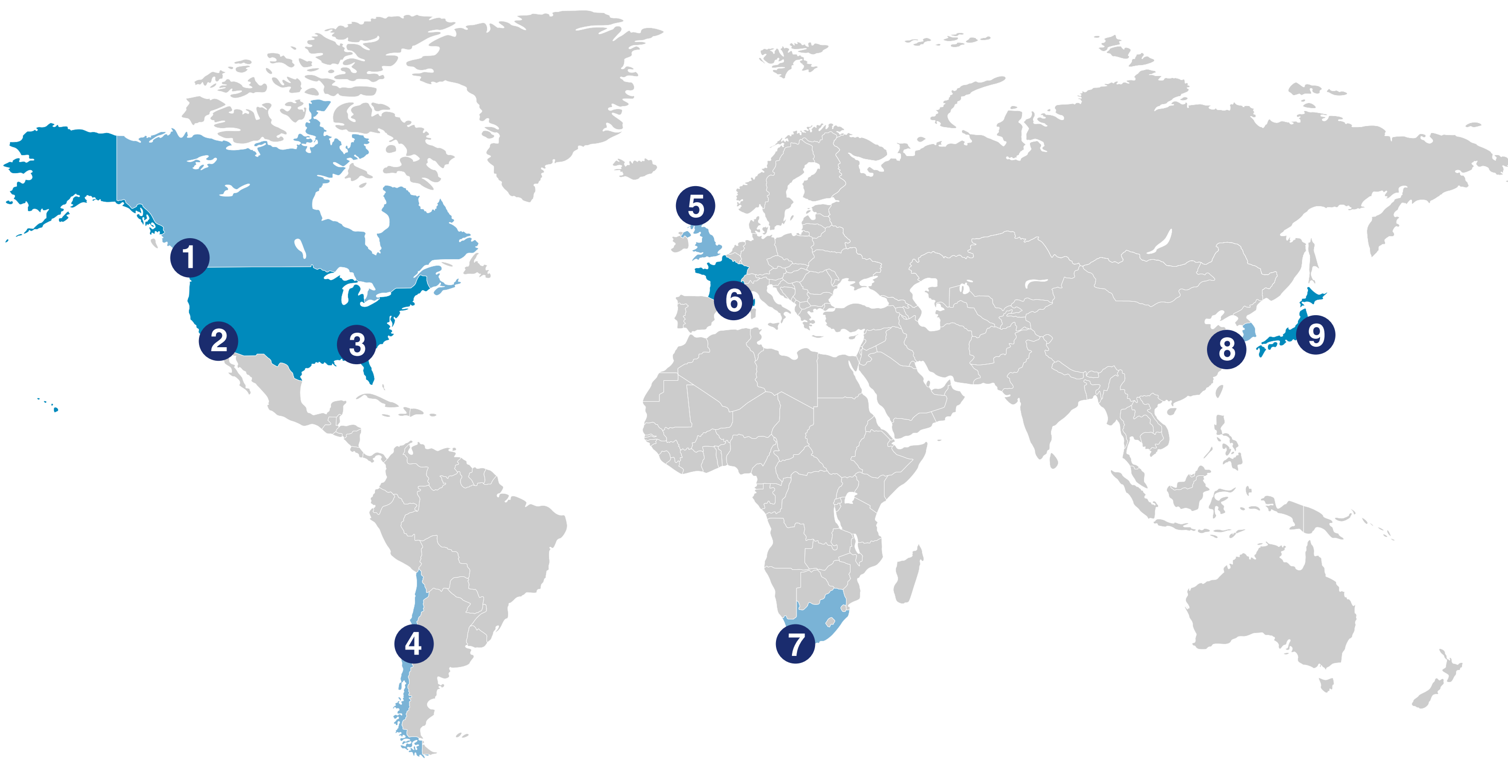
Copper has been shown to have continuous broad-spectrum antimicrobial activity that is expected to remain in effect for the product's lifetime[42], leading to **lower resource utilization and a high return on investment.** Moreover, copper is 100% recyclable and minimal amounts are needed for a product to reach antimicrobial efficacy, thus providing a sustainable conservation model and creating circular economic impacts.

04.
Proposed Use Cases

Use Cases

- **Hospitals** pose a major challenge to infection prevention and control, especially in clinical settings where the most high-risk patients are treated, such as emergency departments and ICUs.
- **Residents of long-term care homes** are especially at risk of acquiring HAIs due to their dependence on care, sharing of facilities with other residents, and living in a confined environment.
- **Schools, colleges, daycares, and other educational institutions** often have children and young adults congregate in enclosed indoor spaces, leaving them exposed to bacteria and viruses.
- **Gym and fitness centres** are ideal locations for bacteria to thrive due to the high humidity. Gym equipment in particular has a high potential to become contaminated with bacteria due to its high-touch nature.
- **Transport infrastructure** such as railway stations, bus stations, underground trains, and airports pose a high risk of exposure to airborne pathogens and downstream transmission of disease due to factors such as high population density, crowded and confined indoor environments, and the interconnectedness of transport networks.

International Examples of Antimicrobial Copper in Action



1. Post-secondary institutions in Vancouver, B.C.
2. Fitness Centre in Toyota Sports Center in Segundo, California
3. Water filling stations in Atlanta International Airport, Georgia
4. Santiago Bueras subway station in Maipu, Chile
5. Acute medical ward in Birmingham, England
6. Long-term care home in Reims, France
7. Primary care clinic in Grabouw, South Africa
8. Mejiro Daycare Centre in Hachioji, Japan
9. Tosilae restaurants in South Korea

Hospitals

HAIs pose a significant burden to Canadian hospitals, resulting in greater healthcare costs through prolonged hospitalization, higher readmission rates, and significantly increased patient morbidity and mortality[43]. One study conducted across three hospitals in Toronto, Ontario, found greater bacterial colonization on hospital elevator buttons than on toilets, including *Staphylococcus, Streptococcus*, and fungi[44]. Several hospitals around the world have implemented antimicrobial copper, examples can be found in the “Reducing Healthcare Associated Infections” section on page 11.

Within hospitals settings, clinical environments where the most high-risk patients are treated, such as emergency departments and ICUs, pose a major challenge for infection prevention and control. While there is no data available to determine the burden of HAIs directly attributable to emergency departments, the invasive procedures performed in this setting place patients at risk of contracting infections[45]. Several local hospitals in Vancouver, British Columbia (including St. Paul’s, Lions Gate and Kooteney Boundary Regional Hospitals) have implemented or are in the process of implementing antimicrobial copper in emergency departments and other high-risk clinical areas[46,47,48].

Patients in intensive care units are also at a higher risk for HAIs, due to their length of stay, compromised immune systems, and frequent interactions with healthcare workers. Examples of ICUs around the world that have implemented antimicrobial copper include:

- Three hospitals in South Carolina and New York placed copper on six common, highly touched objects in ICU rooms as part of a randomized controlled trial that included 414 patients. Researchers found that this reduced the risk of HAIs by more than half at all study sites[49].
- A Chilean ICU outfitted 594 high-contact surfaces with copper across 54 rooms and found a 74–88% reduction in microbial burden compared to 54 control rooms[50].

Long-Term Care

Long-term care was disproportionately affected during the COVID-19 pandemic, highlighting the need for better infection control in this setting to ensure that residents feel safe in their homes and maintain a high quality of life. The risk of HAIs increases linearly with age and elderly populations aged over 65 years have a higher risk of experiencing a more severe disease course following infection than any other age group[51].

Residents in long-term care homes are especially at risk of acquiring HAIs due to their dependence on care, sharing of facilities with other residents, and living in a confined environment[52]. The overall burden of HAIs in long-term care homes is now estimated to exceed that of acute care facilities[53]. Several long-term care units and homes around the world have implemented antimicrobial copper. Some examples include:

- A long-term care unit in Israel implemented copper-impregnated linens, patient gowns and towels and found a significant reduction in indicators of HAIs (e.g. fever) and antibiotic

utilization as part of a crossover, double-blind controlled study of 112 chronic ventilator-dependent patients[54].

- A long-term care home in France outfitted a new wing with copper hard surfaces and found that there was significantly less (RR=0.3) hand-transmitted HAIs compared to a regular wing as part of a prospective observational pilot study of 556 residents[55].
- The Glebe Centre, a long-term care facility in Ottawa, recently implemented copper wrappers on high-touch surfaces; the Director of Environmental Services stated that, "we installed 1,000+ patches on our door handles and elevator handrails to extend the effects of our cleaning efforts. We regularly get comments about how impressive this initiative is from an IPAC perspective"[56].

Educational Institutions and Daycares

Schools, colleges, day cares, and other educational institutions often have children and young adults congregate in enclosed indoor spaces, leaving them exposed to bacteria and viruses. Daycare centers in particular are hot spots for contamination given the lack of hygiene habits among very young children. A study conducted across Danish day care centres found coliform and nasopharyngeal bacteria and respiratory and gastrointestinal viruses present on several surfaces as well as toys and pillows[57].

Several educational institutions and day cares around the world have implemented antimicrobial copper. Some examples include:

- Mejiro Daycare Center in Hachioji, Japan, installed antimicrobial copper on a range of high-touch cut surfaces, including basins, taps, door push plates and handles to meal-serving benches and carts[58].
- A number of post-secondary institutions in British Columbia — including British Columbia Institute of Technology, Simon Fraser University and the University of British Columbia — installed nearly 3,000 antimicrobial copper patches in high-traffic areas throughout their campuses to improve safety for students returning to campuses[59].

Gyms & Fitness Centres

Gyms and fitness centres are ideal locations for bacteria to thrive due the high-humidity environment. Gym equipment in particular has a high potential to become contaminated with bacteria due to their high-touch nature. **One study of metropolitan fitness centres in Memphis, Tennessee, found that staphylococci was present on the majority of surfaces**[60]. Several gyms and fitness centres around the world have implemented antimicrobial copper. Some examples include:

- The Los Angeles Kings installed dumbbells and attachments made with antimicrobial copper surfaces in their strength and training facility in the Toyota Sports Center in California[61].
- The Ahrens Fitness Center in Iowa installed products made from antimicrobial copper in an effort to supplement infection prevention practices[62].

Transportation

Transport infrastructure such as railway stations, bus stations, underground trains, and airports pose a high risk of exposure to airborne pathogens and downstream transmission of disease due to factors such as high population density, crowded and confined indoor environments, and the interconnectedness of transport networks[63]. Several countries around the world have implemented antimicrobial copper on public transit, including:

- The Santiago Bueras subway system in Chile installed 350 metres of antimicrobial copper and is planning on adding 10,000 metres of copper to handrails in its new stations, to provide public transportation users an additional level of safety[64].
- In Canada, Vancouver and Toronto transit authorities are testing the efficacy of antimicrobial copper on high ridership routes on buses, trains, and streetcars, following a successful pilot phase on Vancouver transit that supports copper's ability to kill up to 99.9% of bacteria on transit surfaces[65, 66].
- The Hartsfield-Jackson International Airport in Atlanta installed over 50 water bottle filling stations made from antimicrobial copper[67].

05. Operational Considerations

Regulatory Status

Health Canada granted full registration for the sale and use of six different groups of antimicrobial copper alloys in July 2014 for infection prevention[68]. Antimicrobial copper is the only surface that has been approved and registered by Health Canada for its proven antimicrobial properties. The U.S. Environmental Protection Agency (EPA) approved the registration of copper as a material with antimicrobial properties that can kill >99.9% of bacteria within 2 hours of exposure, as well as viruses, including SARS-CoV-2, making copper the only metal can be used in the United States about which public-health claims can be made with regards to reducing bioburden[69].

Implementation

Copper Formulations

Copper can be incorporated into high-touch surfaces in a variety of ways, including replacing high-touch surfaces with integral copper or covering these surfaces with a functional copper surface or coating. A study conducted in four large Canadian hospitals reported on the durability of three typical copper alloy surfaces and found that integral copper had the greatest antimicrobial efficacy and durability compared to spray-on and copper-impregnated surfaces[70].

Surface selection

While Health Canada and the U.S. Environmental Protection Agency have established standards on how registered antimicrobial copper products may be used in various settings, more work is needed to better understand which high-touch surfaces would benefit most from its installation. A pilot study on the impact of copper in Bone Marrow Transplant units in Vancouver General Hospital found that it was best used where a) compliance with cleaning was suboptimal, b) bacteria are an issue, c) integral products or functional copper surface or coating can be applied[71]. Input should be sought from the local infection-control team and other experts to identify all high-touch surfaces specific to the setting that would benefit from antimicrobial copper.

Installation

Although professional installation of antimicrobial surfaces would mean that the space may have to temporarily close, **copper implementation does not require any special training, ongoing maintenance, or disruption to services after installation**. Implementing antimicrobial copper surfaces into new

infrastructure and equipment is expected to be easier than retrofitting existing surfaces[72]. For hospitals, installation advice is available through the Coalition Healthcare Acquired Infection Reduction (CHAIR) Canada, a non-profit organization (CHAIRCanada.org).

Maintenance

Most standard cleaning and disinfectant products can be used to clean copper, with the exception of Ethylenediaminetetraacetic acid (EDTA), which can reduce copper's efficacy, as well as advanced and accelerated hydrogen peroxide, which may have an effect on the look of the product[73]. Manufacturers' Instructions for Use (MIFU) procedures for copper products should be followed.

Effectiveness

While copper has been proven to eliminate bacteria, its effects are not instantaneous and can take up to two hours to fully kill any bacteria that lands on its surface. Therefore, **copper should be used as an additive measure to a comprehensive cleaning regimen**, as hand washing and other public health guidance should still be practiced.

06. Opportunities

Acting on salient learnings from the COVID-19 pandemic and ongoing evidence around infection risk factors, organizations are placing greater emphasis on the control of bacteria and viruses through modifications and improvements to built environments. Based on the scientific evidence and real world case studies, the application of antimicrobial copper on high-touch surfaces may provide a complimentary solution to bolster regular infection control measures. It is currently the only surface approved for such uses by Health Canada and is supported by a growing array of registered products.

Organizations may consider taking the following actions to advance the deployment of antimicrobial copper in their specific built environments:

1. **Undertake a targeted pilot project** on a specific environment, infrastructure, or equipment class utilizing registered antimicrobial copper products. This approach may include identification and assessment of a high-traffic space for high-touch surface opportunities, coordination with Health Canada-approved suppliers to install antimicrobial copper products, and measurement of results in terms of antimicrobial efficacy, cost-benefit for the organization, and increases in public acceptance/perception of antimicrobial copper for attitudes around safety and comfort. The findings from pilot projects may enable organizations to scale the use of copper products in multiple environments.

2. **Develop new or amend existing design specifications** for operational environments to include the consideration of antimicrobial copper. This approach may target situations where an organization is building new environments or renovating existing environments in a repeatable and scalable fashion.

3. **Build organizational literacy** on the importance of infection control and the value of improving built environments as a solution, by taking advantage of publicly available educational materials, direct engagement with infection control experts, or consultation with product manufacturers or representatives.

4. **Allocate or direct dedicated additional funds** for innovation within built environments to support the activities outlined above, as well as assist in defraying additional expenses that may be incurred in implementing new enhancements such as antimicrobial copper.

Case Study: Vancouver and Toronto Transit

In November 2020, a pilot project was launched in Vancouver, Canada in which various forms of copper protection were installed on frequently touched surfaces on two buses and two SkyTrain cars. During the four-week pilot, the copper surfaces were swabbed twice a week to test for the presence of bacteria. The research team's findings supported copper's ability to kill up to 99.9% of bacteria on transit surfaces. In September 2021, phase two of this pilot was announced, expanding it to a year-long study to include the Toronto Transit Commission. This study will include more buses and SkyTrains in Vancouver as well as buses, subway cars, and street cars in Toronto. This joint project includes additional in-lab research examining copper's effectiveness at killing viruses such as colds and flus.*

Appendix

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