Antimicrobial Copper

Making a material difference to Healthcare

HEI, London

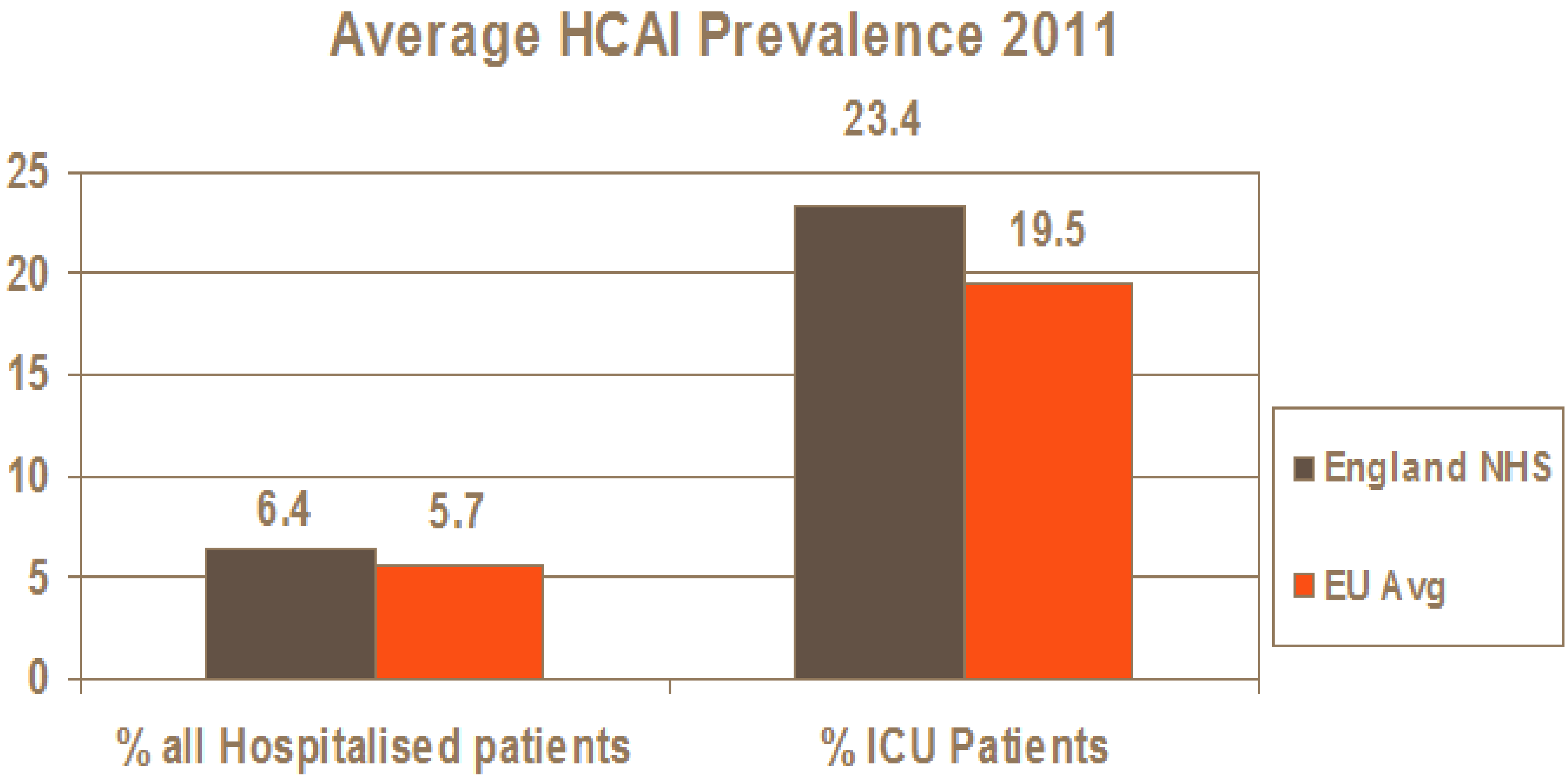
02/12/2015

Andrew Cross

Agenda

- Prevalence & Cost of HCAIs
- The role of the environment in acquisition of infection
- High-priority (high risk) touch surface items
- Why copper? What is Antimicrobial Copper?
- Research and Evidence
- Cost / Benefit

HCAIs / HAIs - Healthcare-Associated Infections



Up to 51% prevalence in ICUs within EU countries

Source: WHO - *The Burden of HealthCare-Associated Infection Worldwide – A Summary.* 2011
WHO - European Health for All Database (HFA-DB)

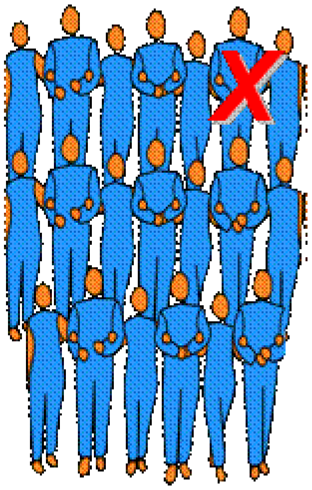
HCAIs in Europe – the grim facts

Per annum…

- Over **4.1 million** patients affected
- **16 million** extra days in hospital
- Additional **€7 billion** direct costs
- **37,000** deaths directly caused by HCAIs
- Additional **110,000 deaths** where HCAIs a contributory factor

Source: WHO - *The Burden of HealthCare-Associated Infection Worldwide – A Summary*. 2011
WHO - European Health for All Database (HFA-DB)

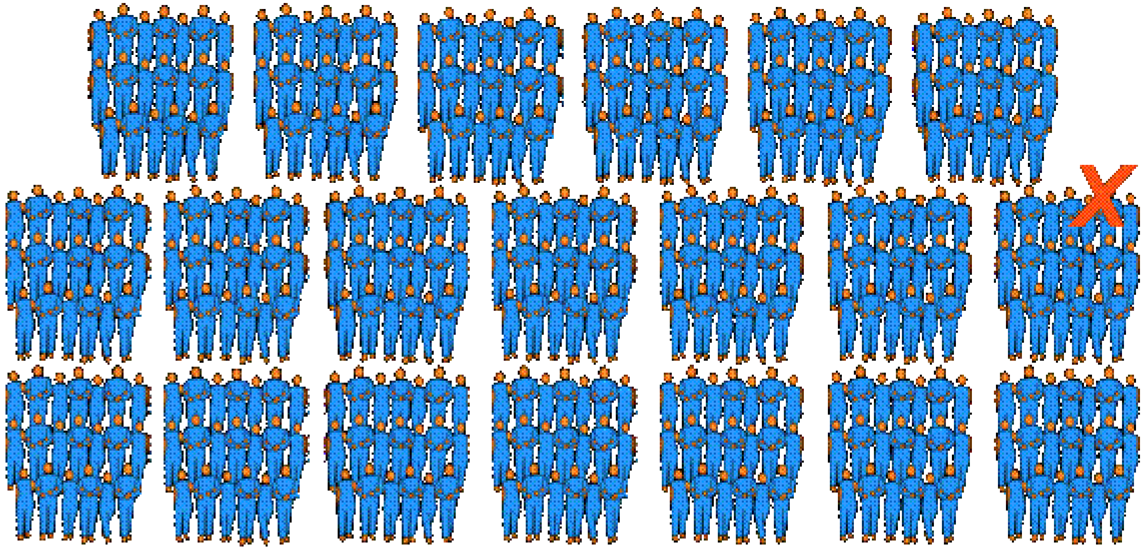
HCAIs / HAIs / Nosocomial Infections: <u>in the US</u>

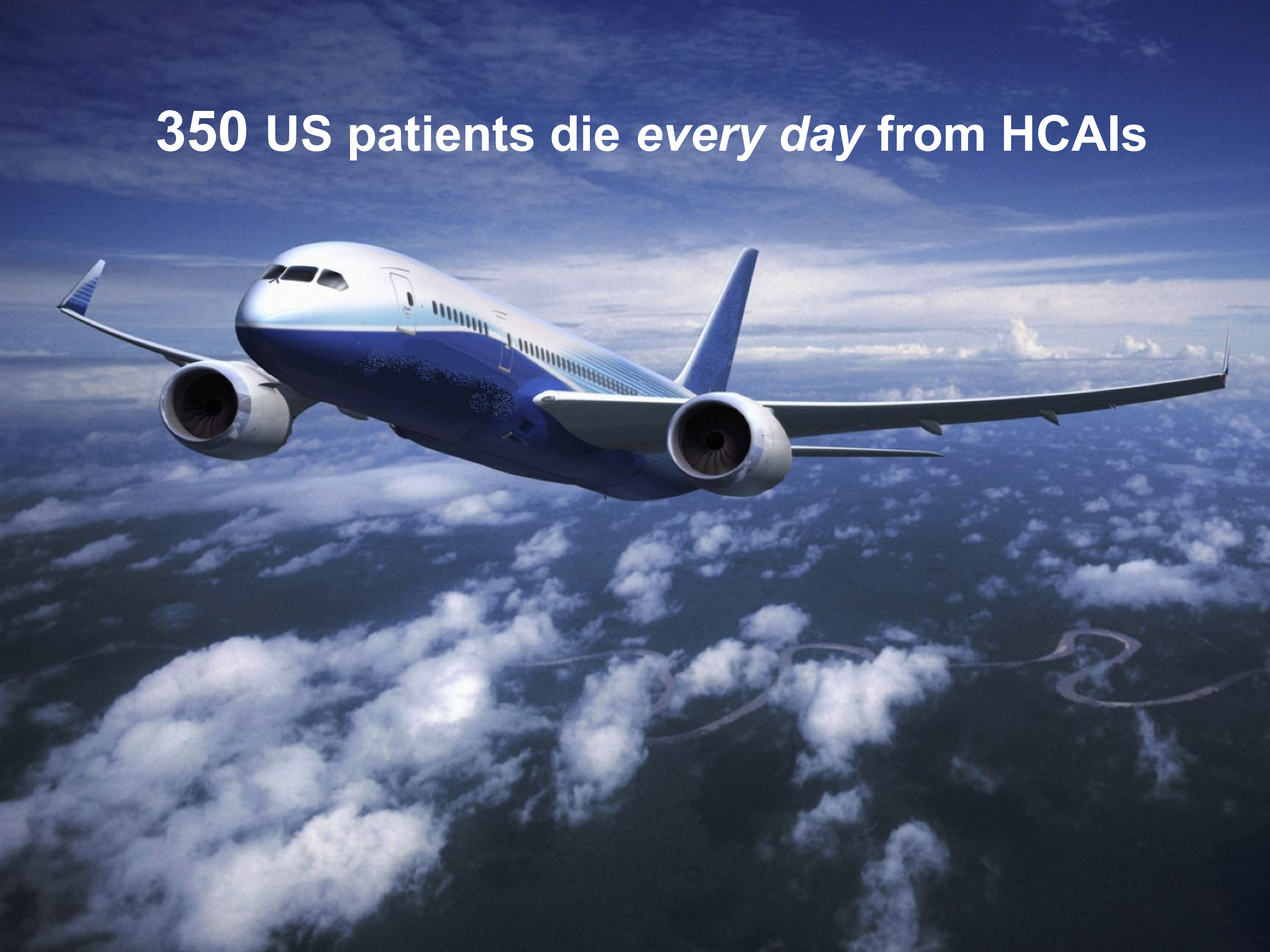


35m US patients hospitalised per annum:

- ~ 1 in 20 acquire infection
- ~ 1 in 20 infected die from that infection

➢ **Approx 1 in 400 risk of death from HAI in US**



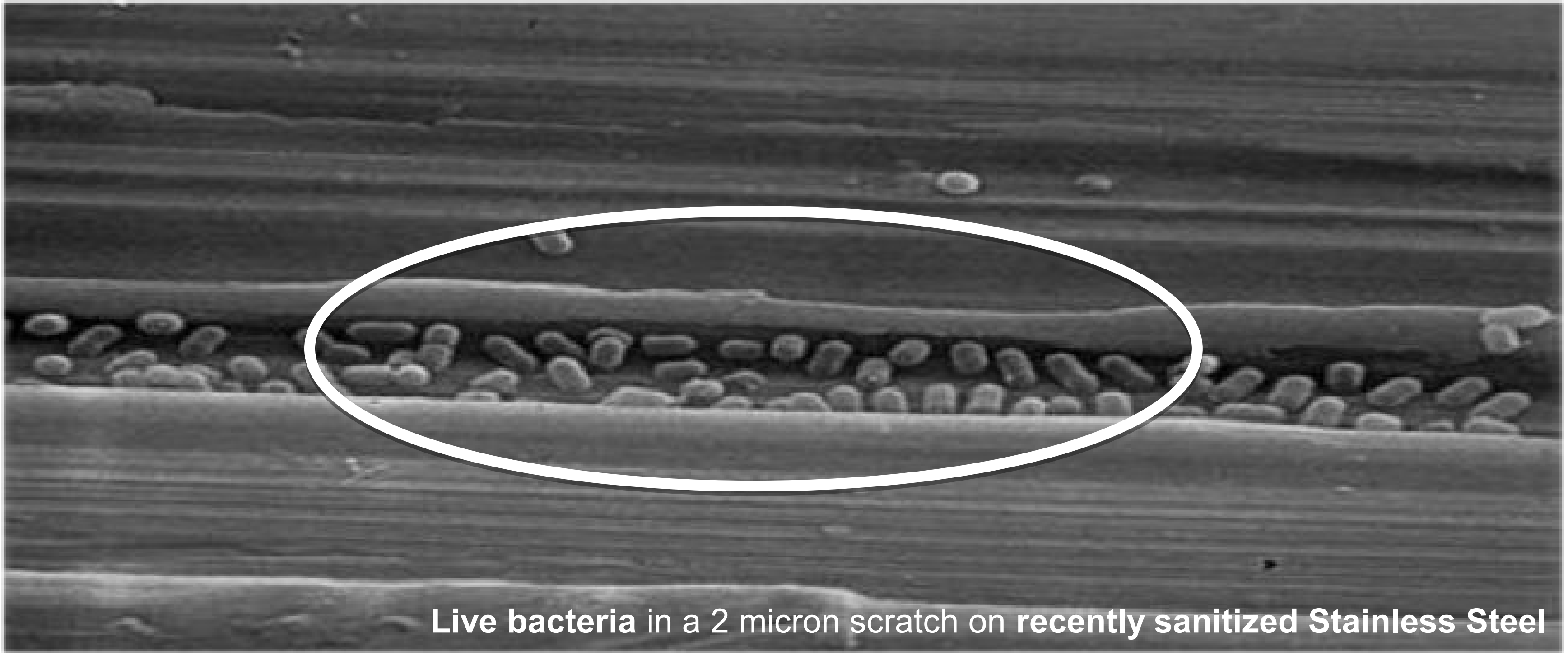

350 US patients die *every day* from HCAIs

The Role of the Environment

Current thinking: **touch surfaces play major role** in spread of infection:

- Pathogens can survive for a long time on standard surfaces
- A contaminated hand spreads pathogens to the next seven surfaces touched
- A single contaminated doorknob or elevator button can spread virus rapidly through entire office buildings, hotels or hospitals
- Increased bed occupancy rates influence HCAI incidence in ICUs
- Patients admitted to a room where an infected patient stayed face greater risk of acquiring that infection.
- There is a correlation between HCAI rates and microbial bioburden in ICU rooms
- Microbial Bioburden → environmental 'Reservoirs of infection'
  *...but also contributes to development of **Antimicrobial Resistance***

Cleaning is Not Enough



- Even after cleaning, a surface **may not be microbiologically clean**
- Inert surfaces give **no protection against recontamination** after cleaning
- Dirty hands contaminate cleaned surfaces, and vice-versa.

Wilks et al, 2006; Barker et al, 2004; Boone & Gerba, 2007

Copper touch surfaces are an *additional* infection prevention measure

High-Risk Touch Surfaces

Hospital beds

Door handles

Sinks

Toilets

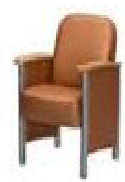
Over-bed tables

Push plates

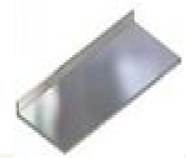
Taps

Dispensers

IV poles



Visitor chairs



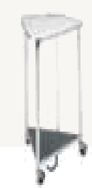
Counters

Trolleys

Grab rails

Patient chairs

Light switches & sockets



Laundry bins

Computer input devices

Bedside tables

Call buttons & pull cords

Bins

http://www.cdc.gov/hai/toolkits/Appendices-Evaluating-Environ-Cleaning.html

“Antimicrobial Copper” includes Cu alloys

Copper CW024A	Admiralty Brass CW706R	Aluminum Bronze CW307G	Copper Nickel CW352H
Red Brass (90/10) CW501L	Phosphor Bronze CW452K	Silicon Aluminum Bronze CW115C	Copper Nickel CW354H
Brass (85/15) CW502L	Phosphor Bronze CW453K	Silicon Bronze CW116C	Nickel Silver CW409J
Brass (80/20) CW503L	Aluminum Bronze CW303G	Silicon Bronze C65500	Nickel Silver (Coin) C76500
Cartridge Brass CW505L	Aluminum Bronze C62400	Silicon Manganese Aluminum Brass C67400	Tin Bronze CB480K
Yellow Brass CW507L	Aluminum Bronze C62500	Manganese Bronze C67500	Aluminum Bronze CB331G

The range of self-coloured alloys enables good variety of aesthetics: ***does not have to “look like copper”***

“Antimicrobial Copper” alloys are....

- **Solid materials** - the antimicrobial properties last the lifetime of the product, unlike coatings.
- **Continuously active**, rapidly reducing pathogens.
- **Completely safe** for humans.
- **Easy to clean**, compatible with standard hospital cleaning.
- **Very durable**.
- **100% recyclable**.
- **Familiar every-day materials**, used for centuries.
- **Available in a range of colours** including copper, gold, silver and bronze.

Proof

Lab Testing:

- over **30 years** of research
- **~ 200 published papers** showing copper's efficacy:
  - ✓ Rapid kill
  - ✓ Broad-spectrum
  - ✓ Multi-modal, complete kill – including DNA/RNA & plasmids

Clinical Trials

- **~40 clinical studies** in differing healthcare settings
- **>80% microbial bioburden reduction** on copper items

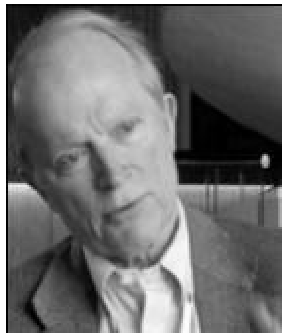
Outcome study: US Dept of Defense Trial (2013)

ICUs in 3 medical centres, copper vs standard control rooms

- **83% bioburden reduction**
- **58% reduction of HCAIs**

Research conducted around the world

Jörg Braun
Prof. Dr. med.



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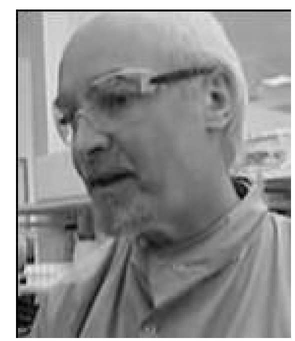


Bill Keevil
Ph.D.

1983: first results from a modest study

Brass Lockset

72 hours after inoculation with E. coli:

Little bacterial contamination

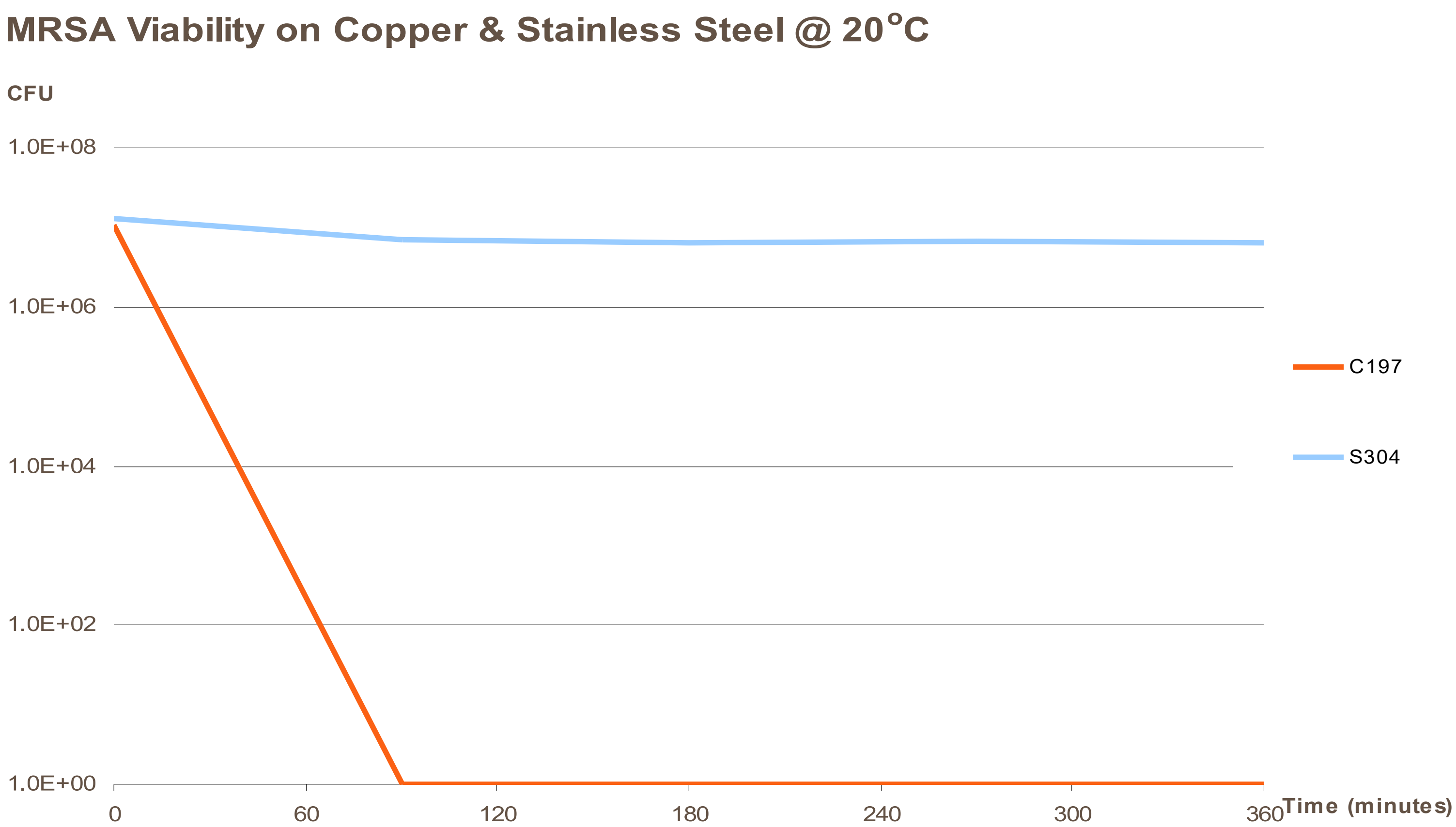
Stainless Steel Lockset

72 hours after inoculation with E. coli:

Heavy bacterial contamination

Source: Doorknobs: A Source of Nosocomial Infection? by P. J. Kuhn, Diagnostic Medicine Nov/Dec 1983

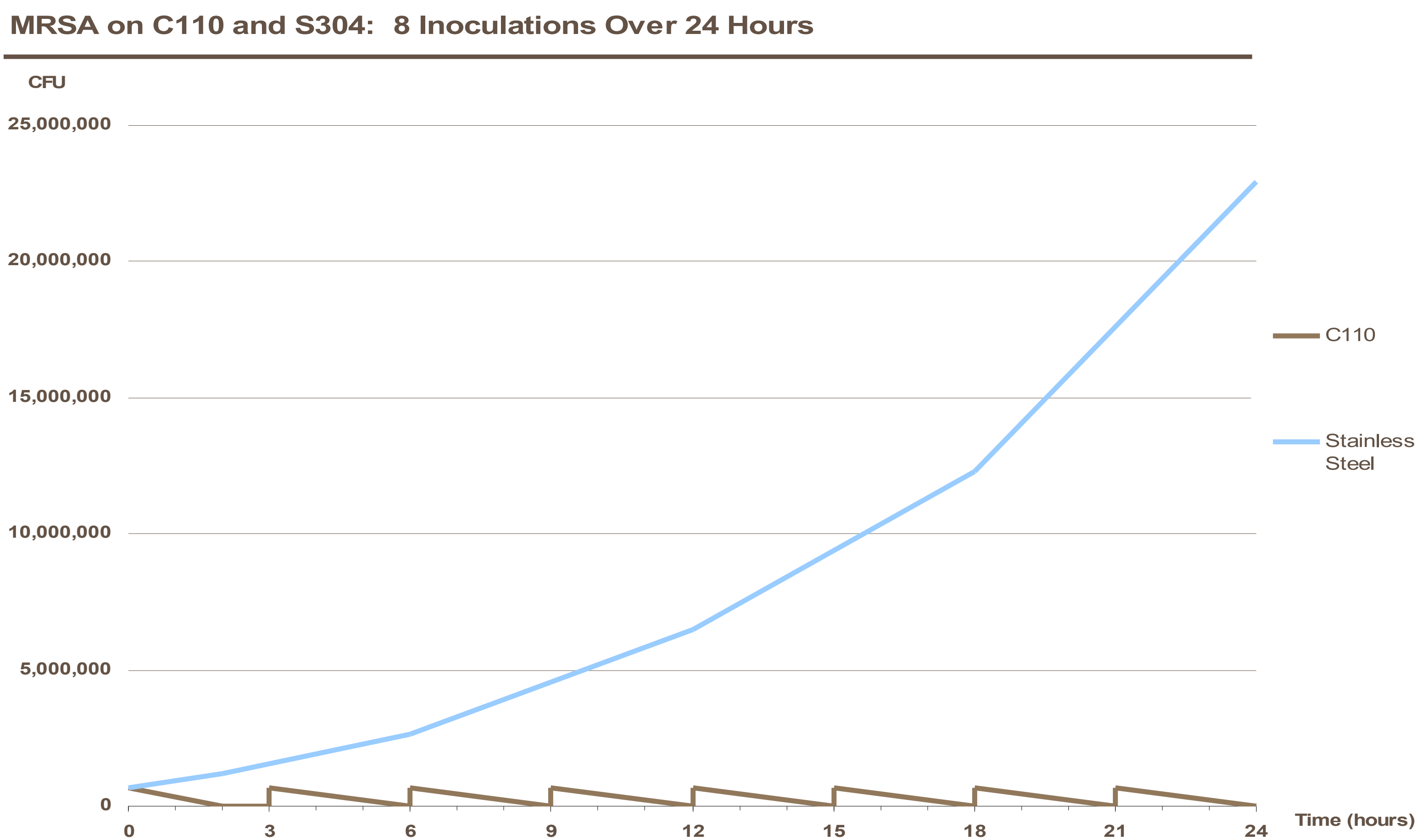
MRSA “wet touch” test: rapid kill on copper



Note: Inoculum was approximately 10 million CFUs. This graph simulates a **wet** contamination incident such as a sneeze. Research simulating a **dry touch shows a much faster kill.**

Source: *Potential Use of Copper Surfaces to Reduce Survival of Epidemic Methicillin-resistant Staphylococcus aureus in the Healthcare Environment* J O Noyce, H Michels and C W Keevil, Journal of Hospital Infection, Vol 63, Issue 3, pp 289-297, July 2006

‘Moist’ recontamination test: copper continues to kill bacteria at the same rate

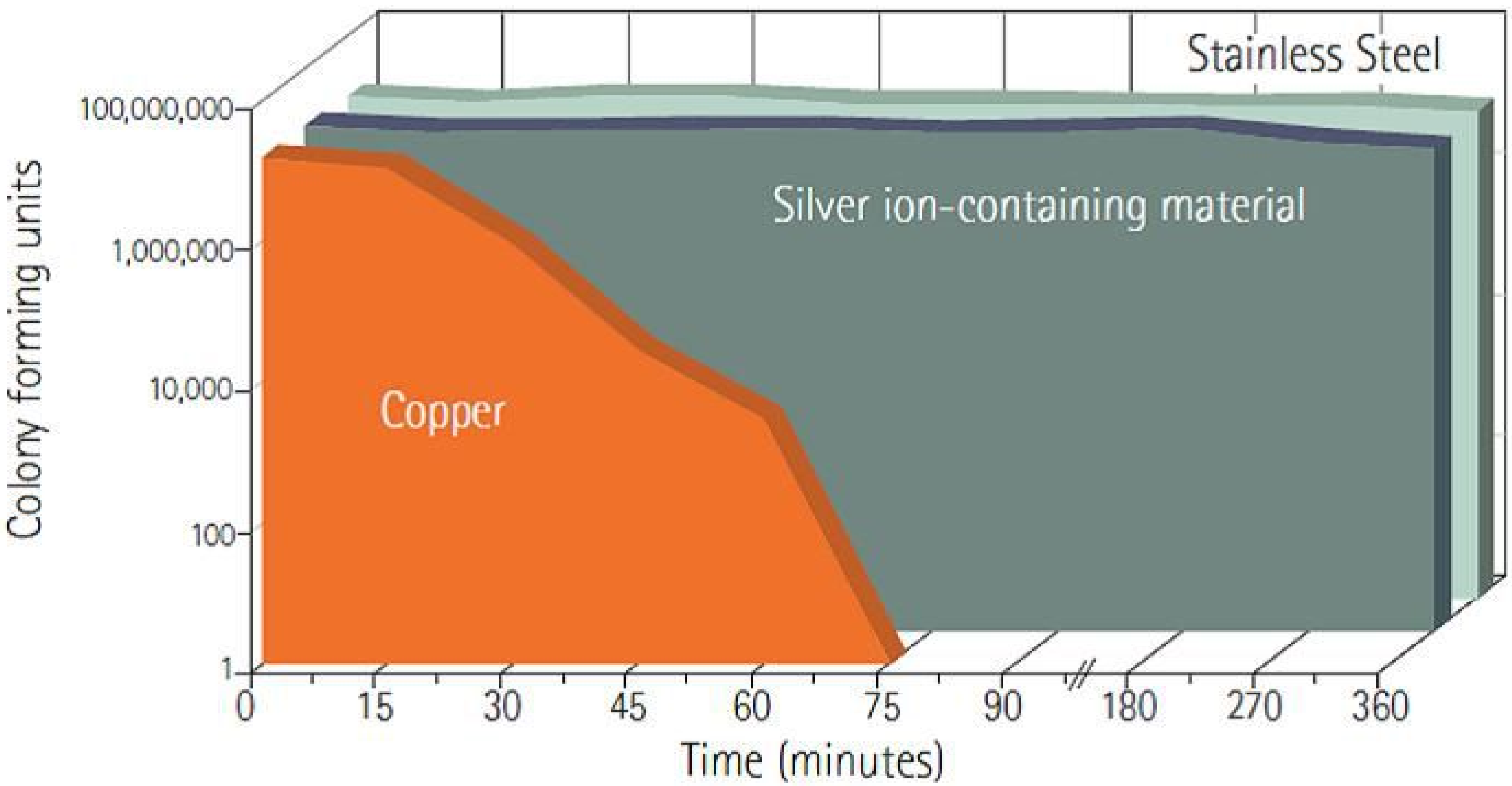


Note: Each inoculum was approximately 1 million CFUs, suspended in a 20 microlitre droplet.

Source: www.epa.gov/pesticides/factsheets/copper-alloy-products.htm

No other material comes close to Antimicrobial Copper's performance

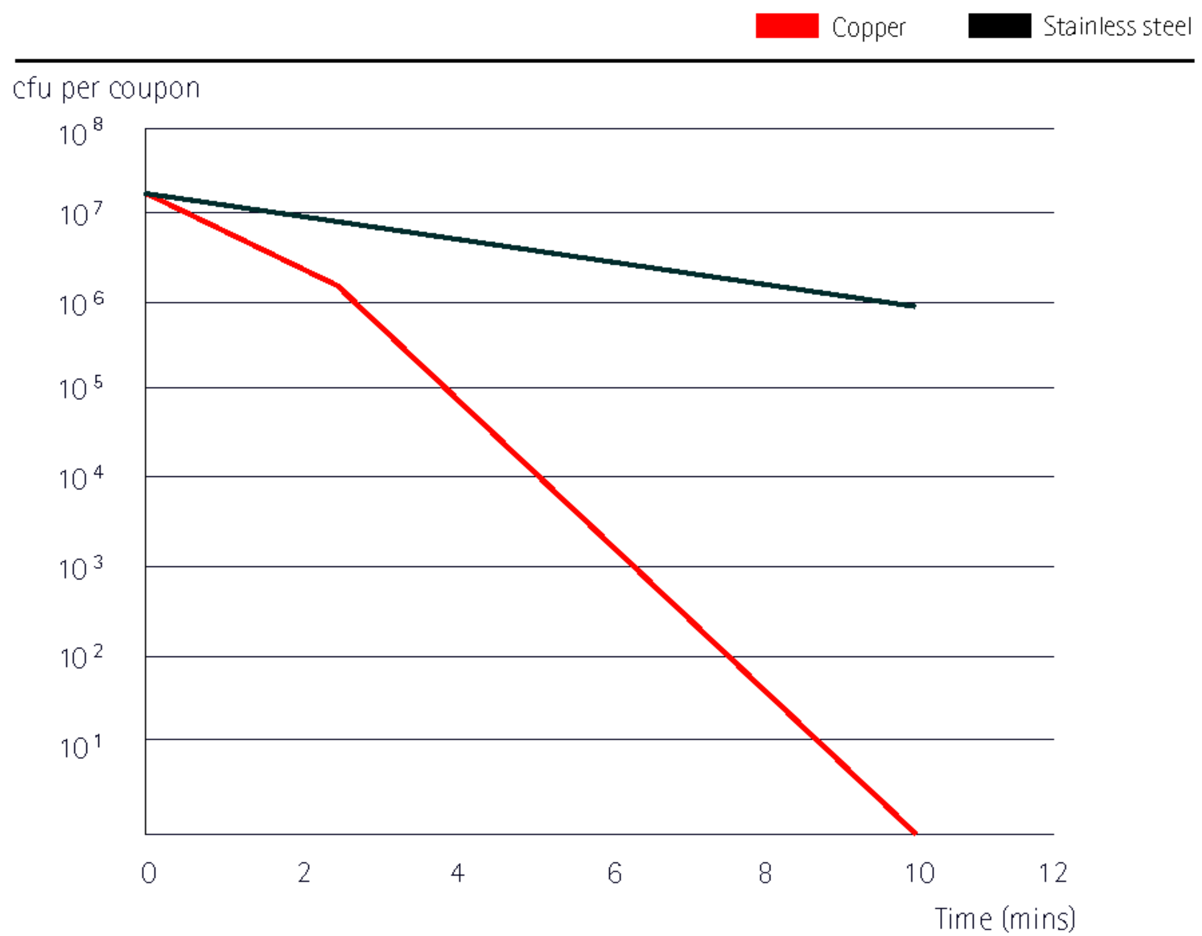
10^7 challenge of MRSA on Copper, Silver-ion containing Material, and Stainless Steel at **20ºC** and **50% RH**



Source: *Effects of temperature and humidity on the efficacy of methicillin-resistant Staphylococcus aureus challenged antimicrobial materials containing silver and copper".* Michels HT, Noyce JO and Keevil CW, Letters in Applied Microbiology, 49 (2009) 191–195.

Subsequent *dry contamination* testing against bacteria show even faster kill rates[1]

Rapid kill of Vancomycin-resistant Enterococcus faecalis - VRE



Source: *Mechanism of Copper Surface Toxicity in Vancomycin-Resistant Enterococci following Wet or Dry Surface Contact*. S. L. Warnes and C. W. Keevil. APPLIED AND ENVIRONMENTAL MICROBIOLOGY, Sept. 2011.

Laboratory studies around the world confirm rapid and broad-spectrum efficacy

Year	Highlight
1994	Legionella
2000	E. coli
2006	MRSA
2007	C. difficile (including spores)
2007	Influenza A (H1N1)
2008	USA EPA registration of >300 alloys against 6 bacteria
2009	Vancomycin-resistant Enterococci
2011	Rapid dry kill – MRSA/VRE
2012	Prevention of horizontal gene transfer
2013	Norovirus
2015	Coronavirus

Source: www.antimicrobialcopper.com/uk/scientific-proof.aspx

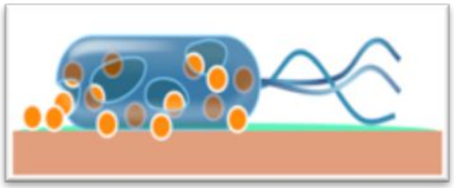
Organisms tested:

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

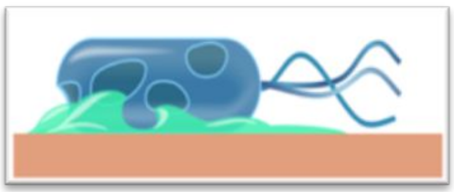
+ many more

Rapid action mechanisms mean bacteria unlikely to develop resistance to copper touch surfaces

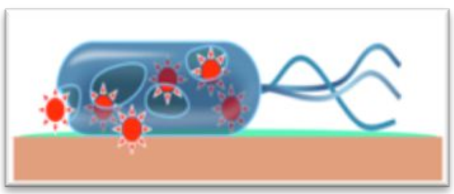
Mode of action



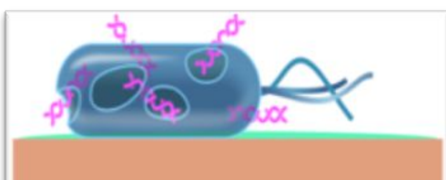
A: Copper dissolves from the copper surface and causes cell damage



B: The cell membrane ruptures, and cell contents “leak out” onto the copper surface



C: Copper ions induce the generation of oxidative stress, which causes further cell damage

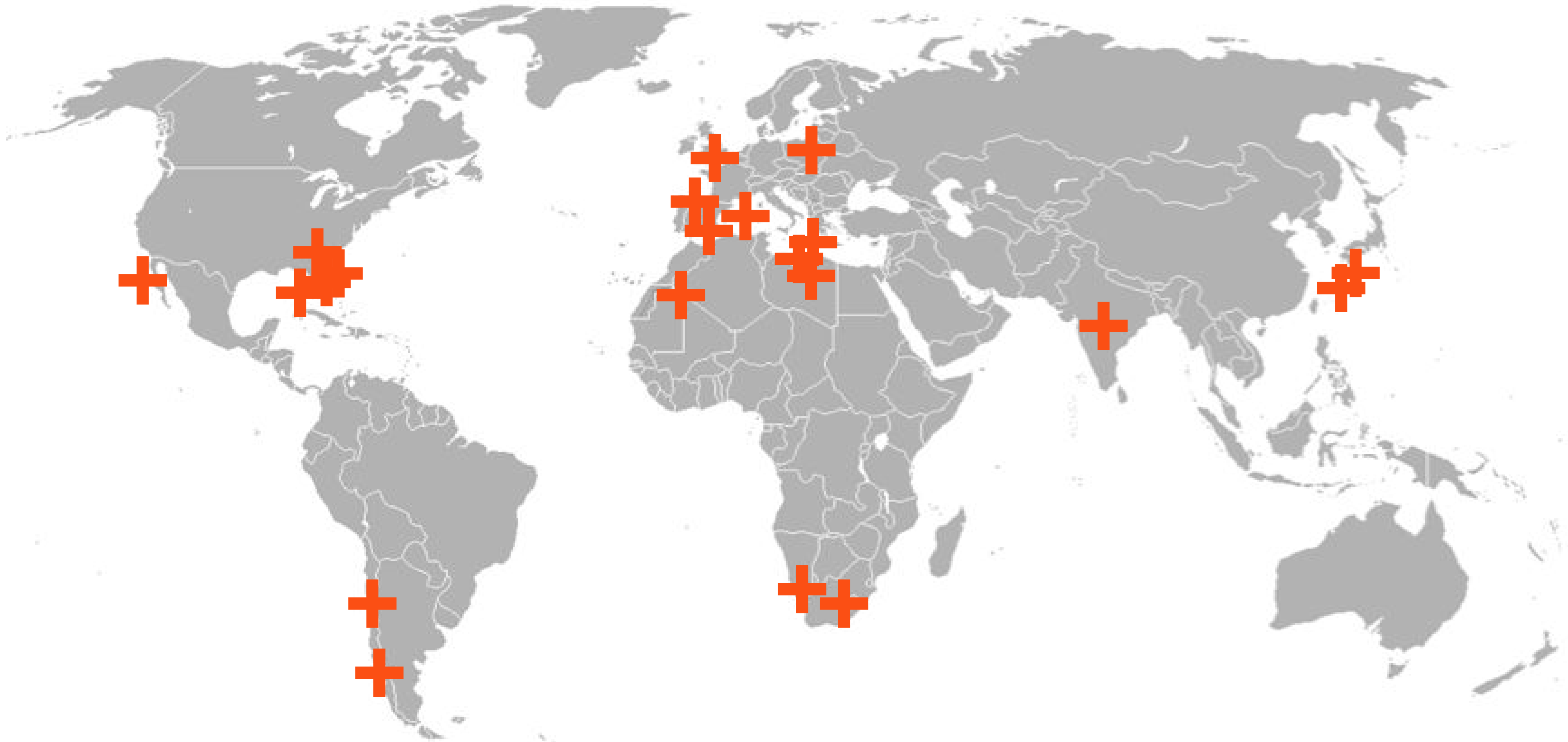


D: Bacterial DNA is degraded, making it highly unlikely that resistance can develop

Note: **multi-modal MOA** means bacteria are highly unlikely to develop resistance to copper

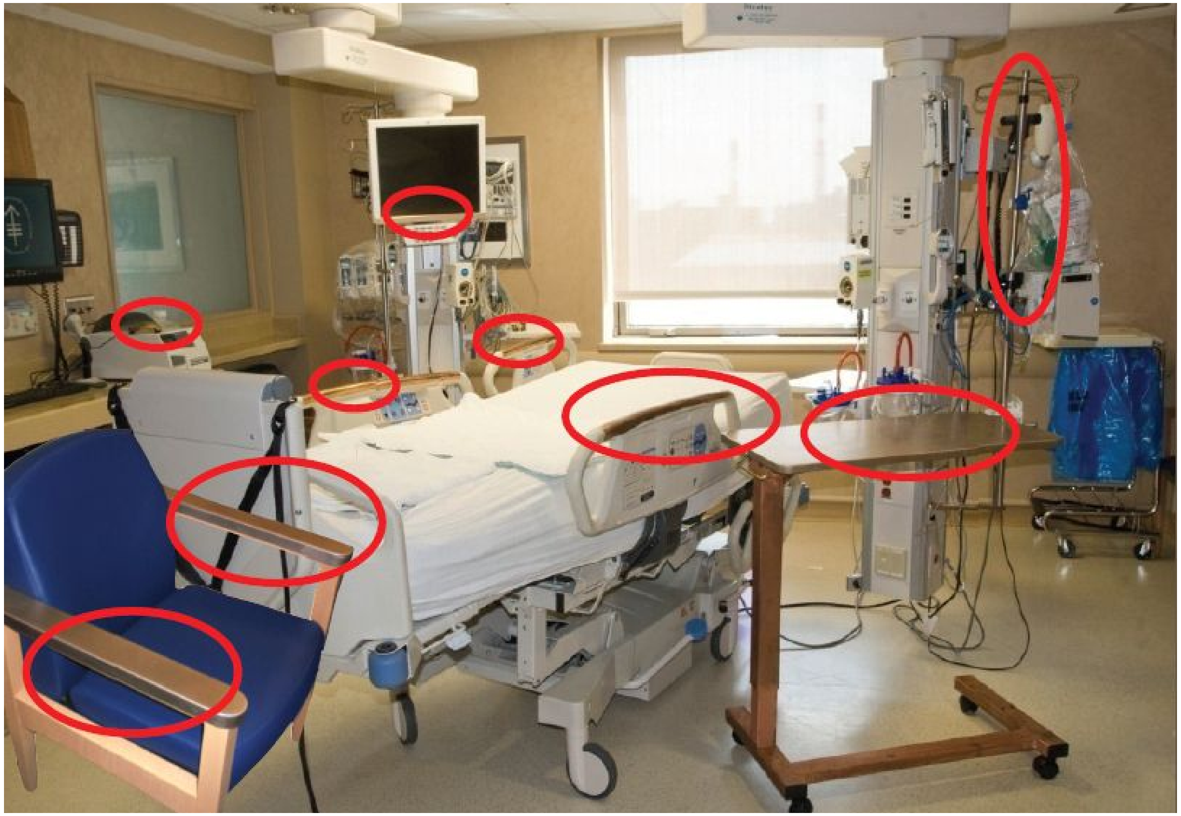
Source: *Metallic Copper as an Antimicrobial Surface*. Grass G, Rensing C and Solioz M, Appl. Environ. Microbiol. March 2011, pp 1541-1547. Vol 77, No 5. doi: 10.1128/AEM.02766-10,

Independent clinical trials conducted at multiple locations around the world



Source: www.antimicrobialcopper.com/uk/scientific-proof/clinical-trials.aspx

Department of Defense study, 3 US hospitals



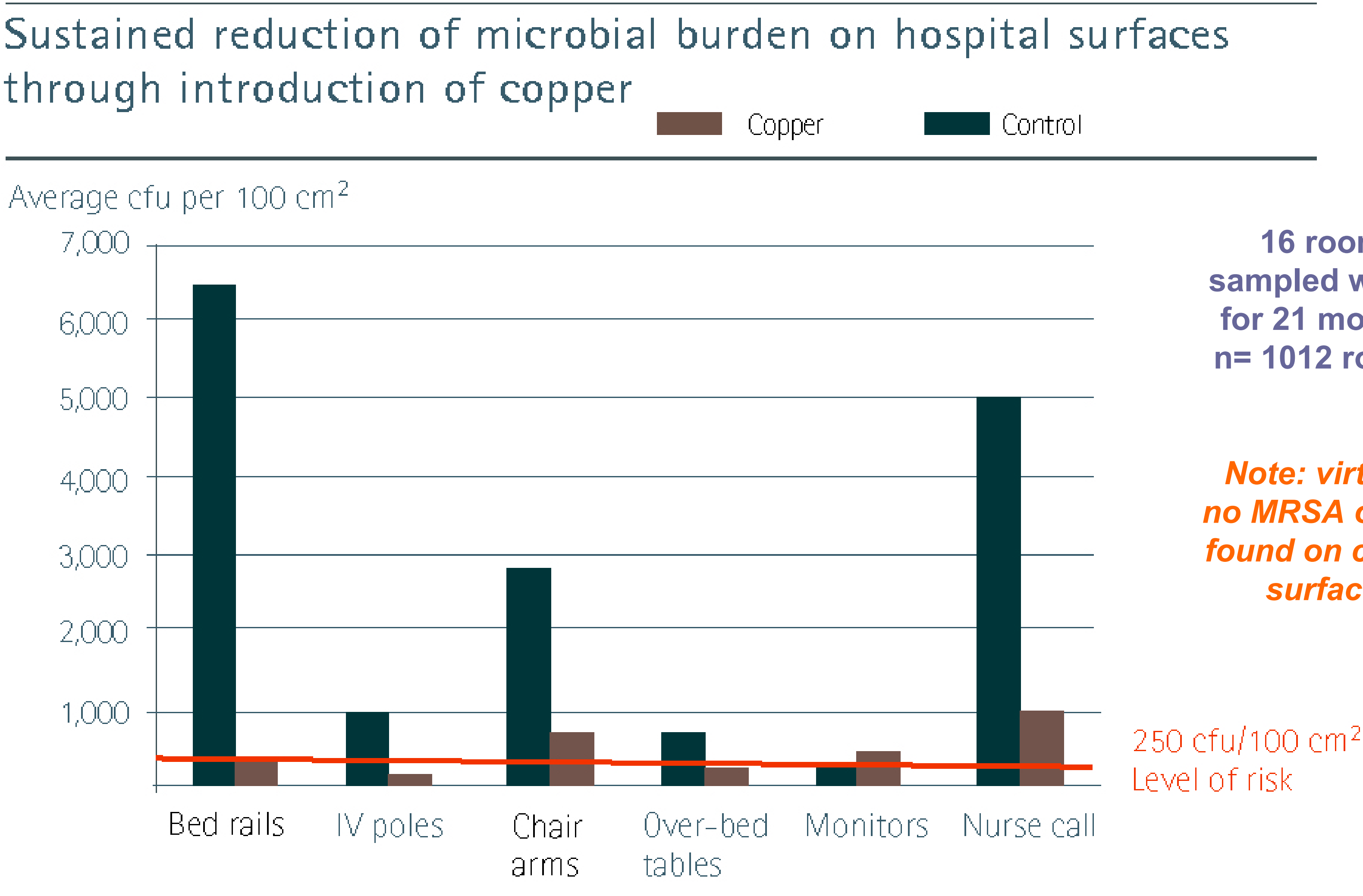
Components upgraded to Antimicrobial Copper:

1. Bed rails
2. Over bed Tables
3. IV Poles
4. Nurse Call buttons
5. Arms of visitor chairs
6. Computer input devices

Copper components *in situ* at Memorial Sloan Kettering Cancer Center

Other sites: Medical University of South Carolina,
Ralph H Johnson VA Medical Center

US Clinical trial results showed 83% reduction of bioburden on copper objects



16 rooms sampled weekly for 21 months, n= 1012 rooms.

Note: virtually no MRSA or VRE found on copper surfaces

Source: Salgado CD, Sepkowitz KA, John JF et al. *Copper surfaces reduce the rate of healthcare-acquired infections in the intensive care unit*. Infect Control Hosp Epidemiol 2013; 34 (5): 479-86.

Copper surfaces reduced the rate of HCAIs in the ICU by 58%

Rooms **without** copper surfaces

Rooms **with** copper surfaces

HCAIs: 8.43%

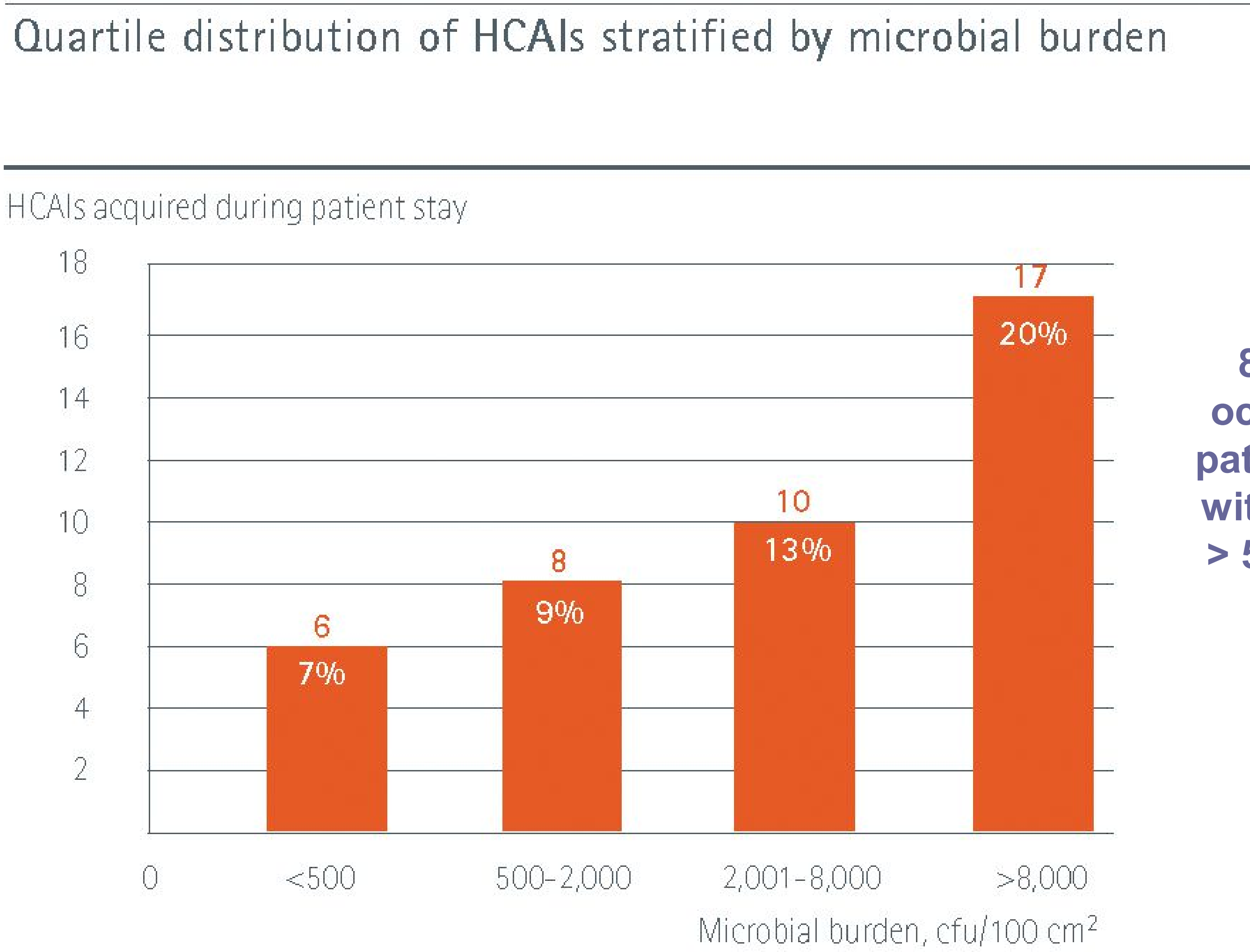
58.1% reduction

(p= 0.013)

HCAIs: 3.4%

Source: Salgado CD, Sepkowitz KA, John JF et al. *Copper surfaces reduce the rate of healthcare-acquired infections in the intensive care unit*. Infect Control Hosp Epidemiol 2013; 34 (5): 479-86.

Link between environmental bioburden and acquisition of HCAIs reported



89% of HCAIs occurred among patients in rooms with a bioburden > 500 cfu/100cm^2

Source: Salgado CD, Sepkowitz KA, John JF et al. *Copper surfaces reduce the rate of healthcare-acquired infections in the intensive care unit*. Infect Control Hosp Epidemiol 2013; 34 (5): 479-86.

The Business Case for Copper

An Economic Evaluation of the use of Copper in Reducing the Rate of Healthcare Associated Infections in the UK

YHEC
York Health Economics Consortium

York Health “Business Case tool” for users

York Health Economics Consortium

- Title Sheet
- Inputs
- Calculations
- Results

Model Inputs

Set-Up | Effectiveness | Cost | Resource Use | References

The purpose of this sheet is to set up the model for the appropriate hospital setting. The typical number of patie
entered in the cells shaded in green. Whether or not copper items will be introduced to general wards, ICU or s
pathogen in the model can be entered in the appropriate green shaded cell .

Number of beds in unit	20
Average length of stay in ICU (days)	5.7
Average length of stay ward/single room (days)	3.0
Calculated number of patients per year (Cohort)	1,200
Yearly change in number of patients	0%

Setting	ICU

Infection to be included in the model:	All Healthcare Associated Infections

Currency:	Euro (€)

Example: 20 bed ICU, new build, UK

Parameter	Value	Note
Number of beds	20	Single room configuration.
Number of patients per annum	1,200	Based on an average stay of 6 days (Edbrooke 2011).
Infection rate (all HCAIs)	25%	27.1% in Cairns 2010. 23.4% in English National Point Prevalence Survey on Healthcare, Health Protection Agency (2012).
Cost per HCAI	£6,000	Negrini (2006) reported the average cost per patient-day over 75 UK ICUs was $1,512 (£1,000) and an HCAI results in an additional 6 days. While the model allows for costs of subsequent outpatient and GP visits to be taken into account, these are not considered here.
Items to be upgraded to copper (or antimicrobial copper alloy)	6 critical items: IV drip pole Bed rails Computer input device Nurse call button Over-bed table Visitor chair	Schmidt MG, Copper Touch Surface Initiative. Microbiology and Immunology, Medical University of South Carolina, Charleston, USA, BMC Proceedings 2011, 5(Suppl 6):O53 (Oral presentation delivered at 1st International Conference on Prevention and Infection Control, June 29-July 2, 2011, Geneva, Switzerland). Sustained Reduction of Microbial Burden on Common Hospital Surfaces through Introduction of Copper, Michael G Schmidt *et al*, Journal of Clinical Microbiology, July 2012, Vol 50, No 7. This study was conducted in single-room ICUs. Other key touch surface replacements are also available – such as door handles, push plates, taps – that comply with current hospital regulatory requirements, and have been identified as high risk touch surfaces in other clinical areas.
Cost of intervention	£30,600	This is the cost difference between copper and standard, non-antimicrobial components, using early market prices. As this example is based on a new build or planned renovation, installation costs would be similar and have therefore not been considered.
Reduction in HCAIs post intervention	20%	Copper Surfaces Reduce the Rate of Healthcare-Acquired Infections in the Intensive Care Unit, Cassandra D Salgado *et al*, Infection Control and Hospital Epidemiology, May 2013, Vol 34, No 5. This study demonstrated a 58% reduction in infections in ICU rooms equipped with copper. The example below uses a conservative figure of 20%.

Example: 20 bed ICU, new build, UK

5 Year Results

Using the above inputs, the model yields a return on investment of less than two months. The cost of copper components is £105,000 compared to £74,400 for standard items. There were 1,200 infections in the copper group and 1,500 in the baseline. This results in a cost per infection averted of £102. The model calculates additional benefits including bed days freed and Quality-Adjusted Life Years. To download the model visit www.antimicrobialcopper.com/uk/why-antimicrobial-copper/the-business-case.aspx or email info@copperalliance.org.uk.

	Copper	Baseline	Incremental
Total cost (excluding cost of infections)*	£105,000	£74,400	£30,600
Number of infections	1,200	1,500	300
Cost per infection averted (excluding cost of infections)			£102.00
Total QALYS gained			107.40
Cost per QALY			£284.92
Cost of infections*	£7,200,000	£9,000,000	-£1,800,000
Total cost of intervention*	£7,305,000	£9,074,400	-£1,769,400
Cost per infection averted			Dominant *

*These are direct costs to the hospital (no GP costs or societal costs have been included in the model)

*Dominant means that Antimicrobial Copper is both the cheaper and the more effective option

Number of bed days saved per year	360
Cost per bed day saved per year	£85.00

The number of bed days saved per year is 360, which would allow an increased capacity in the ICU of 63 beds with a typical length of stay of 5.7 days.

Return on investment	< 2 months

The cost of the copper upgrade is £105,000 compared to £74,400 for installation of non-copper items. There were 1,200 infections in the copper group over the period and 1,500 in the baseline. This results in a cost per infection averted of £102.00.

www.antimicrobialcopper.org

YHEC
York Health Economics Consortium

The YHEC business case model & user guide notes can be downloaded at www.antimicrobialcopper.org

Savings continue long after initial payback period

'After the initial two months, ongoing cost savings will accrue from the reduction in blocked beds and better-directed staff resources.'

Dr Matthew Taylor
YHEC Director

Infection Control Guidance

Antimicrobial Copper has been nominated as an ‘emerging technology to watch’ by key healthcare “watchdogs”

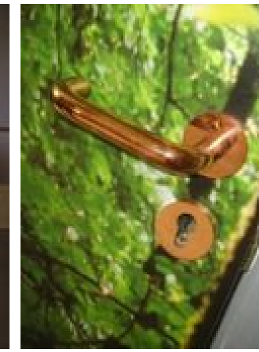
- ***UK:***
  - ***EPIC3***: *National Evidence-Based Guidelines for Preventing Healthcare-Associated Infections in NHS Hospitals in England*
  - ***SHTG***: *Scottish Health Technologies Group*
- ***US:***
  - ***ECRI***: *Top 10 Technology Watch List for the Hospital C-Suite*
  - ***AHRQ***: *Understanding the Role of Facility Design in the Acquisition and Prevention of Healthcare-Associated Infections*
- ***Canada:***
  - ***CNESH***: *Top 10 New & Emerging Health Technology Watch List: 2014*

Implementation is simple

Many different levels of installation taking place
...from basic handles & switches to large-scale upgrades









Example:
Asklepios Hospital, Germany: a lower patient infection rate observed in wards fitted with copper handles.

"This clinical effect has surpassed my expectations"

- Prof Jörg Braun MD, Chief Physician of Internal Medicine at Asklepios Clinic Wandsbek, Germany.

Benefits & role of Copper in healthcare

- **Reduces pathogens on touch surfaces**
- **Reduces infections**
- **Saves lives**
- **Saves £££**
- **Frees-up beds**

= improves efficiency of healthcare

..self disinfecting surfaces, especially copper coated *[sic]* ***surfaces, show promise for reducing the bioburden on hospital surfaces and decreasing healthcare-associated infections.”*** (Weber DJ, 2013)

Weber et al 2013. *The Role of the Surface Environment in Healthcare-Associated Infections*. Curr Opin Infect Dis. 2013 Aug;26(4):338-44. DOI: 10.1097/QCO.0b013e3283630f04

Further references available www.antimicrobialcopper.com/uk/scientific-proof/scientific-references.aspx

Thank you

Next steps?

Questions?

www.antimicrobialcopper.org

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