Your New Weapon in the Fight Against Hospital-Acquired Infections: Antimicrobial Copper

James H. Michel
Manager, Technical Services
Copper Development Association

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Webinar Title and Time

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Thank you for attending today’s Webinar. The program will start at 1:00pm CT.
Presenter

James H. Michel
- M.S. Metallurgical Engineering
- Over 39 years experience in non-ferrous metals industries
- Metallurgy instructor for the American Society of Materials
- Authored various articles on the antimicrobial property of copper
Panelist

Harold Michels, PhD.

- PhD. Materials Science, New York University
- Initiated Antimicrobial Copper research program in 2001
- Co-authored numerous papers on the antimicrobial properties of copper
Copper Development Association

- Not-for-profit trade association representing the U.S. copper industry
- Provide education and training
- Technical material data
- www.copper.org
What is Antimicrobial Copper

Healthcare surfaces are dirtier than you think

Antimicrobial copper surfaces kill bacteria that cause Hospital-Acquired Infections

Available Products
Copper

- Color: copper, metallic
- Properties:
  - Ductile
  - Malleable
  - High thermal Conductivity
  - High electrical Conductivity
  - Easily alloyed
  - Good corrosion resistance
  - Antifouling
  - Readily available
  - Highly recyclable

- Antimicrobial
What is Antimicrobial Copper?

Solid, copper-based metal alloys (e.g. brass, bronze)

Bent, formed, welded, cast, stamped, etc.

Durable, environmental surfaces

Not a coating or surface treatment!
What is Antimicrobial Copper?

U.S. quarters, dimes and nickels are made from copper alloys.
Man Has Used Copper’s Antimicrobial Properties Safely for Centuries

- Humankind’s oldest metal: early uses include water transportation, coins, jewelry, weapons, and more
- Long before the germ theory of disease was developed, civilizations used copper to kill disease-causing organisms
  - Egypt (2000 BC) – purify drinking water and treat wounds
  - Hippocrates (400 BC) – Treat leg ulcers related to varicose veins
  - Aztecs – Copper oxide and malachite for skin conditions
- Most copper in circulation today is recycled
Antimicrobial Copper surfaces not only help combat pathogens, they can be recycled, again and again, without any loss of performance, helping to conserve our planet’s resources.
Agenda

What is Antimicrobial Copper

Hospital surfaces are dirtier than you think

Antimicrobial copper surfaces kill bacteria that cause Hospital-Acquired Infections

Available Products
Hospital-acquired infections result in substantial loss of life, a significant decrease in the quality of patient care, and add an additional cost to the US healthcare system of $45 billion dollars.
Putting the HAI Problem into Perspective

Annual loss of life from HAI’s in America is equivalent to one jumbo jet full of passengers crashing EVERY DAY!
“The built environment in hospitals [furnishings, equipment, hardware, and more] likely accounts for at least 50% of the HAI’s seen in the Medical Intensive Care Units.”

Dr. Michael G. Schmidt
Medical University of South Carolina
WHO 1st International Conference on Prevention & Infection Control
July 1, 2011, Geneva
Cleaning Has Always Been Taken for Granted

- Cleaning has never been regarded as an evidence-based science
- Measuring the cleaning process and its impact on the environment can be inconclusive.
- Current terminal cleaning practices (scrubbing, HP, UV) carry additional cost and are one time use

- We cannot see the enemy until
Even Though This Surface Had Just Been Cleaned…. 

Infectious microorganisms can survive in scratches on disinfected surfaces such as stainless steel and plastics.
Poll Question
Antimicrobial Copper Can Aid in the Fight Against HAI’s

- 80% of infectious diseases transmitted by touch
  - (Tierno, 2001)

- Organism can survive on surfaces for up to:
  - MRSA: 7 months
  - VRE: 4 months
  - *C. difficile* spores: 5 months
  - Rotavirus: 60 days
Bacterial quickly re-contaminate surfaces post cleaning and disinfection

Bacterial burden on bed rails before and after sanitization.

Attaway, et. al. Am. Journal of Infection Control, Published Online February 2012
Agenda

What is Antimicrobial Copper

Healthcare surfaces are dirtier than you think

Antimicrobial copper surfaces kill bacteria that cause Hospital-Acquired Infections

Available Products
Antimicrobial Copper Kills Methicillin-Resistant *Staphylococcus aureus* (MRSA)
**E. Coli O157:H7 Viability**

**Stainless Steel**

0 minutes

31,300,000 CFUs

**Solid Copper**

31,400,000 CFUs

Epifluorescence Images after Staining with Viability Fluorophore CTC
**E. Coli O157:H7 Viability**

<table>
<thead>
<tr>
<th>Surface</th>
<th>Time</th>
<th>Viability (CFUs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless Steel</td>
<td>30 minutes</td>
<td>26,899,425</td>
</tr>
<tr>
<td>Solid Copper</td>
<td></td>
<td>1,600,000</td>
</tr>
</tbody>
</table>

Epifluorescence Images after Staining with Viability Fluorophore CTC
**E. Coli O157:H7 Viability**

Stainless Steel | 60 minutes | Solid Copper

- **25,933,468** CFUs
- **2,740** CFUs

Epifluorescence Images after Staining with Viability Fluorophore CTC
**E. Coli O157:H7 Viability**

- **Stainless Steel**
  - 120 minutes
  - 21,066,000 CFUs

- **Solid Copper**
  - <0.01% CFUs

Epifluorescence Images after Staining with Viability Fluorophore CTC
**E. coli** survives on stainless steel over 28 days
Antimicrobial Copper prevents the build-up of disease-causing bacteria*

8 inoculations over 24 hrs, no cleaning in between

*Laboratory testing shows that, when cleaned regularly, Antimicrobial Copper surfaces kill >99.9% of MRSA, VRE, Staphylococcus aureus, Enterobacter aerogenes, Pseudomonas aeruginosa, and E. coli O157:H7 within 2 hours
Antimicrobial Copper prevents the build-up of disease-causing bacteria*

Antimicrobial Copper

Stainless Steel

MRSA (CFU’s)

![Graph showing bacterial count over time for Antimicrobial Copper and Stainless Steel](image)
40+ Peer-Reviewed & Published Papers

Potential use of copper surfaces to reduce survival of epidemic meticillin-resistant *Staphylococcus aureus* in the healthcare environment

J.O. Noyce a,*, H. Michels b, C.W. Keevil a

a Environmental Healthcare Unit, University of Southampton, Southampton, UK
b Copper Development Association Inc., New York, NY, USA

Received 25 April 2005; accepted 6 December 2005
Available online 2 May 2006
U.S. EPA public health registration for solid, copper alloys (Antimicrobial Copper)

- Groundbreaking registration(s)
- Claims against 6 pathogens
  - Staphylococcus aureus
  - Enterobacter aerogenes
  - Escherichia coli O157:H7
  - Pseudomonas aeruginosa
  - MRSA
  - VRE
- First class of solid surfaces to obtain this form of registration
EPA registration - significance

Antimicrobial Copper surfaces:

- Provide continuous antimicrobial action

- Supplements routine cleaning and disinfection

- Kill bacteria* between routine cleanings

Disinfectants and sanitizers only work when applied

*Laboratory testing shows that, when cleaned regularly, Antimicrobial Copper surfaces kill >99.9% of MRSA, VRE, Staphylococcus aureus, Enterobacter aerogenes, Pseudomonas aeruginosa, and E. coli O157:H7 within 2 hours
“[Antimicrobial Copper has] been rigorously tested and [has] demonstrated antimicrobial activity. After consulting with independent organizations – the Association for Professionals in Infection Control and Epidemiology (APIC) and the American Society for Healthcare Environmental Services (ASHES) – as well as a leading expert in the field (Dr. William A. Rutala, Ph.D., M.P.H.) the Agency has concluded that the use of these products could provide a benefit as a supplement to existing infection control measures.”

- U.S. Environmental Protection Agency*

*http://www.epa.gov/pesticides/factsheets/copper-alloy-products.htm
Infection control is a multifaceted challenge

- Antimicrobial Copper needs to be seen as a supplement to, not a substitute for, standard infection control practices.
- One must continue to follow all current practices, including those practices related to cleaning and disinfection of environmental surfaces.
- Antimicrobial Copper alloy surfaces must not be waxed, painted, lacquered, varnished, or otherwise coated. The alloys tarnish to varying degrees, which does not impair their antimicrobial efficacy.
Poll Question
MRSA on Antimicrobial Copper and silver based coatings

22 C and 50% relative humidity

Indistinguishable:
- Stainless Steel (control)
- Silver coating A
- Silver coating B

## Antimicrobial Copper vs. Silver-Based Coatings

<table>
<thead>
<tr>
<th></th>
<th>Antimicrobial Copper</th>
<th>Silver-containing Coatings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legally permitted to make public health claims</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Continuously Kills Bacteria (in typical indoor environments)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Never Wears Out (ongoing action)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Safe to Use (recyclable)</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

Silver-containing coatings have a “Treated Article Exemption” with EPA which only allows product protection claims. EPA does not require data for this exemption.
Three-Hospital ICU Clinical Trial

- Funded by the Department of Defense
- Sites:

- CDA provided materials procurement support only
Hypotheses:

- Antimicrobial Copper touch surfaces will lower total bacteria in hospital rooms
- Less bacteria = lower risk of infections
- Lower infections = saved lives, reduced treatment costs

Testing the Performance of Antimicrobial Copper Surfaces in the Clinical Setting

Medical Intensive Care Units

- **Phase 1**
  - Determine the baseline bio-load on 6 objects in patient rooms
  - **December 2007**

- **Phase 2**
  - Compare bio-load on copper vs. non-copper objects

- **Phase 3**
  - Measure infection rates of patients in copper vs. non-copper rooms
  - **June 2011**
Phase 1: Selection of Surfaces to Sample

**Surfaces Selected**
- Bed rails
- IV stands
- Over-bed tray tables
- Data input devices (mouse, laptop, touch screen monitor bezel)
- Visitor’s chair (arms)
- Nurses’ call device

**Surfaces Screened but not Selected**
- Laundry hamper
- Door hardware
- Drawer pulls
- Faucet handles
- Keyboards
- Soap/EtOH dispenser
- End table surface
Sampling the built environment

- 100 cm² sterile templates placed over tested surfaces
- Exposed area wiped in a vigorous side to side motion using five strokes both ways (ten total) applying even pressure
- Bacteria liberated from wipe and plated
Phase 1 results: Bio-load Evaluation (Non-Copper Surfaces)

For All Rooms over 318 weeks, 1,113 rooms, 12,058 surfaces

Schmidt et. al. Journal of Clinical Microbiology, 2012, 50(7):2214
Phase 1 Results: Principle observations

Clinical environments carry an average microbial burden 35 times higher than the levels commonly accepted as benign (under 500 CFU/100cm² - Dancer, 2004 and Malik, 2003)
Phase 2: Antimicrobial Copper Products Installed

- Bed rails
- Nurse’s call device
- Data Input Monitor
- Mouse
- Over-bed tray table
- Visitor’s chair
- Laptop
- IV Pole
Phase 2 Results

Comparative Bacterial Load, US Trials

- **Standard Components**
- **Copper Components**

*Plastic, wood, stainless, chrome, laminate*

<table>
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<tr>
<th>Risk</th>
<th>CFU/100cm²</th>
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<tbody>
<tr>
<td>Bed Rails</td>
<td>441</td>
</tr>
<tr>
<td>IV Pole</td>
<td>1,060</td>
</tr>
<tr>
<td>Chair Arm</td>
<td>3,093</td>
</tr>
<tr>
<td>Tray Table</td>
<td>717</td>
</tr>
<tr>
<td>Monitor</td>
<td>331</td>
</tr>
<tr>
<td>Nurse Call</td>
<td>1,286</td>
</tr>
</tbody>
</table>

For All Rooms over 185 Weeks of Sampling, US Hospitals

250 CFU/100cm²
Phase 2 Results: Principle observations

Copper surfaces consistently achieved the **terminal cleaning standard** of 5 Aerobic Colony Forming Units/cm² during clinical care.

MRSA was only isolated once from 3,384 copper surfaces… a **greater than 99.9% reduction** vs. ICU control surfaces. (30 CFU/100 cm² vs. 29,029 CFU/100 cm²)
Antimicrobial Copper’s Performance in ICU Rooms Supported Hypothesis

Average reduction on copper surfaces compared to controls:

Bioburden: 83%

Schmidt et. al. Journal of Clinical Microbiology, 2012, 50(7):2214
Phase 3: Investigating impact on Hospital Acquired Infections

- Strategy: Assess outcomes of patients in rooms containing the copper objects and correlate the environmental burden against the outcome.

- Average patient was exposed to 75% of the maximum “dose” in the copperized rooms and saw 2.8% of the copper “dose” in the non-copper rooms
  - Components move
  - Bariatric beds
  - Routine maintenance

- Large sample size (N=614) to achieve statistical significance
Phase 3 preliminary results*:

Infection-acquisition risk measurement

Study results will be submitted to U.S. EPA for review and approval. Individual results may vary. Infection reduction claims for antimicrobial copper surfaces are not permitted at this time.

*Schmidt, Michael G. “Copper Surfaces in the ICU reduced the relative risk of acquiring an infection while hospitalized”, Slide Session: Innovative Approaches to Infection Controls, WHO 1st International Conference on Prevention & Infection Control, July 1, 2011, Geneva
Phase 3 preliminary results*: 

*Infection-acquisition risk measurement*

This particular study found:

- **40% reduction** in the risk of acquiring an infection (p=0.039, n=651) for patients in rooms where some copper objects travelled out.

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- **61% reduction** in the risk of acquiring an infection (p=0.006, n=541) for patients in rooms with copper rails and some copper objects travelled out

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- **40% reduction** in the risk of acquiring an infection (p=0.039, n=651) for patients in rooms where some copper objects travelled out
- **61% reduction** in the risk of acquiring an infection (p=0.006, n=541) for patients in rooms with copper rails and some copper objects travelled out
- **69% reduction** in the risk of acquiring an infection for patients in rooms where copper objects never travelled out (p=0.008, n=462)

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What is Antimicrobial Copper?

Healthcare surfaces are dirtier than you think

Antimicrobial copper surfaces kill bacteria that cause Hospital-Acquired Infections

Available Products
Sinks

Handwash stations, scrub sinks

Manufacturers: Just Manufacturing, Elkay Commercial Products
IV Poles

Manufacturers: Pedigo, Midbrook Medical
Patient Transport

Manufacturer: Pedigo
Railings and Grab Bars

Manufacturers: Wagner Companies, Rocky Mountain Hardware, CuSalus by Colonial Bronze
Building Products

Manufacturers: Arrowhart, CuSalus by Colonial Bronze, Rocky Mountain Hardware
Work Surfaces

Manufacturers: Midbrook Medical, CuSalus by Colonial Bronze,
Mobile Surfaces

Manufacturers: Midbrook Medical
Building Hardware

Manufacturers: Rocky Mountain Hardware, CuSalus by Colonial Bronze
Cabinet Hardware

Manufacturers: Rocky Mountain Hardware, CuSalus by Colonial Bronze
Cabinet Hardware

Manufacturers: Rocky Mountain Hardware, CuSalus by Colonial Bronze
Equipment/Cart Handles

Manufacturers: CuSalus by Colonial Bronze
Conclusions

- Extensive peer-reviewed publications on lab/clinical testing
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- Only class of solid materials with EPA public health registrations
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- Significant reduction of HAIs observed in multi-site clinical trial
Conclusions

- Extensive peer-reviewed publications on lab/clinical testing
- Only class of solid materials with EPA public health registrations
- Significant reduction of HAIs observed in multi-site clinical trial
- Active supply chain with commercial-grade products available
How to control bacteria in the healthcare environment?

Patient Rooms

Medical Staff Areas

Public Areas
Use Antimicrobial Copper for Contact Surfaces

- **Patient Rooms**
- **Medical Staff Areas**
- **Public Areas**
Thank you

Jim Michel
James.Michel@copperalliance.us
(212) 251-7210

Harold Michels
Harold.Michels@copperalliance.us
(212) 251-7212

www.AntimicrobialCopper.com