Can the use of copper help to prevent infection?

Infection Prevention 2013

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Contents

Introduction – why copper?

Laboratory studies around the world have confirmed rapid and broad spectrum efficacy

Key reports:

1994 Southampton University: verifying efficacy of copper and copper alloys against Legionella spp

2000 against Escherichia coli

2006 against MRSA

2007 against Clostridium difficile (including spores)

2007 against Influenza A (H1N1)

2008 USA Environmental Protection Agency Registration of about 350 alloys

2009 against Vancomycin-resistant Enterococci (VRE)

2011 against MRSA & VRE to show rapid kill

2012 showing copper stops gene transfer

2013 against norovirus

Microorganisms tested:

1. *Acinetobacter baumannii*
2. *Adenovirus*
3. *Aspergillus niger*
4. *Candida albicans*
5. *Campylobacter jejuni*
6. *Clostridium difficile*
7. *Enterobacter aerogenes*
8. *Escherichia coli O157:H7*
9. *Helicobacter pylori*
10. *Influenza A (H1N1)*
11. *Legionella pneumophila*
12. *Listeria monocytogenes*
13. *Klebsiella pneumoniae*
14. *MRSA, E-MRSA & MSSA*
15. *Mycobacterium tuberculosis*
16. *Norovirus*
17. *Poliovirus*
18. *Pseudomonas aeruginosa*
19. *Salmonella enteritidis*
20. *Staphylococcus aureus*
21. *Tubercle bacillus*
22. *Vancomycin-resistant enterococcus (VRE)*

+ many more

HCAIs – Influence of the environment

There has been limited evidence of the role of environmental microbial contamination in HCAI acquisition

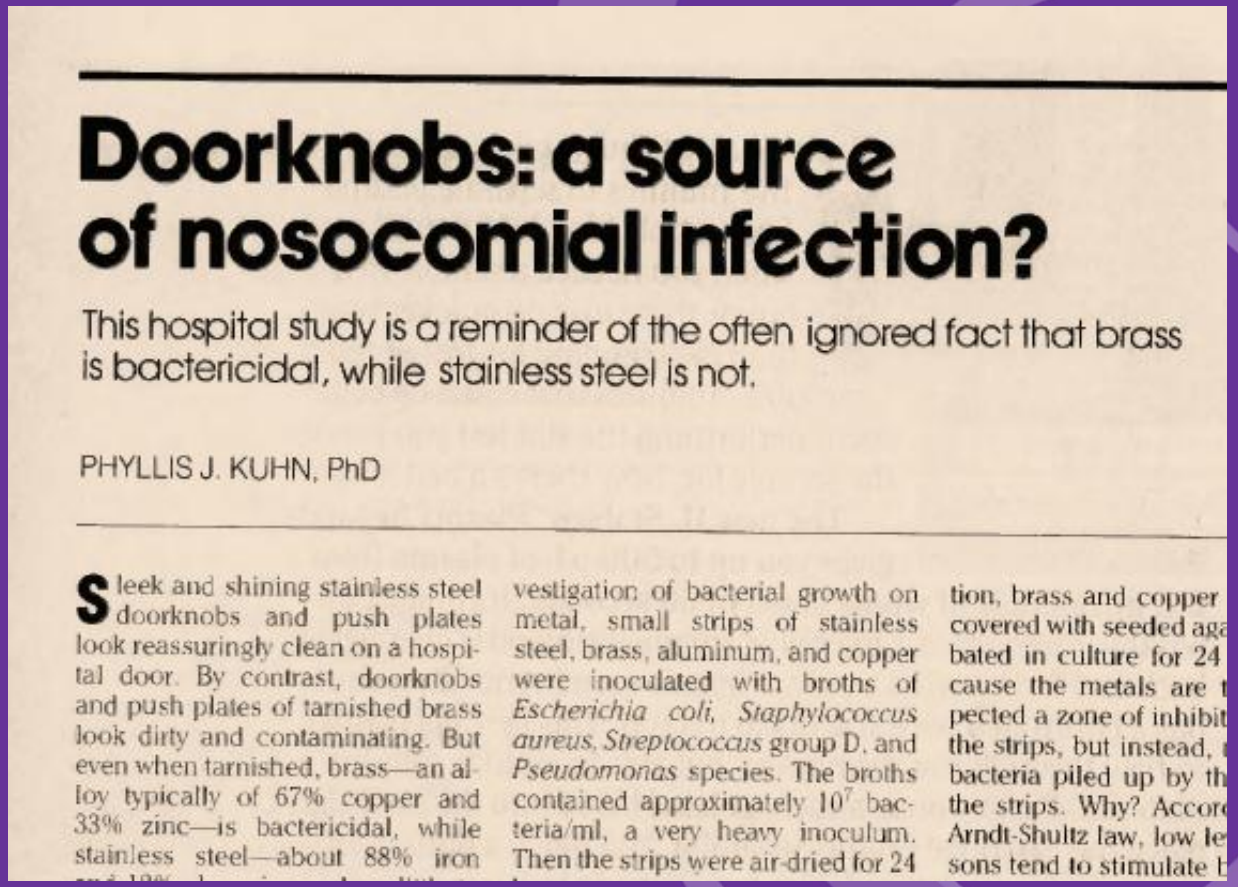
– **but that is changing:**

- proposals for acceptable levels of microorganisms in the clean environment have been proposed – transferred from the food industry (Mulvey et al., J Hosp Infection 77(2011) 25-30)
- there is an increasing awareness of the role of touch surfaces in transmitting infection, evidenced by an increasing number of research papers on the topic
- Infection Control and Hospital Epidemiology (ICHE) published a Special Topic Issue in May 2013:

  The Role of the Environment in Infection Prevention

Clinical trials

1983



Doorknobs: a source of nosocomial infection?

This hospital study is a reminder of the often ignored fact that brass is bactericidal, while stainless steel is not.

PHYLLIS J. KUHN, PhD

Sleek and shining stainless steel doorknobs and push plates look reassuringly clean on a hospital door. By contrast, doorknobs and push plates of tarnished brass look dirty and contaminating. But even when tarnished, brass—an alloy typically of 67% copper and 33% zinc—is bactericidal, while stainless steel—about 88% iron

vestigation of bacterial growth on metal, small strips of stainless steel, brass, aluminum, and copper were inoculated with broths of *Escherichia coli*, *Staphylococcus aureus*, *Streptococcus* group D, and *Pseudomonas* species. The broths contained approximately 10^7 bacteria/ml, a very heavy inoculum. Then the strips were air-dried for 24

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covered with seeded aga
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bacteria piled up by th
the strips. Why? Accord
Arndt-Shultz law, low le
sons tend to stimulate h

Doorknobs: A Source of Nosocomial Infection?

Kuhn, P. *Diagnostic Medicine, Dec 1983*. Hamot Hospital, Pennsylvania, USA

cultures from brass door knobs

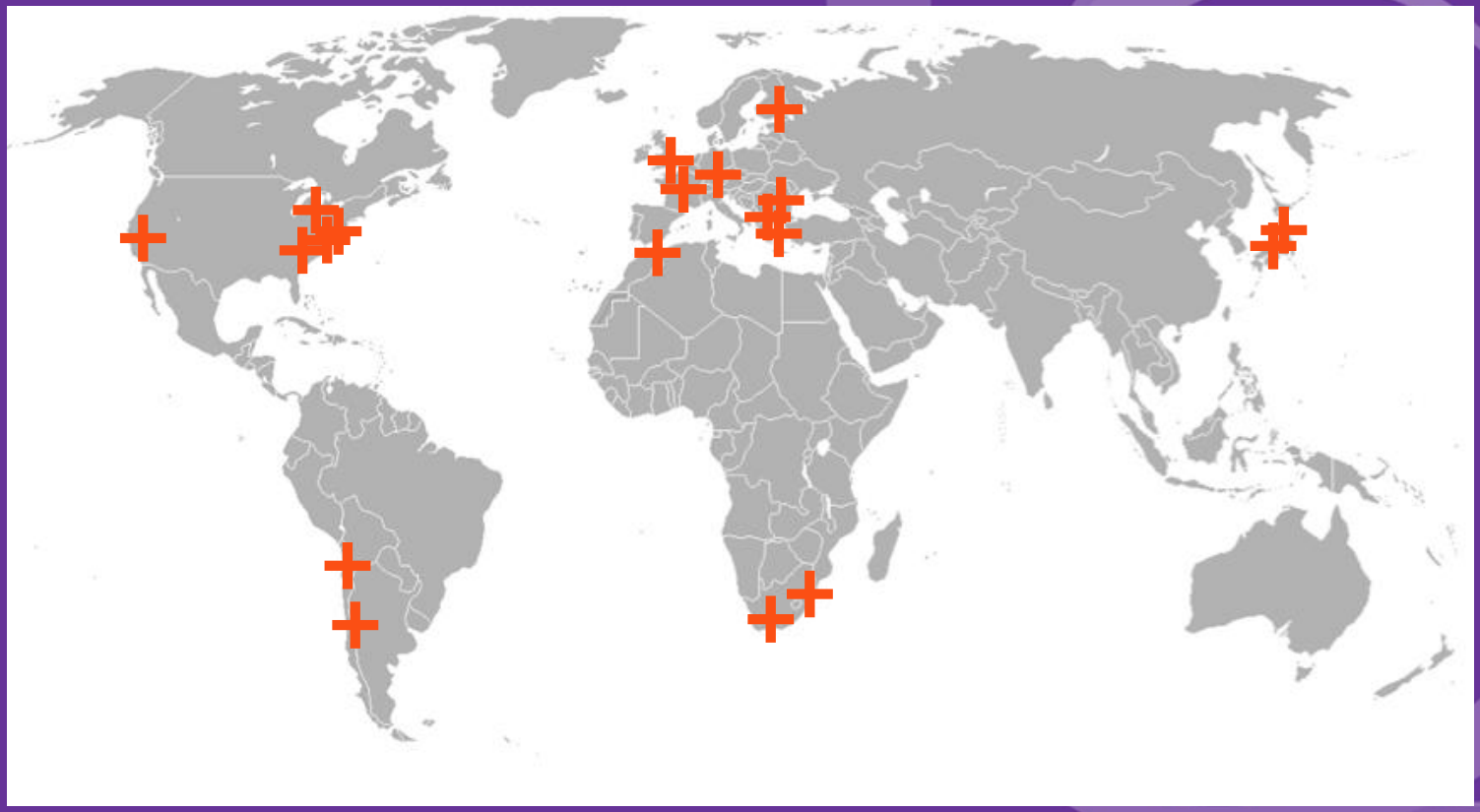
stainless steel door knobs

From the conclusion:

"If your hospital is being renovated, try to retain old brass hardware or have it repeated; if you have stainless steel hardware, make certain that it is disinfected daily, especially in critical-care areas.

We have known for years that certain metals are toxic to bacteria. It is the application of this knowledge to better infection control that warrants further attention."

Independent clinical trials have been conducted at multiple locations around the world



Clinical Trials at University Hospitals Birmingham NHS Foundation Trust - UK

Journal of Hospital Infection (2009) ■, 1–6

Available online at www.sciencedirect.com

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www.elsevierhealth.com/journals/jhin

Role of copper in reducing hospital environment contamination☆

A.L. Casey [a], D. Adams [a], T.J. Karpanen [a], P.A. Lambert [b], B.D. Cookson [c], P. Nightingale [a], L. Miruszenko [a], R. Shillam [a], P. Christian [a], T.S.J. Elliott [a,*]

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Received 20 March 2009; accepted 28 August 2009

KEYWORDS

Summary The environment may act as a rese

INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY JANUARY 2012, VOL. 33, NO. 1

ORIGINAL ARTICLE

The Antimicrobial Efficacy of Copper Alloy Furnishing in the Clinical Environment: A Crossover Study

T. J. Karpanen, PhD;[1] A. L. Casey, PhD;[1] P. A. Lambert, DSc;[2] B. D. Cookson, FRCPath;[3] P. Nightingale, PhD;[4] L. Miruszenko, RGN;[5] T. S. J. Elliott, DSc[5]

(See the commentary by Weber and Rutala, on pages 10–13.)

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.

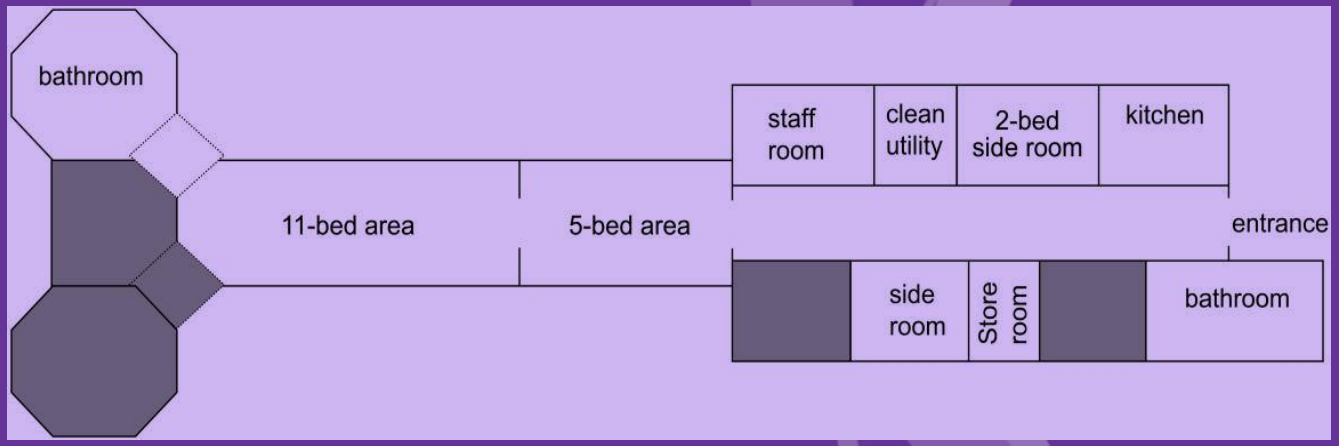
RESULTS. Eight of the 14 copper item types had microbial counts on their surfaces that were significantly lower than counts on standard materials. The other 6 copper item types had reduced microbial numbers on their surfaces, compared with microbial counts on standard items, but the reduction did not 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.

Infect Control Hosp Epidemiol 2012;33(1):3-9

UHB trial environment:

- busy 19 bed acute care “nightingale” ward
- standard cleaning protocols applied throughout the study



Research designed to evaluate:

- reduced contamination levels
- development of resistance to copper




Cohort Ward


UNIVERSITY HOSPITAL
BIRMINGHAM NHS TRUST
It is our intention to provide the highest standards of cleanliness in all our sanitary areas.
If this facility is not clean and does not meet your expectations please speak to a member of the ward staff who will arrange for cleaning to take place.
Thank you.
Very hot water
Very hot water
Very hot water

Results

	Duration	Sample taken	Primary results	Significance level
Phase 1 3 items with crossover	6+6 weeks	duplicates at 7 am and 5 pm (before first and last scheduled cleaning)	**90 – 100% less microbes on copper than controls**	9 out of 10 areas sampled
Phase 2 14 items with crossover	12+12 weeks	duplicates between 2pm and 5 pm (during visiting time and before afternoon cleaning)	**all copper items had a lower microbe count than controls** **no resistance to copper was found in MRSA, MSSA, VRE or coliform strains recovered from the ward**	8 out of 14 areas sampled

Contamination or 'Microbial Burden' results in Chile

- **Calama, Chile – 2010** (very low daily relative humidity ~8%)
- 180 single rooms in an ICU – 30 weeks

  - **49 - 92%** less microorganisms on copper items
  - Average microbial count was significantly lower in rooms with copper **1,851 vs. 11,620 cfu / 100 cm²**. (p= < 0.00001)

Effectiveness of Copper Contact Surfaces in Reducing the Microbial Burden in the ICU of Hospital del Cobre, Calama, Chile
Prado V et al. Poster 56.044, presented at the 14th International Conference on Infectious Diseases, Miami, March 11, 2010.

Contamination or 'Microbial Burden' results in USA

- **Medical University of South Carolina, USA – 2010**
- 59 single bed ICU rooms – 9 weeks

  - **38 – 100%** less microorganisms on copper surfaces
  - **MRSA and VRE** were never isolated from copper objects
  - **>87%** reduction in total mean bioburden (better than terminal clean)

A Pilot Study to Determine the Effectiveness of Copper in Reducing the Microbial Burden of Objects in Rooms of ICU Patients
Salgado CD et al. Poster 183, 5th Decennial International Conference on Healthcare-Associated Infections, Atlanta, March 29, 2010

Use of copper to prevent spread of MRSA in a dermatology ward in Japan

- **Investigated use of bed sheets with a copper coated film**
  - tested with heavily MRSA colonised patient
  - standard sheets had 6,600 to 11,000 CFU of MRSA compared to 20 to 130 CFU

Concluded 'Copper sheets may prevent spread of MRSA contamination in hospital wards'

Use of copper alloy for preventing transmission of MRSA in the dermatology ward.
Niiyama N et al. Acta Dermato-Venereologica 93, 294 to 300, 2013

Clinical studies in USA in three ICUs

- **3 centre study**
- Copper items put in eight single rooms and compared to 8 non-copper rooms
- Six items replaced: bed rails, over bed tables, chairs, call buttons, data devices and IV poles
- Patients randomised

- **Outcome measures:**
  - number of bacteria on surfaces
  - patient colonisation by MRSA & VRE
  - HCAI rates

Microbial Burden on the three ICU study

- Sampled 6 objects in 16 rooms over 43 months
- After 23 months introduced copper items in 8 rooms

  Copper objects had a 83% reduction in average microbial burden

  (465 v 2,674 cfu/100 cm^2 p = <0.0001)

- Also sampled copper bed rail for 6.5 hours post cleaning

  Achieved sustained antimicrobial effect with copper compared to control

  (at 6.5 hours 434 v 5198 cfu/100 cm^2 p = 0.002)

Concluded 'copper provides a potentially safer environment for patients'

Sustained Reduction of Microbial Burden on Common Hospital Surfaces through Introduction of Copper.
Schmidt M et al. J. Clin. Microbiol. 2012, 50(7):2217. DOI: 10.1128/JCM.01032-12.

Copper Continuously Limits the Concentration of Bacteria Resident on Bed Rails within the ICU
Schmidt et al. Infect Control Hosp Epidemiol 2013;34(5):000-000

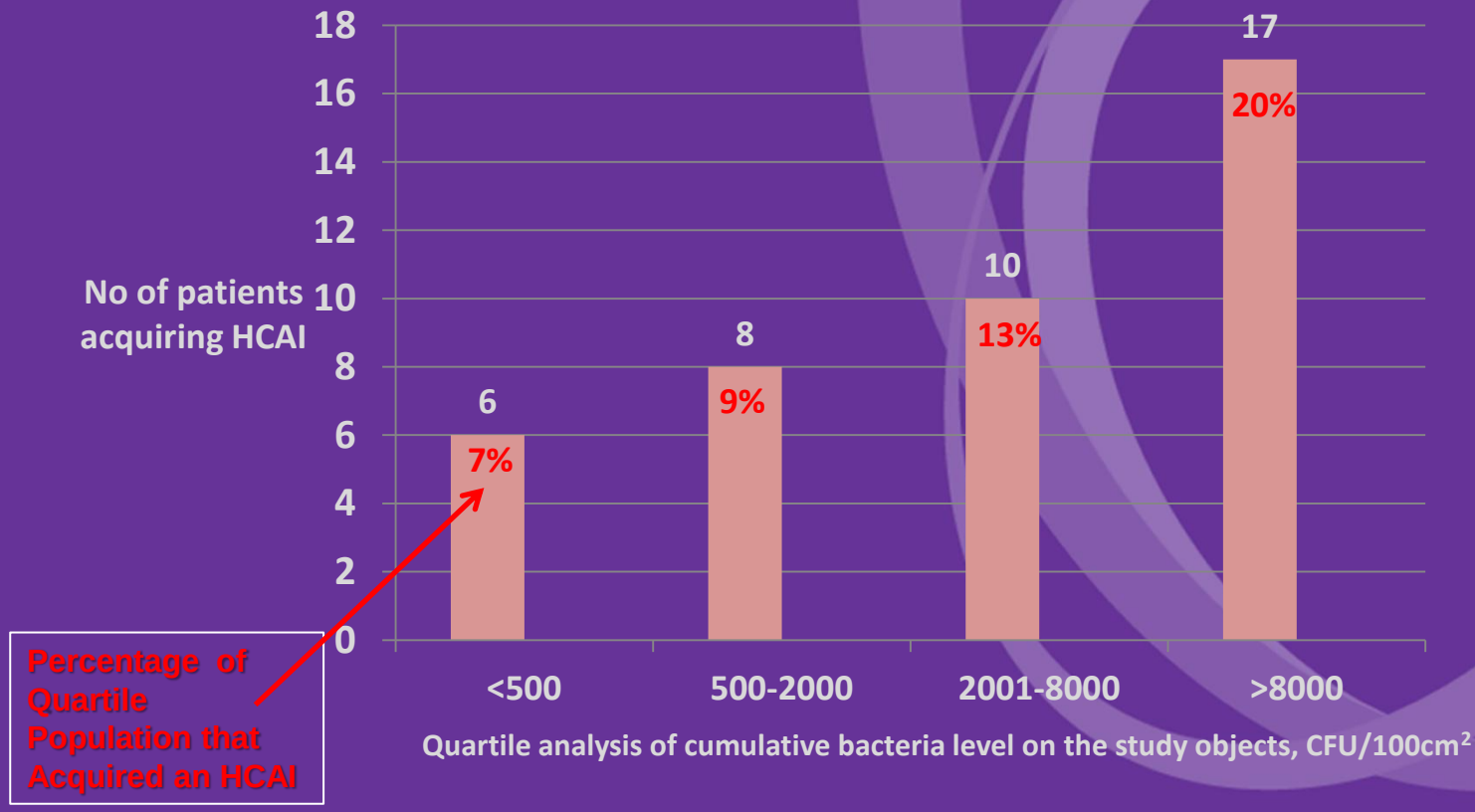
Copper surfaces and HCAIs in the three ICU study

- **294 patients in copper rooms v 320 in standard rooms**
- **Determined HCAI – including blood stream infections, UTI, pneumonia**
- **Trend to reduction in HCAI infections**
  - 17 (5.7%) v 29 (9.0%) (p= 0.13)
  - reduction in blood stream infections: 3 v 11 (p=0.057)
  - no reduction in pneumonia nor UTI

- **On further analysis, a link between microbial burden and HCAI was suggested**

Copper Surfaces Reduce the Rate of Healthcare-Acquired Infections in the Intensive Care Unit. Salgado C et al.
ICHE, Vol. 34, No. 5, Special Topic Issue: The Role of the Environment in Infection Prevention (May 2013), pp. 479-486

Significant association between contamination level and HCAI risk (p=0.038) with 89% of HCAI occurring among patients cared for in a room with a burden >500 cfu/100cm^2



Conclusions of Copper surfaces and HCAI in the ICU study

First clinical study to show possible link between prevention of HCAIs and use of copper in the healthcare environment.

Further studies, appropriately powered, are needed to study the effect of designated copper fomites on specific types of HCAI (e.g. Bloodstream infections)

Conclusions

Overall conclusions of studies - 1

- Results demonstrate that copper offers the potential to significantly reduce the numbers of microorganisms both *in vitro* and in the clinical environment.

- There appears to be a quantifiable link between contamination of the built environment and the risk of HCAIs.

Overall conclusions of studies - 2

- Incorporation of copper into essential items within the built environment of hospitals may offer a unique solution to control and limit HCAIs in an efficient and cost effective manner.

- Additional studies evaluating the critical and optimal placement of antimicrobial copper touch surfaces within the built environment are warranted.

Quote from recent article

- ‘We firmly believe …that self-disinfecting surfaces such as copper… are a significant step forward .. to reduce …. infection causing microbial bioloads on clinical surfaces…’

- ‘We should now ask the question ..why select a non antimicrobial surface when we now know that naturally occurring metals have this intrinsic antimicrobial activity?’

Worthington et al., Infection Cont Hosp Epidemiology 33; 2012.

Can the use of copper help to prevent infection?

Thank you

QUESTIONS?

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