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**Literature search results**

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**Search details**

Antimicrobial properties of copper. Copper properties/surfaces and reducing HCAI / MRSA/ C Diff etc. or similar.

**Resources searched**

NHS Evidence; TRIP Database; Cochrane Library; BNI; CINAHL; EMBASE; MEDLINE; Google Scholar

**Database search terms:**
copper; COPPER; INTRAUTERINE DEVICES, COPPER; antimicrobial; (infect* OR HCAI* OR bacteraemia* OR bacteremia OR MRSA OR "methicillin-resistant staphylococcus aureus" OR MSSA OR "methicillin-sensitive staphylococcus aureus" OR "clostridium difficile" OR "c diff"* OR SSI* OR norovirus OR "glycopeptide-resistant enterococc*" OR GRE* OR sepsis OR septicaemia OR septicemia) adj1 (control* OR prevent* OR reduc* OR eliminat* OR decreas*) adj3 copper; exp INFECTION CONTROL; infect* adj2 (control* OR prevent*); "healthcare associated infection*"; "HCAI*", MRSA; "methicillin-resistant staphylococcus aureus"; METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS; MSSA; "methicillin-sensitive staphylococcus aureus"; "clostridium difficile"; "c diff"*; bacteraemia; bacteremia; sepsis; septicaemia; "bloodstream infection*"; BACTEREMIA; CLOSTRIDIUM DIFFICILE; "surgical site infection*"; SSI*; norovirus; NOROVIRUS; "glycopeptide-resistant enterococc*"; GRE*; (reduc* OR control* OR eliminat* OR decreas*) adj2 infect* OR antimicrobial); infection*

**Evidence/Google Scholar search string(s):**
copper ("infection control" OR "controlling infection" OR "preventing infection" OR "infection prevention" OR "antimicrobial properties")
copper (infection OR antimicrobial)

**Summary**
There is a fair amount of research on this topic. To spare yourselves too much reading, you could just look at the last 5 years. Seems to be generally efficacious, but as always, it depends.

Guidelines and Policy

**Australian Wound Management Association**

Australian and New Zealand clinical practice guideline for prevention and management of venous leg ulcers 2011

1. One RCT in participants with ulcers of at least three months’ duration compared silver sulphadiazine cream (n=28) with both tripeptide copper-complex cream (n=29) and placebo cream (n=29) applied to VLU for a treatment period of four weeks. None of the ulcers treated with tripeptide copper-complex cream and one ulcer treated with placebo cream healed, compared with six ulcers treated with silver sulphadiazine cream. Mean reduction in ulcer area was 18.7% for tripeptide copper-complex cream, 22.5% for the placebo cream and 44% for the ulcers treated with silver sulphadiazine cream. RR for silver sulphadiazine cream compared with placebo cream was 6.21 (95% CI 0.8 to 48.38, p=0.08).

2. However, another trial investigating silver sulphazine reported it to be more effective for reducing mean ulcer area than both tripeptide-copper complex (ES 25.30, 95% CI 20.82 to 29.78, p=0.03) and placebo (ES 21.50, 95% CI 16.66 to 26.34, p=0.05). In the same trial there was no difference in treatments for complete ulcer healing.

**Australian Guidelines for the Prevention and Control of Infection in Healthcare 2010**

When the recommended standards cannot be achieved because of inadequate facilities that are unable to be renovated, other measures such as chlorine treatment, copper-silver ionisation, or ultraviolet lights are recommended to ensure water quality and prevent infection (Sehulster & Chinn 2003).

**Richard Wells Research Centre**


1. A prospective randomised crossover study provided evidence for the effectiveness of daily cleaning of high-touch surfaces with microbre/copper-impregnated cloths on the reduction of MRSA, as discussed above.

2. Four non-randomised, experimental studies, conducted in clinical environments, demonstrated significant reductions in microbial burden of between 80% and 90% on high-touch surfaces coated with metallic copper and/or its alloys compared with similar noncopper surfaces. One RCT conducted in three ICUs reported a significantly lower acquisition of HCAI in patients allocated to rooms with six high-touch copper-coated surfaces (3.4% vs 8.1%, p=0.013).

Evidence-based reviews

**AHRQ Horizon Scanning**

Infectious Disease including HIV/AIDS 2013

See chapter 2 Antimicrobial Copper Surfaces in the Intensive Care Unit for Prevention of Hospital-Acquired Infections.

**Cochrane Database of Systematic Reviews**

Antibiotics and antiseptics for venous leg ulcers 2014
Silver-based preparations: no between-group differences in complete healing were detected when 1% silver sulphadiazine ointment was compared with standard care/placebo and tripeptide copper complex; or when different brands of silver-impregnated dressings were compared; or when silver-impregnated dressings were compared with non-antimicrobial dressings.

Annals of Internal Medicine
Advanced Wound Care Therapies for Nonhealing Diabetic, Venous, and Arterial Ulcers: A Systematic Review 2013

Only 4 studies compared one advanced therapy with another (52–53, 57, 60). Strength of evidence was low for the effect on the proportion of healed ulcers (Figure 2 and Appendix Table 5). In 1 moderate-size, fair-quality trial, use of a silver cream resulted in a greater proportion of healed ulcers (ARD, 21% [CI, 6% to 37%]) than a copper-based cream (57).

Published research – Databases

1. Polymer antimicrobial coatings with embedded fine Cu and Cu salt particles.
   
   **Author(s)** Wei X, Yang Z, Wang Y, Tay SL, Gao W
   
   **Citation:** Applied Microbiology & Biotechnology, July 2014, vol./is. 98/14(6265-74), 0175-7598;1432-0614 (2014 Jul)
   
   **Publication Date:** July 2014
   
   **Abstract:** Many diseases spread due to the bacterial infections, which cause significant economic and personal losses. Contact with infected surfaces is likely to catch infections. Hence, antimicrobial surfaces play an important role in public sectors that can prevent the spreading of disease and infection. Coatings on contact surfaces have been used to provide antimicrobial function. Copper (Cu), as one of the commonly used metals, has long been known to possess germ-killing properties. However, metallic Cu or Cu coatings have not been widely used for the purposes of antimicrobial due to the heavy weight, relatively high cost, limited corrosion resistance and low compatibility of the metal with substrates of non-metallic materials. We have recently developed a polymer-based coating system containing mixtures of fine particles of Cu and Cu salt, which provides excellent antimicrobial properties. The results indicate that the coating with embedded fine Cu salt showed higher antimicrobial property than the coating with only Cu due to the release of more Cu ions. The elimination of 10(6) bacteria by contacting the polymer-Cu coatings needs 8 h, while contacting with the polymer-CuCl2 coatings took only 20 min to kill the same amount of bacteria. We have also used transmission electron microscopy and synchrotron infrared microscopy technique to study the degradation of bacterial cell membrane to understand the mechanism of the antimicrobial function of Cu coating.
   
   **Source:** Medline

2. Adapt or perish–a relentless fight for survival: Designing superbugs out of the intensive care unit
   
   **Author(s)** Colatrella S., Clair J.D.
   
   **Citation:** Critical Care Nursing Quarterly, July 2014, vol./is. 37/3(251-267), 0887-9303;1550-5111 (July-September 2014)
   
   **Publication Date:** July 2014
   
   **Abstract:** Lethal microorganisms have terrorized man since the beginning of time, killing more human beings than anything else in history. The most infamous epidemic, the Black Death, wiped out almost half the population of Europe. To quote H.G. Wells, “adapt or perish, now as ever, is nature’s inexorable imperative.” Superbugs are nature's revenge on humans for their ingenuity. For decades antibiotics, which work by honing in on particular bacteria, have been the chief line of defense against infection. There is growing urgency for the judicious assessment of both conventional and innovative strategies with regard to antibiotic use, infection control, molecular detection of pathogens and adequate treatment
of multidrug-resistant organisms in hospitals, especially critical care units. Financial 
restraints, changing demographics, an aging population and the limited introduction of new 
antibiotics have established an imperative for utilization of goal directed strategies in 
infection prevention and control. Research and development of both clinical and 
environmental weapons to combat these adversaries is essential if man is to adapt, not 
perish, in this fight for survival. This article will provide a snapshot of advances in infection 
prevention and control, including evidence based design, as they relate to the critical care 
environment. 2014 Wolters Kluwer Health | Lippincott Williams & Wilkins.

Source: EMBASE

3. Self-disinfecting and microbiocide-impregnated surfaces and fabrics: What potential in 
interrupting the spread of healthcare-associated infection?

Author(s) Humphreys H.

Citation: Clinical Infectious Diseases, March 2014, vol./is. 58/6(848-853), 1058-4838;1537-
6591 (March 2014)

Publication Date: March 2014

Abstract: Innovative technologies have identified approaches to developing self-
disinfecting surfaces or fabrics to minimize healthcare-associated infection (HCAI). These 
include altering the structure or surface to minimize the attachment of microbes or to delay 
the development of biofilm, using compounds that are activated in the presence of light to 
reduce the microbial burden, and incorporating a heavy metal such as silver or copper with 
intrinsic antimicrobial activity. Most technologies for surfaces and fabrics have been 
assessed in vitro and have been shown to reduce bacterial numbers by >2 logs. However, 
apart from copper-impregnated surfaces, there have been few trials in a clinical setting. 
Copper-impregnated surfaces result in reduced microbial surface counts on surfaces 
commonly found in clinical areas compared with controls, and 1 study has assessed HCAI 
and colonization rates. However, larger and better-designed studies are required 
to determine if these approaches augment current hygiene regimens, especially when these 
are optimally implemented. 2013 The Author 2013. Published by Oxford University Press 
on behalf of the Infectious Diseases Society of America. All rights reserved. For 
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Source: EMBASE

Available in fulltext from Clinical Infectious Diseases at Free Access Content

4. Implementation of antimicrobial copper in a neonatal intensive care unit (NICU).

Author(s) Anagnostakou, Marina, Kouskouni, Evaggelia, Petropoulou, Chrysa, Efstathiou, 
Panos, Karageorgou, Katerina, Manolidou, Zacharoula, Papanikolaou, Spiros, Logothetis, 
Elias, Karyoti, Vassiliki

Citation: CONNECT: The World of Critical Care Nursing, 01 March 2014, vol./is. 9/2(54-
54), 17486254

Publication Date: 01 March 2014

Source: CINAHL

5. Pathogenic adaptations to host-derived antibacterial copper

Author(s) Chaturvedi K.S., Henderson J.P.

Citation: Frontiers in Cellular and Infection Microbiology, 2014, vol./is. 5/FEB, 2235-2988 
(2014)

Publication Date: 2014

Abstract: Recent findings suggest that both host and pathogen manipulate copper content 
in infected host niches during infections. In this review, we summarize recent developments 
that implicate copper resistance as an important determinant of bacterial fitness at the host-
pathogen interface. An essential mammalian nutrient, copper cycles between copper (I)
(Cu<sup>+</sup>) in its reduced form and copper (II) (Cu<sup>2+</sup>) in its oxidized form under physiologic conditions. Cu<sup>+</sup> is significantly more bactericidal than Cu<sup>2+</sup> due to its ability to freely penetrate bacterial membranes and inactivate intracellular iron-sulfur clusters. Copper ions can also catalyze reactive oxygen species (ROS) generation, which may further contribute to their toxicity. Transporters, chaperones, redox proteins, receptors and transcription factors and even siderophores affect copper accumulation and distribution in both pathogenic microbes and their human hosts. This review will briefly cover evidence for copper as a mammalian antibacterial effector, the possible reasons for this toxicity, and pathogenic resistance mechanisms directed against it. 2014 Chaturvedi and Henderson.

Source: EMBASE
Available in fulltext from Frontiers in Cellular and Infection Microbiology at National Library of Medicine

6. Antimicrobial activity of copper against organisms in aqueous solution: A case for copper-based water pipelines in hospitals?

Author(s) Cervantes H.I., Alvarez J.A., Munoz J.M., Arreguin V., Mosqueda J.L., Macias A.E.

Citation: American Journal of Infection Control, December 2013, vol./is. 41/12(e115-e118), 0196-6553;1527-3296 (December 2013)

Publication Date: December 2013

Abstract: Background An association exists between water of poor quality and health care-associated infections. Copper shows microbiocidal action on dry surfaces; it is necessary to evaluate its antimicrobial effect against organisms in aqueous solution. Objective The objective was to determine the in vitro antimicrobial activity of copper against common nosocomial pathogens in aqueous solution. Methods Copper and polyvinyl chloride containers were used. Glass was used as control material. Fourteen organisms isolated from hospital-acquired infections, and 3 control strains were tested. Inocula were prepared by direct suspension of colonies in saline solution and water in each container tested. Bacterial counts in colony-forming units (CFU)/mL were determined at the beginning of the experiment; at 30 minutes; and at 1, 2, 24, and 48 hours. Results Organisms in glass and polyvinyl chloride remained viable until the end of the experiment. Organisms in copper showed a reduction from more than 100,000 CFU/mL to 0 CFU/mL within the first 2 hours of contact (F > 4.29, P <.001). Conclusion Copper containers show microbiocidal action on organisms in aqueous solution. Copper may contribute to the quality of water for human use, particularly in hospitals. 2013 by the Association for Professionals in Infection Control and Epidemiology, Inc.

Source: EMBASE

7. Role of copper oxides in contact killing of bacteria.

Author(s) Hans M, Erbe A, Mathews S, Chen Y, Solioz M, Mucklich F

Citation: Langmuir, December 2013, vol./is. 29/52(16160-6), 0743-7463;1520-5827 (2013 Dec 31)

Publication Date: December 2013

Abstract: The potential of metallic copper as an intrinsically antibacterial material is gaining increasing attention in the face of growing antibiotics resistance of bacteria. However, the mechanism of the so-called "contact killing" of bacteria by copper surfaces is poorly understood and requires further investigation. In particular, the influences of bacteria-metal interaction, media composition, and copper surface chemistry on contact killing are not fully
understood. In this study, copper oxide formation on copper during standard antimicrobial testing was measured in situ by spectroscopic ellipsometry. In parallel, contact killing under these conditions was assessed with bacteria in phosphate buffered saline (PBS) or Tris-Cl. For comparison, defined Cu2O and CuO layers were thermally generated and characterized by grazing incidence X-ray diffraction. The antibacterial properties of these copper oxides were tested under the conditions used above. Finally, copper ion release was recorded for both buffer systems by inductively coupled plasma atomic absorption spectroscopy, and exposed copper samples were analyzed for topographical surface alterations. It was found that there was a fairly even growth of CuO under wet plating conditions, reaching 4-10 nm in 300 min, but no measurable Cu2O was formed during this time. CuO was found to significantly inhibit contact killing, compared to pure copper. In contrast, thermally generated Cu2O was essentially as effective in contact killing as pure copper. Copper ion release from the different surfaces roughly correlated with their antibacterial efficacy and was highest for pure copper, followed by Cu2O and CuO. Tris-Cl induced a 10-50-fold faster copper ion release compared to PBS. Since the Cu2O that primarily forms on copper under ambient conditions is as active in contact killing as pure copper, antimicrobial objects will retain their antimicrobial properties even after oxide formation.

Source: Medline

8. The economic assessment of an environmental intervention: Discrete deployment of copper for infection control in ICUs

Author(s) Taylor M., Chaplin S.

Citation: Value in Health, November 2013, vol./is. 16/7(A353), 1098-3015 (November 2013)

Publication Date: November 2013

Abstract: Objectives: Health Economics evaluations are typically applied to medications or surgery costs, but this unique study has investigated the economic benefits of discrete deployment of antimicrobial copper alloy touch surfaces in ICUs. Copper/copper alloy surfaces have been shown to act as an adjunct to standard infection control practices in diverse clinical settings, continuously reducing contamination by over 90%. A study by Salgado in 2013 investigated the use of copper surfaces in ICUs and reported a 58% reduction in hospital acquired infections. This study investigates the cost-effectiveness of this intervention. Methods: Following an extensive literature review and use of expert opinion a number of factors have been considered in this evaluation. These are the component costs of the items used in the ICU, the cost of and extra day in bed due to an infection, baseline infection rates and risk reduction of copper items. The model is based on a single room configuration in an intensive care unit with 20 beds in the UK using 6 critical items - bed rails, overbed tray table, chair, call button, data device and IV pole. The model has been created to show the economic impact of an environmental intervention. Results: The model predicts the cost of replacing key, frequently-touched surfaces in a 20-bed UK ICU with copper equivalents will be recouped in less than two months. Over 5 years there were 325 fewer infections in the copper arm at a cost per QALY of 262.84. Conclusions: The investigation allowed the derivation of a spreadsheet-based model that uses the best current published information and shows the rapid ROI of a copper intervention. It also calculates the impact on bed days and quality-adjusted life years (QALY). The model is simple, transparent to those with knowledge of spreadsheets, and allows adaptation to specific local settings.

Source: EMBASE

9. The Killer Bug and the Copper Cure.

Author(s) Smith, Bryan

Citation: Men's Health, 01 October 2013, vol./is. 28/8(188-195), 10544836

Publication Date: 01 October 2013

Source: CINAHL
10. What strategies are in place to control microbial burden in hospital environments and how could these change in the future?

**Author(s)** Chirca I., Salgado C.D.

**Citation:** Future Microbiology, September 2013, vol./is. 8/9(1051-1054), 1746-0913;1746-0921 (September 2013)

**Publication Date:** September 2013

**Source:** EMBASE

11. The role of the surface environment in healthcare-associated infections.

**Author(s)** Weber DJ, Anderson D, Rutala WA

**Citation:** Current Opinion in Infectious Diseases, August 2013, vol./is. 26/4(338-44), 0951-7375;1473-6527 (2013 Aug)

**Publication Date:** August 2013

**Abstract:** PURPOSE OF REVIEW: This article reviews the evidence demonstrating the importance of contamination of hospital surfaces in the transmission of healthcare-associated pathogens and interventions scientifically demonstrated to reduce the levels of microbial contamination and decrease healthcare-associated infections.RECENT FINDINGS: The contaminated surface environment in hospitals plays an important role in the transmission of methicillin-resistant Staphylococcus aureus (MRSA), vancomycin-resistant Enterococcus spp. (VRE), Clostridium difficile, Acinetobacter spp., and norovirus. Improved surface cleaning and disinfection can reduce transmission of these pathogens. 'No-touch' methods of room disinfection (i.e., devices which produce ultraviolet light or hydrogen peroxide) and 'self-disinfecting' surfaces (e.g., copper) also show promise to decrease contamination and reduce healthcare-associated infections.SUMMARY: Hospital surfaces are frequently contaminated with important healthcare-associated pathogens. Contact with the contaminated environment by healthcare personnel is equally as likely as direct contact with a patient to lead to contamination of the healthcare provider’s hands or gloves that may result in patient-to-patient transmission of nosocomial pathogens. Admission to a room previously occupied by a patient with MRSA, VRE, Acinetobacter, or C. difficile increases the risk for the subsequent patient admitted to the room to acquire the pathogen. Improved cleaning and disinfection of room surfaces decreases the risk of healthcare-associated infections.

**Source:** Medline

Available in fulltext from Current Opinion in Infectious Diseases at the ULHT Library and Knowledge Services’ eJournal collection

12. Copper surfaces kill norovirus rapidly.

**Author(s)**

**Citation:** Nursing Times, 05 June 2013, vol./is. 109/22(4-4), 09547762

**Publication Date:** 05 June 2013

**Source:** CINAHL

Available in fulltext at Nursing Times; NT; Collection notes: On first login to a ProQuest journal you will need to select 'Athens (OpenAthens Federation)' from Select Region, and then 'NHS England' from Choose your Library.

Available in print at Grantham Hospital Staff Library

Available in fulltext from Nursing Times at the ULHT Library and Knowledge Services’ eJournal collection

**Author(s)** Weber, David J., Rutala, William A.

**Citation:** American Journal of Infection Control, 02 May 2013, vol./is. 41/5(0-), 01966553

**Publication Date:** 02 May 2013

**Abstract:** Methods to improve disinfection of environmental surfaces in hospital rooms include improving cleaning/disinfection by environmental service workers through education and feedback on cleaning effectiveness (eg, use of fluorescent dyes), “no-touch” methods (eg, UV-C light), and self-disinfecting surfaces. Self-disinfecting surfaces can be created by impregnating or coating surfaces with heavy metals (eg, silver or copper), germicides (eg, triclosan), or miscellaneous methods (eg, light-activated antimicrobials). These methods are under active investigation but to date have not been assessed for their ability to reduce health care-associated infections.

**Source:** CINAHL


**Author(s)** Schneider, Philip M.

**Citation:** American Journal of Infection Control, 02 May 2013, vol./is. 41/5(0-), 01966553

**Publication Date:** 02 May 2013

**Abstract:** Continued improvements in low-temperature sterilization systems have resulted in reduced processing times and expanded capabilities for instrument reprocessing. As the relationship of environmental surface contamination and health care-associated infections has become more defined, area disinfection systems and antimicrobial surface technologies have emerged as new strategies for disinfection of surfaces.

**Source:** CINAHL

15. Copper reduced health care-acquired infections.

**Author(s)**

**Citation:** Australian Nursing Journal, 01 May 2013, vol./is. 20/10(47-47), 13203185

**Publication Date:** 01 May 2013

**Source:** CINAHL

*Available in fulltext from Australian Nursing Journal at EBSCOhost*

16. Copper continuously limits the concentration of bacteria resident on bed rails within the intensive care unit.

**Author(s)** Schmidt MG, Attaway lii HH, Fairey SE, Steed LL, Michels HT, Salgado CD

**Citation:** Infection Control & Hospital Epidemiology, May 2013, vol./is. 34/5(530-3), 0899-823X;1559-6834 (2013 May)

**Publication Date:** May 2013

**Abstract:** Cleaning is an effective way to lower the bacterial burden (BB) on surfaces and minimize the infection risk to patients. However, BB can quickly return. Copper, when used to surface hospital bed rails, was found to consistently limit surface BB before and after cleaning through its continuous antimicrobial activity.

**Source:** Medline

17. Copper surfaces reduce the rate of healthcare-acquired infections in the intensive care
OBJECTIVE. Healthcare-acquired infections (HAIs) cause substantial patient morbidity and mortality. Items in the environment harbor microorganisms that may contribute to HAIs. Reduction in surface bioburden may be an effective strategy to reduce HAIs. The inherent biocidal properties of copper surfaces offer a theoretical advantage to conventional cleaning, as the effect is continuous rather than episodic. We sought to determine whether placement of copper alloy-surfaced objects in an intensive care unit (ICU) reduced the risk of HAI. DESIGN. Intention-to-treat randomized control trial between July 12, 2010, and June 14, 2011. SETTING. The ICUs of 3 hospitals. PATIENTS. Patients presenting for admission to the ICU. METHODS. Patients were randomly placed in available rooms with or without copper alloy surfaces, and the rates of incident HAI and/or colonization with methicillin-resistant Staphylococcus aureus (MRSA) or vancomycin-resistant Enterococcus (VRE) in each type of room were compared. RESULTS. The rate of HAI and/or MRSA or VRE colonization in ICU rooms with copper alloy surfaces was significantly lower than that in standard ICU rooms (0.071 vs 0.123; P = .020). For HAI only, the rate was reduced from 0.081 to 0.034 (P = .013). CONCLUSIONS. Patients cared for in ICU rooms with copper alloy surfaces had a significantly lower rate of incident HAI and/or colonization with MRSA or VRE than did patients treated in standard rooms. Additional studies are needed to determine the clinical effect of copper alloy surfaces in additional patient populations and settings.

Source: Medline
OBJECTIVES: The antimicrobial activity of copper surfaces against a variety of contemporary carbapenemase-producing Gram-negative bacteria representative of the most problematic nosocomial pathogens worldwide was evaluated.

METHODS: Twenty-four clinical isolates, comprising four of Escherichia coli, two of Enterobacter spp., eight of Klebsiella pneumoniae and five each of Pseudomonas aeruginosa and Acinetobacter baumannii producing either VIM-1 and/or KPC-2 or VIM-2 or OXA-type carbapenemases, were studied. The antimicrobial activity of 99% copper (Cu99%) and a 63% alloy (Cu63%) was evaluated in comparison with that of stainless steel (SS) and polyvinylchloride (PVC) by incubating ~10^6 cfu/cm^2 of the tested strains on each surface at room temperature.

RESULTS: Copper demonstrated antimicrobial activity against all studied isolates. This effect was observed earlier and was more pronounced for Cu99% than for Cu63%. Cu99% showed a bactericidal effect after <2 h for A. baumannii, 3 h for Enterobacter spp., 5 h for K. pneumoniae and 6 h for P. aeruginosa and E. coli. No viable colonies were recovered from five (20.8%) isolates after 3 h and from nine (37.5%) isolates after 5 h of incubation on Cu99%.

CONCLUSIONS: Copper has significant antimicrobial activity against multidrug-resistant nosocomial Gram-negative pathogens. This supports the hypothesis that replacement of high-contact materials with copper could reduce the high burden of environmental contamination around high-risk patients. However, this strategy should be seen as an adjunctive measure to established cleaning protocols and to good hygiene practices for prevention of hospital-acquired infections.

Source: Medline
Available in fulltext from Journal of Antimicrobial Chemotherapy at Free Access Content
Available in fulltext from Journal of Antimicrobial Chemotherapy at Highwire Press
Available in fulltext from Journal of Antimicrobial Chemotherapy (JAC) at EBSCOhost

20. Metal ions in macrophage antimicrobial pathways: Emerging roles for zinc and copper

Author(s) Stafford S.L., Bokil N.J., Achard M.E.S., Kapetanovic R., Schembri M.A., Mcewan A.G., Sweet M.J.

Citation: Bioscience Reports, 2013, vol./is. 33/4(541-554), 0144-8463;1573-4935 (2013)

Publication Date: 2013

Abstract: The immunomodulatory and antimicrobial properties of zinc and copper have long been appreciated. In addition, these metal ions are also essential for microbial growth and survival. This presents opportunities for the host to either harness their antimicrobial properties or limit their availability as defence strategies. Recent studies have shed some light on mechanisms by which copper and zinc regulation contribute to host defence, but there remain many unanswered questions at the cellular and molecular levels. Here we review the roles of these two metal ions in providing protection against infectious diseases in vivo, and in regulating innate immune responses. In particular, we focus on studies implicating zinc and copper in macrophage antimicrobial pathways, as well as the specific host genes encoding zinc transporters (SLC30A, SLC39A family members) and CTRs (copper transporters, ATP7 family members) that may contribute to pathogen control by these cells. 2013 The Author(s).

Source: EMBASE
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Available in fulltext from Bioscience Reports at Directory of Open Access Journals
Available in fulltext from Bioscience Reports at EBSCOhost
Available in fulltext from Bioscience Reports at National Library of Medicine
Available in fulltext from Bioscience Reports (ältere Jahrgänge) at Free Access Content
21. Copper shows its mettle worldwide.

Author(s) Vessey A

Citation: Health Estate, October 2012, vol./is. 66/9(59-63) (2012 Oct)

Publication Date: October 2012

Abstract: While MRSA rates in England continue to fall, NHS Trusts are looking for smarter ways to achieve further reductions in infection rates, or to support their 'zero-tolerance approaches', and, according to the Copper Development Association (CDA), the not-for-profit, membership-based organisation which supports and promotes 'the correct and efficient use of copper and its alloys', deployment of antimicrobial copper touch surfaces is being adopted in many hospitals and other healthcare facilities worldwide as 'an additional and cost-effective infection control measure'. CDA Director Angela Vessey highlights the benefits, and examines some of the growing number of healthcare installations of 'antimicrobial copper' worldwide.

Source: Medline

22. Characterization and control of the microbial community affiliated with copper or aluminum heat exchangers of HVAC systems.

Author(s) Schmidt MG, Attaway HH, Terzieva S, Marshall A, Steed LL, Salzberg D, Hamoodi HA, Khan JA, Feigley CE, Michels HT

Citation: Current Microbiology, August 2012, vol./is. 65/2(141-9), 0343-8651;1432-0991 (2012 Aug)

Publication Date: August 2012

Abstract: Microbial growth in heating ventilation and air-conditioning (HVAC) systems with the subsequent contamination of indoor air is of increasing concern. Microbes and the subsequent biofilms grow easily within heat exchangers. A comparative study where heat exchangers fabricated from antimicrobial copper were evaluated for their ability to limit microbial growth was conducted using a full-scale HVAC system under conditions of normal flow rates using single-pass outside air. Resident bacterial and fungal populations were quantitatively assessed by removing triplicate sets of coupons from each exchanger commencing the fourth week after their installation for the next 30 weeks. The intrinsic biofilm associated with each coupon was extracted and characterized using selective and differential media. The predominant organisms isolated from aluminum exchangers were species of Methylobacterium of which at least three colony morphologies and 11 distinct PFGE patterns we found; of the few bacteria isolated from the copper exchangers, the majority were species of Bacillus. The concentrations and type of bacteria recovered from the control, aluminum, exchangers were found to be dependent on the type of plating media used and were 11,411-47,257 CFU cm(-2) per coupon surface. The concentration of fungi was found to average 378 CFU cm(-2). Significantly lower concentrations of bacteria, 3 CFU cm(-2), and fungi, 1 CFU cm(-2), were recovered from copper exchangers regardless of the plating media used. Commonly used aluminum heat exchangers developed stable, mixed, bacterial/fungal biofilms in excess of 47,000 organisms per cm(2) within 4 weeks of operation, whereas the antimicrobial properties of metallic copper were able to limit the microbial load affiliated with the copper heat exchangers to levels 99.97 % lower during the same time period.

Source: Medline

Available in fulltext at Current Microbiology; Collection notes: On first login to a ProQuest journal you will need to select 'Athens (OpenAthens Federation)' from Select Region, and then 'NHS England' from Choose your Library.

Available in fulltext from Current Microbiology at EBSCOhost

Available in fulltext from Current Microbiology at EBSCOhost
23. Application of copper to prevent and control infection. Where are we now?

**Author(s)** O’Gorman J, Humphreys H

**Citation:** Journal of Hospital Infection, August 2012, vol./is. 81/4(217-23), 0195-6701;1532-2939 (2012 Aug)

**Publication Date:** August 2012

**Abstract:** BACKGROUND: The antimicrobial effect of copper has long been recognized and has a potential application in the healthcare setting as a mechanism to reduce environmental contamination and thus prevent healthcare-associated infection (HCAI). AIM: To review the rationale for copper use, the mechanism of its antimicrobial effect, and the evidence for its efficacy. METHODS: A PubMed search of the published literature was performed. FINDINGS: Extensive laboratory investigations have been carried out to investigate the biocidal activity of copper incorporated into contact surfaces and when impregnated into textiles and liquids. A limited number of clinical trials have been performed, which, although promising, leave significant questions unanswered. In particular there is a lack of consensus on minimum percentage copper alloys required for effectiveness, the impact of organic soiling on the biocidal effect of copper, and the best approach to routine cleaning of such surfaces. Limited information is available on the ability of copper surfaces to eradicate spores of Clostridium difficile. CONCLUSION: Additional studies to demonstrate that installing copper surfaces reduces the incidence of HCAI are required and the cost-effectiveness of such intervention needs to be assessed. Further research in a number of key areas is required before the potential benefits of using copper routinely in the clinical setting to prevent and control infection can be confirmed and recommended. Copyright 2012 The Healthcare Infection Society. Published by Elsevier Ltd. All rights reserved.

**Source:** Medline

Available in fulltext from Journal of Hospital Infection at the ULHT Library and Knowledge Services’ eJournal collection

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24. Sustained reduction of microbial burden on common hospital surfaces through introduction of copper.

**Author(s)** Schmidt MG, Attaway HH, Sharpe PA, John J Jr, Sepkowitz KA, Morgan A, Fairey SE, Singh S, Steed LL, Cantey JR, Freeman KD, Michels HT, Salgado CD

**Citation:** Journal of Clinical Microbiology, July 2012, vol./is. 50/7(2217-23), 0095-1137;1098-660X (2012 Jul)

**Publication Date:** July 2012

**Abstract:** The contribution of environmental surface contamination with pathogenic organisms to the development of healthcare-associated infections (HAI) has not been well defined. The microbial burden (MB) associated with commonly touched surfaces in intensive care units (ICUs) was determined by sampling six objects in 16 rooms in ICUs in three hospitals over 43 months. At month 23, copper-alloy surfaces, with inherent antimicrobial properties, were installed onto six monitored objects in 8 of 16 rooms, and the effect that this application had on the intrinsic MB present on the six objects was assessed. Census continued in rooms with and without copper for an additional 21 months. In concert with routine infection control practices, the average MB found for the six objects assessed in the clinical environment during the preintervention phase was 28 times higher (6,985 CFU/100 cm(2); n = 3,977 objects sampled) than levels proposed as benign immediately after terminal cleaning (<250 CFU/100 cm(2)). During the intervention phase, the MB was found to be significantly lower for both the control and copper-surfaced objects. Copper was found to cause a significant (83%) reduction in the average MB found on the objects (465 CFU/100 cm(2); n = 2,831 objects [P < 0.0001]). The introduction of copper surfaces to objects formerly covered with plastic, wood, stainless steel, and other materials found in the patient care environment significantly reduced the overall MB on a continuous basis, thereby providing a potentially safer environment for hospital patients, health care workers (HCWs), and visitors.

**Source:** Medline
25. Study shows copper stays cleaner, longer.

**Author(s)**

Citation: Patient Safety Monitor Journal, 01 July 2012, vol./is. 13/7(7-8), 15287637

**Publication Date:** 01 July 2012

**Source:** CINAHL

Available in fulltext at Patient Safety Monitor Journal; Collection notes: On first login to a ProQuest journal you will need to select 'Athens (OpenAthens Federation)' from Select Region, and then 'NHS England' from Choose your Library.

26. Antimicrobial metallic copper surfaces kill Staphylococcus haemolyticus via membrane damage.

**Author(s)** Santo CE, Quaranta D, Grass G

**Citation:** MicrobiologyOpen, March 2012, vol./is. 1/1(46-52), 2045-8827;2045-8827 (2012 Mar)

**Publication Date:** March 2012

**Abstract:** Recently, copper (Cu) in its metallic form has regained interest for its antimicrobial properties. Use of metallic Cu surfaces in worldwide hospital trials resulted in remarkable reductions in surface contaminations. Yet, our understanding of why microbes are killed upon contact to the metal is still limited and different modes of action have been proposed. This knowledge, however, is crucial for sustained use of such surfaces in hospitals and other hygiene-sensitive areas. Here, we report on the molecular mechanisms by which the Gram-positive Staphylococcus haemolyticus is inactivated by metallic Cu. Staphylococcus haemolyticus was killed within minutes on Cu but not on stainless steel demonstrating the antimicrobial efficacy of metallic Cu. Inductively coupled plasma mass spectroscopy (ICP-MS) analysis and in vivo staining with Coppersensor-1 indicated that cells accumulated large amounts of Cu ions from metallic Cu surfaces contributing to lethal damage. Mutation rates of Cu- or steel-exposed cells were similarly low. Instead, live/dead staining indicated cell membrane damage in Cu- but not steel-exposed cells. These findings support a model of the cellular targets of metallic Cu toxicity in bacteria, which suggests that metallic Cu is not genotoxic and does not kill via DNA damage. In contrast, membranes constitute the likely Achilles' heel of Cu surface-exposed cells.

**Source:** Medline

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27. Evaluation of the antimicrobial properties of copper surfaces in an outpatient infectious
disease practice.


Citation: Infection Control & Hospital Epidemiology, 01 February 2012, vol./is. 33/2(200-201), 0899823X

Publication Date: 01 February 2012

Source: CINAHL

28. The antimicrobial efficacy of copper alloy furnishing in the clinical environment: a crossover study.

Author(s) Karpanen TJ, Casey AL, Lambert PA, Cookson BD, Nightingale P, Miruszenko L, Elliott TS

Citation: Infection Control & Hospital Epidemiology, January 2012, vol./is. 33/1(3-9), 0899-823X;1559-6834 (2012 Jan)

Publication Date: January 2012

Abstract: OBJECTIVE: To determine whether copper incorporated into hospital ward furnishings and equipment can reduce their surface microbial load. DESIGN: A crossover study. SETTING: Acute care medical ward with 19 beds at a large university hospital. METHODS: Fourteen types of frequent-touch items made of copper alloy were installed in various locations on an acute care medical ward. These included door handles and push plates, toilet seats and flush handles, grab rails, light switches and pull cord toggles, sockets, overbed tables, dressing trolleys, commodes, taps, and sink fittings. Their surfaces and those of equivalent standard items on the same ward were sampled once weekly for 24 weeks. The copper and standard items were switched over after 12 weeks of sampling to reduce bias in usage patterns. The total aerobic microbial counts and the presence of indicator microorganisms were determined. RESULTS: Eight of the 14 copper item types had microbial counts on their surfaces that were significantly lower than counts on standard materials. The other 6 copper item types had reduced microbial numbers on their surfaces, compared with microbial counts on standard items, but the reduction did not reach statistical significance. Indicator microorganisms were recovered from both types of surfaces; however, significantly fewer copper surfaces were contaminated with vancomycin-resistant enterococci, methicillin-susceptible Staphylococcus aureus, and coliforms, compared with standard surfaces. CONCLUSIONS: Copper alloys (greater than or equal to 58% copper), when incorporated into various hospital furnishings and fittings, reduce the surface microorganisms. The use of copper in combination with optimal infection-prevention strategies may therefore further reduce the risk that patients will acquire infection in healthcare environments.

Source: Medline

Available in fulltext from Infection Control and Hospital Epidemiology at Free Access

Content

29. Copper as an antibacterial agent for human pathogenic multidrug resistant Burkholderia cepacia complex bacteria.

Author(s) Ibrahim M, Wang F, Lou MM, Xie GL, Li B, Bo Z, Zhang GQ, Liu H, Wareth A

Citation: Journal of Bioscience & Bioengineering, December 2011, vol./is. 112/6(570-6), 1347-4421;1347-4421 (2011 Dec)

Publication Date: December 2011

Abstract: The Burkholderia cepacia complex (Bcc) consists of 17 closely related multidrug resistant bacterial species that are difficult to eradicate. Copper has recently gained attention as an antimicrobial agent because of its inhibitory effects on bacteria, yeast, and viruses. The objective of this study was to evaluate the antibacterial activity of copper surfaces and copper powder against members of the B. cepacia complex. The antibacterial activity of different copper surfaces was evaluated by incubating them with Bcc strain suspensions (5x10^7CFU/ml). The bacterial survival counts were calculated and the data for
various copper surfaces were compared to the data for stainless steel and polyvinylchloride, which were used as control surfaces. The antibacterial activity of copper powder was determined with the diffusimetrical technique and the zone of inhibition was evaluated with paper disks. A single cell gel electrophoresis assay, staining assays, and inductively coupled plasma mass spectroscopy were performed to determine the mechanism responsible for the bactericidal activity. The results showed a significant decrease in the viable bacterial count after exposure to copper surfaces. Moreover, the copper powder produced a large zone of inhibition and there was a significantly higher influx of copper ions into the bacterial cells that were exposed to copper surfaces compared to the controls. The present study demonstrates that metallic copper has an antibacterial effect against Bcc bacteria and that copper adversely affects the bacterial cellular structure, thus resulting in cell death. These findings suggest that copper could be utilized in health care facilities to reduce the bioburden of Bcc species, which may protect susceptible members of the community from bacterial infection. Copyright 2011 The Society for Biotechnology, Japan. Published by Elsevier B.V. All rights reserved.

Source: Medline

30. Hospital cleaning in the 21st century

Author(s) Dancer S.J.

Citation: European Journal of Clinical Microbiology and Infectious Diseases, December 2011, vol./is. 30/12(1473-1481), 0934-9723;1435-4373 (December 2011)

Publication Date: December 2011

Abstract: More evidence is emerging on the importance of the clinical environment in encouraging hospital infection. This review considers the role of cleaning as an effective means to control infection. It describes the location of pathogen reservoirs and methods for evaluating hospitals' cleanliness. Novel biocides, antimicrobial coatings and equipment are available, many of which have not been assessed against patient outcome. Cleaning practices should be tailored to clinical risk, given the wide-ranging surfaces, equipment and building design. There is confusion between nursing and domestic personnel over the allocation of cleaning responsibilities and neither may receive sufficient training and/or time to complete their duties. Since less labourious practices for dirt removal are always attractive, there is a danger that traditional cleaning methods are forgotten or ignored. Few studies have examined detergent-based regimens or modelled these against infection risk for different patient categories. Fear of infection encourages the use of powerful disinfectants for the elimination of real or imagined pathogens in hospitals. Not only do these agents offer false assurance against contamination, their disinfection potential cannot be achieved without the prior removal of organic soil. Detergent-based cleaning is cheaper than using disinfectants and much less toxic. Hospital cleaning in the 21st century deserves further investigation for routine and outbreak practices. 2011 Springer-Verlag.

Source: EMBASE

Available in fulltext at European Journal of Clinical Microbiology and Infectious Diseases; Collection notes: On first login to a ProQuest journal you will need to select 'Athens (OpenAthens Federation)' from Select Region, and then 'NHS England' from Choose your Library.

Available in fulltext from European Journal of Clinical Microbiology & Infectious Diseases at EBSCOhost

Available in fulltext from European Journal of Clinical Microbiology & Infectious Diseases at EBSCOhost


Author(s) Chai H, Guo L, Wang X, Fu Y, Guan J, Tan L, Ren L, Yang K

Citation: Journal of Materials Science-Materials in Medicine, November 2011, vol./is. 22/11(2525-35), 0957-4530;1573-4838 (2011 Nov)
Abstract: Bone and intramedullary bacterial infections are one of the most serious complications of the surgical repair of fractures. To reduce the incidence of implant-related infections, several biomaterial surface treatments with integrated antibiotics, antiseptics, or metal ions have been developed for implants. In this study, we evaluated the antibacterial activity and biocompatibility of 317L stainless steel containing 4.5% copper alloy (317L-Cu) in vitro and in vivo using an animal model. Common pathogens of implant-related infections are Staphylococcus aureus and Escherichia coli, which were injected into implant materials to study their antimicrobial potential. We compared antimicrobial potential of 317L-Cu with 317L stainless steel (317L) and titanium (Ti-6Al-4V) alloys as controls. Compared with controls, 317L-Cu materials inhibited colonization by both bacteria in vitro and in vivo. Compared with 317L and Ti-6Al-4V controls, 317L-Cu showed no significant difference in colony formation of osteoblast-like cells on metal surfaces after 72 h of incubation in vitro. Metal screws containing these materials were also made for our vivo study in a rabbit model. Tissue-implants were analyzed for infection and inflammatory changes by hematoxylin-eosin staining of implants in bone. The screw tract inflammation and infection of 317L-Cu was minimal, although some inflammatory cells gathered at acutely infected sites. In addition, after materials had been implanted for 14 days in vivo, the expression of insulin-like growth factor-1 (IGF-1) in osteoblasts around 317L-Cu screws tracts had increased compared with 317L and Ti-6Al-4V controls. Overall, 317L-Cu demonstrated strong antimicrobial activity and biocompatibility in vitro and in vivo and may be used as a biomaterial to reduce implant-related infections.

Source: Medline
Available in fulltext from Journal of Materials Science: Materials in Medicine at EBSCOhost

32. A comparative study to evaluate surface microbial contamination associated with copper-containing and stainless steel pens used by nurses in the critical care unit.

Author(s) Casey AL, Karpanen TJ, Adams D, Lambert PA, Nightingale P, Miruszenko L, Elliott TS

Citation: American Journal of Infection Control, October 2011, vol./is. 39/8(e52-4), 0196-6553;1527-3296 (2011 Oct)

Publication Date: October 2011

Abstract: A clinical study was undertaken to compare the surface microbial contamination associated with pens constructed of either a copper alloy or stainless steel used by nurses on intensive care units. A significantly lower level of microbial contamination was found on the copper alloy pens. Copyright 2011 Association for Professionals in Infection Control and Epidemiology, Inc. Published by Mosby, Inc. All rights reserved.

Source: Medline

33. Antimicrobials waging surface warfare on infections.

Author(s) Cantrell, Susan

Citation: Healthcare Purchasing News, 01 September 2011, vol./is. 35/9(30-36), 10983716

Publication Date: 01 September 2011

Source: CINAHL
Available in fulltext from Healthcare Purchasing News at EBSCOhost

Available in fulltext at Healthcare Purchasing News; Collection notes: On first login to a ProQuest journal you will need to select 'Athens (OpenAthens Federation)' from Select Region, and then 'NHS England' from Choose your Library.
34. New methods to clean ICU rooms.

**Author(s)**: Blazejewski C, Guerry MJ, Preau S, Durocher A, Nseir S

**Citation**: Infectious Disorders - Drug Targets, August 2011, vol./is. 11/4(365-75), 1871-5265,2212-3989 (2011 Aug)

**Publication Date**: August 2011

**Abstract**: Hospital-acquired infections (HAI) represent the most common adverse event in the intensive care unit (ICU). Their prevalence is high and they are associated with increased morbidity and mortality. The environment plays a central role in the transmission of hospital-acquired pathogens (HAP) and in the pathogenesis of HAI. Many bacteria, especially multidrug resistant ones, can survive for several months in the hospital environment in particular in areas close to the patients. It has been proven that pathogens are transmitted from the environment to the patients. Many studies have concluded that current cleaning methods are microbiologically ineffective. This failure concerns daily cleaning as well as terminal cleaning after patient discharge. It has been demonstrated that improvements in environmental cleaning are associated with a decrease in the rate of HAP and of HAI. New cleaning methods could enhance hospital cleaning efficiency. Three new technologies seem promising because they are microbiologically effective, easy and safe to use: (1) hydrogen peroxide vapor and (2) UV light decontamination are used for terminal cleaning. These techniques are effective even in difficultly accessible areas. (3) ultramicrofibers which can be associated with a copper-based biocide can be used for daily cleaning. Other methods such as ozone, steam or high-efficiency particulate air filtration are not efficient enough to be considered serious contenders for the improvement of the quality of the hospital environment. These new technologies have not been yet linked to a decrease in the prevalence and the incidence in HAP and HAI. It remains difficult to justify the extra-cost associated with these new methods until more studies can confirm their effectiveness in the management of HAI.

**Source**: Medline

Available in [fulltext](https://www.ebscohost.com/) from Infectious Disorders - Drug Targets at EBSCOhost

35. Copper surfaces cut hospital infection risk.

**Author(s)**: Freeth S

**Citation**: Australian Nursing Journal, August 2011, vol./is. 19/2(43), 1320-3185;1320-3185 (2011 Aug)

**Publication Date**: August 2011

**Source**: Medline

Available in [fulltext](https://www.ebscohost.com/) from Australian Nursing Journal at EBSCOhost


**Author(s)**: Sarjomaa M, Urdahl P, Ramsli E, Borchgrevink-Lund CF, Ask E

**Citation**: Tidsskrift for Den Norske Laegeforening, August 2011, vol./is. 131/16(1554-7), 0029-2001;0807-7096 (2011 Aug 23)

**Publication Date**: August 2011

**Abstract**: BACKGROUND: The first instance of Legionella infection in a Norwegian hospital was confirmed in 2005. We describe the best-known methods of eradicating Legionella in hospitals MATERIALS AND METHOD: The article is based on the authors’ experience of measures to prevent Legionnaires’ disease in hospitals and on a non-systematic search in PubMed.RESULTS: There are several methods of combating Legionella in hospitals. These include chlorination, heat treatment, and the use of filters. However, recontamination easily re-occurs after eradication. The silver and copper ionisation treatment of water is a well-documented method for the systematic and long-term
eradication of Legionella in water. The disadvantages of this method are that it is expensive, that there is a risk of discolouring the water, and that there is a possibility of developing resistance in environmental bacteria. This resistance mechanism can theoretically be transferred to bacteria that cause illness. INTERPRETATION: We recommend the silver and copper ionisation treatment of water as a method of preventing nosocomial Legionnaires’ disease when standard methods fail and there is a high prevalence of Legionella in the water. The discolouration of operation instruments that occurs as a result of high silver concentrations can be avoided by using a separate water supply for operation units.

Source: Medline
Available in fulltext from Tidsskrift for Den norske laegeforening at Free Access Content

Author(s) Lin YE, Stout JE, Yu VL
Citation: Current Opinion in Infectious Diseases, August 2011, vol./is. 24/4(350-6), 0951-7375:1473-6527 (2011 Aug)
Publication Date: August 2011
Abstract: PURPOSE OF REVIEW: The incidence of hospital-acquired legionellosis appears to be increasing. Presence of Legionella in the hospital drinking water is the only risk factor known with certainty to be predictive of risk for contracting Legionnaires’ disease. RECENT FINDINGS: Given the high frequency of infection by nonpneumophila and nonserogroup 1 species, both Legionella respiratory culture on selective media and urine antigen testing should be available in the hospital clinical microbiology laboratory. If the drinking water is contaminated by nonpneumophila or nonserogroup 1 species, Legionella culture on selective media must be available for patients with hospital-acquired pneumonia. The impact of PCR application for environmental water specimen remains to be elucidated. Its advantage is that it is a rapid test and its weakness is its low specificity. Copper-silver ionization disinfection and point-of-use (POU) filters have proved effective. Chlorine dioxide and monochloramine are under evaluation and their ultimate role remains to be elucidated. Routine Legionella cultures in concert with disinfectant levels are the best indicators for ensuring long-term efficacy. Percentage distal site positivity for Legionella in drinking water is accurate in predicting risk. Quantitative criteria (CFU/ml) have proven inaccurate and should be abandoned. SUMMARY: Infection control professionals, not healthcare facility personnel or engineers, should play the leadership role in selecting and evaluating the specific disinfection modality. Proactive measures of routine environmental cultures for hospital water and disinfection modalities allow for effective prevention of this high-profile hospital-acquired infection.
Source: Medline

38. Antimicrobial efficacy of surface-coated external fixation pins.
Author(s) Furkert FH, Sorensen JH, Arnoldi J, Robioneck B, Steckel H
Citation: Current Microbiology, June 2011, vol./is. 62/6(1743-51), 0343-8651;1432-0991 (2011 Jun)
Publication Date: June 2011
Abstract: In clinical applications, colonization of metal implants by adhesive and biofilm-forming bacteria not only prolong healing but create additional healthcare costs for implant revision and antimicrobial treatment. An in vitro assay was established investigating the antimicrobial surface activity of external fixation pins intended for use in bone fractures and deformities. Test articles made out of stainless steel and coated with a polymer-containing nanoparticulate silver were compared to non-coated reference controls out of stainless steel, copper and titanium. Staphylococcus epidermidis, known as a predominant cause for implant-related infections was used as test organism. Test pins and bacteria were incubated for a period of 20 h found to be sufficient for initiating biofilm formation. After removing non- and low-adherent bacteria by rinsing, two methods were used to isolate high-adherent (sessile) bacteria from the implant surfaces. Besides shaking the implants in
a solution containing small glass beads, a cytobrush technique was used to mechanically harvest viable bacteria. Finally, the amount of detached bacteria was determined by plate counts. Several parameters identified to be critical within the different removal procedures such as the inoculum concentration and the shaking time in the presence of glass beads as well as time of the cytobrush treatment were analysed. The final test scheme resulted in the use of an inoculum of 10(5) colony forming units (CFU) per millilitre, ten rinsing steps for the removal of low adherent bacteria and 5 min of shaking in the presence of glass beads, detaching the high-adherent bacteria. Due to subjective variations impacting the outcome of the procedure, the cytobrush technique was not favoured and finally rejected. Using the in vitro assay developed, it could be demonstrated that fixation pins coated with silver show a 3 log step reduction in the number of biofilm-forming bacteria compared to a non-coated stainless steel or titanium implant. Pins made out of copper showed the highest antimicrobial efficacy, as the number of detached bacteria was found to be below the detection limit, they served as a positive control within this test.

Source: Medline

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39. Infection Control Update.

Author(s)

Citation: Healthcare Purchasing News, 01 June 2011, vol./is. 35/6(36-36), 10983716

Publication Date: 01 June 2011

Source: CINAHL

Available in fulltext from Healthcare Purchasing News at EBSCOhost

Available in fulltext at Healthcare Purchasing News; Collection notes: On first login to a ProQuest journal you will need to select 'Athens (OpenAthens Federation)' from Select Region, and then 'NHS England' from Choose your Library.

40. New insights into the antimicrobial mechanisms of copper touch surfaces

Author(s) Keevil B., Warnes S.

Citation: BMC Proceedings, June 2011, vol./is. 5/, 1753-6561 (29 Jun 2011)

Publication Date: June 2011

Abstract: Introduction / objectives: Survival of pathogens on touch surfaces contributes to increasing incidence and spread of antibiotic resistance and infection in hospitals. One way to address this could be to use biocidal surfaces in conjunction with improved cleaning regimes. Exposure to moist copper alloy surfaces, to simulate fomite contamination, resulted in a rapid kill of significant bacterial, viral and fungal pathogens. We now report studies on dry surfaces with a range of pathogens to elucidate the antimicrobial mechanism. Methods: Clinical isolates of VRE, MRSA, E. coli O157, A. baumannii and Salmonella were inoculated onto copper alloy and stainless steel surfaces. Survivors were assessed by culture on agar media, respiration using CTC reduction, membrane potential using Rhodamine 123 and cell membrane integrity using BacLight stain. Genomic and plasmid DNA integrity was determined using gel electrophoresis and a sensitive genomic fragmentation assay. Contribution of Cu(I) or Cu(II) ions, and superoxide or hydroxyl free radical to the antimicrobial effect was determined by the protective effect of copper chelators and reactive oxygen species quenchers. Results: Copper surface toxicity in enterococci and MRSA involved Cu(I) and (Cu(II) ion release and generation of superoxide, resulting in rapid collapse of membrane potential, arrested respiration and DNA breakdown. Fenton reaction generation of hydroxyl radicals was more important in Gram-negative bacteria and this was also accompanied by a compromised cell membrane. Conclusion: Contact surfaces containing copper could be useful to help prevent spread of viable
pathogens. The rapid destruction of genomic and plasmid nucleic acid could prevent mutational resistance developing and also help reduce the spread of antibiotic resistance genes to receptive and potentially more virulent organisms, as well as genes responsible for virulence.

**Source:** EMBASE

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41. Copper surfaces in the ICU reduced the relative risk of acquiring an infection while hospitalized

**Author(s)** Schmidt M.G.

**Citation:** BMC Proceedings, June 2011, vol./is. 5/, 1753-6561 (29 Jun 2011)

**Publication Date:** June 2011

**Abstract:** Introduction / objectives: The acquisition of microbes with the subsequent development of an infection while hospitalized continues to challenge healthcare worldwide. The CDC estimates the overall risk, mortality and cost to the USA to be ~5%, 100,000 deaths and ~45 billion additional dollars; rates for Medical Intensive Care Units (MICU) are higher where the risk often exceeds 25%. At issue is whether reducing the microbial burden of the environment can lead to an effective method to limit the risk of acquiring an infection while hospitalized. Methods: A multi-site clinical trial was conducted within the MICU of 3 US hospitals. The study addressed two issues. First, the effectiveness with which antimicrobial copper touch surfaces would lower the microbial burden found on commonly touched objects and secondly whether a reduction to burden would mitigate the acquisition of an infection while being treated in rooms with copper objects. Microbial burden was assessed in experimental and control rooms once each week. 650 patients were evaluated in order to address whether the presence of copper objects in the room had an impact on the rate of MRSA and/or VRE colonization/infection and/or HAI acquisitions according to the surveillance definition for acute care settings of the CDC/NHSN. Results: The median burden observed on copper surfaces was 97% less than the control surfaces which concomitantly resulted in a significant reduction to the number of infections seen in patients treated in copper rooms. Conclusion: Use of antimicrobial copper surfaces facilitated a reduction in burden to levels below those suggested for the terminal-cleaning standard of 5 cfu/cm<sup>2</sup>. Risk mitigation of the environmental burden resulted in a concomitant mitigation of the HAI rates for patients treated in rooms with selected high impact touch surfaces fabricated from antimicrobial copper.

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42. Metallic copper as an antimicrobial surface.

Author(s): Grass G, Rensing C, Solioz M

Citation: Applied & Environmental Microbiology, March 2011, vol./is. 77/5(1541-7), 0099-2240;1098-5336 (2011 Mar)

Publication Date: March 2011

Abstract: Bacteria, yeasts, and viruses are rapidly killed on metallic copper surfaces, and the term "contact killing" has been coined for this process. While the phenomenon was already known in ancient times, it is currently receiving renewed attention. This is due to the potential use of copper as an antibacterial material in health care settings. Contact killing was observed to take place at a rate of at least 7 to 8 logs per hour, and no live microorganisms were generally recovered from copper surfaces after prolonged incubation. The antimicrobial activity of copper and copper alloys is now well established, and copper has recently been registered at the U.S. Environmental Protection Agency as the first solid antimicrobial material. In several clinical studies, copper has been evaluated for use on touch surfaces, such as door handles, bathroom fixtures, or bed rails, in attempts to curb nosocomial infections. In connection to these new applications of copper, it is important to understand the mechanism of contact killing since it may bear on central issues, such as the possibility of the emergence and spread of resistant organisms, cleaning procedures, and questions of material and object engineering. Recent work has shed light on mechanistic aspects of contact killing. These findings will be reviewed here and juxtaposed with the toxicity mechanisms of ionic copper. The merit of copper as a hygienic material in hospitals and related settings will also be discussed.

Source: Medline

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Available in fulltext from Applied and Environmental Microbiology at National Library of Medicine
Available in fulltext from Applied and Environmental Microbiology at Free Access Content


Author(s): Lin YE, Stout JE, Yu VL

Citation: Infection Control & Hospital Epidemiology, February 2011, vol./is. 32/2(166-73), 0899-823X;1559-6834 (2011 Feb)

Publication Date: February 2011

Abstract: Hospital-acquired Legionnaires' disease is directly linked to the presence of Legionella in hospital drinking water. Disinfecting the drinking water system is an effective preventive measure. The efficacy of any disinfection measures should be validated in a stepwise fashion from laboratory assessment to a controlled multiple-hospital evaluation over a prolonged period of time. In this review, we evaluate systemic disinfection methods (copper-silver ionization, chlorine dioxide, monochloramine, ultraviolet light, and hyperchlorination), a focal disinfection method (point-of-use filtration), and short-term
disinfection methods in outbreak situations (superheat-and-flush with or without hyperchlorination). The infection control practitioner should take the lead in selection of the disinfection system and the vendor. Formal appraisals by other hospitals with experience of the system under consideration is indicated. Routine performance of surveillance cultures of drinking water to detect Legionella and monitoring of disinfectant concentrations are necessary to ensure long-term efficacy.

Source: Medline
Available in fulltext from Infection Control and Hospital Epidemiology at Free Access

44. Copper resistance is essential for virulence of Mycobacterium tuberculosis


Citation: Proceedings of the National Academy of Sciences of the United States of America, January 2011, vol./is. 108/4(1621-1626), 0027-8424;1091-6490 (25 Jan 2011)

Publication Date: January 2011

Abstract: Copper (Cu) is essential for many biological processes, but is toxic when present in excessive amounts. In this study, we provide evidence that Cu plays a crucial role in controlling tuberculosis. A Mycobacterium tuberculosis (Mt) mutant lacking the outer membrane channel protein Rv1698 accumulated 100-fold more Cu and was more susceptible to Cu toxicity than WT Mt. Similar phenotypes were observed for a M. smegmatis mutant lacking the homolog Ms3747, demonstrating that these mycobacterial copper transport proteins B (McTB) are essential for Cu resistance and maintenance of low intracellular Cu levels. Guinea pigs responded to infection with Mt by increasing the Cu concentration in lung lesions. Loss of McTB resulted in a 1,000- and 100-fold reduced bacterial burden in lungs and lymph nodes, respectively, in guinea pigs infected with Mt. In mice, the persistence defect of the Mt McTB mutant was exacerbated by the addition of Cu to the diet. These experiments provide evidence that Cu is used by the mammalian host to control Mt infection and that Cu resistance mechanisms are crucial for Mt virulence. Importantly, Mt is much more susceptible to Cu than other bacteria and is killed in vitro by Cu concentrations lower than those found in phagosomes of macrophages. Hence, this study reveals an Achilles heel of Mt that might be a promising target for tuberculosis chemotherapy.

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45. Antimicrobial activity of copper and silver nanofilms on nosocomial bacterial species.

Author(s) Codita I, Caplan DM, Dragulescu EC, Lixandru BE, Coldea IL, Dragomirescu CC, Surdu-Bob C, Badulescu M

Citation: Romanian Archives of Microbiology & Immunology, October 2010, vol./is. 69/4(204-12), 1222-3891:1222-3891 (2010 Oct-Dec)
Abstract: Contaminated surfaces are possible vehicles in infection transmission. It is known that both Copper (Cu) and Silver (Ag) efficiently inactivate microbes by direct contact. Aiming at using these metals for benefitting from their antimicrobial effect, but to avoid subsequent toxic effects, we evaluated the antimicrobial activity of nanometric thin Silver and Copper films covering less expensive materials. Using a modified version of the Japan Industrial Standard JIS Z 2801:2000, we demonstrated the antimicrobial activity of the surfaces covered with metal ions nanoﬁlms on microorganisms possibly involved in nosocomial infections and on Bacillus anthracis, bacteria with possible implication in bioterrorist attacks. Copper covered surfaces proved to have better antimicrobial activity than Silver surfaces. Silver covered surfaces showed better activity on Gram negative bacteria than on Gram positive cocci. Going deeper with studies on antimicrobial effects using new methods with better direct and/or functional discriminatory capacity is needed in order to provide additional information on the mechanisms of Silver and Copper nanoﬁlms antimicrobial activity.

Source: Medline

Available in fulltext from Romanian Archives of Microbiology and Immunology at Free Access Content

46. Survival of bacteria on metallic copper surfaces in a hospital trial.

Author(s): Mikolay A, Huggett S, Tikana L, Grass G, Braun J, Nies DH

Citation: Applied Microbiology & Biotechnology, August 2010, vol./is. 87/5(1875-9), 0175-7598;1432-0614 (2010 Aug)

Publication Date: August 2010

Abstract: Basic chemistry of copper is responsible for its Janus-faced feature: on one hand, copper is an essential trace element required to interact efﬁciently with molecular oxygen. On the other hand, interaction with reactive oxygen species in undesired Fenton-like reactions leads to the production of hydroxyl radicals, which rapidly damage cellular macromolecules. Moreover, copper cations strongly bind to thiol compounds disturbing redox-homeostasis and may also remove cations of other transition metals from their native binding sites in enzymes. Nature has learned during evolution to deal with the dangerous yet important copper cations. Bacterial cells use different efflux systems to detoxify the metal from the cytoplasm or periplasm. Despite this ability, bacteria are rapidly killed on dry metallic copper surfaces. The mode of killing likely involves copper cations being released from the metallic copper and reactive oxygen species. With all this knowledge about the interaction of copper and its cations with cellular macromolecules in mind, experiments were moved to the next level, and the antimicrobial properties of copper-containing alloys in an "everyday" hospital setting were investigated. The alloys tested decreased the number of colony-forming units on metallic copper-containing surfaces by one third compared to control aluminum or plastic surfaces. Moreover, after disinfection, repopulation of the surfaces was delayed on copper alloys. This study bridges a gap between basic research concerning cellular copper homeostasis and application of this knowledge. It demonstrates that the use of copper-containing alloys may limit the spread of multiple drug-resistant bacteria in hospitals.

Source: Medline

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47. Effect of the dried residues of two hand gels on the survival of meticillin-resistant Staphylococcus aureus and Acinetobacter calcoaceticus-baumannii.

Author(s) Hall TJ, Wren MWD, Wareham DW, Jeanes A, Gant VA
Abstract: We assessed the ability of the residues of an alcohol-based hand gel (hand gel A) and an Aloe vera-based CuAL42 copper biocide-containing hand gel (hand gel B), to support the survival of meticillin-resistant Staphylococcus aureus (MRSA) and Acinetobacter calcoaceticus-baumannii (ACCB). One-millilitre samples of hand gels A and B were spread over marked 20 cm² areas and dried overnight. MRSA or ACCB (1 x 10⁴ CFU) were spread onto the dried residue and contact plated at various times. MRSA and ACCB survived for 8 hours on hand gel A residue, whilst MRSA did not survive on hand gel B residue and ACCB survived less than 30 min. Low concentrations of hand gel A facilitate the growth of ACCB, but this is not the case for hand gel B. Hand gel A is extensively used in UK hospitals and its residue left on high-touch surfaces may support the survival of bacteria that cause healthcare-acquired infections.

Source: CINAHL

48. Susceptibility of 169 USA300 methicillin-resistant Staphylococcus aureus isolates to two copper-based biocides, CuAL42 and CuWB50.

Author(s) Luna VA, Hall TJ, King DS, Cannons AC

Citation: Journal of Antimicrobial Chemotherapy, May 2010, vol./is. 65/5(939-41), 0305-7453;1460-2091 (2010 May)

Abstract: OBJECTIVES: To test the activity of two copper-based biocides, CuAL42 and CuWB50, and benzalkonium chloride against 169 isolates of methicillin-resistant Staphylococcus aureus (MRSA) pulsotype USA300, a virulent, multiply resistant, widespread clone in the USA.METHODS: Tests including MIC, MBC and time-kill studies were performed multiple times.RESULTS: The MIC range, MIC(50) and MIC(90) (0.59-18.75, 4.69 and 4.69 ppm, respectively) and the MBC range, MBC(50) and MBC(90) (1.17-18.75, 4.69 and 9.38 ppm, respectively) for CuAL42 were identical with those obtained with CuWB50, except that the MBC range for CuWB50 was wider (0.59-37.5 ppm). In time-kill studies, a 6 log(10) reduction of cfu was achieved within 1 h (150 ppm) and 0.5 h (300 ppm) for CuAL42, and 1.5 h (150 ppm) and 0.75 h (300 ppm) for CuWB50.CONSELUTIONS: Both copper-based biocides can effectively kill USA300 MRSA and may facilitate the eradication of the organism from healthcare settings.

Source: Medline

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Available in fulltext from Journal of Antimicrobial Chemotherapy at Highwire Press
Available in fulltext from Journal of Antimicrobial Chemotherapy (JAC) at EBSCOhost

49. Efficacy of copper-silver ionization in controlling biofilm- and plankton-associated waterborne pathogens.

Author(s) Shih HY, Lin YE

Citation: Applied & Environmental Microbiology, March 2010, vol./is. 76/6(2032-5), 0099-2240;1098-5336 (2010 Mar)

Abstract: The study was to determine the efficacy of copper-silver ionization against the formation of Pseudomonas aeruginosa, Stenotrophomonas maltophilia, and Acinetobacter baumannii in biofilms and planktonic phases. At concentrations below the EPA limits, ionization has potential to control the three waterborne pathogens, in addition to Legionella, in hospital water systems for nosocomial infection control.

Source: Medline

Available in fulltext from Applied and Environmental Microbiology at National Library of
50. Role of copper in reducing hospital environment contamination

**Author(s)** Casey AL, Adams D, Karpanen TJ, Lambert PA, Cookson BD, Nightingale P, Miruszenko L, Shillam R, Christian P, Elliott TS

**Citation:** Journal of Hospital Infection, January 2010, vol./is. 74/1(72-7), 0195-6701;1532-2939 (2010 Jan)

**Publication Date:** January 2010

**Abstract:** The environment may act as a reservoir for pathogens that cause healthcare-associated infections (HCAIs). Approaches to reducing environmental microbial contamination in addition to cleaning are thus worthy of consideration. Copper is well recognised as having antimicrobial activity but this property has not been applied to the clinical setting. We explored its use in a novel cross-over study on an acute medical ward. A toilet seat, set of tap handles and a ward entrance door push plate each containing copper were sampled for the presence of microorganisms and compared to equivalent non-copper-containing items on the same ward. Items were sampled once weekly for 10 weeks at 07:00 and 17:00. After five weeks, the copper-containing and non-copper-containing items were interchanged. The total aerobic microbial counts per cm² including the presence of 'indicator microorganisms' were determined. Median numbers of microorganisms harboured by the copper-containing items were between 90% and 100% lower than their control equivalents at both 07:00 and 17:00. This reached statistical significance for each item with one exception. Based on the median total aerobic cfu counts from the study per iod, five out of ten control sample points and zero out of ten copper points failed proposed benchmark values of a total aerobic count of <5cfu/cm². All indicator microorganisms were only isolated from control items with the exception of one item during one week. The use of copper-containing materials for surfaces in the hospital environment may therefore be a valuable adjunct for the prevention of HCAIs and requires further evaluation. Copyright 2009 The Hospital Infection Society. Published by Elsevier Ltd. All rights reserved.

**Source:** Medline

51. Performance of ultramicrofibre cleaning technology with or without addition of a novel copper-based biocide.

**Author(s)** Hamilton D, Foster A, Ballantyne L, Kingsmore P, Bedwell D, Hall TJ, Hickok SS, Jeanes A, Coen PG, Gant VA

**Citation:** Journal of Hospital Infection, January 2010, vol./is. 74/1(62-71), 0195-6701;1532-2939 (2010 Jan)

**Publication Date:** January 2010

**Abstract:** This study compared the bacterial removal performance of ultramicrofibre cloths and mops (UMF) moistened with water (UMF+water), with those moistened with a novel copper-based biocide (UMF+CuWB50, 300ppm) in several working hospital environments, specifically accident and emergency (A&E) and three other wards. A total of 13 defined sampling sites (10 sites per ward) were sampled in order to retrieve, culture, and
enumerate total viable (bacterial) counts (TVC) for each site. We sampled 1h before, and 1 and 4h after, cleaning three times per week. The trial ran for 7 weeks. Two wards were cleaned with UMF+water for 3 weeks, and UMF+CuWB50 for 4 weeks. The reverse applied to the other two wards in a cross-over design fashion, to eliminate ward- and time-specific bias. Multivariate statistical analyses were used to establish extent and significance of any perceived differences, and to eliminate the effects of potential confounders. Cleaning with UMF+water reduced TVC on the test surfaces by 30%, whereas cleaning with TVC+CuWB50 reduced TVC by 56%. CuWB50 had two separate effects; a direct antibacterial effect (evident shortly after cleaning), and a residual antibacterial effect that lasted approximately 2 weeks. The residual effect requires regular application of CuWB50 if it is to persist. This 'real life' hospital implementation study demonstrates encouraging microbiological cleaning performance for UMF, which is further enhanced with CuWB50.

Source: Medline
Available in fulltext from Journal of Hospital Infection at the ULHT Library and Knowledge Services' eJournal collection

52. Potential for preventing spread of fungi in air-conditioning systems constructed using copper instead of aluminium.

Author(s) Weaver L, Michels HT, Keevil CW
Citation: Letters in Applied Microbiology, January 2010, vol./is. 50/1(18-23), 0266-8254;1472-765X (2010 Jan)
Publication Date: January 2010
Abstract: AIMS: As copper has been previously suggested as an antimicrobial surface, we tested the effectiveness of copper as an antifungal surface which could be used in air-conditioning systems as an alternative to aluminium.METHODS AND RESULTS: Coupons of copper (C11000) and aluminium were inoculated with fungal isolates (Aspergillus spp., Fusarium spp., Penicillium chrysogenum and Candida albicans) for various time periods. Culture on potato dextrose agar and an in situ viability assay using the fluorochrome FUN-1 were used to determine whether spores had survived. The results showed increased die off of fungal isolates tested compared to aluminium. In addition, copper also prevented the germination of spores present, thereby reducing the risk of the release of spores.CONCLUSIONS: Copper offered an antifungal surface and prevented subsequent germination of spores present. FUN-1 demonstrated that fungal spores entered into a viable but not culturable (VBNC) state on copper indicating the importance of using such methods when assessing the effect of an antifungal as culture alone may give false results.SIGNIFICANCE AND IMPACT OF STUDY: Copper offers a valuable alternative to aluminium which could be used in air-conditioning systems in buildings, particularly in hospital environments where patients are more susceptible to fungal infections.
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Available in fulltext from Letters in Applied Microbiology at Ingenta
Available in fulltext from Letters in Applied Microbiology at Wiley

53. Inactivation and injury of Escherichia coli in a copper water storage vessel: effects of temperature and pH.

Author(s) Sharan R, Chhibber S, Attri S, Reed RH
Citation: Antonie van Leeuwenhoek, January 2010, vol./is. 97/1(91-7), 0003-6072;1572-9699 (2010 Jan)
Publication Date: January 2010
Abstract: Copper has been used as a disinfectant since ancient times and recent research has demonstrated that antimicrobial copper surfaces may have practical applications in healthcare and related areas. The present study was carried out to establish the effects of temperature and pH on inactivation and sub-lethal injury of Escherichia coli in water stored in a copper vessel, to determine the operational limits of the process in terms of these variables. To investigate the effects of temperature, a bacterial suspension at pH 7.0 was stored for up to 48 h in copper vessels at 5, 15, 25 and 35 degrees C. For pH, a bacterial suspension was stored at 30 degrees C for up to 48 h in copper vessels at pH 6.0, 7.0, 8.0 and 9.0. Both temperature and pH had substantial effects on inactivation and injury, with the fastest inactivation observed at elevated temperature and at pH values furthest from neutrality, while the greatest amount of sub-lethal injury, manifest as sensitivity to conventional aerobic enumeration, was observed at a temperature of 35 degrees C. These findings have important implications for the practical application of copper-based water disinfection methods, in terms of their likely efficacy under environmental conditions.

Source: Medline

Available in fulltext at Antonie van Leeuwenhoek; Collection notes: On first login to a ProQuest journal you will need to select 'Athens (OpenAthens Federation)' from Select Region, and then 'NHS England' from Choose your Library.

54. Antimicrobial efficacy of copper touch surfaces in reducing environmental bioburden in a South African community healthcare facility.

Author(s) Marais F, Mehtar S, Chalkley L

Citation: Journal of Hospital Infection, January 2010, vol./is. 74/1(80-2), 0195-6701;1532-2939 (2010 Jan)

Publication Date: January 2010

Source: Medline

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Author(s) Kampf G, Hall TJ, Wren MWD, Jeans A, Gant VA

Citation: American Journal of Infection Control, 01 October 2009, vol./is. 37/8(691-692), 01966553

Publication Date: 01 October 2009

Source: CINAHL

56. Decontamination of laundry at low temperature with CuWB50, a novel copper-based biocidal compound [corrected] [published erratum appears in AM J INFECT CONTROL 2010 Feb;38(1):84].

Author(s) Hall TJ, Wren MWD, Jeans A, Gant VA

Citation: American Journal of Infection Control, 01 August 2009, vol./is. 37/6(478-483), 01966553

Publication Date: 01 August 2009

Abstract: BACKGROUND: Traditional laundry decontamination relies on thermal disinfection that degrades textiles. We investigated the ability of a novel copper-based biocidal compound, CuWB50, to assist in the decontamination of swatches purposely contaminated with Staphylococcus aureus and Acinetobacter during "real-life" low-temperature machine washing with and without 2 commercial detergents. METHODS: Contaminated and noncontaminated swatches were attached to ballast sheets and washed
in cold water for 15 minutes in an industrial Electrolux machine. We assessed colony-forming units (cfu) on the swatches and in the postwash water. RESULTS: Low-temperature machine washing produced only partial reductions in viable methicillin-resistant Staphylococcus aureus and Acinetobacter calcoaceticus baumannii counts on swatches and resulted in cross contamination of other swatches in the same wash. Washing with CuWB50 alone at high concentration (100 mg/L), however, resulted in superior decontamination compared with water alone, whereas washing with a combination of detergent and CuWB50 at low concentration (5 mg/L) yielded synergistic and complete decontamination of swatches and postwash water. CONCLUSION: Our results show highly effective laundry decontamination using CuWB50 with detergent at low temperature and are timely both in terms of rising energy costs and textile degradation issues.

**Source:** CINAHL

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57. New hospital disinfection processes for both conventional and prion infectious agents compatible with thermosensitive medical equipment.


**Citation:** Journal of Hospital Infection, 01 August 2009, vol./is. 72/4(342-350), 01956701

**Publication Date:** 01 August 2009

**Abstract:** With the detection of prions in specific tissues in variant and sporadic Creutzfeldt-Jakob diseases, efficient decontamination for human transmissible spongiform encephalopathy (TSE) agents, that is compatible with medical equipment, has become a major issue. We previously described the cleavage of prions on exposure to copper (Cu) and hydrogen peroxide (H(2)O(2)) and have used this property to develop efficient prion decontamination processes. To validate this approach, in-vitro assays on genuine human and animal prions using both brain homogenates and steel wires to mimic contamination of medical equipment were conducted. In-vivo experiments using steel wire in the hamster 263K model were then used to evaluate the effect on prion infectivity. Assays on classical pathogens following international norms completed these prion experiments. In-vitro data confirmed the full decontamination efficacy of H(2)O(2)/Cu on different TSE strains. Combination of Cu with peracetic acid, used for endoscope disinfection, also revealed improved prion decontamination. Animal assay demonstrated efficacy on TSE infectivity of H(2)O(2)/Cu alone or in combination with detergents (reduction factor >/=5.25log(10)). Assays on classical pathogens confirmed the disinfection properties of the different processes. Taken together, these new disinfection processes are efficient for both conventional and prion infectious agents and are, compatible with thermosensitive medical equipment. They can be adapted to hospitals' and practitioners' routine use, and they present reduced risks for the environment and for healthcare professionals. Copyright © 2009 The Hospital Infection Society

**Source:** CINAHL

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58. A comparison of the antibacterial efficacy and cytotoxicity to cultured human skin cells of 7 commercial hand rubs and Xgel, a new copper-based biocidal hand rub.

**Author(s)** Hall TJ, Wren MWD, Jeanes A, Gant VA

**Citation:** American Journal of Infection Control, 01 May 2009, vol./is. 37/4(322-326), 01966553

**Publication Date:** 01 May 2009

**Abstract:** BACKGROUND: Hand cleanliness is important in hospital infection control, but skin irritation from frequent alcohol-based hand rub use reduces compliance. We have compared a new copper biocide/Aloe vera-based biocidal hand rub (Xgel) with 7 commercially available hand rubs. METHODS: Hand rubs were cultured with human skin cells for 24 hours after which cytotoxicity was assessed using the sulforhodamine B assay.
The EN 12054 bacterial suspension test protocol was used to assess biocidal activity of 2 of the least cytotoxic hand rubs (Xgel and Purell). RESULTS: Hand rubs had 50% cytotoxic concentrations ranging from >10% to <0.1% vol/vol. In the EN12054 assay, Xgel reduced colony forming units (CFU) by >10(8) with methicillin-resistant Staphylococcus aureus (MRSA) and Acinetobacter in 1 minute, whereas Purell only reduced CFU by 10(4) and 10(5), respectively. Purell was ineffective against C difficile spores, whereas Xgel produced a 3 x 10(3) reduction in CFU. CONCLUSION: The hand rubs had a wide range of cytotoxicity values for human skin cells, with Xgel being the least cytotoxic to human skin cells. In the EN 12054 bacterial suspension test, Xgel was more effective than Purell against all organisms tested. It should be noted that these in vitro results may not translate into clinical differences.

Source: CINAHL

59. Copper surfaces effective in controlling MRSA.

Author(s)

Citation: Nurse Educator, 01 May 2009, vol./is. 34/3(113-113), 03633624
Publication Date: 01 May 2009
Source: CINAHL

60. The observatory. Infectious diseases: killing superbugs.

Author(s)

Citation: MLO: Medical Laboratory Observer, 01 August 2008, vol./is. 40/8(10-10), 05807247
Publication Date: 01 August 2008
Source: CINAHL


Author(s)

Citation: Journal of Hospital Infection, 01 February 2008, vol./is. 68/2(179-179), 01956701
Publication Date: 01 February 2008
Source: CINAHL

62. Survival of Clostridium difficile on copper and steel: futuristic options for hospital hygiene.

Author(s) Weaver L, Michels HT, Keevil CW

Citation: Journal of Hospital Infection, February 2008, vol./is. 68/2(145-51), 0195-
Abstract: Clostridium difficile is rapidly becoming a major cause of hospital-acquired infections worldwide, due in part to transmission of the faecal pathogen between contaminated hands and contact surfaces. Accordingly, this study evaluated survival of C. difficile vegetative cells and spores on the contact surface commonly found in healthcare settings, stainless steel, compared to five copper alloys (65-100% copper content). C. difficile requires prolonged incubation to grow and therefore the total number and number of viable cells was estimated using a fluorescence dual-staining technique. For viability assessment the redox dye 5-cyano-2,3-ditolyl tetrazolium (CTC) was used to measure metabolic activity. Results demonstrated that copper alloys with a copper content >70% provide a significant reduction in survival of C. difficile vegetative cells and spores on copper alloys compared with stainless steel. Complete death of spores was observed after 24-48 h on copper alloys whereas no significant death rate was observed on stainless steel even after 168 h. The use of CTC gave comparable results to culture and offers a more rapid viability analysis (8 h) than culture. The results suggest that using copper alloys in hospitals and other healthcare facilities could offer the potential to reduce spread of C. difficile from contaminated surfaces.

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63. Antimicrobial efficacy of copper surfaces against spores and vegetative cells of Clostridium difficile: The germination theory

Author(s) Wheeldon L.J., Worthington T., Lambert P.A., Hilton A.C., Lowden C.J., Elliott T.S.J.

Citation: Journal of Antimicrobial Chemotherapy, 2008, vol./is. 62/3(522-525), 0305-7453;1460-2091 (2008)

Publication Date: 2008

Abstract: Objectives: Persistent contamination of surfaces by spores of Clostridium difficile is a major factor influencing the spread of C. difficile-associated diarrhoea (CDAD) in the clinical setting. In recent years, the antimicrobial efficacy of metal surfaces has been investigated against microorganisms including methicillin-resistant Staphylococcus aureus. This study compared the survival of C. difficile on stainless steel, a metal contact surface widely used in hospitals, and copper surfaces. Methods: Antimicrobial efficacy was assessed using a carrier test method against dormant spores, germinating spores and vegetative cells of C. difficile (NCTC 11204 and ribotype 027) over a 3 h period in the presence and absence of organic matter. Results: Copper metal eliminated all vegetative cells of C. difficile within 30 min, compared with stainless steel which demonstrated no antimicrobial activity (P < 0.05). Copper significantly reduced the viability of spores of C. difficile exposed to the germinant (sodium taurocholate) in aerobic conditions within 60 min (P < 0.05) while achieving a >2.5 log reduction (99.8% reduction) at 3 h. Organic material did not reduce the antimicrobial efficacy of the copper surface (P > 0.05). Conclusions: The use of copper surfaces within the clinical environment and application of a germination solution in infection control procedures may offer a novel way forward in eliminating C. difficile from contaminated surfaces and reducing CDAD. The Author 2008. Published by Oxford University Press on behalf of the British Society for Antimicrobial Chemotherapy. All rights reserved.

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64. In vitro efficacy of copper and silver ions in eradicating Pseudomonas aeruginosa, Stenotrophomonas maltophilia and Acinetobacter baumannii: Implications for on-site disinfection for hospital infection control

**Author(s)** Huang H.-I., Shih H.-Y., Lee C.-M., Yang T.C., Lay J.-J., Lin Y.E.

**Citation:** Water Research, January 2008, vol./is. 42/1-2(73-80), 0043-1354 (January 2008)

**Publication Date:** January 2008

**Abstract:** Pseudomonas aeruginosa, Stenotrophomonas maltophilia and Acinetobacter baumannii are major opportunistic waterborne pathogens causing hospital-acquired infections. Copper-silver ionization has been shown to be effective in controlling Legionella colonization in hospital water systems. The objective was to determine the efficacy of copper and silver ions alone and in combination in eradicating P. aeruginosa, S. maltophilia and A. baumannii at the concentration applied to Legionella control. Kill curve experiments and mathematical modeling were conducted at copper and silver ion concentrations of 0.1, 0.2, 0.4, 0.8 and 0.01, 0.02, 0.04, 0.08 mg/L, respectively. The combinations of copper and silver ions were tested at concentrations of 0.2/0.02 and 0.4/0.04 mg/L, respectively. Initial organism concentration was ca. of 3x10^6 cfu/mL, and viability of the test organisms was assessed at predetermined time intervals. Samples (0.1 mL) withdrawn were mixed with 10 μL neutralizer solution immediately, serially diluted and plated in duplicate onto blood agar plates. The culture plates were incubated for 48 h at 37 degreeC and enumerated for the cfu (detection limit 10 cfu/mL). The results showed all copper ion concentrations tested (0.1-0.8 mg/L) achieved more than 99.999% reduction of P. aeruginosa which appears to be more susceptible to copper ions than S. maltophilia and A. baumannii. Silver ions concentration of 0.08 mg/L achieved more than 99.999% reduction of P. aeruginosa, S. maltophilia and A. baumannii in 6, 12 and 96 h, respectively. Combination of copper and silver ions exhibited a synergistic effect against P. aeruginosa and A. baumannii while the combination exhibited an antagonistic effect against S. maltophilia. Ionization may have a potential to eradicate P. aeruginosa, S. maltophilia and A. baumannii from hospital water systems. 2007 Elsevier Ltd. All rights reserved.

**Source:** EMBASE

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65. Is copper-silver ionisation safe and effective in controlling legionella?

**Author(s)** Cachafeiro SP, Naveira IM, Garcia IG

**Citation:** Journal of Hospital Infection, 01 November 2007, vol./is. 67/3(209-216), 01956701

**Publication Date:** 01 November 2007

**Abstract:** Copper-silver ionisation is gaining popularity worldwide as a water disinfection method. We review the literature that supports the effectiveness and safety of the copper-silver ionization pertaining to legionella control in water distribution systems. A search between January 1997 and January 2007 was conducted in relevant health databases: Medline, Embase, NHS CRD, Cochrane Library Plus, Web of Knowledge, IME (Spanish Medical Index) and IBECS (Health Sciences Bibliographic Index). Ten published studies were selected according to inclusion and exclusion criteria previously established; most of these were experimental. Legionella levels decrease with the application of any of the procedures used in these studies and the procedures can be combined to obtain better outcomes. No studies containing an economic evaluation were found. We conclude that copper-silver ionisation is an effective method to control legionella, bearing in mind that eradication cannot be achieved by any method in isolation. Maintaining high temperatures in the water system can maximise effectiveness of the method. Copper-silver appears to be safe, as long as ion levels are monitored and kept within international recommended levels. More studies with concurrent control group, long follow-up and economic evaluation are required to properly assess this procedure. Copyright © 2007 The Hospital Infection Society

**Source:** CINAHL

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66. Handling infection control.

**Author(s)**

**Citation:** Nursing Management - UK, 01 April 2007, vol./is. 14/1(5-5), 13545760

**Publication Date:** 01 April 2007

**Source:** CINAHL

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67. Are exotic solutions the answer to the NHS superbug problem?

**Author(s)** White, C

**Citation:** Nursing Times, Mar 2007, vol. 103, no. 12, p. 9., 0954-7762 (March 20, 2007)

**Publication Date:** March 2007

**Abstract:** Comments on novel approaches to the control of MRSA in hospitals, including the use of copper, silver-impregnated garments, anti-microbial gowns and essential oil vaporisers. It is suggested that there are disadvantages to these initiatives and that staff should be focusing on good hygiene practices. [(BNI unique abstract)] 0 references

**Source:** BNI

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Available in print at Grantham Hospital Staff Library

Available in print at Pilgrim Hospital Staff Library

Available in fulltext from Nursing Times at the ULHT Library and Knowledge Services' eJournal collection

68. Survival of Listeria monocytogenes Scott A on metal surfaces: Implications for cross-contamination

**Author(s)** Wilks S.A., Michels H.T., Keevil C.W.

**Citation:** International Journal of Food Microbiology, September 2006, vol./is. 111/2(93-98), 0168-1605 (01 Sep 2006)

**Publication Date:** September 2006

**Abstract:** Listeria monocytogenes is an important re-emerging pathogen which is commonly found in the environment. Many outbreaks have been associated with the contamination of food produce, often linked to cross-contamination from surfaces or equipment to prepared foodstuffs. In the present study a number of copper-base metal alloys have been used to assess the survival times of L. monocytogenes on different materials, in comparison with stainless steel. High concentrations (10^7) of bacteria were placed on metal coupons cut from each alloy. After defined incubation times, coupons were placed in tubes containing phosphate buffered saline and vortexed to remove the cells. Aliquots were then plated onto tryptone blood agar plates and the number of colony forming units counted. The high concentration of bacteria was used to represent a "worst-case" scenario. The results indicate that survival is greatly reduced on a copper-base alloy compared to stainless steel. Viable cells could be detected on stainless steel after 24 h incubation at room temperature. On copper, brass, aluminium bronze and silicon bronze, no viable bacteria could be detected after 60 min incubation, indicating a 5 log
reduction (the detection limit of the procedure was 100 bacteria). No cells could be
detected from copper nickel and copper nickel zinc alloys, after 90 min incubation. The
viability stain, 5-cyano-2,3-ditolyl tetrazolium chloride (CTC), confirmed these results, with
actively respiring bacteria being clearly labelled on stainless steel after 24 h. The results
suggest that careful choice of surface material could reduce the potential risk of cross-
contamination in industrial, commercial and domestic environments. 2006 Elsevier B.V. All
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Source: EMBASE

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

Author(s) Noyce, J, Michels, H, Keevil, C

Citation: Journal of Hospital Infection, Jul 2006, vol. 63, no. 3, p. 289-297, 0195-6701 (July
2006)

Publication Date: July 2006

Abstract: Research on the effectiveness of copper and brass in the control of MRSA in
healthcare settings, compared to stainless steel. Metal coupons were prepared with 3
strains of MRSA and viability of the air-dried deposits was compared. Recommendations
are made about the use of stainless steel for work surfaces and door handles in hospital
environments. ([BNI unique abstract]) 29 references

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

Author(s) Noyce JO, Michels H, Keevil CW

Citation: Journal of Hospital Infection, 01 July 2006, vol./is. 63/3(289-297), 01956701

Publication Date: 01 July 2006

Abstract: Epidemic meticillin-resistant Staphylococcus aureus (EMRSA) emerged in the
early 1980s with EMRSA-15 and -16 being the most prevalent strains within the UK. MRSA
transmission between patients is largely via the hands of healthcare workers, and
contamination of the hospital environment may occur. The objective of this study was to
evaluate the effectiveness of copper and brass to reduce the viability of air-dried deposits
of three MRSA strains [MRSA (NCTC 10442), EMRSA-1 (NCTC 11939) and EMRSA-16
(NCTC 13143)] compared with stainless steel. MRSA and EMRSA [10(7)colony-forming
units (CFU)] were inoculated on to coupons (1 cm x 1 cm) of copper, brass or stainless
steel and incubated at either 22 degrees C or 4 degrees C for various time periods. Viability
was determined by resuspending removed CFUs and plating out on tryptone soy agar
plates in addition to staining with the respiratory indicator fluorochrome 5-cyano-2,3-ditolyl
tetrazolium. On pure copper surfaces, 10(7) MRSA, EMRSA-1 and EMRSA-16 were
completely killed after 45, 60 and 90 min, respectively, at 22 degrees C. In contrast, viable
organisms for all three strains were detected on stainless steel (grade 304) after 72 h at 22
degrees C. At 4 degrees C, complete kill was achieved on copper for all three strains within
6 h. The results demonstrate an antimicrobial effect of copper on MRSA, EMRSA-1 and -16
in contrast to stainless steel. Consequently, the contemporary application of stainless steel
in hospital environments for work surfaces and door furniture is not recommended.

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71. Prevention and control of health care-associated waterborne infections in health care facilities

**Author(s)** Exner M., Kramer A., Lajoie L., Gebel J., Engelhart S., Hartemann P.

**Citation:** American Journal of Infection Control, June 2005, vol./is. 33/5 SUPPL. 1(S26-S40), 0196-6553 (June 2005)

**Publication Date:** June 2005

**Abstract:** The current article is a review of the public health risks attributable to waterborne pathogens in health care. The consequences of health care-associated infections (HAIs) are discussed. Not only are Legionella spp involved in HAIs, but also Pseudomonas aeruginosa, other gram-negative microorganisms, fungi, and amoeba-associated bacteria. This is particularly noteworthy among immunocompromised patients. New prevention strategies and control measures brought about through advanced planning, facility remodelling and reconstruction, disinfection, and filtration have resulted in a significant reduction of the incidence of waterborne HAIs. The positive consequences of a comprehensive multibarrier approach including prevention and control programs in health care facilities are discussed. Environmental cultures are now integrated within the infection control program of some European countries. In high-risk areas, the application of disposable sterile point-of-use filters for faucets and shower heads appears to be the practice of choice to efficiently control waterborne pathogens and to prevent infections. 2005 Association for Professionals in Infection Control and Epidemiology, Inc.

**Source:** EMBASE

72. Water disinfection with ozone, copper and silver ions, and temperature increase to control Legionella: seven years of experience in a university teaching hospital.

**Author(s)** Blanc DS, Carrara P, Zanetti G, Francioli P

**Citation:** Journal of Hospital Infection, 01 May 2005, vol./is. 60/1(69-72), 01956701

**Publication Date:** 01 May 2005

**Abstract:** The efficacy of ozonation, copper-silver ionization and increased temperature in controlling Legionella spp. in the hot water distribution networks of a university hospital was evaluated. Two separate water distribution networks were studied; network 1 which supplies the surgical intensive care units, and network 2 which supplies the medical intensive care units and the emergency room. Network 1 has been disinfected by ozonation since 1995, and network 2 has been disinfected by ionisation since 1999. The hot water temperature was increased from 50 to 65 degrees C in 1998 and 2000 in networks 1 and 2, respectively. Water samples and swabs of the water outlets were cultured for Legionella spp. between four and six times each year, providing data before and after implementation of the disinfection procedures. There was no significant difference in the proportion of samples positive for Legionella spp. after ozonation in network 1 or after ionization in network 2. In both networks, there was a significant reduction in legionella isolates after increasing the hot water temperature to 65 degrees C. Maintaining the hot water temperature above 50 degrees C throughout both networks proved to be the most effective control measure in our hospital. Copyright © 2005 The Hospital Infection Society

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73. Putting copper into action: copper-impregnated products with potent biocidal activities.

**Author(s)** Borkow G, Gabbay J

**Citation:** FASEB Journal, November 2004, vol./is. 18/14(1728-30), 0892-6638;1530-6860 (2004 Nov)
**Abstract:** Copper ions, either alone or in copper complexes, have been used for centuries to disinfect liquids, solids, and human tissue. Today copper is used as a water purifier, algicide, fungicide, nematocide, molluscicide, and antibacterial and antifouling agent. Copper also displays potent antiviral activity. We hypothesized that introducing copper into clothing, bedding, and other articles would provide them with biocidal properties. A durable platform technology has been developed that introduces copper into cotton fibers, latex, and other polymeric materials. This study demonstrates the broad-spectrum antimicrobial (antibacterial, antiviral, antifungal) and antimite activities of copper-impregnated fibers and polyester products. This technology enabled the production of antiviral gloves and filters (which deactivate HIV-1 and other viruses), antibacterial self-sterilizing fabrics (which kill antibiotic-resistant bacteria, including meticillin-resistant Staphylococcus aureus and vancomycin-resistant Enterococci), antifungal socks (which alleviate symptoms of athlete's foot), and anti-dust mite mattress covers (which reduce mite-related allergies). These products did not have skin-sensitizing properties, as determined by guine pig maximization and rabbit skin irritation tests. Our study demonstrates the potential use of copper in new applications. These applications address medical issues of the greatest importance, such as viral transmissions; nosocomial, or healthcare-associated, infections; and the spread of antibiotic-resistant bacteria.

**Source:** Medline

Available in fulltext from FASEB Journal, The at Highwire Press

Available in fulltext from FASEB Journal - Federation of American Societies for Experimental Biology, The at Free Access Content

74. **A proven method of Legionella control: there's gold in copper-silver ionization.**

**Author(s)** Muder R

**Citation:** Hospital Infection Control, 01 January 2004, vol./is. 31/1(9-10), 0098180X

**Publication Date:** 01 January 2004

**Source:** CINAHL

75. **Experiences of the first 16 hospitals using copper-silver ionization for Legionella control: implications for the evaluation of other disinfection modalities.**

**Author(s)** Stout JE, Yu VL

**Citation:** Infection Control & Hospital Epidemiology, 01 August 2003, vol./is. 24/8(563-568), 0899823X

**Publication Date:** 01 August 2003

**Abstract:** BACKGROUND AND OBJECTIVES: Hospital-acquired legionnaires' disease can be prevented by disinfection of hospital water systems. This study assessed the long-term efficacy of copper-silver ionization as a disinfection method in controlling Legionella in hospital water systems and reducing the incidence of hospital-acquired legionnaires' disease. A standardized, evidence-based approach to assist hospitals with decision making concerning the possible purchase of a disinfection system is presented. DESIGN: The first 16 hospitals to install copper-silver ionization systems for Legionella disinfection were surveyed. Surveys conducted in 1995 and 2000 documented the experiences of the hospitals with maintenance of the system, contamination of water with Legionella, and occurrence of hospital-acquired legionnaires' disease. All were acute care hospitals with a mean of 435 beds. RESULTS: All 16 hospitals reported cases of hospital-acquired legionnaires' disease prior to installing the copper-silver ionization system. Seventy-five percent had previously attempted other disinfection methods including superheat and flush, ultraviolet light, and hyperchlorination. By 2000, the ionization systems had been operational from 5 to 11 years. Prior to installation, 47% of the hospitals reported that more than 30% of distal water sites yielded Legionella. In 1995, after installation, 50% of the hospitals reported 0% positivity, and 43% still reported 0% in 2000. Moreover, no cases of hospital-acquired legionnaires' disease have occurred in any hospital since 1995. CONCLUSIONS: This study represents the final step in a proposed 4-step evaluation
process of disinfection systems that includes (1) demonstrated efficacy of Legionella eradication in vitro using laboratory assays, (2) anecdotal experiences in preventing legionnaires’ disease in individual hospitals, (3) controlled studies in individual hospitals, and (4) validation in confirmatory reports from multiple hospitals during a prolonged time (5 to 11 years in this study). Copper-silver ionization is now the only disinfection modality to have fulfilled all four evaluation criteria.

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From 1st fifty results:

Antimicrobial properties of copper plasma-modified polyethylene
W Zhang, YH Zhang, JH Ji, J Zhao, Q Yan, PK Chu - Polymer, 2006 - Elsevier
Copper plasma immersion ion implantation is utilized to produce an antibacterial surface on polyethylene. XPS analysis of the plasma-treated materials reveals that a relatively large amount of copper, about 11% relative to carbon, is implanted into the near surface region. ...
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P Airey, J Verran - Journal of Hospital Infection, 2007 - Elsevier
... The aim of this study was to evaluate the antimicrobial properties of copper in comparison with ... of material on copper is presumably due to the high reactivity of copper, resulting in ... Disinfection; Hospital-acquired infection; Hygiene; Infection control; Staphylococcus aureus. ...
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Antimicrobial properties of copper alloy surfaces, with a focus on hospital-acquired infections
HT Michels, W Moran, J Michel - Advanced Materials & Processesw Web ..., 2008 - tistrip.be
ABSTRACT Recent laboratory studies show that several bacteria, known to be human pathogens, die when they come in contact with dry copper and copper alloy surfaces at room temperature. The amount of live bacteria drops by several orders of magnitude, to...

Size-dependent antimicrobial properties of CuO nanoparticles against Gram-positive and-negative bacterial strains

A Azam, AS Ahmed, M Oves, MS Khan... - International journal of ..., 2012 - ncbi.nlm.nih.gov

... Antimicrobial properties. In this study, the copper oxide nanoparticles showed remarkable antibacterial activity against both Gram-positive (B. subtilis and S. aureus) and Gram-negative (E. coli and P. aeruginosa) bacteria (Table 2). The extent of inhibition of bacterial growth ...

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The antimicrobial properties of some copper (II) and platinum (II) 1, 10-phenanthroline complexes

NS Ng, P Leverett, DE Hibbs, Q Yang, JC Bulanadi... - Dalton ..., 2013 - pubs.rsc.org

Despite advances in the development of antimicrobial agents, infectious diseases remain amongst the top five causes of mortality in countries of any socioeconomic class worldwide, accounting for 13.3 million deaths. 1, 2 An estimated 1.4 million people are affected by ...

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Bacterial killing by dry metallic copper surfaces

CE Santo, EW Lam, CG Elowsky... - Applied and ..., 2011 - Am Soc Microbiol

... targets have not yet been elucidated. Such knowledge is needed to better understand why surfaces made from copper alloys exhibited efficient antimicrobial properties in recent successfully completed hospital trials (4, 19, 23). ...

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... of temperature and humidity on the efficacy of methicillin-resistant Staphylococcus aureus challenged antimicrobial materials containing silver and copper

HTMichels, JO Noyce... - Letters in applied ..., 2009 - Wiley Online Library

... Aims: To compare silver and copper, metals with known antimicrobial properties, by evaluating the effects of temperature and humidity on efficacy by challenging with methicillin resistant Staphylococcus aureus (MRSA). Methods ...

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[HTML] Antimicrobial activity of copper surfaces against suspensions of Salmonella enterica and Campylobacter jejuni

G Faúndez, M Troncoso, P Navarrete... - BMC ..., 2004 - biomedcentral.com

Background Salmonella enterica and Campylobacter jejuni are amongst the more prevalent bacterial pathogens that cause foodborne diseases. These microorganisms are common contaminants of poultry and poultry products. This study was aimed to evaluate the ...

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[HTML] Antimicrobial efficacy of copper surfaces against spores and vegetative cells of Clostridium difficile: the germination theory

LJ Wheeldon, T Worthington... - ... of Antimicrobial ..., 2008 - Br Soc Antimicrob Chemo

Objectives Persistent contamination of surfaces by spores of Clostridium difficile is a major factor influencing the spread of C. difficile-associated diarrhoea (CDAD) in the clinical setting. In recent years, the antimicrobial efficacy of metal surfaces has been investigated ...

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Potential use of copper surfaces to reduce survival of epidemic meticillin-resistant< i> Staphylococcus aureus</i> in the healthcare environment

JO Noyce, H Michels, CW Keevil - Journal of Hospital Infection, 2006 - Elsevier

Epidemic meticillin-resistant Staphylococcus aureus (EMRSA) emerged in the early 1980s
with EMRSA-15 and-16 being the most prevalent strains within the UK. MRSA transmission between patients is largely via the hands of healthcare workers, and contamination of the ...

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